

A realist review of the evidence

Sun safety intervention effectiveness in school settings



Sun safety intervention effectiveness in primary and secondary school settings: A realist review prepared by the Sax Institute for Cancer Council NSW.
August 2024

This report was prepared by Nick Petrunoff, Samuel Harley, Anton du Toit, Margret Lo, Anika Garg, Eleanor Wilson, Rebecca Gordon, Eileen Goldberg, and Alice Knight with input from Cancer Council NSW August 2024
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Sun safety intervention effectiveness in primary and secondary school settings: A realist review

Prepared by the Sax Institute for Cancer Council NSW. August 2024.

This report was prepared by Nick Petrunoff, Samuel Harley, Anton du Toit, Margret Lo, Anika Garg, Eleanor Wilson, Eileen Goldberg, Rebecca Gordon, Alice Knight from the Sax Institute with input from Claire Osborne, Tara Ray, Clare Stephens and Elizabeth King from Cancer Council NSW.



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Abbreviations and definitions

| Term | Definition |
|---------------------|---|
| Activities | An organised, time limited action that is put in place to contribute to a particular outcome. |
| BMI | Body Mass Index, a function of an individual's weight and height. Commonly used as an indicator of obesity. |
| CCNSW | Cancer Council New South Wales. |
| Effective | Interventions were categorised as effective if the study achieved statistically significant results and it was designed to determine this (see effectiveness definition below). |
| Effectiveness | Studies designed to test whether an intervention was effective in 'real world' settings are referred to as effectiveness studies. For example, a study that uses an experimental design (e.g, a cluster randomised controlled trial) to randomly assign participants to either an intervention group or a control group (i.e., not exposed to the intervention), to test for causal attribution of the intervention on outcomes. The inclusion of a control group for comparison with results achieved in the intervention group adds confidence that the results were not due to chance. |
| Efficacy | The ability for an intervention or program to achieve the desired outcome or impact on the target population in 'ideal' clinical or laboratory settings. Studies in this review were all effectiveness studies conducted in 'real world' school or community settings. |
| Impactful | Interventions were categorised as impactful if the study demonstrated impacts, but it was not designed to determine if an intervention was effective. For example, a pilot study with short-term before-after follow-up and no control that achieved statistically significant impacts on key outcomes. Such interventions are also often referred to as 'promising' (see definition for promising below). |
| Mechanism of change | Key factors that lead to either the success or failure of a proposed program component achieving the proposed outcomes. |

| Term | Definition |
|-------------------|---|
| Program | A suite of planned components, and activities, developed to bring about specified outcome(s) in an identified population. |
| Program component | A group of activities that aim to achieve an outcome(s). |
| Promising | Insufficient evidence of impact to be categorised effective, but initial results show promise for the intervention demonstrating impacts on desired outcomes. For example, there are no existing studies designed to test effectiveness to date, there is only one effectiveness study which was conducted with a specific population which limits the generalisability of the findings to other populations; or, the majority of studies demonstrating impacts were at high risk of bias since the measures for the main outcomes were subjective and had not been previously validated. |
| RAMESES | Realist and meta-narrative evidence synthesis evolving standards. |
| RCT | Randomised Controlled Trial. |
| Realist Review | A type of systematic review that seeks to understand how and why complex interventions achieve the desired outcome in particular contexts by exploring the underlying mechanism of action. |
| SSSAP | Sun Safe Student Ambassadors Program. |
| UV | Ultraviolet Radiation. |
| UVI | Ultraviolet Index. |

Executive summary

Background

The purpose of this review is to synthesise the national and international evidence base on sun safety interventions delivered in the school setting. The findings from the review will help guide how SunSmart is delivered in New South Wales (NSW) primary schools and inform future strategies for engaging NSW secondary schools in sun safety.

Review objectives

The objectives (a-d) of this realist review are to:

- a) Identify and describe effective or impactful sun safety interventions delivered in schools.
- b) Describe their implementation characteristics and the outcomes achieved.
- c) Describe the mechanisms that contributed to, or enabled, their success.
- d) Identify adaptations or modifications that may be necessary to enhance the effectiveness of these interventions in an Australian setting, or for feasible implementation at scale.

Summary of methods

Between May 2023 and July 2024, the Sax Institute and Cancer Council NSW (CCNSW) conducted a realist review of sun safety interventions implemented in school settings to identify the mechanisms that contributed to their success and understand the contexts in which key outcomes were achieved. The realist review method was chosen as the most suitable approach to review sun safety interventions within the school setting, as it was developed for synthesising information on complex interventions to unpack what works, under what circumstances and why (1). This included:

- A review of source documents provided by CCNSW.
- An additional search of five databases - PubMed, Scopus, PsycINFO, ERIC (Education Resources Information Centre) and Cochrane Library.
- For both the source documents and reviews identified in the additional searches, the reference lists were checked to identify additional articles at the full text screening stage.

Papers published prior to 2013 were excluded, except for source documents highlighted as a priority for inclusion by CCNSW. Papers were assessed according to whether they were deemed 'effective' or 'impactful' by the authors of this review, as defined in the Abbreviations and definitions section.

Key findings

A total of 46 documents (43 peer-reviewed studies and three reports from grey literature) contributed data to address the review objectives.

Objective a. Identify and describe sun safety interventions delivered in schools

From 46 studies identified, there were 10 studies conducted in a primary school setting, 23 studies conducted in a secondary school setting, 10 studies conducted across both primary and secondary schools, and three further studies conducted in a community setting; the studies undertaken in community settings were included as they were deemed to provide parallel evidence of high relevance to the review objectives.

The studies included a broad range of study designs. Nine review articles were included, eight of which were systematic reviews and two of these included meta-analyses. There was one unpublished rapid review. While pre-post studies were the most common type (12 studies), there were also 10 Randomised-Controlled Trials (RCTs) and five longitudinal studies. There were four cross-sectional studies and six mixed method studies, one of which used the qualitative component to produce a separate publication.

The location of the schools was reported in 30 papers, with 15 undertaken in metropolitan areas, two in rural areas, and 13 in multiple localities. The remaining 16 studies did not report location. Sixteen of the studies had undertaken research in Australia; of these, six were conducted in schools in New South Wales, four in Victoria, three in Western Australia, two in Queensland, and one was conducted nationally.

Objectives b-d. For interventions that were deemed effective or impactful, describe their implementation characteristics, outcomes achieved, key mechanisms for success, adaptations or modifications necessary for the Australian context, or for feasible implementation at scale

Of the 46 studies, 18 were categorised as effective, two were categorised as ineffective and 26 were categorised as impactful. In primary schools, many interventions were policy focused (7/10). Whereas in secondary schools, primary and secondary school settings, and community settings, most effective or impactful interventions included targeted behavioural components (34/34), with the majority using education as their main activity.

Of the 10 studies conducted in primary schools, all four that were designed to test effectiveness demonstrated statistically significant results and were therefore categorised as effective. The remaining six studies which were not designed to test effectiveness were categorised as impactful. Of the studies that were deemed effective, three were focused on policy support. From these, Buller et al. (2020) (2) and Reynolds et al. (2020) (3) both examined the same policy intervention from the USA. For both studies, key mechanisms for success were contact with school principals and the use of trained sun safety coaches to support sun protection policy implementation. Further, an effective Australian study by Wright et al. (2019) (4) used play-based incentives to improve implementation of the SunSmart program with a focus on sunscreen use and sun-safe hat wearing. An impactful study conducted by Russo et al. (2023) (5), while not primarily designed to test effectiveness, also provided insights into the feasibility of policy implementation support strategies to promote and enable sun protective hat wearing in NSW primary schools. The authors used a theoretically informed toolkit to support 'champions' to tailor policy implementation support strategies to the local needs of the school as a key mechanism for achieving impact. Overall, policy implementation support is a promising strategy to engage NSW primary schools in sun safety. Strategies such as interactive education with outdoor elements and training of pre-service teachers are promising strategies identified in this realist review that have relatively less evidence of effectiveness. These promising strategies could be further evaluated for effectiveness before implementing them at scale.

There were 23 interventions conducted in secondary schools. Of these, nine were designed to determine effectiveness and seven were deemed to be effective. The remaining 14 studies which were not designed to test effectiveness were categorised as impactful. Of the studies conducted in secondary school settings, all of the studies (n = 23) focused on behavioural interventions. Further, of the 10 studies conducted in both primary and secondary school settings, eight focused on behavioural interventions. These behavioural studies primarily evaluated educational strategies and, of the studies that were deemed effective, appearance-based educational strategies (6-10) were the most common type of behavioural intervention. However, one systematic review cautioned against focusing solely on educational strategies to impact sun safety behaviour in secondary schools because these strategies require high levels of support to be built into curriculum or educational systems to achieve ongoing and scalable impact (11). Notably, from those studies that were deemed effective in the secondary school setting, only one study investigated an environmental strategy, and this was combined with behavioural strategies (12). This was surprising given that two systematic reviews identified environmental strategies such as shade provision as promising for secondary schools (11, 13). Pettigrew et al (2020) (12) undertook a combined environmental and behavioural study, whereby ultraviolet radiation (UV) meter displays combined with brief educational strategies were associated with increased knowledge of the UV index. In summary, the most promising sun safety interventions in the secondary school setting are those behavioural interventions which incorporate messaging around appearance (often linked to technology), and environmental strategies such as shade provision. Messaging around the immediate effects of sunburn could be considered as an alternative to appearance focused messaging, although further research is needed to determine if this is effective for promoting sun safety.

Three studies evaluated the impact of community-based interventions. Acuna et al (2020) (14) conducted a systematic review to determine the effectiveness of a video-based intervention on cancer prevention knowledge and behaviours amongst an adult population. The authors concluded that utilising web and social media platforms was an effective method to reach diverse audiences to improve awareness of cancer risk factors. Further, two studies which aimed to evaluate the impact of interventions demonstrated that educational videos and television advertising could improve individual and population level awareness of skin cancer prevention activities (15, 16).

Amongst all studies in all settings, the key mechanisms for success included many innovative approaches, which represent a suite of promising strategies. In the body of this report, the studies have been summarised in the findings section and they have also been summarised in a typology for components of contemporary sun safety interventions in the discussion section, including:

- technology-based strategies (e.g. use of UV camera technology)
- policy support strategies (e.g. engaging with school principals and the provision of tailored policy implementation support via coaches)
- strategies which focus on environmental support (e.g. creation of shade)
- innovative educational approaches which move beyond didactic health education to incorporate interactivity and use of technology.

Notably, all promising interventions shared common mechanisms for success: they were theoretically informed and clearly articulated “how” and “why” they intended to achieve outcomes; they recognised the importance of taking an inter-disciplinary approach, so that both education and health perspectives were considered, and they often tailored their interventions to be age appropriate.

Recommendations

This report suggests a range of promising strategies to improve sun safety engagement and

outcomes amongst NSW primary and secondary schools. These are grouped by theme rather than importance.

Theoretical underpinning

1. Ensure that any new approach to implementing SunSmart has a clear theoretical underpinning to support: a) better understanding of the underlying mechanisms of change which influence outcomes; b) consistent implementation; and c) a higher quality of evaluation when, and if, the program is scaled in the future.

Partnerships and funding

Integrating sun safety in primary and secondary education settings will require ongoing development of inter-disciplinary partnerships between public health and education practitioners, researchers and policy makers (17).

Funding partnerships

2. Given the resource-intensive nature of the identified policy support strategies (e.g. coach support model) (2), partnerships to assist with funding them may be necessary for implementation at scale.

Educational partnerships

3. Focusing on developing partnerships with educational leaders and experts will enable co-production of resources, collaborative decision making and ongoing active feedback, which could extend the reach, impact and sustainability of sun safety interventions in NSW primary and secondary schools. Pursuing collaborative opportunities will also ensure that sun safety interventions can be contextualised within their setting to address the discrete needs and resources of the relevant school community (18).

Discretionary program partnerships

4. Due to the presence of many discretionary health and wellbeing priorities for schools, programs are often delivered by external third-party providers. Partnerships that align sun safety with other relevant programs could increase the salience of sun safety for schools (19, 20).

Education sector engagement and advocacy

5. This review identified many effective and promising approaches to increasing sun safety in schools. For many of these, integration within school systems will require advocacy for top-down support from peak bodies in the sector, such as the integration of sun safety into curriculum and legislation to mandate minimum standards for shade provision in schools as a capital works priority (20). Nicholson (2016) (20) postulated that advocacy for structural change with peak body leaders for regulations and/or policy that requires secondary schools to comply with sun safety recommendations could be a promising approach to implementing sun protection in secondary schools. Developing strategies that build on the insights from consultations with the authors of the studies included in this report, as well as stakeholders with experience in the education sector, (including peak body representatives, teachers, school representatives, and those with expertise in implementation and system science) will help to contextualise program improvements.
6. A need for improved evaluation. Few studies reported on the impacts of sun safety policy and

related policy support strategies (2, 18, 21). Evaluation of the effects of policy support strategies on policy adoption, and staff and student sun safety behaviours, should be prioritised to better understand the impact on policy adoption in practice, and to support advocacy efforts and future improvements.

Considerations for implementing sun protection interventions in schools

Creating a stronger rationale for sun safety

7. This realist review includes an evaluation of the NSW SunSmart program, where the need for a more compelling rationale was identified as a pre-requisite for schools to understand why they are such a priority setting in the framing of skin cancer prevention with local communities (21). Tailored communications aimed at the whole school community could be helpful in supporting engagement with sun safety (3). CCNSW could explore various social media and digital marketing strategies to disseminate key messages and elevate the importance of sun safety measures within the school community (15). Such strategic communication could play a pivotal role in raising the salience of sun safety amongst school communities, which may in turn assist with reducing the ambivalence towards sun safety in schools.

Implementation support

8. Three Australian studies (21-23) from the review which were conducted in primary schools highlighted that a key challenge for the SunSmart program is to identify effective strategies to improve sun safe policy comprehensiveness and adoption of policy elements as well as membership uptake and renewal. For primary schools, promising policy support strategies identified in the review such as tailored policy support based on assessments of readiness (3, 5), could be explored.
9. This realist review found that personalised assistance provided by implementation coaches can significantly improve sun protection practices in a school setting. Reynolds et al. (2020) (3) found that schools that were assisted by implementation coaches adhered to sun protection practices post-intervention (including sun safe clothing, improved communication with parents and an increase in role modelling and sun safe curriculum elements) better than those who were not assisted by an implementation coach.

Reward and recognition

10. Elements of the program could be supported through incentives, rewards and recognition to motivate schools to engage with sun safety, to implement sun safe actions and to continuously improve (4).

Equity

11. A systematic way of targeting support for schools who have a greater need should be considered. Accordingly, an equity lens should be employed that could include analyses of socioeconomic conditions by geographic area, past and present engagement with sun safety and a schools' capacity and motivation to implement the intervention.

Scalability and adaptability

12. Interventions that had been implemented at scale were identified in this review and key findings about how they were scaled are summarised in the findings section of this report. These could help inform any future scaling strategies.
13. Prior to scaling up the intervention, evaluation of its feasibility, implementation, effectiveness

and cost-benefit should be undertaken. Modelling of different ways of prioritising support, and the cost implications, should also be considered. This would provide robust evidence to support how the program is scaled and would add strength to any requests for funding.

14. Consideration could be given to the fidelity-adaptability tension described in a knowledge synthesis report by The Australian Prevention Partnership on implementing policies and programs in chronic disease prevention (17).

Background

Melanoma and all other skin cancers present the highest cost burden to the Australian health system of any cancer type, representing \$1.7 billion annually (24). In 2014 to 2018 melanomas comprised 11% and 13% of cancers in the general population and in people aged 15-24 years, respectively. Melanoma incidence rates in people aged 15-24 years have significantly decreased since peaking in 1994 to 1998, from 106 to 43 cases per 1,000,000 people in 2014 to 2018. Melanoma is the most commonly diagnosed cancer amongst young adults aged 20-39 years, and the third most diagnosed cancer amongst all Australians (25). Primary prevention media campaigns about sun safety are likely to be responsible for the decrease in melanoma incidence rates in Australia amongst the under-40s since the 1990s, however, despite this decrease, melanoma was still the second most common type of cancer diagnosed in people aged 15-24 in 2014 to 2018 (25, 26). There is strong evidence that harmful sun exposure in childhood and adolescence is causally linked to skin cancer in adulthood (27). It is estimated that, by age 20, individuals may have already been exposed to half the total UV radiation they will encounter by age 60 (28). This provides a strong rationale to enhance and advocate for multicomponent approaches to skin cancer prevention targeting children, adolescents and young adults (28).

The SunSmart program is a flagship skin cancer prevention program for Cancer Council NSW (CCNSW), targeting children under 12 years of age. The goal of the SunSmart program is to reduce children's exposure to UV radiation and their subsequent skin cancer risk. The program supports the development and implementation of a policy with 10 sun safety recommendations aimed at facilitating change in the physical environment, curriculum, and behaviours.

A 2021 CCNSW-funded evaluation of the SunSmart program (21) indicated a decay in the personal relevance and salience of sun safety messages amongst the NSW primary school community. The evaluation found that whilst school stakeholders see a need for and support the SunSmart program, their engagement in sun safety was mixed, based on the perception that it is a well-established topic, and generally not seen as an especially urgent issue. The benefits of sun protection efforts are predominantly articulated with a long-term health and safety lens, and although schools can identify immediate tangible benefits, they don't often think of it in those terms, which limits its perceived value. Schools additionally indicated that sun safety competes for limited discretionary attention and investment due to their time-poor environment. School stakeholders perceived that much sun safety work has been done and achievements made, including the widespread use of sun safe hats by students in primary schools. Furthermore, few schools felt that they had inadequate shade or reported receiving negative feedback from parents, suggesting that very few parents consider their schools' performance in sun safety to be poor. In the absence of immediate feedback to the contrary, it is easy for schools to consider their performance in this space to be sufficient and that the 'job is done' in respect to sun safety in schools. This evaluation identified a clear opportunity for CCNSW to strengthen how sun safety is perceived and improve how SunSmart is delivered to NSW primary school communities. The evaluation also identified the need to include a review of sun safety

intervention effectiveness in secondary schools to identify practical strategies that could strengthen engagement with sun safety in both primary and secondary school settings.

CCNSW commissioned the Sax Institute to undertake a review of the effectiveness of sun safety interventions in primary and secondary school settings as a first step to identify where new strategies and approaches could be undertaken to enhance sun safety engagement and outcomes amongst NSW primary and secondary schools.

The objectives (a-d) of this realist review are to:

- a. Identify and describe effective or impactful sun safety interventions delivered in schools.
- b. Describe their implementation characteristics and the outcomes achieved.
- c. Describe the mechanisms that contributed to, or enabled, their success.
- d. Identify adaptations or modifications that may be necessary to enhance the effectiveness of these interventions in an Australian setting, or for feasible implementation at scale.

The purpose of this evidence review is to synthesise the national and international evidence base on sun safety interventions delivered in the school setting. The findings from the review will help guide how SunSmart is delivered in NSW primary schools and inform future strategies for engaging NSW secondary schools in sun safety.

Methods

This realist review considered the realist and meta-narrative evidence synthesis evolving standards (RAMESES) publication guidelines for realist syntheses (29) to ensure elements of good practice for realist reviews were reflected in the conduct and reporting.

Methodological approach

The realist review method was chosen as the most suitable approach to review sun safety interventions within the school setting, as it was developed for synthesising information on complex interventions to unpack what works, for whom and under what circumstances (1).

Source document review and additional searches:

(i) **Source documents.**

CCNSW provided 106 source documents in a master-list, for consideration for inclusion in this evidence review. Priority documents (n=35) were highlighted in green.

(ii) **Additional searches.**

The Population, Intervention, Comparison, Outcomes and Study design (PICOS) lens was applied to the review questions to develop the search strategy. However, the 'C' was adapted to context instead of the usual comparison. Specifically, context refers to the primary and secondary school settings. In addition, since the primary and secondary school settings define the target population (i.e., students, their parents or carers and teachers) it was not necessary to specify search terms for the target population. The target population was also defined in the first inclusion criteria.

The R package 'litseachr' was used to add search terms by text mining of the abstracts and keywords of an intermediate search.

The search included five databases – PubMed, Scopus, PsycINFO, ERIC (Education Resources Information Centre) and Cochrane Library. The syntax in the example Scopus search strategy below was adapted and modified according to the specific requirements of different databases. Appendix A includes search syntax for each database/search engine.

| | |
|-----------|---|
| Database: | Scopus |
| Terms: | TITLE-ABS-KEY (intervention* OR program* OR initiative* OR strateg* OR campaign* OR policy OR policies OR "cancer prevention") AND TITLE-ABS-KEY (school*) AND |

| | |
|-------------|---|
| | <p>(TITLE-ABS-KEY (((sun OR UV OR ultraviolet or heat) w/2 (protect* OR safe*)) OR sunscreen OR "ultraviolet radiation" OR "UV radiation" OR "sun smart" OR "sunsmart"))</p> <p>AND</p> <p>TITLE-ABS-KEY (evaluat* OR effective* OR efficac* OR impact OR outcome* OR assessment OR "pre-post" OR "randomised controlled trial" OR "randomized controlled trial" OR "controlled trial" OR "quasi-experimental" OR RCT OR "cluster randomized" OR "systematic review")</p> <p>AND</p> <p>PUBYEAR > 2012</p> |
| Date limit: | 2013—present |

For both the source documents and reviews identified in the additional searches, the reference lists of review articles were checked to identify additional articles at the full text screening stage.

Eligibility criteria and limits

Inclusion criteria for studies, were:

1. Human populations of primary to secondary school age, their parents, carers and teachers;
2. Interventions could be multi-strategic or a single strategy including educational programs, policy changes and environmental modifications;
3. Primary/elementary and middle/high school settings and other settings that could be applied to primary or secondary school settings were included if they were deemed to provide parallel evidence of high relevance to the objectives of the review;
4. Reported on outcomes or measurement of impacts related to reducing sun exposure (e.g., reduction in sunburn rates), and improving sun safety behaviours (e.g. increased use of sun protection measures); exception for intervention studies with parallel evidence (e.g. reduction in other risk behaviours);
5. Peer reviewed and grey literature using a range of methodologies were included (e.g., quantitative, qualitative, mixed methods). Descriptive reports (e.g., grey literature evaluation reports) were included;
6. Quantitative review papers whose primary papers predate 2013 were excluded, with exceptions from the source documents or where advised by CCNSW that the paper was important;
7. Expert opinions and book chapters were excluded;
8. Papers which were more focused on implementation science rather than specific elements of sun safety were excluded but noted as papers to revisit.

Unpublished studies were only included if they met the above criteria and provided enough information for readers to interpret their results fully. They included details of the intervention itself and

on the implementation of the intervention and/or provided important information to address the research objectives.

Exclusion criteria:

- Studies in the Early Childhood/preschool setting were excluded.

The limits of the search were:

- Papers published in the last 10 years, including grey literature
- Papers published in English only
- Countries and jurisdictions within scope are: Australia, New Zealand, the United States the United Kingdom.

Assessment of studies to be included

For documents from the source document master-list, two independent assessors (NP, one other contributor who is not an author) screened all documents, with particular attention given to studies highlighted by CCNSW. The inclusion criteria were first trialled using title and abstract, with the independent reviewers noting articles to be included/excluded, citing reasons. They then met to compare and discuss any discrepancies before reaching agreement on the articles for full text screening.

Papers identified by database searches were uploaded to Covidence for title and abstract screening. Three reviewers (NP, ML, AG) screened the first 50, then met to discuss those where conflicts occurred. Following this, two reviewers (ML, AG) screened the remaining papers by title and abstract and met with a third reviewer (NP) to discuss any conflicts. Both the source documents and the documents identified via searches were screened in full text within Covidence by three reviewers (NP, ML, AG).

Data extraction

A data extraction table was developed by four reviewers (AK, AG, ML, NP). Five reviewers each trialled extracting data from five papers into a live document before meeting to discuss the trial. Each paper in the trial was selected to represent a different study design (systematic review, mixed methods, before-after study and a feasibility study). Following this trial, three reviewers (AG, ML, NP) independently extracted data from the same five papers before meeting to assess the consistency of their data extraction. The data extraction table was transferred into Covidence before two reviewers (AG, ML) extracted the data from all included studies. In keeping with the realist approach, extraction was iterative initially, with the two reviewers discussing the approach with a third reviewer (NP). The final data extraction table included the columns with headings shown below.

Table 1. Data extraction table columns and a description of what they contain

| Heading | Description |
|---------------------------------|---|
| Document Origin | Included papers were categorised as either 'Source documents' (obtained from Cancer Council NSW's master-list) or 'Search', (documents found in the database search). |
| Document Type | Papers were described as either an academic journal or grey literature. |
| Source | Authors, date, and title of the publication. |
| Intervention type | Interventions were categorised as Behavioural (B), Policy (P), Environment (E), or Multi-component (MC) ^a . Multiple categories were selected for interventions where relevant. |
| Study Design, Duration | The study's design and duration were categorised. |
| Participants | When possible, the number of participating students, teachers, and schools, the age range of participants, and the percentage of participants that were male were noted. |
| Context | Sociodemographic information on the participants was described to aid in determining applicability of the interventions to different social contexts. |
| Location and Setting | The country and geographic classification (metro, regional, or rural) of the location in which the intervention was conducted was described. In addition, the intervention setting was categorised into either primary school, secondary school, both primary and secondary school, or community. |
| Intervention Details | Essential aspects of the intervention were recorded including its main components, the mode(s) of delivery, the resources required for implementation, and stakeholder involvement. |
| SunSmart Policy Recommendations | The NSW SunSmart policy identifies 10 recommendations (scheduling outdoor activities, shade provision and use, availability and wearing of sun protective hats and sun protective clothing, sunscreen use, staff role modelling, informing the school community, the wearing of sunglasses (optional), and strategies to support the implementation and review of the sun protection policy) for primary school sun |

| Heading | Description |
|---|---|
| | protection. The interventions found in the literature were classified according to whether they targeted any or all of these 10 recommendations and the corresponding components were listed. |
| Effective or Impactful on outcomes. Limitations. | Interventions were deemed effective in this report if the study was designed to determine this and achieved statistically significant results. Interventions were impactful if the study demonstrated impacts but it was not designed to determine if an intervention was effective (30). ^b Key results were described. Limitations were also described to aid interpretation of the results. |
| Feasibility, Acceptability, and Equity Considerations | Concerns noted by authors regarding the feasibility and acceptability of their interventions were described. In addition, any considerations the authors made for equity or diversity prior to implementation of their interventions were noted. |
| Mechanism(s) of Change | Key factors that led to either the success or failure of the interventions were recorded when described or hypothesised by the authors. |

^aMulti-component interventions could contain two or more intervention types (e.g. behavioural and environment).

^bFor example, an RCT or quasi-experimental study design with a control that achieved statistically significant results would be 'effective', since a control group adds confidence that the results were not just due to chance. Whereas a small pilot study with short-term before-after follow-up and no control or a repeat cross-sectional observational study that showed an intervention achieved impacts on key outcomes would be 'impactful'.

Study appraisal

The key criteria used to appraise the studies was relevance to the research objectives. For this, the reviewers asked themselves the question: *is the information contained in the full text of the document good enough to make a substantial contribution to achieving the research objectives?* Specifically, reviewers sought to ascertain whether the documents contained detailed descriptions of the core elements of the intervention, the outcomes achieved and the mechanisms by which the intervention may have achieved these outcomes. As per principles of good practice in realist syntheses (29), the selection and appraisal stage ran in parallel whilst the full text documents were analysed in detail. At this stage, some of the source documents were excluded as they did not make substantial contributions to achieving the research objectives.

Analysis processes

A structure for the synthesis of the findings was drafted by two reviewers (NP, AD) and reviewed by one other (AK). The columns for the data extraction tables (Appendix 2) and a description of what they would contain (Table 1) were drafted prior to data extraction.

Whilst summarising the data, patterns amongst the findings were examined, such as consistency of outcomes for intervention types, anomalies or findings from studies reporting on novel interventions. For Objective a) (completed by AD with contributions from AG and ML), the summary was descriptive and focused on the columns up to, but not including intervention details.

In the second part of the process, the structure specifies criteria for a more detailed analysis of the study findings. This included capturing detail on the context, intervention elements, how the outcomes were achieved (Objectives a-b, completed by RG, ML and NP), the key mechanisms by which the outcomes were achieved, as well as considerations relating to feasibility, acceptability, generalisability and equity (Objectives c-d, completed by NP). Of the 46 studies that were identified, the criteria used by the reviewers resulted in 44 interventions being graded as either effective (n=18) or impactful (n=26). Studies designed to test whether an intervention was effective in 'real world' settings are referred to as effectiveness studies (see Abbreviations and definitions section for full definition). Studies were categorised as impactful if the study demonstrated statistically significant impacts, but it was not designed to determine if an intervention was effective (see Abbreviations and definitions section for full definition). Throughout the report, the language mirrors that of the study's author.

Findings

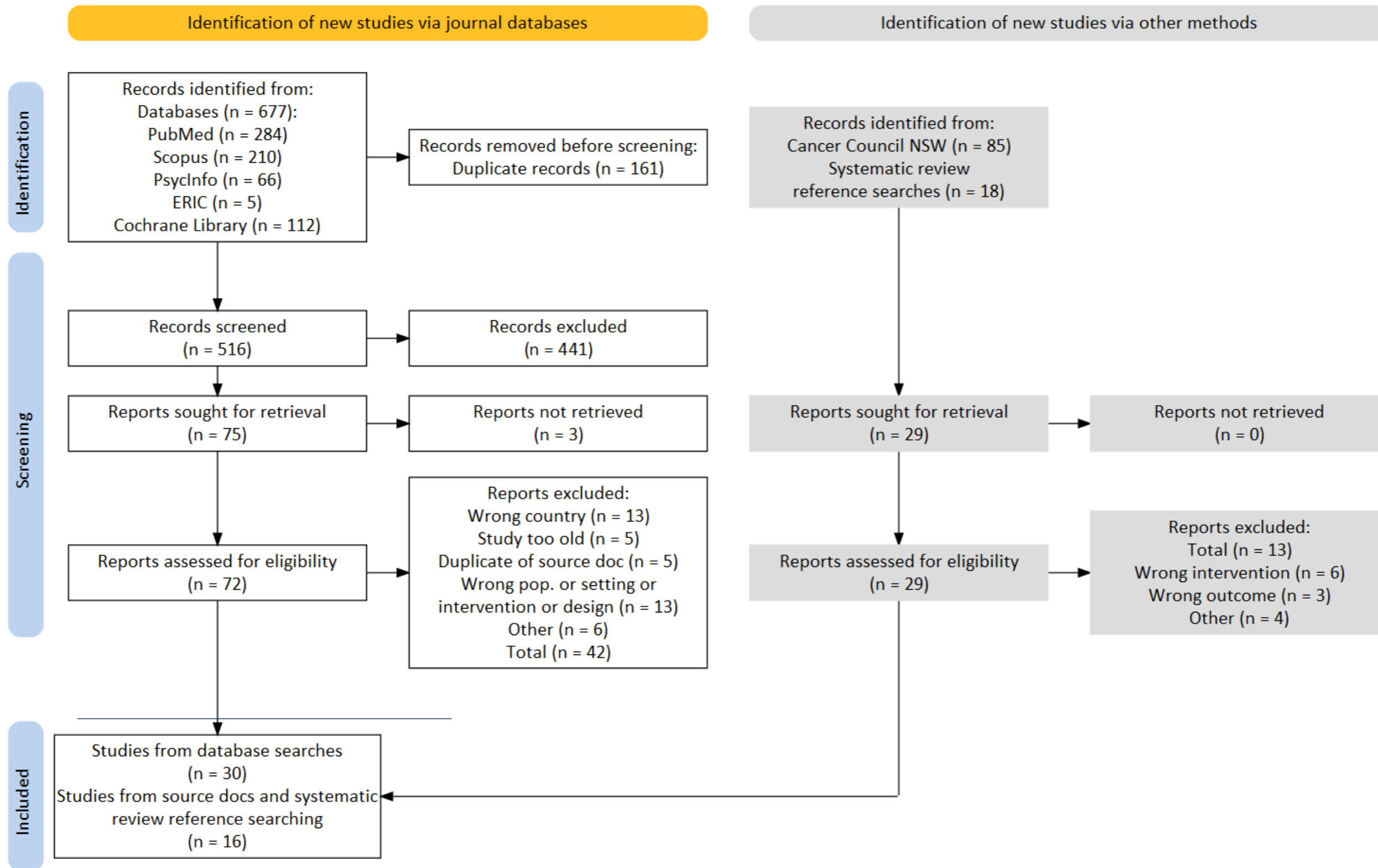


Figure 1. PRISMA flow diagram of included studies realist review of interventions to inform the SunSmart revamp.

Figure 1 shows the flow of included studies. A total of 46 documents were included in the qualitative data synthesis for this realist review, of which 43 were from academic journals and three were from grey literature. From these, 30 documents were identified via database searches, 14 were prioritised for inclusion by CCNSW and two were from bibliography searches. Findings relating to the four objectives are presented below.

Objective a: To identify and describe sun protection interventions delivered in school settings

Overview of all the identified interventions

Table 2 provides a descriptive summary of the characteristics of studies included in the review by setting and for all studies. This section describes all the included studies' origins (source documents or searches), intervention types (behavioural, policy, environment or multicomponent), study designs and durations, participants, locations and settings. These reflect the first seven columns (except for sociodemographic context) of the data extraction tables for included peer-reviewed studies and grey literature, which are described in more detail in Appendix 2.

A total of 46 studies were included in the review. There were 10 studies conducted in a primary school setting (2-5, 21-23, 31-33), 23 studies conducted in a secondary school setting (6-11, 19, 20, 34-48), 10 studies conducted across both primary and secondary schools (13, 49-57), and three further studies conducted in a community setting (included here as parallel evidence) (14-16). Fourteen studies were drawn from the source documents provided by CCNSW (5, 11, 12, 20-23, 35, 36, 42, 50, 52, 54, 56) (of which three were grey literature) and the remaining 32 from journal database searches, two of which were identified via a review of bibliographies of included studies (2-4, 6-10, 13-16, 19, 31-35, 37-41, 43, 45-49, 51, 53, 55, 57).

Interventions were categorised into four types: behavioural, environmental, policy, and multi-component. Behavioural interventions were by far the most common, appearing in 36 studies (71%) (6-12, 15, 16, 19-21, 31-43, 45-49, 51-53, 55-57). There were eleven policy interventions (22%) (2-5, 20-23, 42, 50, 52), six environmental interventions (11-13, 31, 52, 53) and four multi-component interventions (13, 46, 53, 56).

There were eight published systematic reviews (11, 13, 14, 19, 52, 53, 56, 57) and two of these included meta-analyses (52, 57). There was one unpublished rapid review included in the analysis (54). The interventions included a broad range of study designs. While pre-post studies were the most common type (12 studies), there were also 10 randomised controlled trials and five longitudinal studies. There were four cross-sectional studies and six mixed method studies, one of which used the qualitative component to produce a separate publication (42).

Within the nine review articles there was a total of 235 papers reviewed. There were 95 studies from the US, 64 from Europe, 16 from the UK, and 10 from Canada. There were 42 from Australasia, 13 from Asia, 9 from South America, and 2 from Africa. Most systematic reviews focused primarily or exclusively on high income countries.

Study duration ranged from one day to 24 years, with a median length of four months. The number of participants in studies was sometimes expressed as the number of students (27 studies), and

sometimes as the number of schools participating (32 studies), though 24 studies reported both number of students and number of schools. Sample sizes were generally large, with a median of 487 students in studies reporting that metric of participation, and a median of seven schools where that metric was reported.

The location of the schools was reported in 30 papers, with 15 in metropolitan areas, two in rural areas, and the remaining 13 papers had schools in a combination of areas. Fifteen of the studies had undertaken research in Australia; of these, six were conducted in schools in New South Wales, three in both Victoria and Western Australia, two in Queensland, and one was conducted nationally.

Table 2. Characteristics of included studies by setting and for all settings

| | Primary school <i>n</i> | Secondary school <i>n</i> | Both primary and secondary <i>n</i> | Community | All settings ¹ |
|--|----------------------------|---------------------------|-------------------------------------|----------------|---------------------------|
| Total number of studies | 10 | 23 | 10 | 3 | 46 |
| Peer-reviewed | 9 | 22 | 9 | 3 | 43 |
| Grey literature | 1 | 1 | 1 | 0 | 3 |
| From search | 6 | 17 | 6 | 3 | 32 |
| Source docs | 4 | 6 | 4 | 0 | 14 |
| Study designs | | | | | |
| Systematic Review | 0 | 2 | 5 | 1 | 8 |
| Rapid Review | 0 | 0 | 1 | 0 | 1 |
| RCT | 4 | 5 | 1 | 0 | 10 |
| Longitudinal | 0 | 5 | 0 | 0 | 5 |
| Pre-post | 1 | 7 | 3 | 1 | 12 |
| Cross-sectional | 2 | 1 | 0 | 1 | 4 |
| Mixed Methods | 3 | 3 | 0 | 0 | 6 |
| Total student participants (N)² | 8,440 (3 studies reported) | 11,598 (18 studies) | 2,636 (3 studies) | 33 (1 study) | 22,707 |
| Total participating schools (N)³ | 2,945 (9 studies reported) | 728 (19 studies) | 27 (3 studies) | Not applicable | 3,700 |

| | Primary school <i>n</i> | Secondary school <i>n</i> | Both primary and secondary <i>n</i> | Community | All settings ¹ |
|---|----------------------------|---------------------------|-------------------------------------|-------------------|---------------------------|
| Age range⁴ | 5-12 | 11-18 | 0-18 | 8-24 | 0-24 |
| Male participants⁵ (average) | 39.5% (5 studies reported) | 44.9% (13 studies) | 44.5% (2 studies) | 50.8% (2 studies) | 37.5% |
| Countries | | | | | |
| Australia | 7 | 7 | 1 | 1 | 16 |
| National | 1 | 0 | 0 | 0 | 1 |
| NSW | 4 | 1 | 1 | 0 | 6 |
| QLD | 1 | 1 | 0 | 0 | 2 |
| VIC | 0 | 3 | 0 | 1 | 4 |
| WA | 1 | 2 | 0 | 0 | 3 |
| USA | 3 | 11 | 4 | 1 | 19 |
| New Zealand | 0 | 1 | 0 | 0 | 1 |
| UK | 0 | 3 | 0 | 0 | 3 |
| Systematic Reviews with multiple countries | 0 | 2 | 5 | 1 | 8 |
| Geographical classification⁶ | | | | | |
| Metro | 8 | 16 | 4 | 1 | 28 |
| Regional | 6 | 4 | 1 | 0 | 10 |
| Rural | 4 | 5 | 2 | 1 | 11 |
| Intervention Type⁷ | | | | | |
| Behavioural | 4 | 23 | 8 | 3 | 38 |
| Environment | 1 | 2 | 3 | 0 | 6 |
| Policy | 7 | 2 | 2 | 0 | 11 |

| | Primary school <i>n</i> | Secondary school <i>n</i> | Both primary and secondary <i>n</i> | Community | All settings ¹ |
|--|-------------------------|---------------------------|-------------------------------------|-----------|---------------------------|
| Multicomponent | 0 | 1 | 3 | 0 | 4 |
| SunSmart policy recommendations | | | | | |
| Scheduling outdoor activities | 3 | 2 | 0 | 1 | 6 |
| Shade | 5 | 6 | 5 | 1 | 17 |
| Hats | 8 | 5 | 4 | 2 | 19 |
| Clothing | 6 | 5 | 3 | 1 | 15 |
| Sunscreen | 6 | 11 | 5 | 3 | 25 |
| Role modelling of staff, families and visitors | 5 | 2 | 1 | 0 | 8 |
| Curriculum | 1 | 5 | 1 | 0 | 7 |
| Engaging the school community | 5 | 16 | 6 | 1 | 28 |
| Sunglasses | 3 | 4 | 1 | 0 | 8 |
| Implementation and review | 6 | 2 | 3 | 0 | 11 |

¹Total studies from all settings; ²26 primary studies reported number of student participants; ³31 primary studies reported the number of participating schools; ⁴22 studies reported age range of students (staff and parents are excluded); ⁵Only 23 studies reported % male; ⁶Not mutually exclusive; ⁷Not mutually exclusive (each component of multi-component interventions was also counted as an individual component).

Evaluations conducted in primary school settings

Table 3 summarises the studies' author (year), country, design and intervention type and study title for each study conducted in primary school settings. From the 10 studies conducted in primary school settings, the main intervention types studied were policy interventions (seven studies) (2-5, 21-23) and behavioural interventions (four studies) (21, 31-33); noting that one paper included elements of both types of intervention (21) and one paper studied a combined behavioural and environmental intervention (31).

Study designs used in selected studies were RCT (n = 4) (2-4, 32); longitudinal (n = 1) which was pseudo-longitudinal or a repeat cross-sectional design (23); pre-post (n = 1) (31); cross-sectional (n = 1) (22); and, mixed-methods (n = 3) (5, 21, 33). The number of primary schools involved in each study ranged from five to 1,593, with a median of 118 (reported for nine studies). Where student sample sizes were reported (for three studies) they ranged from 103 to 4,627, with a median of 3,710. Study durations ranged from one day to six years, with a median of 18 months.

Of the 10 studies in primary school settings, seven were from Australia (4, 5, 21-23, 31, 33), and three from the US (2, 3, 32). Eight studies included schools in metropolitan areas, six included schools in regional areas, and four included schools in rural areas.

Table 3. Overview of studies in the primary school setting

| Author (Year), Country. Design. Intervention type | Study title |
|---|---|
| Buller et al. (2020), US RCT. Policy | Parent reports of sun safety communication and behaviour for students in a randomised trial on a school policy implementation intervention |
| Harrison et al. (2016), Australia Cross-sectional. Policy | Sun protection policies of Australian primary schools in a region of high sun exposure |
| Hunkin et al. (2020), Australia Pseudo-Longitudinal (Repeat cross-sectional). Policy | The National SunSmart Schools Program: Impact on sun protection policies and practices in Australian primary schools |
| Lee Solano et al. (2022), Australia Pre-post. Behavioural and Environmental. | Effect of an interactive educational activity using handheld ultraviolet radiation dosimeters on sun protection knowledge among Australian primary school students |
| Miller et al. (2021), US RCT. Behavioural | Sun protection changes among diverse elementary school children participating in a sun safety intervention: A latent transition analysis of a randomized controlled trial |
| Reynolds et al. (2020), US RCT. Policy | Randomized controlled trial evaluating an intervention supporting implementation of sun safety policies in California public elementary schools |
| Russo et al. (2023), Australia Mixed methods. Policy | The formative evaluation and pre-testing of a SunSmart policy implementation support toolkit targeting sun safe hat-wearing in NSW primary schools |
| Scott et al. (2023), Australia Mixed methods. Behavioural | A novel skin cancer prevention strategy: Preservice teachers' perceptions of a sun safety intervention and experiences in schools |

| Author (Year), Country. Design. Intervention type | Study title |
|--|--|
| Wright et al. (2019), Australia Cluster RCT. Policy | Protect your skin and let the fun begin: The results of an intervention to improve NSW primary schools' implementation of the SunSmart Program |
| ORIMA Research (2021), Australia Mixed methods. Behavioural. Policy | SunSmart Program Evaluation Report: Cancer Council NSW |

Evaluations conducted in secondary school settings

Twenty-three studies were undertaken in secondary schools (6-12, 19, 20, 34-43, 45-48) and Table 4 summarises the studies' author (year), country, design and intervention type and study title for each. The main intervention type studied was behavioural interventions (23 studies) (6-12, 19, 20, 34-43, 45-48). There was additionally one policy intervention (20, 42), one multi-component intervention (46) and two environmental interventions (11, 12).

Study designs used in selected studies included five RCTs (8, 9, 39, 43, 48), two systematic reviews (11, 19), seven pre-post studies (6, 7, 10, 36, 40, 45, 46), five longitudinal studies (12, 35, 37, 38, 41) and one cross-sectional study (35).

The number of schools involved in each study ranged from one to 586, with a median of three (reported for 19 studies). Sample sizes were reported for 19 studies, ranging from 38 to 2,479, with a median of 435. Study durations ranged from two days to 24 years, with a median of 21.5 months.

Of the 21 studies that were not systematic reviews, six were from Australia (12, 20, 35, 36, 42, 48), 11 from the US (6-10, 12, 34, 39, 40, 46, 47), two from Scotland (37, 38), one from New Zealand (41), and one from Wales (43). Sixteen studies included schools in metropolitan areas (6, 7, 9, 10, 12, 20, 34-36, 39, 41-43, 45, 46, 48), four included schools in regional areas (7, 20, 42, 48), and five included schools in rural areas (10, 20, 36, 40, 42).

Table 4. Overview of studies conducted in secondary school settings

| Author (Year), Country. Design. Intervention type. | Study title |
|---|---|
| Calco et al. (2023), USA Multiple Systematic review. Behavioural | A systematic review of evidence-based high school melanoma prevention curricula |
| Cassel et al. (2018), USA Mixed methods. Behavioural | Adapting a skin cancer prevention intervention for multi-ethnic adolescents |

| Author (Year), Country. Design. Intervention type. | Study title |
|--|---|
| Chaudhry et al. (2021), USA Pre-post Behavioural | Sun Protection Outreach Teaching by Students (SPOTS)- Evaluating the efficacy of skin cancer prevention education for adolescents |
| Clare et al. (2022), Australia Longitudinal (quasi-experiment). Behavioural. | The effects of using the Sun Safe App on sun health knowledge and behaviors of young teenagers: Results of pilot intervention studies |
| Davis et al. (2015), USA Pre-post. Behavioural | Evaluation of the Students are Sun Safe (SASS) project: A university student-delivered skin cancer prevention program for schools |
| Hanna et al. (2022) Australia Pre-post. Behavioural | Effect of the SunSafe Student Ambassador Program on the attitudes, knowledge and behaviour of Australian high-school students towards sun safety: a prospective study |
| Hubbard et al. (2018), Scotland Longitudinal. Behavioural | Promoting sunscreen use and skin self-examination to improve early detection and prevent skin cancer: Quasi-experimental trial of an adolescent psycho-educational intervention |
| Hubbard et al. (2020), Scotland Longitudinal. Behavioural | Sun protection education for adolescents: A feasibility study of a wait-list controlled trial of an intervention involving a presentation, action planning, and SMS messages and using objective measurement of sun exposure |
| Jensen et al. (2022), USA RCT. Behavioural | Tailored visuals, implementation interventions, and sun safe behaviour: A longitudinal message experiment |
| Jia et al. (2020), USA RCT. Behavioural | Gamification improves melanoma visual identification among high school students: Results from a randomized study |
| Loescher et al. (2019), USA Pre-post. Behavioural | Implementation of the Students Are Sun Safe (SASS) project in rural high schools along the Arizona-Mexico border |
| McNoe et al. (2021), Multiple Systematic review. Behavioural. Environmental. | Effectiveness of sun protection interventions delivered to adolescents in a secondary school setting: A systematic review |

| Author (Year), Country. Design. Intervention type. | Study title |
|--|---|
| McNoe et al. (2022), New Zealand Longitudinal. Behavioural | Photoaging intervention delivered to adolescents in secondary schools: A feasibility study |
| Nicholson (2016), Australia Mixed methods - Qualitative interviews, focus groups and questionnaire. Behavioural; Policy | Sun protective policies and actions in Victorian secondary schools |
| Nicholson et al. (2020), Australia. Qualitative focus groups as part of the above mixed methods study. Behavioural; Policy | Teacher perceptions of sun protection practices in the secondary school setting: Barriers, enablers and recommendations for future. |
| Owen et al. (2018), UK Wales cRCT. Behavioural | The impact of an appearance-focused facial-ageing intervention on adolescents' attitudes toward sun protection |
| Pettigrew et al. (2020), Australia Longitudinal, Behavioural. Environmental. | The potential of ultraviolet radiation meters in secondary schools as a sun protection intervention mechanism for adolescents |
| Sharma et al. (2022), USA Pre-post. Behavioural | Implementing a skin cancer prevention lesson to enact institutional change: A schoolwide survey |
| Steele et al. (2020), USA Pre-post. Behavioural, Multicomponent | "Live Sun Smart!" Testing the effectiveness of a sun safety program for middle schoolers |
| Truong et al. (2021), USA Cross-sectional, Behavioural | A sun safety pilot program using a tanning myths-focused video contest for Utah adolescents: Cross-sectional analysis |

| Author (Year), Country. Design. Intervention type. | Study title |
|---|---|
| Tuong et al. (2014), USA RCT. Behavioural | Effect of appearance-based education compared with health-based education on sunscreen use and knowledge: A randomized controlled trial |
| White et al. (2019), Australia RCT. Behavioural | Effectiveness of a theory-based sun-safe randomised behavioural change trial among Australian adolescents |
| Wu et al. (2019), USA Pre-post. Behavioural | A four-group experiment to improve western high school students' sun protection behaviours |

Evaluations conducted in both primary and secondary school settings

Ten studies were set in combined primary and secondary school settings (13, 49-54, 56-58) and Table 5 shows the author (date), study design, intervention type and study title for each. The main intervention types studied were behavioural interventions (six studies) (49, 51, 53, 56-58) and multi-component interventions (three studies) (13, 53, 56). There were two systematic reviews with meta-analyses (52, 57); three systematic reviews (13, 31, 53), a rapid review (54), an RCT (50) and three pre post studies (49, 51, 58).

The number of schools involved in each study ranged from one to 19, with a median of seven (reported for three studies). Where sample sizes were reported (for four studies) they ranged from 33 to 1,441, with a median of 598. Study duration was reported in five studies and ranged from two months to six years, with a median of ten months.

Of the 10 studies, one was from Australia (54), four were from the US (49-51, 58) and five were systematic reviews which included studies from multiple countries (13, 52, 53, 56, 57). Four studies included schools in metropolitan areas (49-51, 58), one included schools in regional areas (50), and two included schools in rural areas (50, 51).

Table 5. Overview of studies conducted in both primary and secondary school settings

| Author (date), Country. Design. Intervention type. | Study title |
|---|--|
| Asdigian et al. (2023), US Pre-post. Behavioural | Design and effectiveness of the Youth Engaged Strategies for Changing Adolescent Norms! (YES-CAN!) program for reducing skin cancer risk |

| Author (date), Country. Design. Intervention type. | Study title |
|--|---|
| Buller et al. (2011), US RCT. Policy | Motivating public school districts to adopt sun protection policies: A randomized control trial |
| Kouzes et al. (2017), US Pre-post. Behavioural | Sun Smart Schools Nevada: Increasing knowledge among school children about ultraviolet radiation. |
| Langford et al. (2015), multiple Systematic review and meta-analysis. Behavioural, Environmental and Policy | The World Health Organization's Health Promoting Schools framework: a Cochrane systematic review and meta-analysis |
| Lorenc et al. (2013), multiple Systematic review. Behavioural. Environment. Multi-component | Resource provision and environmental change for the prevention of skin cancer: Systematic review of qualitative evidence from high-income countries |
| Makin et al. (2018), Australia Rapid review. Behavioural | Evidence Check: Targeted programs for skin cancer prevention |
| Miller et al. (2015), US Pre-post. Behavioural | SunSmart: Evaluation of a pilot school-based sun protection intervention in Hispanic early adolescents |
| Reyes-Marcelino et al. (2021), multiple Systematic review. Behavioural. Multi-component | School-based interventions to improve sun-safe knowledge, attitudes and behaviours in childhood and adolescence: A systematic review |
| Sim et al. (2021), multiple Systematic Review and Meta-Analysis. Behavioural | The effectiveness of educational programmes in promoting sun protection among children under the age of 18: a systematic review and meta-analysis |
| Thoonen et al. (2020), multiple Systematic review. Environment. Multi-component | Are environmental interventions targeting skin cancer prevention among children and adolescents effective? A systematic review |

Evaluations conducted in community settings

Three studies were completed in a community setting (14-16). All were identified in peer-reviewed journals and all interventions were behavioural in nature. There was one systematic review (14), one repeat cross-sectional study (15) and one pre-post study (16).

Participants of studies conducted in community settings varied in age. In the systematic review, participants were predominantly adults. Dobbinson et al. (2015) studied both adolescents and adults (15). Finally, Wu et al. (2018) studied families, parents, and their children which included both youth and adolescents (16).

Of the three studies, one was based in Australia (15), another in the US (16), and the systematic review drew on studies from multiple countries, including the US, the Netherlands, and South Korea. One study was implemented in a rural setting (16), and the other in a metropolitan setting (15).

These articles provide insight into the efficacy of new forms of technology, such as the use of social and mass media (14, 15). These interventions may prove effective for comparable populations of interest, however, their applicability in a school setting has not been tested.

Table 6. Overview of studies conducted in other settings

| Author (Year), Country Design. Intervention type. | Study title |
|---|---|
| Acuna et al. (2020), Multiple Systematic review. Behavioural | Harnessing digital videos to promote cancer prevention and education: A systematic review of the literature from 2013-2018 |
| Dobbinson et al. (2015), Australia Repeat cross-sectional. Behavioural | Continued impact of SunSmart advertising on youth and adults' behaviours. |
| Wu et al. (2018), US Pre-post. Behavioural | A novel educational intervention targeting melanoma risk and prevention knowledge among children with a familial risk for melanoma. |

Objectives b-d: For effective or impactful interventions, what were their implementation characteristics, outcomes achieved, key mechanisms for success and adaptations or modifications necessary for the Australian context, or for feasible implementation at scale

As described in the Abbreviations and definitions section, interventions were categorised as effective if the study was designed to determine if the intervention was effective and achieved statistically significant results (30). Additionally, interventions were categorised as impactful if the study demonstrated impacts, yet it was not designed to determine if the intervention was effective. For example, a confirmatory RCT or another longitudinal study design with a control group (e.g. quasi-experiment) that achieved statistically significant results would be 'effective'. Whereas a small pilot study with short-term before-after follow-up and no control group, or a repeat cross-sectional observational study that showed an intervention achieved impacts on key outcomes would be 'impactful'.

For each of the effective or impactful interventions, this section describes the implementation characteristics and the outcomes they achieved. It also describes the key mechanisms that contributed to their success and considers whether adaptations or modifications for Australian settings are necessary by looking at their context and any information on the feasibility and acceptability of the interventions. Under each of the four settings of primary school, secondary school, primary plus secondary school and community, effective interventions are described first, followed by impactful interventions. Both effective and impactful interventions are listed in order of the hierarchy for strength of evidence of the study designs (59). Tables 7-13 were developed to summarise these factors for each effective or impactful intervention by setting.

Evaluations conducted in primary school settings

Effective or impactful interventions in primary schools

Of the 10 studies conducted in primary schools all four (2-4, 32) which were designed to measure effectiveness demonstrated statistically significant results and were therefore categorised as effective. These studies are summarised in Table 7 and described below. The remaining six studies which were not designed to test effectiveness were categorised as impactful (5, 21-23, 31, 33) and are summarised in Table 8.

Effective interventions in primary schools

RCTs

All four studies from primary school settings which were categorised as effective in this review were RCTs. Two studies, Reynolds et al. (2020) (3) and Buller et al. (2020) (2), were based on the same intervention with 118 schools in California.

Buller et al. (2020) describe an RCT over 20 months in 118 schools (2). The study aimed to evaluate an intervention focused on the implementation of a school sun safety policy (SSS). Coaches met with school principals and the district's sun safety policy was reviewed, a sun safety practice checklist was completed, information and resources were provided, and plans were formulated for implementing sun safety practices. Coaches tailored their assistance based on the school principals' readiness for implementing the desired sun safety practices. After the first meeting, coaches sent a monthly email, tailored to the principals' readiness, needs and interest. Coaches facilitated the implementation process, monitored progress, assisted principals in overcoming implementation barriers and supplied supplementary information and resources. Additionally, parents were asked to complete an online post-test survey with questions related to changes in child sun safety behaviours.

The study found that increased sun protective behaviours among children were reported by parents who received information about sun safety and in schools where at least one sun safety measure was implemented (clothing, less time outdoors at midday, less sunburn). More parents from intervention schools reported receiving information about sun safety ($p=0.017$) compared to the control group. Further, when compared to the control group, parents of children in the intervention group were more likely to report that their children were wearing sun-protective clothing when not in school ($p=0.033$). In schools where the principal reported implementing at least one sun safety practice, parents reported that students spent less time outdoors ($p=0.033$) and that fewer students were sunburned when compared to schools where the principal did not implement a sun safety practice ($p=0.009$). Parents who reported that they received information about sun safety from the school also reported greater student sun safety behaviour than parents who did not receive information about sun safety ($p=0.008$). *Key mechanisms for success of the intervention were trained sun safety coaches meeting with school principals to review the district's Sun Safety Policy and providing tailored support based on their readiness to implement change, as well as providing information to parents.* Since the intervention included in-person meetings with school principals to provide policy support this may not

be feasible for implementation at scale. However, modifying the intervention to meet via videoconference or telephone may be more feasible.

Reynolds et al. (2020) (3) examined the same intervention as Buller et al. (2020) (2), focusing on the impact of supporting schools to implement sun safety policies and/or practices, however the intervention was modified to include a telephone coaching session rather than in-person meetings with principals. The intervention also included the completion of a sun safety practice checklist, identifying up to three sun safe practices to implement, completing a plan for implementation, and provision of tailored sun safety resources. The intervention was built on organisational innovation principles in Diffusion of Innovation Theory, a theory that seeks to explain how, why and at what rate new ideas are spread. All school districts in the trial had previously adopted a policy on sun safety. The intervention included the provision of guidance to show how sun safety practices could align with the school's unique needs and environment. It also included planning for the effective implementation of sun safety practices, ensuring that they were customised to the school's context and existing practices. Additionally, the intervention facilitated communication with the broader school community including staff, students, and parents.

The principal and a teacher at each school reported on their schools' sun safe practices at 20-months post baseline. The study found that the intervention was effective at increasing implementation of sun safety practices in public elementary schools, producing effects for a) the total number of practices implemented; b) practices reflecting elements of district policy; and c) enacting practice elements not included in district policy. The most implemented practices post intervention included educating students on sun safety, students' use of sun protective clothing, communication to parents, in-service training of staff, and encouragement of staff to model sun safe behaviours. *Key mechanisms for success were the use of trained sun safety coaches to support implementation via telephone contact with principals and provision of information to parents.* Modification of the policy support to be conducted via telephone may make this more feasible than in-person meetings. However, this intervention is still resource-intensive, so targeting it to schools in high need of policy support may make it more scalable.

Wright et al. (2019) (4) conducted an 18-month study with a cluster-RCT design in five intervention and 15 control schools in Greater Western Sydney to improve implementation of the SunSmart Program. It was designed to combat negative perceptions of hat wearing, which were explored in depth in earlier qualitative research (60) and used play-based incentives to encourage sunscreen use. Objective measurements of students' hat wearing behaviours, sunscreen application, and teachers' role-modelling behaviours, were collected for baseline, post-test and follow-up data. The main intervention component was the provision of 'fun wheelies' (mobile bins containing play equipment) to intervention schools, to be used by students as a reward for wearing sun-safe hats and applying sunscreen. There were minimal improvements in hat-wearing behaviours among students and teachers in intervention schools. Whilst there was a statistically significant increase in individuals wearing hats, the effect size was small. However, for sunscreen use there was a large, positive intervention effect. *A key mechanism for the success of the intervention was using play-based incentives to reward positive behaviour. However, negative association amongst stakeholders to the 'No Hat, No Play' motto as a punitive procedure, which is not an actual recommendation of the SunSmart policy¹, may have impacted students' ability to enact hat wearing behaviours. Another success factor was student involvement via an identified student leader who was responsible for*

¹ The wording used to frame this SunSmart policy recommendation is "No hat, play in the shade".

bringing out the 'fun wheelie' and ensuring that children used sunscreen before they took play equipment. Both intervention and control schools were supplied sunscreen, and the intervention school also received the 'fun wheelie'. Sunscreen use increased from baseline in both intervention and control schools, suggesting that the provision of sunscreen alone is effective, however adding play equipment increases the effectiveness of the intervention. Given the resource intensive nature of the provision of sunscreen and play equipment to schools, partnerships to assist with funding could be considered to support implementation at scale as well as a systematic approach to adapting support to the diverse needs of individual schools.

Miller et al. (2021) conducted latent transition analysis of an RCT. The intervention compared two sun safety intervention conditions (curriculum only and curriculum plus science lab) to a control condition (32). Schools assigned to the curriculum-only condition received three one-hour lessons designed for children from diverse ethnic and racial backgrounds and with diverse skin phenotypes. These lessons were taught by trained health educators. Schools assigned to the curriculum plus science lab condition received the same lessons in addition to a one-hour science lab lesson in which children measured UV in their playground, developed hypotheses about variability in UV Index around the school, and read and interpreted graphs of their UV measurements. This American study involved 3,710 students who were predominantly (69%) Hispanic/Latino ethnicity and from metropolitan schools participating over four years.

A higher proportion of intervention group participants (31%) with low sun safe behaviours at baseline transitioned to higher sun safe behaviours compared to controls (0%). However, it is not possible to ascertain from the results the number of students in the intervention versus the control group shifting between different behaviours at the follow-up period since only the combined intervention and control group proportions for each category of sun safe behaviour at baseline are presented. Whilst the differences in these proportions between the intervention and control group are statistically significant, they may not be meaningful if few intervention group participants were in the low sun safe behaviour category at baseline. A key mechanism for success of this intervention was tailoring the curriculum to the participants' diverse backgrounds to ensure messaging was relevant. As with any curriculum-focused initiative, a high-level of support is required from education departments to be feasible for implementation at scale. Consideration would additionally need to be given to lesson content if implemented at scale, as the lessons in this study were specifically designed for students from diverse backgrounds with diverse skin phenotypes.

Table 7. Effective primary school interventions: the main components, outcomes achieved & considerations for implementation at scale

| Author (Year). Title | Design | Type | Main intervention component(s) | Outcomes achieved | Considerations for implementation at scale |
|--|-------------|------|---|---|--|
| Buller et al. (2020). Parent reports of sun safety communication and behaviour for students in a randomised trial on a school policy implementation intervention | RCT | P | Policy support – in-person meeting with principal, policy implementation support tools provided | Parents who reported that they received information about sun safety from school reported greater composite student sun safety behaviour than parents not receiving this information. | Resource intensive Accessing principals |
| Reynolds et al. (2020). Randomized controlled trial evaluating an intervention supporting implementation of sun safety policies in California public elementary schools | RCT | P | Policy support – telephone meeting with principal, policy implementation support tools provided | Intervention principals reported implementing more sun safety practices overall. | Accessing principals Still resource intensive, even though the intervention is phone based not face to face. May be targeted instead of universal delivery |
| Wright et al. (2019). Protect your skin and let the fun begin: The results of an intervention to improve NSW primary schools' implementation of the SunSmart Program | Cluster-RCT | P | Policy support – play-based incentives and free sunscreen, supported by student leadership | In the intervention, more individuals wore a hat, a cap, or a sun-safe hat. The effect size was small. However, for sunscreen use there was a large, positive intervention effect. | Both effective, adding play-based incentive more so. Cost of provision of play equipment may mean this is more suited to targeted provision to schools identified as needing more support. |
| Miller et al. (2021). Sun protection changes among diverse elementary schoolchildren participating in a sun safety intervention: A latent transition analysis of a randomized controlled trial | RCT | B | Interactive curriculum Practical outdoor UV experiment | A higher proportion of intervention group participants (31%) with low sun safe behaviours at baseline transitioned to higher sun safe behaviours compared to controls (0%). | Curriculum designed for ethnically diverse US population |

Impactful interventions in primary schools

The following six studies were categorised as impactful (5, 21-23, 31, 33), since they were not designed to test effectiveness, yet they achieved statistically significant results for key outcomes. Those studies deemed as impactful are shown in Table 8 and described below.

Hunkin et al. (2020) (23) evaluated changes to sun safety policies and practices in Australia to assess the impact of the National SunSmart Schools Program over a six-year period using a pseudo-longitudinal (i.e., repeat cross-sectional surveys) design. A random sample of greater than 15% of eligible primary schools across each of the eight states and territories of Australia was selected in 2011 (n=1557 schools selected and data from 859 was analysed) and 2016 (n=1533 schools selected and data from n=643 was analysed) and asked to complete a survey describing their current sun safety policies and practices. Data from a survey conducted in 2005 (n=932) was also analysed. This repeat cross-sectional study showed that SunSmart program membership achieved several impacts over time, including a significantly greater likelihood of many policies and practices being employed. However, the proportion of schools with a SunSmart policy showed only small, non-significant improvements between 2005 and 2016 and policy comprehensiveness was low in all schools. NSW joined the SunSmart program later than other states and between 2011 and 2016 the number of NSW schools participating in the program increased from 34% to 81%. This allowed some analysis of implementation of policies and practices related to non-membership and membership. The authors concluded that work needs to be done to increase written policies in schools and incorporate sun safety material into curricula. *The key mechanism for success was the SunSmart program free membership scheme. However, the results indicate that the proportion of schools with a written policy showed only a small and nonsignificant improvement in their sun safe behaviours between 2005 and 2016. Furthermore, policy comprehensiveness across the board was low.* The CCNSW mixed methods evaluation of the NSW SunSmart program (21) provides further insights into issues which effect membership uptake and renewal in NSW.

Lee Solano et al. (2022) (31) conducted a pilot study with no control group to investigate impacts on students' UV related knowledge of an interactive educational activity conducted in five regional and metropolitan schools in NSW using UV dosimeters to measure UV exposure. Students completed a before and after questionnaire over one day to assess knowledge of UV, the UV index, sun safety behaviours and health risks associated with sun exposure. The intervention comprised a UV dosimeter-based outdoor activity followed by a classroom lesson. The session took between 60- and 90-minutes. Students were assigned to small groups of 4-6 to participate in an outdoor learning activity, with each group facilitated by a member of the research team. They estimated the UV index, considering the weather, time of day and season, and then used the UV dosimeters to record actual UV index data at each location. Students also tested the effectiveness of four types of sun safety: sunglasses, protective clothing (school uniform), hats and sunscreen (spread on a glass slide). Students then returned to the classroom to print a graph of the UV index levels measured with the UV dosimeter. Students participated in an interactive slideshow presentation to consolidate key learning points about UV radiation and sun safety. After adjustment for school, grade and gender the mean difference between the before-after survey knowledge scores was statistically significant ($p < 0.0001$). The greatest improvement was for questions related to the UV index. It should be noted that long-term follow up was not undertaken so retention of the information was not measured. *A key component of the intervention was interactivity (students were active participants). Specifically, the*

study included the use of a UV dosimeter to engage students in an interactive outdoor activity followed by a classroom lesson. The UV dosimeters and software were user-friendly. They require annual calibration and cost around AUD \$200 each but could be loaned at no cost. This intervention does require curriculum time, but it was acceptable to staff and students.

A cross-sectional study by Harrison et al. (2016) (22) aimed to assess the comprehensiveness of current sun safety policies in primary schools in Queensland. To achieve this, the authors searched school websites to locate policies in school handbooks, policy links and/or prospectuses. Where a policy was not present, but the school had referred to one on their website, school prospectus or handbook, the school was contacted to obtain it. The schools' policies (n=723) were assessed for comprehensiveness using a pre-determined set of criteria based on Cancer Council's SunSmart schools program policy recommendations. Although the descriptive study was not designed to test effectiveness or measure impacts, the survey found that 90.9% of schools had a sun safety policy, suggesting SunSmart impacted policy uptake. However, a review by trained assessors indicated that most of policies were not comprehensive. This is consistent with the study by Hunkin and colleagues from 2020 (23), which also found the comprehensiveness scores of the sun safety policies were low and areas for improvement in policy adoption were identified.

Russo et al. (2023) (5) conducted formative research and developmental intervention design research with some evaluation of implementation using a mixed-methods approach. They explored the usefulness of an implementation support toolkit to enable and increase sun safe hat-wearing in 14 schools in Greater Western Sydney within the context of the SunSmart program. The toolkit was based on formative research to identify sun safety behaviours and practices, barriers and motivators to hat wearing, and resource needs. Identified motivators were school policies, role modelling, incentives and knowledge. Most (12/14) schools reported that the toolkit helped them to implement the 'No hat, play in the shade' SunSmart program policy recommendation and nine schools suggested that it supported implementation of the recommendation that all students wear sun safe hats when outside for play, sport and teaching. Follow-up interviewer administered surveys found an increased proportion of sun safe hat wearing in seven of the 14 participating schools. The descriptive quantitative findings from the evaluation of the implementation phase indicated that a practical toolkit tailored by champions to suit local needs and supported by school leadership, is a promising approach for supporting the implementation of SunSmart policy recommendations. Champions reported that the ability to select resources according to local needs was useful and that the toolkit effectively supported sun safe hat wearing. The study concluded that local champions and leadership buy-in can potentially improve policy implementation. *Key components of the intervention were local champions (principals or teachers), formative research and involvement of stakeholders to ensure the toolkit responded to actual need, as well as promoting a tailored approach suited to the priorities of individual schools. The theoretically informed 'Motivation, Access, Triggers' model may also have contributed to success.*

Scott et al. (2023) (33) conducted a mixed-methods study to investigate pre-service teachers' (second- and fourth-year Bachelor of Primary Education students) perceptions and experiences of sun safety following a brief pilot intervention and placement in primary schools in Western Australia. The sample group attended an interactive 45-minute sun safety education workshop delivered by the research team and after they completed their normal school-based placements as required for their degree, they completed a short survey. Participants reported feeling more knowledgeable, skilled and confident to teach sun safety in school. The study concluded that including more rigorous curriculum content and pedagogical approaches to sun safety education is a novel strategy which could feasibly

support pre-service teachers' self-efficacy to effectively deliver sun safety curriculum in Australian schools. It appears that this would be well-received by pre-service teachers. *A key component for success of the intervention was education targeting pre-service teachers who could then potentially embed sun safety in their teaching. Also, the interactive workshop included theoretical and practical components such as quizzes, props and teaching resources.*

In 2021, CCNSW commissioned an evaluation using mixed-methods evaluation of the reach, adoption, impact and maintenance of the SunSmart schools program in NSW primary schools (21). It aimed to determine the extent to which primary schools in NSW were implementing the program; whether they were effectively utilising the recommended SunSmart policies and practices; and the impact of the program on sun safety knowledge, attitudes and behaviours. In addition, the evaluation addressed 14 research questions. The research included online surveys of school representatives (n=394, 16.2% of all NSW schools with available contact details in a database), parents with at least one child attending a NSW primary school (n=806) and individual interviews with principals (n=10) and school staff (n=32 across five focus groups) from a large sample of metropolitan, regional and rural primary schools.

The evaluation concluded that NSW primary schools appeared to be implementing SunSmart recommendations to a moderate yet inconsistent extent regardless of the presence or absence of a current SunSmart policy. Stakeholders also shared the perception that sun safety is being sufficiently addressed and may not require further attention and investment. Some key findings of the evaluation included:

- While NSW schools considered sun safety to be important, it was also considered to be a mature topic where many gains have been made over time. So, while important, sun safety was not an urgent issue to address.
- Program awareness was moderately strong while understanding of how the program worked, including membership and benefits, was found to be low.
 - In particular, understanding of program membership was found to be poor and there was a lack of knowledge regarding whether their schools' own membership status was current (i.e., within the three-year membership cycle). Rather, predictors of sun safe attitudes, outcomes and practices in individual schools were more aligned with their perceptions of whether their school was SunSmart.
- Implementation of the SunSmart program in NSW was found to be moderate and inconsistent.
 - The extent of implementation of three of the 10 SunSmart recommendations was assessed as 'moderately strong' (i.e., wearing sun protective hats, using shade and reviewing the sun safety policy) with four rated as 'moderately weak' or 'weak' (i.e., sun safe clothing, sunscreen, informing the school community and sunglasses).

Table 8. Impactful primary school interventions: the main components, outcomes achieved & considerations for implementation at scale

| Author (Year). Title | Design | Type | Main intervention component(s) | Outcomes achieved | Considerations for implementation at scale |
|---|------------------------|------|--|--|---|
| Hunkin et al. (2020). The National SunSmart Schools Program: Impact on sun protection policies and practices in Australian primary schools. | Repeat cross-sectional | P | Australian SunSmart – national policy adoption. | SunSmart program membership achieved modest impacts, including a significantly greater likelihood of some policies and practices being employed. However, the results of the self-reported online surveys indicate that the proportion of schools with a written policy showed only a small and nonsignificant improvement in their sun safe behaviours between 2005 and 2016. | Policy comprehensiveness low nationally. Scalable strategies for effective policy support are needed. Targeted prioritisation of schools for more intensive policy support may be needed. Results for individual states/territories should be interpreted cautiously given the sample sizes achieved were much less than the samples of >15% of schools sought. |
| Lee Solano et al. (2022). Effect of an interactive educational activity using handheld ultraviolet radiation dosimeters on sun protection knowledge among Australian primary school students. | Pre-post | B+E | Environmental interactive outdoor activity utilising UV dosimeter. Education in classroom lesson. | The greatest improvement was seen in knowledge related to the UV index. | Teachers, older students or others could run the activity themselves with basic instruction. |
| Harrison et al. (2016). Sun protection policies of Australian primary schools in a region of high sun exposure. | Cross-sectional | P | Australian SunSmart – Queensland policy adoption. | SunSmart program membership achieved several impacts, including a significantly greater likelihood of many policies and practices being employed. | Mandatory policy for government schools supported written policy adoption. These results should be interpreted cautiously since the comprehensiveness criteria were assessed by accessing mostly online policies without any direct observation. |
| Russo et al. (2023). The formative evaluation and pre-testing of a SunSmart policy implementation support toolkit targeting sun safe hat-wearing in NSW primary schools. | Mixed methods | P | Policy support – theoretically informed toolkit for champions to support local implementation needs. | High written policy adoption (90.9%), toolkit supported hat-wearing behaviours | There needs to be more than one champion to guide implementation, supported by leadership buy-in and whole of school engagement. |

| Author (Year). Title | Design | Type | Main intervention component(s) | Outcomes achieved | Considerations for implementation at scale |
|---|---------------|------|--|---|--|
| Scott et al. (2023). A novel skin cancer prevention strategy: Preservice teachers' perceptions of a sun safety intervention and experiences in schools. | Mixed methods | B | Preservice teacher training via 45-minute interactive workshop. | Increased teacher knowledge and sun safe behaviours. | Involving preservice teachers would require support from institutes of higher learning that train teachers to achieve scale. Possibly even teachers' association. |
| ORIMA (2021). SunSmart NSW Evaluation Report. | Mixed methods | B+P | Evaluation of the implementation of the ten recommendations within the NSW SunSmart policy, from the perspective of school informants, parents, principals and teachers. | Small but significant differences between member schools and non-members for SunSmart policy areas. | Provides the key areas to address via the SunSmart program in NSW. The findings provide evidence for reshaping how NSW school communities engage with sun safety through a more compelling, contemporary and personally relevant sun safety program. |

Other components, outside the SunSmart policy recommendations, identified in this review that could support improved delivery of the SunSmart program in NSW primary schools

Components which could encourage policy implementation / review / sun safety practices at the school level

- Co-creation / stakeholder involvement / champions

Involving stakeholders (e.g. principal, teachers, school community) in planning the intervention, reviewing policy and/or developing materials appeared to help increase buy-in and engagement (5, 48), as did using local champions and having key people (e.g. trained 'coaches') to support implementation (61, 62)

- Clear communication and definitions

The 2021 evaluation of the NSW SunSmart program noted the importance of clear messages and definitions to support understanding and engagement with the SunSmart program (21).

Components which could support behaviour change or increased awareness / knowledge

- Interactivity / active student participation and appropriate incentives

The study by Lee Solano et al. (2022) (31), which used an interactive activity (with UV dosimeters) was effective in engaging students and suggests this type of intervention could be feasible with primary aged children. Furthermore, the study by Wright et al (2019) (4) utilised active student participation through play-based incentives, whereby a positive reward, (a wheelie bin of toys), was associated with the application of sunscreen. The authors found that a play-based incentive significantly improved sunscreen application in primary school aged children and highlighted the importance of positive reinforcement.

Evaluations conducted in secondary school settings

There were 23 interventions conducted in secondary schools (6-8, 10-12, 19, 20, 34-43, 45-48, 63), nine of which were designed to determine effectiveness (8, 9, 11, 12, 19, 38, 39, 43, 48) and 14 of which were categorised as impactful (6, 7, 10, 20, 34-37, 40-42, 45-47), since they were not designed to test effectiveness, yet they achieved statistically significant results for key outcomes.

Effective interventions in secondary schools

From nine studies designed to determine if interventions were effective, seven were rated as effective and two were not (38, 48). Table 9 summarises the main intervention components, outcomes and considerations for implementation at scale.

Systematic reviews

A systematic review by Calco et al. (2023) (19) focused on interventions involving high-school curricula, which were predominantly undertaken in high-income countries. Only studies involving a skin health-based curriculum delivered in schools to high school-aged adolescents (grades 9-12) were included. A total of 25 studies with 22,683 adolescent participants were analysed. All studies

were rated either '1' or '2' for quality of evidence, with '1' being the highest quality and allocated to RCTs and '2' for a well-designed controlled trial without randomisation or a prospective comparative cohort trial. Sixteen studies showed a significant increase in knowledge, 21 studies showed changes in behaviour and 15 studies showed significant changes in attitudes. Key intervention elements included:

- lectures, delivered by teachers or by medical students, university students or peers
- interactivity in the form of games or activities (most interventions) and some interventions were based on educational theories

The review concluded that few education programs targeting skin cancer prevention incorporated multiple, well-studied education theories and early detection as key parts of their curricula. *Similarly, incorporating activities based on educational theory, such as the Theory of Planned Behaviour, appearance-based focus, gamification and the Goal Setting Theory of Motivation is important in creating a measurable curriculum aimed at the prevention and early detection of melanoma. Interdisciplinary collaboration in educational public health interventions can also prove effective.* In the discussion, the authors state that interdisciplinary collaboration is important to ensure knowledge of the effectiveness of educational intervention strategies and evidence-based pedagogy, beyond the scope of public health professionals.

McNoe et al. (2021) (11) undertook a systematic review of the effectiveness of sun safety interventions delivered to adolescents in a secondary school setting. Thirteen studies from various countries were included: Australia (n=3), Iran (n=3), USA (n=2), Brazil (n=1), China (n=1), Denmark (n=1), Spain (n=1) and Turkey (n=1). The outcomes of interest were interventions that aimed to either improve sun safety behaviour and/or reduce UV radiation exposure or skin damage. Only papers with outcomes of "actual behaviour," UV radiation exposure or physiological outcomes were included. These were sun safety behaviours (use of sun protective hats, clothing, sunglasses, sunscreen or shade), reduced UV radiation exposure (staying indoors during peak UV radiation, or reduction in objectively measured UV radiation, self-reported intentional tanning or sunbed use), and physiological outcomes (erythema, naevi development, skin damage or skin cancer development). The studies predominantly aimed to increase knowledge of the risks of sun exposure and the importance of sun protective behaviours (use of sunscreen, avoiding tanning and sunburn) as well as encouraging sun protective behaviours. In addition to lecture material, five interventions had an interactive component such as games, role playing or appearance-focused applications (apps) or photographs. One was an environmental intervention. No studies were rated as strong, but of the five which were rated as moderate, three found evidence for effectiveness. The review concluded that most sun safety interventions targeting adolescents are health-based, emphasising the association between UV radiation exposure and skin cancer and that these have limited success in changing behaviour. *Two promising interventions were identified. The first was an appearance-based intervention using facial ageing technology in the classroom. The second was an environmental intervention with the provision of a real-time UV index display meter in the school playground. The types of interventions showing the most promise in improving outcomes were those that moved beyond pure health education. The review also stated it was preferable that interventions be based on theory.*

RCTs

Jensen et al. (2022) (8) analysed data on a four-arm intervention cluster-RCT study carried out in Utah high schools. They examined the underlying cognitive mechanisms at work. For context, participants primarily identified as White, followed by Black or African American, Asian or Asian

American, and American Indian/Alaskan Native. Participants received one of four interventions (education-only, education plus sunscreen efficacy demonstration, education plus implementation intervention and education plus tailored UV photograph). Interventions were delivered in group settings (e.g., classrooms) with multiple students present during each session. All interventions included a 20-minute educational component. Students in the implementation intervention group also wrote down their intended sun safety behaviours, when and where they would do them and action steps to successfully implement the behaviour. Compared with the implementation intervention, participants in the tailored UV condition reported increased fear and threat to freedom and decreased appearance norms and benefits of tanning immediately following exposure to the intervention and decreased outdoor tanning one month post intervention. *Key mechanisms for success include the addition of a tailored UV photograph, which shifted participant perceptions of the benefits of tanning.* Specifically, participants were less likely to agree with the statement “I look better with a suntan” after viewing a personalised photograph that revealed (invisible) UV radiation damage to their skin. *Mediation analysis found that these reductions in tanning occurred via a pathway involving indirect effects of tailored images on fear and perceived appearance benefit of tanning.*

Jia et al. (2020) (39) used gamification to improve visual melanoma identification amongst metropolitan schools in the USA. The intervention was a matching game to assist with the early detection of melanoma. In each of the six rounds of the matching game, participants were asked to identify the correct melanoma image among three unlabelled skin lesion images. Each round concluded with educational feedback. Following the pamphlet (control) or game, participants were asked to identify forty images, labelling each image as a melanoma or a benign nevus (i.e., birthmark or mole). The accuracy in correctly identifying the images was significantly higher in the gamified cohort. Most subjects preferred games followed by pamphlets, social media and lectures. *Key mechanisms for success were gamification combined with educational feedback.*

Owen et al. (2018) (43) tested the impact of an appearance-focused facial ageing intervention on attitudes towards sun safety using an RCT design over two days. They included 237 Caucasian students (60 Intervention, 176 Control) from one metropolitan school in Wales. In the intervention group, the participants began by discussing their awareness and attitudes towards sun safety and UV radiation exposure. The experimenter then took a photograph of each participant's face and uploaded the photograph onto APRIL Age Progression Software. The experimenter explained that the photographs on the left-hand side of the screen would show their face aged if they had been using sun protection and not using sunbeds, and on the right-hand side of the screen they would see their face aged with UV radiation exposure and no sun protection. The photographs moved through the ages from the participant's current age, in 2-year intervals, up to the age of 72 years. Participants in the group then took part in a brief discussion about the intervention. The control group completed the same questionnaire as the intervention group and after completing it they were allowed to talk to each other in small groups. Then, they were given the follow-up questionnaire and a debrief sheet to complete. The intervention was deemed effective since adolescents who had participated in the appearance-focused intervention had significantly greater intentions to use sun protection, significantly more negative sun risk beliefs, lower sun benefit attitudes and higher perceived sun damage susceptibility. *The key mechanisms for success were a focus on skin appearance, personalisation by using the participants' individual photos for the age progression software and the use of interactive technology.*

Tuong et al. (2014) (9) compared the effect of appearance-based education with health-based education on sunscreen use and knowledge using videos. For context, most of the participants were

non-white and were on a subsidised lunch program. The videos were approximately five minutes in duration and guided by the Health Belief Model, which was developed to explain and predict health-related behaviours. The health-based video discussed the growing incidence of melanoma among young people and the link between skin cancer risk and UV radiation exposure. It also explained how using sun protection could lower skin cancer risk. The appearance-based video discussed the contribution of UV light to premature cutaneous ageing and how sunscreen use could help delay signs of skin ageing. Within-group analysis showed that the appearance-based group reported significantly higher mean sunscreen use at the 6-week follow-up period compared with baseline. In contrast, the health-based video intervention group reported a mean sunscreen application frequency that was not significantly different from baseline. Specific features of the videos were a choice of actress that reflected the ethnically diverse target population, computer generated images, animations, pop culture references and humour. *Key components of the intervention were appearance-based education, tailored video content which resonated with the target population and age-appropriate engagement strategies including popular culture references and humour.*

This review identified two studies that were deemed to be ineffective, as the intervention did not statistically significantly alter the primary outcome (38, 48). White et al. (2019) (48) utilised the Theory of Planned Behaviour, a psychological theory that links beliefs to behaviour, to design a school-based intervention to improve the rates of sun protective behaviours amongst Australian teenagers. Whilst the authors did report a significant increase in weekend sun protective behaviour between time points for the experimental group, the intervention failed to achieve any statistically significant impact on weekday sun-protective behaviour between the control and intervention group. Hubbard (2018) (38) employed a quasi-experimental design to assess the impact of a school-based intervention to educate young people on the risks of skin cancer and to promote self-examination. Whilst the study failed to demonstrate a statistically significant impact of the intervention, which the authors attribute to a lack of statistical power within the experimental design, it did demonstrate the feasibility for a larger scale study to be conducted.

Longitudinal studies

In their quasi-experimental study, Pettigrew et al. (2020) (12) considered the potential of UV radiation meters in secondary schools as a sun safety intervention mechanism for adolescents in two schools in Western Australia over two months, with students completing a pre-and-post-survey. The two schools had a similar demographic profile and were of a similar size. The intervention school received a UV radiation meter, and the control school was waitlisted to receive a meter at the conclusion of the study. A presentation was delivered to students at the intervention school. The presentation lasted approximately 15 minutes and explained the purpose of the UV Index and the threshold of a UV level of '3' as the reading at which sun protection is required. Consistent with the information provided, a sign featuring a graduated call to action was attached to the meter at the intervention school. Both schools had extensive grassed ovals and open spaces. The intervention was deemed effective since respondents from the intervention school exhibited significant improvements in awareness of; (a) the purpose of the UV Index and, (b) the UV Index threshold for sun protection. *Key elements were that the intervention school received a UV meter. The prominently placed UV meter may have been a visual cue which prompted knowledge recall.* This strategy is potentially worthwhile as a means of supplementing other skin cancer prevention strategies since it is highly acceptable to the target audience, however, the cost per school could be prohibitive. Another potential challenge to scalability is the need to calibrate the UV meters at periodic intervals. The results of this exploratory study

indicate that the provision of salient, real-time UV Index information in schools may constitute a viable and acceptable means of ensuring adolescents have the information they require to make informed decisions about sun safety. Establishing effective communication with individuals at multiple levels within participating schools can reinforce and optimise intervention implementation.

Table 9. Effective secondary school interventions: main components, outcomes achieved and considerations for implementation at scale

| Author (Year). Title | Design | Type | Main intervention component(s) | Outcomes achieved | Considerations for implementation at scale |
|--|--------|------|--|---|--|
| Calco et al. (2023). A Systematic Review of Evidence-Based High School Melanoma Prevention Curricula | SR | B | Curriculum-based interventions. | Most studies found increases in knowledge, behaviour and attitudes. | Consider educational theories when planning curriculum to prevent skin cancer. The Theory of Planned behaviour was the most used theory. Other educational components included appearance-based focus, gamification and goal setting. |
| McNoe et al. (2021). Effectiveness of Sun Protection Interventions Delivered to Adolescents in a Secondary School Setting: A Systematic Review | SR | B+E | Review suggests technology and environmental interventions have the most promise | Three of five studies rated “moderate” quality were effective. The most promising interventions used a variety of approaches e.g. shade provision and technology. Outcomes similar across included studies: use of sun protection items, UVR exposure, physiological. | Preferable interventions should be theory-based to account for mediating factors that achieve behaviour change. Most interventions were health-based and had limited success changing behaviour. Educational interventions were resource heavy. The authors noted the significant capital investment associated with the provision of shade sails. |
| Jensen et al. (2022). Tailored Visuals, Implementation Interventions, and Sun Safe Behavior: A Longitudinal Message Experiment | RCT | B | Education + tailored UV photograph. | Decreased outdoor tanning one-month post-intervention. Mediation analysis found reduced tanning occurred via a pathway of indirect effects of tailored images on fear and perceived appearance benefit of tanning. | Costs of UV camera system and transport to schools needs to be considered from a scalability point of view. |
| Jia et al. (2020). Gamification improves melanoma visual identification among | RCT | B | Gamification to improve melanoma identification. | Correctly identifying the images was significantly higher in the gamified cohort. | Participants preferred games, then pamphlets, social media and lectures. |

| Author (Year). Title | Design | Type | Main intervention component(s) | Outcomes achieved | Considerations for implementation at scale |
|--|--------------------------------|------|---|--|--|
| high school students: Results from a randomized study | | | | | |
| Owen et al. (2018). The impact of an appearance-focused facial-ageing intervention on adolescents' attitudes toward sun protection | RCT | B | Photoaging software showing impacts of no sun safety. Personalised by using participants' own photos | Greater sun safety use intent, more negative sun risk beliefs, lower sun benefit attitudes, higher perceived sun damage risk. | Authors state appearance-focused interventions may be more effective for females who may value appearance more. |
| Tuong et al. (2014). Effect of appearance-based education compared with health-based education on sunscreen use and knowledge: A randomized controlled trial | RCT | B | Appearance-based education via video. Personalisation: mixed race actress, same age. Engagement: humour, animation. | Appearance-based group higher sunscreen use vs. no change in health-based group. Knowledge higher for both | Theory-informed – Health Belief Model. Appearance-based education may be more effective than health-based education. |
| Pettigrew et al. (2020). The potential of UVR meters in secondary schools as a sun protection intervention mechanism for adolescents | Longitudinal, Quasi-experiment | B+E | UVR meter placed in school + brief UV index education. Sign featuring graduated call to action. | Increased knowledge of UV index purpose and threshold. High acceptability of UV radiation meter. Sun safety behaviour changes not evident. | Placement of UV radiation meters is promising. High baseline shade use may explain no behaviour change being found. |

Impactful interventions in secondary schools

Of the 14 studies which were not designed to measure efficacy or effectiveness, all 14 were deemed impactful interventions (6, 7, 10, 20, 34-37, 40-42, 45-47). The study designs included three longitudinal quasi-experiments, seven pre-post studies, three mixed methods and one cross-sectional study.

Longitudinal studies

The Clare et al. (2022) quasi-experimental pilot study involving 57 (29 Intervention, 28 Control) year 7 and 8 students from metropolitan Perth over 10 months aimed to determine the effects of using the *Sun Safe* app on the knowledge and behaviours of teenagers (35). The intervention group downloaded the *Sun Safe* app to their iOS mobile device, which has features including:

1. A home page with that day's maximal temperature and UV index.
2. Predictive data on the maximal temperature and UV index linked to the times when sun protection for that day was recommended and subsequent days, accessed through a 'view this week' button.
3. Educational content in learn feature.
4. Easy and hard quizzes in quiz feature.
5. Capacity to set daily notifications to check the UV Index.
6. A reminder to reapply sunscreen set with a countdown, after which a notification is sent.

The control group downloaded a placebo app (the SunDial app) from the Australian Apple app store. While the focus of the placebo app was on the sun, no information was imparted relating to sun health. The *Sun Safe* app was impactful since it achieved greater increases in knowledge about UV and the impact of overexposure to UV amongst users compared to the SunDial app control group. However, it did not achieve statistically significant impacts for reducing sunburn instances and time spent outdoors, although the study was not powered to detect changes in behaviours since a follow-on confirmatory effectiveness study is planned. *The information delivered via the Sun Safe app (e.g., the learn and quiz tabs) was rated particularly highly by intervention participants, suggesting it was a key mechanism for achieving significantly greater outcomes for knowledge in the intervention group compared to the control group.* However, the authors stated that further development may be required to improve user engagement, such as incorporation of gamification (which was suggested by users in the app's co-design process).

Hubbard et al. (2020) (37) aimed to assess the feasibility and acceptability of an earlier sun safety education intervention with an additional intervention component – Short Messaging System (SMS). The study employed a wait-list controlled trial with quasi-experimental design and involved 487 students (385 Intervention, 102 Control) in six schools (5 Intervention, 1 Control) in Scotland. For context, most children in both the intervention and control groups were white (93% and 95% respectively). Automated text messages were sent on two days a week for seven weeks during the summer holidays. The intervention impacted students' sun safety behaviours more than skin self-examination with no intervention component. The percentage of participants reporting more severe sunburn was lower post-intervention than pre-intervention. *Key elements were that the intervention was delivered by a skin cancer nurse, a young adult skin cancer survivor gave a talk about their experience of melanoma and students were provided with an information booklet on sun safety and self-examination followed by automated SMS messages for seven weeks during summer.*

McNoe et al. (2022) (41) assessed the feasibility of delivering a photoaging intervention to secondary school students using a longitudinal study design. Most students were European New Zealanders (n=36), six were New Zealand Māori and three were from other cultural backgrounds. The intervention consisted of UV photographs, a PowerPoint presentation, and other UV “experimental” activities. The UV camera took three black and white photographs of each student: the first under “white light,” the second using a UV filter that displays signs of sun damage not visible to the naked eye and the third using the same UV filter but with sunscreen applied to the participant. The intervention was impactful since students could recall facts delivered. Whilst this photoaging software and equipment was deemed impractical, the approach could be practical using more modern equipment and software. However, since it is an educational intervention, it requires being built into curriculum to achieve scale.

Pre-post

Chaudhry et al. (2021) (6) looked at the impact of using medical students to teach school students about skin cancer prevention and early detection. They analysed both changes in student knowledge and behaviour and medical students’ confidence in counselling patients. Eighty-one percent of students were Fitzpatrick skin type 1-3 (pale white, fair skin, darker white) and nineteen percent type 4-6 (light brown, brown, dark brown or black). The intervention was deemed impactful and one third of participants reported increased use of sunscreen during program delivery in winter months and their reported intention to wear sunscreen during the upcoming summer months increased by 11% from 56% to 67% ($p < 0.001$). Belief that sunscreen is effective in preventing skin cancer increased and there was a 61% improvement in the belief that a tan is unhealthy ($p < 0.001$). *Key mechanisms for the success of the intervention included a community outreach program using dermatology-trained medical students who are closer in age to the students than parents and teachers to deliver an interactive multimedia curriculum. The program used both appearance- and health-based motivators. It also used a video of two teenagers describing their experience of melanoma.* Whilst high-level support is required to implement curriculum interventions into an already busy high-school curriculum, targeting early high-school years, as this program does, may be more feasible than targeting later high-school years.

Davis et al. (2015) (7) also looked at a university student delivered intervention, ‘Students are Sun Safe’ (SASS), which targeted middle school and high school students. Although individual demographic information was not recorded, it was reported that across the five school districts the percentage of white students ranged from 12% to 65%, the percentage of African American students ranged from 3% to 6%, the percentage of Hispanic students ranged from 25% to 82%, the percentage of Asian/Pacific Islander ranged from 0.6% to 4%, and the percentage of Native American students ranged from 0.6% to 5%. The intervention involved delivery of curriculum by university students who received credit for the service-learning course and in-turn were required to deliver a set amount of hours for the credit. The intervention was impactful. Student participants perceived their risk of skin cancer during their lifetime as higher after the intervention. Participants did not report a change in their short-term sunscreen use, or their short-term tanning behaviours. However, after the Project SASS intervention, participants reported that tanned skin was less appealing than before the intervention. Self-reported tanning behaviours did not show any change among high school students but were statistically less frequent among the middle school student participants. *Key mechanisms for the intervention achieving some impact included the use of the Health Belief Model as a conceptual*

framework. SASS was a university student led, media-based, interactive sun safety program. The university students received specific training in presenting sun safety activities.

Hanna et al. (2022) (36) tested the effect of the ‘SunSafe Student Ambassador Program’ on the attitudes, knowledge and behaviours of Australian secondary school students in respect to sun safety. For context, the intervention was evaluated in a government funded selective state girls’ school and a government funded coeducational school in NSW. The intervention began with a comprehensive 1-day training session to educate student representatives from secondary schools on skin cancer prevention and early detection; specifically, the five forms of sun protection and the ABCDE approach to early detection of skin cancer were taught. These student ambassadors were also taught presentation skills and were required to workshop their own SunSafe presentation as part of the training. Template PowerPoint slides were provided, as well as access to one-to-one guidance with a ‘presentation skills’ expert to optimise performance of the ambassadors and to support accurate and standardised information. The students then returned to their schools to deliver their SunSafe presentation to their peers. Immediately post-intervention, there was a significant increase in the number of students who correctly identified that the following factors increased the risk of melanoma: having many moles, having atypical/odd-shaped moles, getting sunburnt as a child and getting a blistering sunburn even once. The total composite knowledge score showed very strong evidence for improvement. For the behaviour questions, there was evidence of an improvement in daily sunscreen use. After three months, analysis showed that students from both schools had a statistically significant improvement in knowledge and attitudes and had reduced the amount of time spent outdoors. The composite score (out of 18) of all knowledge questions improved. *Key mechanisms for success include that the intervention was peer-led with a train-the-trainer approach where student representatives were trained to be student ambassadors and to develop a SunSafe presentation, gaining presentation skills as well as knowledge.* Given the intervention involved 11-16-year-old students it may be feasible to implement across a broad age range in secondary schools, or even late primary school.

Loescher et al. (2019) (40) implemented the ‘Students are Sun Safe’ (SASS) intervention in rural high schools located on the Arizona-Mexico border in the USA. The feasibility study which included impact and process evaluation used a pre-post test repeat cross-sectional design involving 220 students, where most of the students were Hispanic. The intervention included a participatory research framework and peer educators. Peer educators were recruited to complete three 20-minute online training modules developed by community partners and a university team. They then visited the university and presented at their schools. This study was classified as impactful as the overall assessment of sun protective knowledge increased along with the number of sun protective behaviours. Classroom participants showed sustained knowledge and behaviour improvements over four months for most items. *Key mechanisms for the success of this project were the establishment of peer educators and use of a community-based participatory research framework. The latter approach is particularly important when the target population is underserved and understudied.*

Steele et al. (2020) (46) conducted a multi-component sun safety prevention pilot using pre-post design over three weeks with 57 middle school students in one school in North Carolina, USA. The school was a private school with high annual tuition fees. The intervention consisted of an in-class presentation and two weeks of sun safety electronic messages. The in-class component was a 30-minute interactive, educational presentation and a sunscreen application demonstration using a live-action UV camera. Students then received electronic messages with sun safety infographics three times a week for two weeks. The intervention was impactful since it was associated with an increase

in total knowledge score and total attitude, yet behaviour scores did not change significantly. *Key mechanisms for achieving impacts were an in-class interactive presentation and two weeks of sun safety electronic messages. Using technology in sun safety interventions can further engage students in multimedia education styles and can release sun safety programs from the time constraints on health education during school calendar days. One major success factor for this study was that the program was created for and tailored to both the age of the study population and the resources available in the setting.* Considering what electronic resources are widely available will be important when considering scaling up such interventions.

Sharma et al. (2022) (45) conducted a high school-wide study to assess students' current understanding of skin cancer prevention, provide an up-to-date instruction lesson and evaluate changes in students' knowledge and behaviours. The study was a repeat cross-sectional pre-post design which was conducted over one month in one large (n=1,025 students) metropolitan high school in California, USA. The intervention included a skin cancer lesson presentation, which was created and narrated by students. It consisted of a four-minute video outlining the incidence of risk factors, preventive measures, self-screening techniques and treatment options for skin cancer. The intervention was assessed as being impactful by this realist review due to there being significant changes in knowledge gain, knowledge decay and knowledge persistence throughout all grade levels. Behavioural changes included an increase in students wearing sunscreen 5-7 days per week and students examining themselves for changing moles. *The key mechanisms for success included a four-minute skin cancer video narrated by a student.* Brief videos may be a feasible inclusion in multi-component sun-safety interventions delivered in busy secondary schools. The objectives of this study were later integrated into proposed changes for the Health Education Framework for California Public Schools, highlighting the benefits of engagement and advocacy with sector leaders.

In Wu et al.'s (2019) (10) four group experimental study, repeat cross-sectional surveys were conducted to measure improvements in high school students' sun safety behaviours, with a pre-post design over four months in 11 schools (n=1,573 students) in Utah, USA. There were four main interventions. The first was a control group where a skin cancer education PowerPoint presentation was provided. This presentation included information on skin cancer incidence, risk factors, causes of skin cancer, strategies to prevent and screen for skin cancer, and common misconceptions about skin cancer and prevention strategies. The second group utilised UV photographs. Each student received a personalised UV photograph that showed their current facial UV skin damage caused by UV radiation exposure. The third intervention was a behaviour change worksheet which aimed to increase self-efficacy for carrying out skin cancer prevention strategies and used an implementation intention setting framework, which draws on self-regulation and motivation theories. The last condition was where students used a UV-generating flashlight and UV sensor to test and record the amount of UV radiation detected when the light was blocked by sunscreens of differing sun protection factors. Students also viewed the educational presentation from the control condition. This realist review deemed that the intervention was impactful – as the authors found that all four intervention arms were associated with significant improvements in sun safety behaviours. The photograph condition was superior in controlling intentional tanning and sunburn when compared to the behaviour change worksheet. The worksheet was associated with greater increases in sun protection use when compared with the photograph. *Key mechanisms for success of the intervention arms included a personalised behaviour change worksheet (sun safety goal setting and planning) based on an implementation setting framework and use of personalised photographs to show current facial skin damage due to UV radiation exposure.*

Cross-sectional

Truong and colleagues (2021) (47) conducted a pilot case-control study which included post intervention surveys with 109 high school students (22 Intervention, 87 Control) using a tanning myths-focused video contest. They designed and sponsored an annual statewide contest running from 2015 to 2018, in which Utah teenagers voluntarily created one-minute public service announcement videos debunking tanning myths. Between three and 10 finalists and their families attended a celebratory event at the University of Utah Department of Dermatology each year where their videos were viewed, students' achievements were recognised and the importance of sun-protective behaviours was stressed. A cohort of adolescents from high schools who participated in the video contest and a cohort of adolescents from the same high schools who did not participate were electronically surveyed post-intervention about tanning intentions on sun-protective behaviours and understanding of tanning myths. Although knowledge of skin cancer facts did not differ between video contest and non-video contest participants ($p=0.14$ and $p=0.11$, respectively), video contest participants were more likely to correctly identify two tanning myths and achieved significantly higher overall knowledge scores than control group participants. *The key mechanisms for success included getting youth involved in creating their own videos, involving family and making it celebratory.*

Mixed methods

Cassel et al. (2018) (34) tested the impact of a school-based skin cancer prevention intervention, 'SunSafe in the Middle School Years' adapted for multiethnic high school students. Context included that the intervention was undertaken in Hawai'i, USA, and 51.6% of students were Asian, 30.4% were Native Hawaiian/ Pacific Islander, 8.4% were white, 3.5% were Hispanic, 2.7% were black and 3.2% were of two or more ethnicities. Qualitative and quantitative methods were used to test the acceptability, fit, intent to use, and preliminary efficacy/impacts of the adapted SunSafe intervention. The Systematic Observation of Sun Protection Factors instrument was used to objectively measure behavioural changes. Initial key-informant interviews were conducted with two health education teachers and the principal to introduce them to the project. Following the interviews, students of an interviewed teacher were recruited to participate in one-hour guided discussions held during a health class. The purpose of the student discussions was to elicit input regarding modifications to a SunSafe intervention that would appeal to high school aged multiethnic students. The SunSafe intervention and resources were presented by the research team to the students for prior review to facilitate the subsequent discussions. These resources and materials included the following: (1) a set of seven educational handouts and posters for student and their parents on UV radiation protection; (2) a slide presentation on sun safety containing 34 slides for delivery in the classroom; and (3) a set of interactive classroom activities to support experiential student learning. The modified SunSafe curriculum consisted of a pre-test, 30-minute presentation, modelling of sun protection apparel and a question-and-answer session, followed by a post-test. Branded resources were distributed and included a revised educational brochure, UV radiation-sensitive wristbands and a message pen. There were significant increases in student knowledge, attitudes, and intended sun safety behaviours at the post-test time frame of 12 months. While students' attitudes toward tanning were related to their perceptions of their own complexions, they were willing to change their sun safety behaviours after learning about the risk of skin cancer. *A key mechanism for successful adaptation of the intervention was student involvement in the co-adaptation of the program. The preliminary discussions created buy-in and power-sharing as students had an active role in the project's redesign. This resulted in a messaging shift from safety to appearance, which is a more immediate concern for teenagers. As a result, program branding was changed from 'SunSafe' to 'Love Your Skin'.*

Nicholson et al. (2016) (20) analysed a questionnaire and qualitative interview plus focus group data related to sun protective policies and actions in a selection of Victorian secondary schools. Most schools were in regional or remote areas and areas of social disadvantage. The Victorian SunSmart secondary school program was potentially impactful with respect to policy uptake, since almost three-quarters of secondary schools surveyed reported that they had a written policy or guidelines on UV or sun safety. However, this study did not consider whether involvement with the SunSmart program was related to the presence of a policy. Written sun protection policies were associated with student and staff hat wearing, but not with other practices such as shade or curriculum. Key elements were focus groups and telephone interviews, which are likely to have provided a more accurate assessment of policy adoption than the study by Harrison and colleagues in primary schools, which assessed those policies found primarily on school websites. This study confirmed an important contextual finding, which was that, without regulatory support, strong leadership is required to promote and implement sun safety practices within secondary schools. Participants also referred to the importance of environmental interventions, such as shade structures, that may improve sun safety without repeated emphasis on behavioural changes (64). The Nicholson et al. (2020) peer-reviewed publication extends the qualitative focus group data from the same study described in the 2016 unpublished report by the same group described above and draws on the enablers and barriers for teachers to change sun safety practices within schools (42). Enablers included viewing sun safety as a 'duty of care' and increasing staff accountability, which may lead to a more comprehensive approach when designing and enacting sun safety policies in secondary schools. Barriers included: pressure to meet other health and wellbeing priorities; variable staff culture regarding sun safety between schools; and the challenges in engaging secondary school students in sun safety, noting how heavily adolescents are influenced by cultural norms.

Other components, outside the SunSmart policy recommendations, that could be valuable to inform an approach to engaging NSW secondary schools in sun safety.

Compared to the primary school setting, in the secondary school setting a larger proportion of interventions were educational and their content reflected the age of the students. This included more complex concepts, e.g. melanoma versus skin cancer, early detection and self-examination and the effectiveness of sun safety behaviours such as sunscreen. Some also incorporated appearance (6-10) rather than health-based messaging only. Components such as gamification (39) were also considered to be effective in engaging this age group.

Peer-delivered interventions and interventions where students actively participated in developing materials also appear to successfully engage secondary school students and support achieving the desired outcomes and/or targeted behaviours (36, 40). Moreover, presentations by other young people who had experienced cancer were reported to resonate with secondary school students (6, 7, 36, 37, 40, 49).

Although they did not feature prominently, environmental interventions such as provision of shade or sunscreen (12, 13) and prominent displays of the UV index in schools appear promising for secondary schools (11).

There were several promising intervention approaches targeting secondary school students. A systematic review by Calco et al. (2023) highlighted the integration of interactive elements within sun safety curricula, including engaging activities such as games, role-playing scenarios and social media advocacy, aiming to enhance students' understanding of sun safety (19). Interventions included objective measures of either UV through a radiation meter (12, 46) or melanin using a handheld reflectance spectrophotometer (37). Tuong et al. (2014) (9) and Wu et al. (2019) (10) utilised

appearance-based videos and personalised photographs to demonstrate the impact of UV damage and improve students' knowledge and behaviours regarding sunscreen use and sun safety.

Table 10. Impactful secondary school interventions: main components, outcomes achieved and considerations for implementation at scale

| Author (Year). Title | Design | Type | Main intervention component(s) | Outcomes achieved | Considerations for implementation at scale |
|---|--|------|---|---|--|
| Clare et al. (2022). The Effects of Using the Sun Safe App on Sun Health Knowledge and Behaviors of Young Teenagers: Results of Pilot Intervention Studies | Longitudinal (Quasi-experiment, Pilot) | B | Mobile-app based (SunSafe) Education, information and reminders conducted during three intervention studies. | Increased sun health knowledge, especially related to UV index. No significant impacts on behaviours, but the measure was outdoor sun exposure which was impacted by the COVID-19 pandemic. | Follow-on confirmatory study planned. Information delivered was highly rated. App re-development will consider increases to user-engagement e.g. via gamification. |
| Hubbard et al. (2020). Sun protection education for adolescents: A feasibility study of a wait-list controlled trial of an intervention involving a presentation, action planning, and SMS messages and using objective measurement of sun exposure | Longitudinal (Quasi-experiment, Feasibility) | B | Nurse-delivered in-class presentation plus 5-minute film and brief talk from young adult skin cancer survivor. Booklet on skin self-examination. Melanin and erythema measured by handheld reflectance spectrophotometer. SMS. | Impacted students' sun safety behaviours more than skin self-examination. The percentage of participants reporting more severe sunburn is lower post-intervention than pre-intervention. | Students said listening to the personal story of the cancer survivor was the best feature of the presentation. Intervention intensive. Requires a nurse and peer-presenter, which may not be scalable. |
| McNoe et al. (2022). Photoaging Intervention Delivered to Adolescents in Secondary Schools: A Feasibility Study | Longitudinal (feasibility) | B | UV photographs, a PowerPoint presentation, and other UVR "experimental" activities. The main component was UV photographic software that displayed three photos in normal white light, a UV filter displaying signs of skin damage and the same UV filter but with sunscreen applied to show protective coverage. | Students were able to recall facts about sun safety. | The UV photographic equipment was impractical to set up, and inefficient since one person views their photos at a time. More modern UV photo equipment would be more practical. This intervention is reliant on being built into curriculum and there were recommendations from the teaching staff involved regarding this (see full data extraction in Appendix 2 for details). Author notes the intervention would not work with a single classroom teacher. |

| Author (Year). Title | Design | Type | Main intervention component(s) | Outcomes achieved | Considerations for implementation at scale |
|--|----------------------------------|------|---|---|---|
| Wu et al. (2019). A four-group experiment to improve Western high school students' sun protection behaviours | Pre-post (four group experiment) | B | Each school received one of four intervention components: control (education only), education plus personalised UV photograph, education plus behaviour change worksheet, and education plus sunscreen activity (involving UV torch and UV sensor). | All interventions improved sun safety. Photograph was superior to worksheet in controlling intentional tanning and sunburn. Worksheet was superior to photograph for increasing sun safety use. | A short-term intervention which was feasible and acceptable for schools to implement. Students were mainly White and Hispanic with family history of skin cancer. Generalisability may be an issue. |
| Chaudry et al. (2021). Sun Protection Outreach Teaching by Students (SPOTS)- Evaluating the Efficacy of Skin Cancer Prevention Education for Adolescents | Pre-post | B | Medical students delivered education about skin cancer prevention and early detection. Interactive multi-media curriculum. Appearance-based motivators. Videos from teens with melanoma. | Several knowledge, attitude and behavioural measures increased pre to post-test. | Use of dermatology trained medical students has strengths – authoritative and closer in age to students. Medical students also provide an additional voice for sun safety in addition to parents, teachers, and physicians and help keep the program cost-effective and sustainable. Requires support from medical educators. |
| Davis et al. (2015). Evaluation of Project Students are Sun Safe (SASS): A University Student-Delivered Skin Cancer Prevention Program for Schools | Pre-post | B | University student-led education + activities. Presentation: health-based + images of skin damage and video from skin cancer survivor. Interactive activities: UV skin analyser shows UV-damaged skin. | Higher perception of risk of skin cancer and less appeal for tanned skin. No behavioural (sunscreen use, tanning) impacts found, although participants did report intent to change. | The peer-led instruction and hands-on activity approaches appealed to participants and teachers. |
| Hanna et al. (2022). Effect of the SunSafe Student Ambassador Program on the attitudes, knowledge and behaviour of Australian high-school students towards sun safety: a prospective study | Pre-Post | B | Training 'student ambassadors' to present to peers. Ambassadors learn presentation skills. | Knowledge and attitude score improvement. Improvement in wearing sunscreen daily immediately after presentation; reduced time spent outdoors after three months. | Educating a few students in a school to engage the whole school is efficient. |

| Author (Year). Title | Design | Type | Main intervention component(s) | Outcomes achieved | Considerations for implementation at scale |
|---|---------------------------------|-------|--|---|---|
| Loescher et al. (2019). Implementation of Project Students Are Sun Safe (SASS) in Rural High Schools Along the Arizona-Mexico Border | Pre-Post (Feasibility) | B | Online training modules for peer educators. Peer presentations at their schools. Interactive activities. | Overall knowledge scores increased. Number of self-reported sun protective behaviours increased. Knowledge sustained over 3-4 months. | Online peer educator training appropriate for intervention delivery to rural high schools. |
| Steele et al. (2020). "Live Sun Smart!" Testing the effects of a sun safety program for middle school. | Pre-post (Pilot) | MC, B | In-class education and interactive activities + electronic messages. | Increased total knowledge scores and negative addition to tanning. Minimal or no significant change in behaviours. | Use of technology and tailoring to the participants and resources available. |
| Sharma et al. (2022). Implementing a Skin Cancer Prevention Lesson to Enact Institutional Change: A Schoolwide Survey | Pre-post | B | Education via a 4-minute video narrated by students. Video described the incidence of risk factors, preventive measures, self-screening techniques, and treatment options for skin cancer. | Significant changes in knowledge. Behavioural changes included increased sunscreen wearing and examining moles. | Brevity of the video may make it more feasible for delivery at scale in schools. |
| Truong et al. (2021). A Sun Safety Pilot Program Using a Tanning Myths-Focused Video Contest for Utah Adolescents: Cross-sectional Analysis | Cross-sectional (Feasibility) | B | Contest to develop 1-minute public service announcement video debunking tanning myths. | Video contest participants were more likely to correctly identify tanning myths and achieved higher knowledge scores. | Youth creation of videos, whole family involvement. Consider resource-limited families' access to recording devices |
| Nicholson et al. (2016). Sun protective policies and actions in Victorian secondary schools | Cross-sectional (mixed methods) | B+P | Review of SunSmart policies at Victorian secondary schools. | Almost three-quarters of secondary schools surveyed reported that they have a written policy or guideline on UV or sun safety. | Qualitative findings showed that providing support to school principals is critical, especially where there are no clear or mandated standards to uphold existing policies. |

| Author (Year). Title | Design | Type | Main intervention component(s) | Outcomes achieved | Considerations for implementation at scale |
|---|---|------|--|---|---|
| Nicholson et al. (2020). Teacher perceptions of sun protection practices in the secondary school setting: Barriers, enablers and recommendations for future (NB: this utilises qualitative data from the same study above) | Cross-sectional (mixed methods, qualitative component) | B+P | Qualitative interviews with key informants from Victorian secondary schools. | The study provided insights into factors needed for SunSmart to achieve outcomes in secondary schools, including a cultural shift towards schools accepting sun safety as a duty of care and stronger support from governments and regulatory agencies. | Without regulatory support strong leadership is required to implement and enforce sun safety practices within schools. |
| Cassel et al. (2018). Adapting a Skin Cancer Prevention Intervention for Multiethnic Adolescents | Mixed methods (some impact) | B | Adapted intervention for multiethnic adolescents. Education via presentation and handouts. Interactive activities. | Increases in student knowledge, attitudes, and intended sun safety behaviours at post-test. | Student involvement in co-adaptation of the program. Considering the framing of messaging from a safety perspective to appearance e.g. 'SunSafe' to 'Love Your Skin'. |

Evaluations conducted in both primary and secondary school settings

There were 10 evaluations conducted in both primary and secondary school settings (13, 49-54, 56-58), six of which were designed to determine if the interventions were effective (13, 50, 52, 54, 56, 57) and four of which were designed to test if the interventions had an impact (49, 51, 53, 55).

Effective interventions

All six studies designed to determine intervention effectiveness were deemed effective (13, 50, 52, 54, 56, 57). These are summarised in Table 11 below.

Systematic reviews with meta-analyses

Langford et al. (2015) (52) conducted a systematic review and meta-analysis of interventions which were underpinned by the World Health Organisation's Health Promoting Schools framework. Most of the studies were conducted in high income countries. Many intervention types were included in this meta-analysis, including areas of focus like nutrition, physical activity, mental health and bullying. Olson et al. (2007) (65) was the only study included in Langford and colleagues' review, which focused on sun safety. Olson et al. (2007) used an education intervention which included a 30-minute presentation followed by each student viewing their skin's UV damage via skin ultrasound technology (65). They found that after two years of intervention exposure, adolescents at the beach/pool in intervention communities were significantly better protected than those in control communities. *Whilst the Health Promoting Schools framework was effective to guide interventions improving several aspects of student health, Langford et al. noted that they did not have enough data to draw conclusions about the effectiveness of the Health Promoting Schools approach for sun safety interventions in the school setting. Effects were small for other interventions, but potentially useful at a population level. For Olson and colleagues' intervention specifically, the key mechanism for success was the use of the skin ultrasound technology.*

Sim et al. (2021) (57) conducted a systematic review and meta-analysis that focused on educational programmes which aimed to impact sun safety knowledge, beliefs and behaviours. Educational programmes were found to have small-to-moderate effects across all outcomes of interest. There were three trends in intervention effectiveness according to population and intervention characteristics. Those that recruited older children, utilised new media and incorporated interactivity in teaching were more likely to find an intervention effect. *Overall, Sim and colleagues identified that digitally-delivered interactive interventions may be the most promising method of education for secondary school students. The authors were unable to discern similar promising trends in the primary school setting.*

Systematic reviews

Makin et al. (2018) completed a rapid review (54) of skin cancer prevention interventions across multiple settings including schools, as part of an evidence-check report undertaken for the NSW Skin Cancer Prevention Strategy. The review found that targeted programs were effective and one-off educational interventions of short duration were shown to have short-term positive effects on sun safety behaviours in school settings in addition to other settings included in the review. The evidence

supported the implementation of behavioural change interventions for skin cancer prevention in most of the priority settings identified: early childhood, primary schools, secondary schools, outdoor occupational settings, outdoor recreational settings and health care settings. Overall, the review found stronger results for sustained multicomponent interventions that included educational components, policy, recognition of prevention efforts (e.g. program membership), provision of protective equipment where necessary and behavioural reminders in settings with UV exposure. In primary schools, the sole intervention trial of strong quality provided all participating students two wide-brimmed hats (one for school and one for home) and delivered four classroom education sessions on the benefits of sun safety with an emphasis on hat use. There were significant increases in hat-wearing at intervention schools. Two interventions using text message reminders were identified and resulted in significant positive changes in multiple sun safety behaviours. In secondary schools, educational interventions had mixed results. The number of students observed to use shaded sites varied significantly. *In summary, the review found that sustained multicomponent interventions that included educational components alongside policy achieved stronger results.* Promising strategies identified included formal recognition of skin cancer prevention efforts where appropriate, provision of sun protective equipment where appropriate and behavioural reminders in settings where UV exposure is likely, including via mobile technology.

Reyes-Marcelino et al. (2021) conducted a systematic review of school-based interventions (56) that focused on assessing measures of sun-safe behaviours and changes in these behaviours and knowledge. The authors found that most studies assessed measures of sun safe behaviours and observed significant improvements in sun safe knowledge amongst students. *This review identified that interventions which took a more hands-on approach to learning improved attitudes towards sun safety. It also found that: multi-component interventions tended to have a greater impact on knowledge and behaviour; repeated exposure of an intervention was also beneficial; and interventions should be tailored to suit the age group of the students.*

Another systematic review by Thoonen et al. (2020) (13) focused on environmental interventions in high-income countries that targeted skin cancer prevention. *The authors highlighted the importance of providing shade and sun protective clothing as they may be more effective interventions than the provision of free sunscreen, which was the most common environmental intervention due to its accessibility and lower cost. However, more studies are needed to test other environmental interventions like clothing standards and shade provision. The authors note that sunscreen alone does not provide adequate protection against ultraviolet radiation and advocate for future research to examine the impact of other sun safety practices.*

RCT

Buller et al. (2011) (50) conducted a randomised controlled trial for a policy program, 'Sun Safe Schools', in Colorado and California, USA. This intervention encouraged schools to adopt sun safety policies, supported by policy information provided through printed materials, a website, in-person meetings with administrators, and presentations to school boards. As context, half of participating students were Caucasian, and most district staff were Caucasian. The control group received a mailing directing them to state and national resources on school sun safety. School engagement in sun safety was assessed between the intervention and control group. While the percentage of districts who adopted a sun safety policy was not statistically different between groups, districts in the intervention group adopted stronger policies. Improved categories in the intervention group included sun safety education for students, provision of outdoor shade and outreach to parents. *A key finding*

from this intervention was that personal contact, printed materials, and online resources can help motivate school districts to adopt stronger sun protection policies.

Table 11. Effective primary and secondary school interventions: main components, outcomes achieved and considerations for implementation at scale

| Author (Year). Title | Design | Type | Main intervention component(s) | Outcomes achieved | Considerations for implementation at scale |
|--|----------|--------|--|--|--|
| Langford et al. (2015). The WHO's Health Promoting Schools framework (HPS): a Cochrane systematic review and meta-analysis | SR (+MA) | B+E+P | WHO HPS. One sun safety intervention: education via presentation + viewing UV damage via skin ultrasound technology. | Interventions that applied the HPS were effective for certain health areas, such as physical fitness and tobacco use. This review was unable to determine the effectiveness of HPS for sun safety as only one study, Olson (2007), was effective in promoting sun safety. | Whilst overall effect sizes are small, the population impact are important given the large reach and adoption of these programs. |
| Sim et al. (2021) The effectiveness of educational programmes in promoting sun protection among children under the age of 18: a systematic review and meta-analysis | SR (+MA) | B | 12 trials on sun safety knowledge. 10 trials reported on attitudes and beliefs towards sun safety. 20 trials reported on sun safety behaviour intentions and behaviours. | Small-to-moderate effects of educational programmes across all sun safety outcomes of interest; negligible effect sizes were demonstrated when specific outcomes were meta-analysed. | A promising approach for secondary schools - digital interactive interventions. Educational programmes that recruited older children, utilised new media and incorporated interactivity were more effective. See White (2019) and Owen (2018). |
| Reyes-Marcelino et al. (2021). School-based interventions to improve sun-safe knowledge, attitudes and behaviors in childhood and adolescence: a systematic review | SR | MC + B | Broad spectrum of intervention components. | Around half of participants reported improved attitudes towards tanning desirability. Half of the studies that looked at sunburns and nevi spots found reductions. Key intervention features included: elementary school settings, interactive features or multiple components and incorporating social norm influences. | Active educational approaches improved attitudes. Multi-component interventions had greater effects on improving knowledge and behaviours. Repeated exposure was beneficial. |

| Author (Year). Title | Design | Type | Main intervention component(s) | Outcomes achieved | Considerations for implementation at scale |
|---|--------|--------|--|--|---|
| Thoonen et al. (2020). Are Environmental Interventions Targeting Skin Cancer Prevention among Children and Adolescents Effective? A systematic review | SR | E + MC | Sunscreen provision. Shade supply. | Inconsistent results for sunscreen provision. Findings regarding the effects of economic interventions on nevi and sunburn incidence, such as free provision of sunscreen, were contradictory. One study found that children who received free sunscreen had developed less nevi at the end of the intervention period, whereas another study found no effects of free sunscreen provision on nevi incidence. Shade supply was identified as the most promising. | Shade provision was promising. |
| Makin et al. (2018). Evidence Check: Targeted programs for skin cancer prevention | Review | B | Targeted programs preventing skin cancer. Primary: providing wide-brimmed hats. Secondary: shade use. | Short duration education achieved short-term positive effects. In secondary schools, educational strategies had mixed results. | Stronger results were achieved for sustained multicomponent interventions. |
| Buller et al. (2011). Motivating Public School Districts to Adopt Sun Protection Policies: A Randomized Control Trial | RCT | P | Sun safe policy-promotion program, focused primarily on policy adopted, with those in the intervention group receiving more hands-on assistance. | 12 school districts in the intervention group and six districts in the control adopted or strengthened policy over two years. | A key finding of this study was that personal contact, printed materials and online resources can help districts adopt sun safety policies. |

Impactful interventions

Of the four studies which were not designed to measure efficacy or effectiveness, all four were deemed impactful (49, 51, 53, 55). These are summarised in Table 12 below.

Pre-Post

Asdigian et al. (2023) (49) developed a middle and high school skin cancer prevention program in Colorado, USA, titled 'Youth Engaged Strategies for Changing Adolescent Norms' (YESCAN!). The program involved school-based peer leaders using a youth-participatory peer-led approach to support high school students in developing and delivering short narrative videos and promoting related materials on skin cancer prevention to middle school students. Participating middle and high school students completed pre-and post-program surveys that assessed skin cancer attitudes, perceived norms and behavioural intentions. *In summary, Asdigian et al. (2023) (49) found positive outcomes resulting from the use of a 28-lesson curriculum, which incorporated guest lecturers with personal melanoma experience.* More specifically, students were significantly less likely to engage in outdoor tanning, and significantly more likely to use sunscreen, wear a hat, and wear sun protective clothing. Due to time constraints at participating schools, it was not possible for high school students to lead multiple educational sessions with middle school students or to implement the social media component of the program. Acceptability increased amongst adolescents via inclusion of peer-leaders. It is worth noting that a 28-lesson curriculum, although well-designed, may not be feasible in an Australian context due to an already busy curriculum with many competing health and wellbeing priorities.

Kouzes et al. (2017) (51) created a Sun Smart Schools pilot program whereby sun safety education and flexible sun safety policy were combined to support sun safe practices. The curricula content was designed to meet schools' common core requirements and schools were asked to adopt a written sun safety policy. Both private and public schools (n=7) in metropolitan areas in Nevada, USA, were included in this intervention, including elementary, middle and high school students and parents. When considering whether this intervention was impactful, behaviour changes to reduce UV exposure were seen amongst all groups. Elementary and high school students increased their sunscreen use, middle school students and parents increased long sleeve shirt usage in the middle of the day, whilst high school students increased their hat and long-sleeve shirt usage. This program proved to be successful by adjusting each curriculum to be age appropriate. *The program consisted of numerous essential elements but allowed participating schools flexibility in how to implement these elements based on contextual needs.*

In 2015, a pre-post study design of a pilot school-based sun safety program that explicitly focused on Hispanic students was conducted by Miller et al. (55). The program ran from 2006 to 2012 and incorporated sun safety lessons and messaging that were delivered to both primary and secondary schools across 19 schools in urban neighbourhoods of Los Angeles, USA. The results showed significant improvements across sun safety knowledge, attitudes and self-efficacy to wear sunscreen, however, there was no change in sun protective behaviours. *The authors highlighted the importance of ensuring that interventions are tailored to the cultural and demographic backgrounds of participants.*

Systematic review of qualitative studies

In 2013, Lorenc et al. (53) completed a systematic review that assessed the effectiveness of studies that had focused on resource provision, environmental change and multi-component interventions. The papers that were included in this systematic review were mainly school-based or policy-based and were all from high-income countries. The findings of this review revealed that higher levels of sun safety behaviours were associated with higher perceived risk and severity of skin cancer and greater perceived benefits of sun safety. *A key consideration with some of these studies was the time invested in intervention implementation.* Potential institutional barriers were identified in schools, including challenges with rescheduling outdoor activities and the investment required to provide appropriate shade structures. Sun safety and its uptake was largely dependent on whether participants were already aware of the effects of sun exposure (i.e., sunburns). Moreover, role modelling from parents, and authority figures like teachers, encouraged sun safety.

Table 12. Impactful primary and secondary school interventions: main components, outcomes achieved and considerations for implementation at scale

| Author (Year). Title | Design | Type | Main intervention component(s) | Outcomes achieved | Considerations for implementation at scale |
|---|-------------------------------|-----------|---|--|---|
| Asdigian et al. (2023). Design and Effectiveness of the Youth Engaged Strategies for Changing Adolescent Norms! (YES-CAN!) Program for Reducing Skin Cancer Risk | Pre-post | B | Cross-curricula (28 lessons) education. Teachers free to adapt curriculum and toolkit to student needs and teacher training styles. Suite of evidence informed strategies. | Normative behaviours and beliefs impacted across primary and high school students. | Intensive training for peer leaders in skin cancer science, health communication, narrative story development and video production. A 28-lesson curriculum, although well-designed, may not be realistic. |
| Kouzes et al. (2017). Sun Smart Schools Nevada: Increasing Knowledge Among School Children About Ultraviolet Radiation. | Pre-post (Pilot) | B | Numerous essential elements allowed participating schools flexibility in how best to implement these elements in age-appropriate evidence-based curriculum and written policy for sun safety. | Many behavioural and attitudinal impacts were reported. | Teachers, older students or others could run the activity themselves with basic instruction. |
| Miller et al. (2015). SunSmart: evaluation of a pilot school-based sun protection intervention in Hispanic early adolescents | Pre-post (process evaluation) | B | Based upon a large-scale US sun safety intervention and further developed for a Hispanic student population. | There were knowledge, attitude and behaviour changes. | The role of acculturation and social environment on behaviour are important factors to be explored. |
| Lorenc et al. (2013). Resource provision and environmental change for the prevention of skin cancer: systematic review of qualitative evidence from high-income countries | SR of Qualitative studies | B, E + MC | Most interventions looked at sun-related behaviour and sun safety beliefs. Most papers with interventions were policy-based. | Consistent with the quantitative literature, higher positive sun safety behaviours are associated with higher perceived risk and severity of skin cancer + greater perceived benefits of sun safety. | The risk and potential severity of skin cancer were not seen as important concerns, and non-deliberate tanning is seen as less dangerous |

Evaluations conducted in community settings

The three interventions conducted in community settings are summarised in Table 13 below (14-16). One of the interventions (14) used a study design to determine effectiveness while the remaining two studies were deemed impactful interventions (15, 16).

Effective interventions

Systematic review

In 2020, Acuna et al. conducted a systematic review to identify the use of online digital videos amongst adult populations and their impact on cancer prevention knowledge and behaviour, and attitudes to cancer education videos (14). The authors included interventions with a range of preventive health interventions, such as use of sunscreen, smoking cessation and diet and lifestyle improvements. Eleven interventions with an online video component were identified and included in the review, where it was found that an increase in awareness and understanding of cancer risk factors was associated with the viewing of online digital videos across a diverse range of populations. *Dissemination of information through website pages and social media were discovered to be effective in reaching diverse target populations.*

Impactful interventions

Pre-post

A 2018 study conducted by Wu et al. involved a pre-post study design to examine the impact of a 30-minute educational intervention that consisted of visuals and key information on melanoma risk and prevention (16). The intervention was targeted towards children with a familial risk of developing melanoma and conducted within a university setting. This intervention significantly increased parents' intentions of having their children avoid peak UV radiation hours, and their intentions of having their children wear hats. Overall, this intervention found that educational health promotion interventions were impactful. Generalisability of the findings from this US study needs to be considered since most participants had fair skin tones and average family incomes were high. However, the approach of targeting education towards children with a high familial risk via presentations, video and pictures with brief text is novel.

Cross-sectional

Another study completed in 2015 by Dobbinson et al. focused on the impact of a sustained sun protection advertising campaign on behaviour change amongst youth and adults in the community setting (15). Cross-sectional weekly telephone surveys of Melbourne residents were conducted over summers from 1987–1988 to 2010–2011 and analysed in 2012–2014. The authors employed a quasi-longitudinal study design, which utilised repeat cross-sectional surveys. A sun safety mass media campaign was completed and broadcast across televisions during the Australian summer. TV advertisement audience sizes, measured four weeks prior to participant interviews, were positively related to reduction in mean body exposure, and significantly increased sunscreen use. Moreover, tan preference significantly reduced. These associations were stronger amongst those aged 14-24 than

those aged 45-69. *These findings support the idea that youth-focused television campaigns can have positive population-wide effects.*

Table 13. Effective and impactful community interventions: main components, outcomes achieved and considerations for implementation at scale

| Author (Year). Title | Design | Type | Main intervention component(s) | Effective/Impactful, Outcomes achieved | Considerations for implementation at scale |
|---|-----------------|------|--|---|--|
| Effective | | | | | |
| Acuna et al. (2020). Harnessing digital videos to promote cancer prevention and education: A systematic review of the literature from 2013-2018 | SR | B | Interventions all had an online video. Cancer risk reduction messages and education on Twitter, YouTube and Facebook. One study compared personalised and non-personalised videos, as well as text-only videos | Most of the studies that had a study outcome of knowledge demonstrated that among participants who viewed online digital videos, there was an increase in awareness and understanding of the risk factors and screening procedures related to cancer. | Whilst overall effect sizes are small, the population impact are important given the large reach and adoption of these programs. |
| Impactful | | | | | |
| Wu et al. (2018). A novel educational intervention targeting melanoma risk and prevention knowledge among children with a familial risk for melanoma. | Pre-post | B | Education. Visuals delivered through a PowerPoint presentation and short videos. | Increases in the parents' intentions for their children to exhibit sun safe behaviours. | Targets children with familial melanoma risk. Generalisability of these findings should be considered since families had high average incomes and participants were mostly fair skinned. |
| Dobbinson et al. (2015). Continued Impact of SunSmart Advertising on Youth and Adults' Behaviors. | Cross-sectional | B | A SunSmart mass media campaign in the form of TV advertisements were broadcast over multiple summers. | Increased SunSmart TV advertisement audience sizes for the four weeks prior to interview were related to improvements in respondents' sun safety. | Youth-focused campaigns can have positive population-wide effects. |

Discussion and recommendations

The aim of this review was to identify effective and impactful skin cancer prevention interventions, which have been conducted nationally and internationally in school settings. It sought to understand the details of their implementation, the outcomes they achieved and the main mechanisms for achieving the outcomes. It also considered any adaptations or modifications that may be necessary in the Australian context, or for feasible implementation at scale.

From 46 studies identified across school and community settings, 20 were designed to test effectiveness (e.g. they used an experimental or quasi-experimental study design). Two of these were classified as ineffective (38, 48) as they did not achieve statistically significant results for their main outcomes. Despite these studies not achieving statistically significant results, analysis of these documents provided meaningful learnings. For example, White et al. (2019) (48) highlighted the utility of theoretical models and used the Theory of Planned Behaviour to inform intervention design.

The remaining 26 studies included in the review which were not designed to measure effectiveness (e.g., pilot, feasibility, exploratory mixed-methods, observational) found statistically significant impacts on the outcomes of interest, which resulted in them being classified as impactful. Some studies achieved statistically significant results for increased knowledge, whilst results for behaviour change were not statistically significant, few studies used objective outcome measures and although the outcomes of interest were generally consistent, the instruments for measurement were inconsistent and most had not undergone tests for validity and/or reliability. Therefore, there were 44 studies that were deemed effective or impactful, representing a suite of promising strategies to help guide how SunSmart is delivered in NSW primary schools and inform future strategies for engaging NSW secondary schools in sun safety.

In the findings section, Tables 7-13 were created to aid prioritisation and selection of promising strategies. These are presented by setting and whether they were deemed to be effective or impactful, as defined in the Abbreviations and definitions section. These summarise the main components of the interventions, the main outcomes they achieved and key considerations for implementation at scale in Australian schools. These promising strategies are further summarised here by primary school and secondary school settings, with information on the key mechanisms for their success and considerations for implementation at scale. Finally, they are grouped under four typologies for contemporary interventions.

Primary schools

Although the SunSmart program is being implemented in primary schools across Australia, there were few documents describing evaluation. Further, the included evaluations of the SunSmart program in primary schools were based on descriptive cross-sectional (i.e., snapshots at a single point in time) (21, 22) or repeat cross-sectional (i.e., snapshots at repeated points over time) (23) studies of the

program's reach and policy adoption, with self-reported measures of the extent to which the SunSmart program's policy recommendations were implemented.

The connections found in previous research between sun safe policies and improved sun safe behaviours relied heavily on self-reported data and may over-represent actual practices. An observational study conducted in NSW SunSmart primary schools found that actual hat-wearing was significantly lower than what was reported in previous national surveys. The same study found that the level of hat wearing varied considerably from school to school (66).

While sun protective behaviours do occur in many Australian primary schools, these behaviours may be limited to the school setting, indicating a need for "additional support and engagement to holistically enforce the principles of the SunSmart Program" beyond the school environment (60). This is consistent with other research which has found that "the policy needed to be implemented holistically and consistently in order to support the behaviour" (60).

In NSW, there was one mixed methods evaluation (quantitative surveys and qualitative interviews plus focus groups) which aimed to determine the extent to which NSW primary schools were implementing the SunSmart program policy recommendations, as well as the impacts of the SunSmart program on sun safety knowledge, attitudes and behaviours (21). The 2021 evaluation of the NSW SunSmart program in primary schools indicated that there was a decay in the personal relevance and salience of sun safety messages amongst the NSW primary school community (21). While sun safety is still considered important and schools see a need for and support the SunSmart program, overall engagement in sun safety was found to be mixed, based on the perception that it is a well-established topic where achievements have been made and appeared to be dated when compared to other more contemporary concerns facing school communities. Further, the evaluation found that the SunSmart program and membership experience lacked meaning and perceived benefit, and that program membership was not clearly associated with improved sun safe policy implementation (21). Together, these studies suggest that whilst the SunSmart program has had good initial reach in Australian primary schools, contemporary implementation of the SunSmart program's policy recommendations is likely to be modest and inconsistent. These findings represent a distinct opportunity to develop a more compelling, contemporary and personally relevant approach to reshape how NSW primary school communities engage with sun safety (21).

Most (7/10) of the interventions identified in primary school settings focused on policy adoption or policy implementation support strategies (2-5, 21-23). Of the four interventions designed to test effectiveness, three were focused on policy support and all of these were deemed effective. From these, Buller et al. (2020) (2) and Reynolds et al. (2020) (3) both examined the same policy intervention from the USA and found that a key mechanism for success was contact with school principals. An Australian study by Wright et al. (2019) (4) used an environmental incentive (free sunscreen alone or with play equipment) to improve the implementation of SunSmart policy areas of sunscreen use and hat wearing. An impactful study conducted by Russo et al. (2023) (5), while not primarily designed to test effectiveness, also provided insights into the feasibility of policy implementation support strategies to promote and enable sun protective hat wearing in NSW primary schools. The authors used a theoretically informed toolkit to support 'champions' to tailor policy implementation support strategies to the local needs of the school as a key mechanism for success. Overall, policy implementation support is a promising strategy to engage NSW primary schools in sun safety. Given the resource intensive nature of these policy implementation support strategies,

partnerships to assist with funding them may be necessary for implementation at scale as well as enabling a systematic approach to targeting support for schools with the greatest need. Strategies such as interactive education with outdoor elements (31, 32) and training of pre-service teachers (33, 67, 68) are promising strategies identified in this realist review that have relatively less evidence of effectiveness. These promising strategies could be further evaluated for effectiveness.

Secondary schools

It is notable that the review identified many studies that had been implemented in secondary schools (n=23) or both primary and secondary schools (n=10). This may reflect the importance of reaching adolescents for preventing skin cancer and/or the maturity of programs in primary school settings, meaning research to develop strategies for secondary school settings is a logical next step.

Considering evaluations of sun safety policies in secondary schools, the present review only identified one Australian study by Nicholson et al. (2016) from Victoria, and the data was used for a report and a separate peer-reviewed publication (20, 42). The publication used the focus group data from the qualitative component of the overall study (42). The overall study assessed sun protection policy adoption and the implementation of practices via self-report online survey. It also examined barriers and enablers to implementing sun safety policy and practices in secondary schools via focus group discussions and interviews. They found 73% of schools reported having a written policy or guideline on UV or sun protection. However, the actual proportion of schools with written policies or guidelines is likely to be lower, given that more than 70% of schools in the random sample did not participate in the study. Further, these results should be interpreted with some caution, as the presence of a documented policy may not necessarily translate into practice or behaviour change (69, 70). Shade was identified as a popular strategy to reduce UV exposure in both the online survey and focus group discussions (20). Nicholson et al. also concluded that leadership support was a critical factor for successful sun safety policy implementation in secondary schools, and that sustainable change to the secondary school ethos may be challenging without a mandate from regulatory bodies, thus highlighting the potential benefits of engagement and advocacy with sector leaders (20, 42). The qualitative component of the study found that pragmatic, acceptable approaches to improving sun safety in secondary schools included student-led initiatives, staff and student role-modelling initiatives and increasing shade availability for active and passive recreation (42). Consistent with these findings, increasing shade was a recommended key strategy for improving sun safety in secondary schools in two systematic reviews (11, 13) and another systematic review found that educational programs recruiting older children were effective (57).

The present review found that most studies conducted in secondary school settings were focused on behavioural interventions, comprising 23 of the 23 identified studies that were conducted in secondary schools only. Further, of the 10 studies conducted in both primary and secondary school settings, eight of these also focused on behavioural interventions (49, 51-57). These studies primarily evaluated educational strategies and from close examination of the studies that were deemed effective, it is evident that appearance-based educational strategies (6-9) were prominent as the main components of these behavioural interventions. However, one systematic review cautioned against focusing solely on educational interventions to impact sun safety behaviours in secondary schools since they require a high-level of support to be built into curriculum or educational systems to achieve ongoing and scalable impact (10).

From those studies that were deemed effective in the secondary school setting, it is surprising that only one study investigated an environmental strategy (12), especially considering that two systematic reviews identified shade provision as the most promising strategy for secondary schools (11, 13). Pettigrew et al. (2020) (12) undertook a combined environmental and behavioural study, whereby ultraviolet radiation (UV) meter displays combined with brief educational strategies were associated with increased knowledge of the UV index (12). Moreover, the importance of shade was supported by a Victorian study in secondary schools undertaken in 2009 (64). This study was not included in this review since it was published prior to 2013. It involved a cluster-RCT intervention identified in a systematic review (11) and investigated the effects of building shade (i.e., shade sails) in secondary schools, where students in schools with increased shade were significantly more likely to use shade than those in control schools (64). Subsequent studies by the same authors explored the factors associated with secondary school student use of shade sail areas (15, 71). They found that student shade-seeking behaviours appeared to be strongly influenced by the presence of tables and seats, whilst other contextual factors such as temperature and grass presented less of an influence.

In summary, the most promising sun safety interventions in the secondary school setting are those behavioural interventions which incorporate messaging around appearance (often linked to technology), and environmental strategies such as shade provision. For appearance-based education, whilst these strategies seem promising, the potential positive impacts on sun safety need to be weighed up against potential negative impacts on self-esteem and concerns about fear-based messaging (with the appearance-based messaging used to elicit fear). Indeed, this was raised during qualitative consultations with academics who authored papers included in this realist review. An alternative strategy that was suggested was to use messaging about the immediate impacts of sunburn and the associated discomfort, since the impacts of sun safety on appearance may be too distal to motivate sun safe behaviours amongst adolescents who are often focused on things that impact them in the short-term. Moreover, this review highlights the importance of involving students in program implementation, for example, Russo et al. (2023) (5) highlighted the importance of utilising multiple student 'champions' to ensure whole of school engagement. Further investigation should be considered to determine the scalability, widespread feasibility and equity of environmental strategies such as shade provision, as the cost implications of shade implementation and maintenance may require links with infrastructure funding schemes for schools and/or partnerships with other organisations to support shade access.

These findings informed the following themes.

Key themes to guide how SunSmart is delivered in NSW primary schools and inform future strategies for engaging NSW secondary schools in sun safety

Mechanisms of success were apparent across all promising interventions

Theoretically informed interventions support better implementation and evaluation, as well as an understanding of the underlying mechanisms of change which influence outcomes. McNoe and colleagues (2021) (11) stated: *"It is preferable for interventions to be designed using theoretical foundations as this takes into account the mediating factors which are influential in achieving behavioural change"*. Whilst mediation analysis is a method that is well suited to identifying pathways

for mechanisms achieving their outcomes, which would be useful for identifying theory that address these, this review only identified one study which utilised mediation analysis (8). Of the 13 studies included in the review by McNoe and colleagues, seven reported that they were based on a theory. These included Protection Motivation Theory (72, 73), the PRECEDE model (74), the Health Belief Model (9), the Theory of Planned Behaviour (48), the Extended Parallel Process Model (10), or some combination of behavioural frameworks (75).

In their review of curricula-focused interventions, Calco and colleagues (2023) (19) paid attention to the educational theories underpinning them. They found that the Theory of Planned Behaviour was the most used theory. Other educational theories guiding curricula-based interventions included using an appearance-based focus (rather than a health-based focus) and incorporating gamification and goal setting. The Cognitive Theory of Multimedia Learning was also used. In addition, this review found other theories underpinning interventions included a Motivation Action Triggers model (5) and the Diffusion of Innovation theory (3).

In reference to the importance of inter-disciplinary approaches to creating curriculum and educational interventions, Calco et al (2023) (19) state:

“...this review highlights the importance of inter disciplinary collaboration in educational public health interventions. Knowledge about the effectiveness of educational intervention strategies and evidence-based pedagogy, beyond the scope of well-intended health care providers and public health professionals, should be sought. Recognizing this need and intentionally incorporating interdisciplinary expertise into thoughtful curriculum design can be a crucial stepping stone, maximizing the efforts already being undertaken in schools worldwide for any number of educational efforts”.

Innovative educational approaches described below should also be noted when considering successful educational and curricula-based interventions.

A systematic review of school-based interventions underpinned by the World Health Organisation’s Health Promoting Schools (HPS) Framework demonstrated effectiveness in specific health domains such as increasing physical activity, decreasing Body Mass Index (BMI) and rates of tobacco consumption (52). However, the authors noted that there was insufficient data to draw conclusions on the efficacy of using the HPS framework for skin cancer prevention at the time they conducted their review.

Interventions need to be tailored to be age appropriate. For example, outdoor activities (31, 32) or play-based strategies (4) are age appropriate for primary school students. Whereas appearance-based messaging is age appropriate for secondary school students (6-10), and for education or curricula-based interventions, interactivity is appropriate for all ages of primary and secondary school children.

A typology for contemporary interventions emerged

Four contemporary types of interventions were identified: technology-based; environmental; policy implementation support; and innovative education. The common mechanisms of success referred to above were cross-cutting for many of these.

Technology-based

Technology presents opportunities to reach students and the school community at scale. Reviews have stated this may be particularly promising for engaging secondary school students (11, 57).

Two studies examined the benefits of interactive exercises that involved measuring UV radiation and demonstrated that utilising these practical tools can improve knowledge about the harms of UV radiation and the importance of sun safety behaviours (31, 32).

In line with the finding that appearance-based education may be more impactful with secondary school students, personalised use of photos to demonstrate current UV skin damage and to illustrate ageing progression over time, were found to be promising strategies (6, 8-10, 41)

Using videos for brief and personalised storytelling of peers' journeys through melanoma diagnosis and treatment was evident amongst novel strategies to reach secondary school students (6), as were other forms of video incorporated into educational strategies to reach school students (10, 45) and the broader community (14). Electronic messaging (37) and infographics (46) were other innovative uses of technology in sun safety interventions for secondary school students.

Since mobile technology is ubiquitous amongst youth, mobile apps present an opportunity to reach this age group. This can be as a part of their regular curriculum, or via another mode. Regulations pertaining to the use of mobile phones in schools could mean that apps used during school hours may need to be on school approved devices and/or the use of apps is allocated as an activity students complete out of school hours. To ensure this use of technology does not contribute to widening gaps in health equity, assessments should be made regarding student access to such technology. Gamification via mobile apps (76) or otherwise (57) emerged as a promising strategy to engage secondary school students. A new generation of mobile apps has emerged called 'Just In Time Adaptive Interventions' (JITAI) (76), which may be more impactful than apps which do not integrate the same level of interactivity. For example, apps incorporating JITAI principles in their design could use location data to trigger messaging related to the UV index when it detects the user is outdoors for a certain period of time when the UV index is three or above and sun safety measures are recommended. JITAI apps may also use information from the user (e.g. skin type, eye colour) to tailor appropriate educational messaging and quizzes.

Environment

For the secondary school setting, the outdoor environment may be a particularly promising area for sun safety interventions. McNoe and colleagues' (2021) review of interventions in secondary schools found that although only two studies included interventions focused on strategies involving the school outdoor environment, they were effective (11). Building shade (i.e., shade sails) resulted in schools with increased shade observing significantly more shade use than in control schools in a cluster-RCT (64), and the use of a UV radiation meter prominently placed where adolescents gathered in a school, with brief education accompanying it, resulted in significant improvements in knowledge of the UV index in the intervention school compared to the control school (12). In addition, Nicholson and colleagues' evaluation of sun safety policies in Victorian secondary schools (20, 42) found that shade provision for areas of active and passive recreation was an acceptable sun safety strategy for secondary schools. This suggests that shade provision could be a highly acceptable policy element to promote for adoption in NSW secondary schools.

Thoonen and colleagues' (2020) review of environmental interventions targeting skin cancer prevention in children and adolescents (13), included interventions which involved creating shade in schools and provision of sunscreen. The authors found that five of seven included studies were effective. They stated that overall, the provision of shade showed the most promising and consistent results in increasing sun safety behaviour. The results for provision of sunscreen were inconsistent, and studies testing this were included in the review. It is worth noting that there have been more studies published since the review undertaken by Thoonen et al. which have found provision of sunscreen to be effective for increasing sunscreen use. For example, large effect sizes for sunscreen use were observed in intervention vs. control schools in one cluster-RCT in primary schools (4). However, even larger effect sizes were found when sunscreen use was coupled with a reward, for example, by providing access to play equipment for children who applied sunscreen (4).

Policy implementation support

Of the included studies that were undertaken in the primary school setting, seven of 10 focused on sun safety policy (2-5, 21-23). Amongst the large volume of studies in secondary school settings and those undertaken in both primary and secondary schools identified in this review, there were five that focused primarily on sun safety policy - two of 23 studies identified in secondary schools (20, 42), and three of 10 studies in primary and secondary schools (50, 53, 55). Many of these studies investigated ways of supporting policy adoption amongst schools who already had policies. Primary school examples from the US involved in-person meetings with school principals (2) and telephone support for school principals (3) to review their policies. Australian examples included novel use of play equipment to encourage greater adoption of certain SunSmart core policy areas (4) and use of a policy support toolkit based on theory (5). A primary and secondary school example from the US involved program staff meeting with key contacts in the schools to review their policies (50).

Several studies highlighted the disparity between the presence of a written sun safety policy and a school's sun safety practices (22, 69, 70). Turner and colleagues demonstrated this by comparing the hat wearing rates of schools with and without SunSmart policies and found no significant differences in hat wearing behaviours (69). In addition to advocating for the creation of sun protection policies within schools, it is critical to support the development and design of these policies to improve comprehensiveness and ensure appropriate implementation (69).

Innovative educational approaches (beyond didactic health education)

Educating primary and secondary school students via interventions delivered in school is resource intensive (11). However, of the 46 interventions included in this review, 37 were behaviourally focused and many involved strategies to educate school-aged children. In their systematic review of sun safety interventions in secondary schools, McNoe and colleagues (2021) (11) stated that *'the interventions showing the most promise were those that moved beyond a pure health education approach and used innovative approaches such as ... use of technology (e.g., appearance-based apps or real-time ultraviolet index (UVI) monitors).'* Sim and colleagues (2021) reviewed the effectiveness of educational programs in promoting sun safety among children under the age of 18 and found small to moderate effects of educational programs across all outcomes of interest (57). However, they also stated that educational programs that recruited older children (e.g. to assist with peer-led implementation strategies), utilised new media and incorporated interactivity, were more effective. Since the curriculum is crowded with competing health, safety and wellbeing priorities, and

teachers are time poor, making it easy for educators was a focus of many educational and curricula-based interventions. The review identified many promising examples:

- Interactive UV education and experiments involving technology to measure UV was a strategy used in both primary and secondary schools (12, 31, 32, 46, 56).
- Appearance-based (as opposed to health-based) information delivery was prominent in strategies developed for high schools (6, 8-10).
- University student-led delivery of education (7), pre-service teacher education (33) and medical student delivery of education (6) featured in strategies tailored to high school students.
- Peer-based education also featured in interventions which were delivered in high-schools, including student ambassadors receiving presentation training (36) and online training for peer-educators was used for delivery to schools in rural areas (40).
- Personal stories from late teens or early adults about their melanoma journey were noted as elements of multi-component educational interventions that high school students engaged with (6, 7, 37, 49).
- Brief videos often featured in multi-component educational interventions (6, 14, 16, 37, 45).
- Apps which included educational video and quizzes were emerging (35, 76).
- Gamification to improve lesion detection was effective (39).
- Flexible curricula which could be adapted for local delivery was another educational strategy (51).

Regardless of whether these educational intervention strategies are effective, to achieve impact at scale sun safety messaging and information must be built into curricula so that it can reach each new cohort of students, year after year (11). In addition, complementary strategies, such as mass media campaigns targeting children, adolescents and young adults, have been found to be impactful in Australia (15). These may be more feasible from a cost perspective if delivered via social media platforms, which are cheaper than traditional methods of communication, such as television and radio.

Strengths and limitations

Strengths of this realist review include the realist methodology, which was developed for understanding the context, mechanisms and outcomes of complex interventions (1). The realist methodology aligned well with the objectives of this review, which sought to unpack details of implementation, key mechanisms for success and any adaptations that may be necessary for the Australian context, or for feasible implementation at scale. The realist methodology also allowed for the inclusion of a broad range of literature sources (peer-reviewed and grey) and study designs which were not solely focused on demonstrating effectiveness. This resulted in many promising interventions being identified.

A key limitation of this realist review was that the focus on identifying interventions meant the review did not explore theory driving contemporary education practice and innovative educational and systems approaches to successfully embedding programs in schools. A range of research indicated that a theoretical basis (acknowledging mediating factors) is important for successful implementation of programs in educational settings and for embedding them in educational systems to ensure they are sustained. Another limitation of this review is that it did not include health promotion interventions in the school setting beyond skin cancer prevention content, and only included five databases in the

search strategy. In addition, authors of key studies, and other experts in the field, were not contacted to identify literature that may have been missed in the searches.

Recommendations

This report suggests a range of promising strategies to improve sun safety engagement and outcomes amongst NSW primary and secondary schools. These are grouped by theme rather than importance.

Theoretical underpinning

1. Ensure that any new approach to implementing SunSmart has a clear theoretical underpinning to support: a) better understanding of the underlying mechanisms of change which influence outcomes; b) consistent implementation; and c) a higher quality of evaluation when, and if, the program is scaled in the future.

Partnerships and funding

Integrating sun safety in primary and secondary education settings will require ongoing development of inter-disciplinary partnerships between public health and education practitioners, researchers and policy makers (17).

Funding partnerships

2. Given the resource-intensive nature of the identified policy support strategies (e.g. coach support model) (2), partnerships to assist with funding them may be necessary for implementation at scale.

Educational partnerships

3. Focusing on developing partnerships with educational leaders and experts will enable co-production of resources, collaborative decision making and ongoing active feedback, which could extend the reach, impact and sustainability of sun safety interventions in NSW primary and secondary schools. Pursuing collaborative opportunities will also ensure that sun safety interventions can be contextualised within their setting to address the discrete needs and resources of the relevant school community (18).

Discretionary program partnerships

4. Due to the presence of many discretionary health and wellbeing priorities for schools, programs are often delivered by external third-party providers. Partnerships that align sun safety with other relevant programs could increase the salience of sun safety for schools (19, 20).

Education sector engagement and advocacy

5. This review identified many effective and promising approaches to increasing sun safety in

schools. For many of these, integration within school systems will require advocacy for top-down support from peak bodies in the sector, such as the integration of sun safety into curriculum and legislation to mandate minimum standards for shade provision in schools as a capital works priority (20). Nicholson (2016) (20) postulated that advocacy for structural change with peak body leaders for regulations and/or policy that requires secondary schools to comply with sun safety recommendations could be a promising approach to implementing sun protection in secondary schools. Developing strategies that build on the insights from consultations with the authors of the studies included in this report, as well as stakeholders with experience in the education sector, (including peak body representatives, teachers, school representatives, and those with expertise in implementation and system science) will help to contextualise program improvements.

6. A need for improved evaluation. Few studies reported on the impacts of sun safety policy and related policy support strategies (2, 18, 21). Evaluation of the effects of policy support strategies on policy adoption, and staff and student sun safety behaviours, should be prioritised to better understand the impact on policy adoption in practice, and to support advocacy efforts and future improvements.

Considerations for implementing sun protection interventions in schools

Creating a stronger rationale for sun safety

7. This realist review includes an evaluation of the NSW SunSmart program, where the need for a more compelling rationale was identified as a pre-requisite for schools to understand why they are such a priority setting in the framing of skin cancer prevention with local communities (21). Tailored communications aimed at the whole school community could be helpful in supporting engagement with sun safety (3). CCNSW could explore various social media and digital marketing strategies to disseminate key messages and elevate the importance of sun safety measures within the school community (15). Such strategic communication could play a pivotal role in raising the salience of sun safety amongst school communities, which may in turn assist with reducing the ambivalence towards sun safety in schools.

Implementation support

8. Three Australian studies (21-23) from the review, which were conducted in primary schools, highlighted that a key challenge for the SunSmart program is to identify effective strategies to improve sun safe policy comprehensiveness and adoption of policy elements as well as membership uptake and renewal. For primary schools, promising policy support strategies identified in the review such as tailored policy support based on assessments of readiness (3, 5), could be explored.
9. This realist review found that personalised assistance provided by implementation coaches can significantly improve sun protection practices in a school setting. Reynolds et al. (2020) (3) found that schools that were assisted by implementation coaches adhered to sun protection practices post-intervention (including sun safe clothing, improved communication with parents and an increase in role modelling and sun safe curriculum elements) better than those who were not assisted by an implementation coach.

Reward and recognition

10. Elements of the program could be supported through incentives, rewards and recognition to

motivate schools to engage with sun safety, to implement sun safe actions and to continuously improve (4).

Equity

11. A systematic way of targeting support for schools who have a greater need should be considered. Accordingly, an equity lens should be employed that could include analyses of socioeconomic conditions by geographic area, past and present engagement with sun safety and a schools' capacity and motivation to implement the intervention.

Scalability and adaptability

12. Interventions that had been implemented at scale were identified in this review and key findings about how they were scaled are summarised in the findings section of this report. These could help inform any future scaling strategies.
13. Prior to scaling up the intervention, evaluation of its feasibility, implementation, effectiveness and cost-benefit should be undertaken. Modelling of different ways of prioritising support, and the cost implications, should also be considered. This would provide robust evidence to support how the program is scaled and would add strength to any requests for funding.
14. Consideration could be given to the fidelity-adaptability tension described in a knowledge synthesis report by The Australian Prevention Partnership on implementing policies and programs in chronic disease prevention (17).

Appendices

Appendix A — Search strategies

1. PubMed

((sun[tw] OR uv[tw] OR ultraviolet[tw] OR heat[tw] OR sunlight[Mesh])
AND
(protect*[tw] OR safe*[tw]) OR sunscreen[tw] OR "ultraviolet radiation"[tw] OR "UV radiation"[tw] OR
"sun smart"[tw] OR 'sunsmart'[tw] OR "Sunscreening Agents/therapeutic use"[Mesh])
AND
(intervention[tw] OR intervention*[tw] OR program*[tw] OR initiative*[tw] OR strateg*[tw] OR
campaign*[tw] OR policy[tw] OR policies[tw] OR "cancer prevention"[tw] OR "Primary
Prevention"[Mesh])
AND
(school*[tw] OR school)
AND
(evaluat*[tw] OR effective*[tw] OR efficac*[tw] OR impact[tw] OR outcome*[tw] OR assessment[tw]
OR pre-post[tw] OR "randomised controlled trial"[tw] OR "randomized controlled trial"[tw] OR
"controlled trial"[tw] OR quasi-experimental[tw] OR rct[tw] OR "cluster randomized"[tw] OR
"systematic review"[tw] OR "Program Evaluation"[Mesh] OR "Clinical Study"[Publication Type])
AND
(2013:2023[pdat])
NB MESH terms included in the PubMed syntax, over and above the search terms included in other
databases' search syntax.

2. Scopus

(TITLE-ABS-KEY (((sun OR UV OR ultraviolet or heat) w/2 (protect* OR safe*)) OR sunscreen
OR "ultraviolet radiation" OR "UV radiation" OR "sun smart" OR "sunsmart")
AND
TITLE-ABS-KEY (intervention* OR program* OR initiative* OR strateg* OR campaign* OR policy OR policies
OR "cancer prevention")
AND
TITLE-ABS-KEY (school*)
AND
TITLE-ABS-KEY (evaluat* OR effective* OR efficac* OR impact OR outcome* OR assessment OR "pre-
post" OR "randomised controlled trial" OR "randomized controlled trial" OR "controlled
trial" OR "quasi-experimental" OR RCT OR "cluster randomized" OR "cluster randomised" OR
"systematic review")
)
AND
PUBYEAR > 2012

3. PsycINFO

((sun.mp. OR uv.mp. OR ultraviolet.mp. OR heat.mp.) ADJ2 (protect*.mp. OR safe*.mp.) OR
sunscreen.mp. OR "ultraviolet radiation".mp. OR "UV radiation".mp. OR "sun smart".mp. OR
'sunsmart'.mp.)

AND

(intervention*.mp. OR program*.mp. OR initiative*.mp. OR strateg*.mp. OR campaign*.mp. OR policy.mp. OR policies.mp. OR "cancer prevention".mp.)

AND

(school*.mp.)

AND

(evaluat*.mp. OR effective*.mp. OR efficac*.mp. OR impact.mp. OR outcome*.mp. OR assessment.mp. OR 'pre-post'.mp. OR "'randomised controlled trial".mp. OR "'randomized controlled trial".mp. OR "'controlled trial".mp. OR 'quasi-experimental'.mp. OR rct.mp. OR "'cluster randomized".mp. OR "'systematic review".mp.)

4. ERIC (Education Resources Information Centre)

summary(((sun OR UV OR ultraviolet OR heat) w/2 (protect* OR safe*)) OR sunscreen OR "ultraviolet radiation" OR "UV radiation" OR "sun smart" OR "sunsmart")

AND

summary(intervention* OR program* OR initiative* OR strateg* OR campaign* OR policy OR policies OR "cancer prevention")

AND

summary(school*)

AND

summary(evaluat* OR effective* OR efficac* OR impact OR outcome* OR assessment OR "pre-post" OR "randomised controlled trial" OR "randomized controlled trial" OR "controlled trial" OR "quasi-experimental" OR RCT OR "cluster randomized" OR "cluster randomised" OR "systematic review")

5. Cochrane Library

((sun:ti,ab,kw OR uv:ti,ab,kw OR ultraviolet:ti,ab,kw OR heat:ti,ab,kw) NEAR/2 (protect*:ti,ab,kw OR safe*:ti,ab,kw) OR sunscreen:ti,ab,kw OR "'ultraviolet radiation":ti,ab,kw OR "'UV radiation":ti,ab,kw OR "'sun smart":ti,ab,kw OR 'sunsmart':ti,ab,kw)

AND

(intervention*:ti,ab,kw OR program*:ti,ab,kw OR initiative*:ti,ab,kw OR strateg*:ti,ab,kw OR campaign*:ti,ab,kw OR policy:ti,ab,kw OR policies:ti,ab,kw OR "cancer prevention":ti,ab,kw)

AND

(school*:ti,ab,kw)

AND

(evaluat*:ti,ab,kw OR effective*:ti,ab,kw OR efficac*:ti,ab,kw OR impact:ti,ab,kw OR outcome*:ti,ab,kw OR assessment:ti,ab,kw OR 'pre-post':ti,ab,kw OR "'randomised controlled trial":ti,ab,kw OR "'randomized controlled trial":ti,ab,kw OR "'controlled trial":ti,ab,kw OR 'quasi-experimental':ti,ab,kw OR rct:ti,ab,kw OR "'cluster randomized":ti,ab,kw OR "'systematic review":ti,ab,kw)

Appendix B — Data extraction tables

Table A. Data extracted for peer-reviewed studies

| Document Origin | Source (Author, date, title) | Intervention Type (behavioural, policy, environment, multicomponent) | Study Design (design, duration) | Participants (# teachers, #students, #schools, age range, % male) | Context (sociodemographic information) | Location and Setting (country, geographic region, setting type) | Intervention Details (main components, delivery mode, resources, stakeholder involvement) | NSW SunSmart policy recommendation area(s) ¹ | Effective or Impactful on outcomes. ² Limitations | Feasibility, Acceptability, and Equity Considerations | Mechanism(s) of Change (key factors to success or failure) |
|-----------------------|--|--|---|---|---|---|---|---|---|--|---|
| Primary School | | | | | | | | | | | |
| Searches | Buller et al. (2020) Parent reports of sun safety communication and behaviour for students in a randomised trial on a school policy implementation intervention | Policy | RCT, 20 months. | 118 schools, 1,758 parents, 1 (933), C (825), 564 students per school, 5-11 years, 50% male | Children were distributed across all of the primary school ages, with half being female. Majority of children were White and Hispanic. On average, 27.8% of students were English-learners, 64.1% participated in a free/reduced-price meal program. Parents were predominantly female, middle-aged, educated, and White. | United States of America Primary School | The intervention involved trained sun safety coaches providing support to school staff for policy implementation. Coaches met with school principals and the content of the district's sun safety policy was reviewed, a sun safety practice checklist was completed, information resources provided, and plans formulated for implementing sun safety practices. Coaches assessed the school principals' readiness for implementing practices and tailored their assistance based on readiness. Following the first meeting, coaches sent a monthly email, tailored to the principals' readiness, needs and interest. Coaches encouraged implementation, checked on implementation, helped principals cope with implementation barriers and provided additional resources. | The intervention reported on by these studies included the following NSW SunSmart policy recommendations: Scheduling outdoor activities; Shade; Hats; Clothing; Sunscreen; Role modelling of staff, families and visitors, Engaging the school community; Sunglasses and Implementation and review. | This was effective. More parents from schools in intervention group reported receiving information about sun safety (p=0.017). The prediction that parents would report better sun safety of children in the intervention than control groups was supported by parents reports on their children wearing sun-protective clothing when not in school (p=0.033). In schools where the principals reported implementing at least one sun safety practice, parents reported that students spent less time outdoors (p=0.033) and reported that fewer students were sunburned than at schools where principals did not implement (p=0.009). Parents who reported that they received information about sun safety from the school reported greater composite student sun safety behaviour than parents not receiving this information (p=0.008). Limitations: Self-report questionnaires were used, increasing the potential for bias in participant responses. | NR. Although, since the incorporation of in-person meetings with school principals is resource-intensive and dependant on gaining the time of busy principals. Therefore, this intervention may not be feasible for implementation at scale. | Trained sun safety coaches meeting with school principals to review the district's Sun Safety Policy and provide tailored support and providing information to parents. The tailored supported included completing a plan informed by a checklist completed with the principal and tailoring their support based on readiness to implement change. Improvements were not as comprehensive as they hoped. The intervention appeared to increase only sun-protective clothing use. It could be that the 20-month intervention period was too short for the school practices to affect students and intervention efforts are needed to sustain practice implementation to achieve change in student skin cancer prevention. |
| Source Documents | Hunkin et al. (2020) The National SunSmart Schools Program: Impact on sun protection policies and practices in Australian primary schools | Policy | Pseudo-Longitudinal (i.e., Repeated Cross-sectional) design, 6 years. | 950 schools (2011), 643 schools (2016) | Nearly all participating schools were co-educational. | Australia, Metro/Regional/Rural Primary School | SunSmart program | This document is the National SunSmart Policy and therefore includes all 10 policy recommendations. | This was impactful. This observational study showed SunSmart program membership achieved several impacts, including a significantly greater likelihood of many policies and practices being employed. However, the proportion of schools with policies showed only small, non-significant improvements in their sun safe behaviours between 2005-2016 and policy comprehensiveness was low in all schools. Schools recommending gold-standard SunSmart hats significantly increased. Sunscreen was available in most or all classrooms and there was a significant increase from 2005 levels. Shade provision for outdoor activities showed some | NR | The key mechanism is the SunSmart program free membership scheme. However, one of the main aims of the National SunSmart Schools Program was to promote the development of written sun safety policies in schools. The present results indicate that the proportion of schools with a written policy showed only a small and nonsignificant improvement between 2005 and 2016. Furthermore, while the present findings show that policies at SunSmart schools were typically more comprehensive than those at |

| Document Origin | Source (Author, date, title) | Intervention Type (behavioural, policy, environment, multicomponent) | Study Design (design, duration) | Participants (# teachers, #students, #schools, age range, % male) | Context (sociodemographic information) | Location and Setting (country, geographic region, setting type) | Intervention Details (main components, delivery mode, resources, stakeholder involvement) | NSW SunSmart policy recommendation area(s) ¹ | Effective or Impactful on outcomes. ² Limitations | Feasibility, Acceptability, and Equity Considerations | Mechanism(s) of Change (key factors to success or failure) |
|-----------------|---|--|---|---|---|---|---|---|--|--|--|
| | | | | | | | | | <p>variability across years, with 2016 levels significantly higher than 2005, but significantly lower than 2011. Almost all schools held assemblies indoors or outside of peak UV periods, up significantly from 80% in 2005. Peak UV avoidance was also undertaken with regard to PE classes and school sport. Sun safety education was a markedly less frequent constituent of sun safety policies.</p> <p>Limitations: Self-report questionnaires were used, increasing the potential for bias in participant responses. As well, there was a low response rate, influencing the accuracy of data. When looking at the roles that participants had in schools, they varied greatly, impacting the potential responses.</p> | | <p>non-SunSmart schools, policy comprehensiveness across the board was low, in line with previous findings.</p> <p>The Cancer Council NSW evaluation of the NSW SunSmart program [4] in the grey literature table provides insights into issues which effect membership uptake and renewal in NSW.</p> |
| Searches | Lee Solano et al. (2022) Effect of an interactive educational activity using handheld ultraviolet radiation dosimeters on sun protection knowledge among Australian primary school students. | Behavioural; Environment | Exploratory pilot study with pre-post design and no control group, 1 day. | 4,267 students, 5 schools, 8-12 years, 53.4% male | Two schools were in inner urban areas, one in an outer suburban area, one in an urban beach district, and one outside the Sydney metropolitan area. | Australia (NSW), Regional/Metro Primary school | The intervention comprised a UV dosimeter-based outdoor activity followed by a classroom lesson. The session took between 60- and 90-min. Students were assigned to small groups of 4-6 to participate in an outdoor learning activity, with each group facilitated by a member of the research team. They estimated the UV index, considering the weather, time of day, and season, and then used the UV dosimeters to record actual UV index data at each location. Students also tested the effectiveness of four types of sun protection: sunglasses, protective clothing (school uniform), hats, and sunscreen (spread on a glass slide). Students then returned to the classroom to print a graph of the UV index levels measured from the UV dosimeter. Students participated in an interactive slideshow presentation to consolidate key learning points about UV radiation and sun safety. | Curriculum, scheduling outdoor activities | <p>This was impactful. The mean difference between the before-after survey knowledge scores adjusted for school, grade and gender was 2.6 ($p < 0.0001$). Girls scored an average 0.2 points higher than boys ($p = 0.01$). The greatest improvement was for questions related to the UV index.</p> <p>Limitations: Post-test survey was done directly after the intervention. Long-term follow up was not conducted, so retention of knowledge has not been assessed.</p> | <p>Acceptability: The intervention was well received by students and staff. The students were enthusiastic, curious, and engaged with the content of the indoor and outdoor components. The teachers gave overwhelmingly positive feedback and were impressed with the engagement of the students as well as the range and complexity of the concepts being learned. Feasibility: A teacher could feasibly run this session on their own especially if they conducted the outdoor activity in one or two groups, or for the older children in small groups with more detailed instructions provided. The UV dosimeters and software that we used are user friendly. They require annual calibration and cost around \$200 each but can be loaned at no</p> | <p>Use of a UV dosimeter to engage students in an interactive outdoor activity followed by a classroom lesson. The UV Index was an impactful way to teach primary school students about fluctuations in ambient UV throughout the day and in response to shade and other sun protection measures. This was reinforced in the class activity by printing the UV Index levels measured using the UV dosimeters on graphs so that students could visualise the data and compare with their initial estimations.</p> |

| Document Origin | Source (Author, date, title) | Intervention Type (behavioural, policy, environment, multicomponent) | Study Design (design, duration) | Participants (# teachers, #students, #schools, age range, % male) | Context (socio-demographic information) | Location and Setting (country, geographic region, setting type) | Intervention Details (main components, delivery mode, resources, stakeholder involvement) | NSW SunSmart policy recommendation area(s) ¹ | Effective or Impactful on outcomes. ² Limitations | Feasibility, Acceptability, and Equity Considerations | Mechanism(s) of Change (key factors to success or failure) |
|------------------|---|--|---|--|---|---|--|--|--|---|--|
| | | | | | | | | | cost. This intervention does require curriculum time. Equity: not referred to explicitly, although the school locations sampled were diverse. | | |
| Searches | Reynolds et al. (2020) Randomized controlled trial evaluating an intervention supporting implementation of sun safety policies in California public elementary schools | Policy | RCT, 20 months. | 118 schools, 1 (58), C (60), 118 principals, 113 teachers. Principal ages ranged from 39 to 56. Teacher ages ranged from 32 to 55. 27.3% of principals were male. 13.3% of teachers were male. | Majority of teachers and principals were more than one race. Participating schools were from 17 different countries and they were diverse in size. As well, participating schools had a diverse range of student characteristics. | United States of America, Metro/Regional/Rural Primary School | In the Sun Safe Schools intervention, sun safety coaches met via telephone with principals . This was done to review the district's sun safety policy , complete a sun safety practice checklist identifying up to three practices to implement, plan for implementation, and provide sun safety resources. This intervention provided guidance on sun safety practices that fit the school's needs and environment, how to plan the implementation of practices, how to adapt practices, and how to communicate with staff, students, and parents. To provide principals with resources, coaches were trained to assess readiness for implementing practices using a staging matrix based on Diffusion of Innovation Theory. This matrix matched the innovation stage to sun safe practice resources within each policy category. Coaches sent a monthly email containing information pieces aimed at skin cancer prevention topics, tailored to principals' readiness, needs and interest. Educational staff and researchers were relevant stakeholders. | Scheduling outdoor activities; Shade; Hats; Clothing; Sunscreen; Role modelling of staff, families and visitors; Engaging the school community; Implementation and review. | This was effective. Intervention principals reported implementing more sun safety practices overall ($p < 0.005$) and more practices not present in the district's policy ($p = 0.005$). Principals and teachers combined replicated these findings and also reported implementing more practices present in the district policy ($p = 0.005$). In sum, the intervention increased sun safety practices in public elementary schools. Limitations: Self-report questionnaires were used, increasing the potential for bias in participant responses. | Many district administrators may feel that UV poses a low risk and that feasibility of skin cancer prevention is reduced by competing educational priorities and limited financial resources. | Review of policy by coach with principle via telephone and follow-up communication with school principals. The fact that there was a policy may have indicated to personnel that sun safety practices are being prioritised. When teachers are convinced to engage in sun safety themselves, this modelling motivates students to also practice sun safety. Conveying sun safety to parents may also motivate sun safety behaviour in families. |
| Source Documents | Russo et al. (2023) The formative evaluation and pre-testing of a SunSmart policy implementation support toolkit targeting sun safe hat-wearing in NSW primary schools | Policy | Formative and developmental design with some evaluation of implementation using mixed methods, 1.5 years. | 16 schools, 16 administrators. Two schools were withdrawn from the project resulting in 14 schools. | The schools varied in size (159-700 students) and their level of socioeconomic disadvantage varied. | Australia (NSW), Metro/Regional/Rural Primary School | A theoretically informed toolkit based on a Motivation Action Triggers model the research team created was developed. It comprised of resources that addressed the school curriculum, school environment/ethos, and broader school community. Champions were provided an action plan template and a step-by-step guide to implementation. Schools trialed the resources selected in their action plans. | Hats; Role modelling of staff, families and visitors; Engaging the school community; Implementation and review. | This was impactful. The study was not designed to test effectiveness. However, the formative research resulted in development of policy implementation support approaches. Impacts: Follow-up interviewer administered surveys found an increased proportion of sun-safe hat wearing in the 14 participating schools. The descriptive quantitative findings from the evaluation of implementation phase indicate that a practical toolkit prioritised by champions to suit local needs and supported by school leadership, is a promising for supporting SunSmart policy implementation in a school setting. The qualitative findings show | The schools that were included in the sample had self-reported high sun safety behaviour. As such, they may have been more accepting of the toolkit. | The core policy support components of the intervention were a practical toolkit and actions prioritised by champions to suit local needs and support policy implementation. Perceptions of what elements schools felt were useful are described. Champions and the use of them can either support or act as a barrier to the intervention. Champions should provide sufficient leadership and if they don't, this can be detrimental. Time constraints can also act as a barrier. A simple step-by-step guide for the champions to support a locally |

| Document Origin | Source (Author, date, title) | Intervention Type (behavioural, policy, environment, multicomponent) | Study Design (design, duration) | Participants (# teachers, #students, #schools, age range, % male) | Context (sociodemographic information) | Location and Setting (country, geographic region, setting type) | Intervention Details (main components, delivery mode, resources, stakeholder involvement) | NSW SunSmart policy recommendation area(s) ¹ | Effective or Impactful on outcomes. ² Limitations | Feasibility, Acceptability, and Equity Considerations | Mechanism(s) of Change (key factors to success or failure) |
|-----------------|---|--|---------------------------------|---|---|---|--|---|--|--|--|
| | | | | | | | | | that participants felt many intervention elements were useful. Limitations: The schools that this toolkit were implemented in already reported high hat-wearing behaviours. | | tailored approach to supporting policy implementation. |
| Searches | Scott et al. (2023) A novel skin cancer prevention strategy: Preservice teachers' perceptions of a sun safety intervention and experiences in schools | Behavioural | Mixed methods, 3 months. | 186 preservice teachers, 18-54 years, 20.9% male | Majority of pre-service students were from Australia, have had both their primary and secondary schooling in Australia, and speak mainly English. | Australia (WA), Metro Primary School | The preservice teacher sun safety intervention was an exploratory pilot to inform a large study and comprised of a face-to-face interactive workshop. The sample group both attended an interactive short 45 min sun safety education workshop delivered by the research team and after they completed their normal school-based placements as required for their degree, they completed a short survey. | Shade; Hats; Clothing; Implementation and review. | This was impactful. The mixed-methods exploratory pilot study did not test effectiveness. Impacts: The post-intervention preservice teacher survey found that some participants reported developing a new daily sun safety routine after the intervention, with many reporting that they used the smartphone application to check the UVI. Most reported clear sun safety messages in their placement schools. However, only 34.4% reported they had been briefed on the school's sun safety procedures. Limitations: First, this was an exploratory pilot study with a relatively homogeneous sample from one tertiary institution, which may limit the generalisability of findings. Second, as this pilot study intended to inform a future larger study, there was no control group. Third, the focus group questions were not piloted. Fourth, the focus groups interviews were conducted by research team members, who also conducted the intervention, which potentially introduced participant bias. | While the novel 45-minute workshop intervention for preservice teachers shows promise as a feasible strategy to raise knowledge and awareness of the UVI amongst students, further testing is required and feasibility of integration of this strategy into teacher training curriculum is yet to be assessed. This requires support from governing bodies, school administrators, and school communities. | Key mechanisms include the training of preservice teachers, which could potentially embed sun safety in teaching early. Also, interactivity of the workshop. Participant recommendations included more consistent approaches to sun safety across Australian primary schools with a greater focus on UVR and UVI education, rather than compliance management. Furthermore, innovating and enriching existing teacher education curriculum and programs to include more rigorous content and pedagogical approaches to sun safety, UVR and the UVI education is novel and could support PSTs self-efficacy to deliver sun safety to students. |
| Searches | Wright et al. (2019) Protect your skin and let the fun begin: The results of an intervention to improve NSW primary schools implementation of the SunSmart Program | Policy | Cluster RCT, 18 months. | 20 schools, 1 (5), C (15), 103 students, 11 teachers, 4 executive staff, 31 parents | Lack of resources meant that this intervention could only be used in 5 intervention sites. Other information wasn't provided. | Australia (NSW) Primary School | The SunSmart Policy Support and Intervention Study was conducted to determine the feasibility of an intervention to support NSW SunSmart schools based on the premise that effective HPS initiatives can be constrained by a lack of collaboration among the school community, and also between schools and relevant health agencies. Stakeholders included health agencies. | Hats; Sunscreen; Role modelling of staff, families and visitors | This was effective. In the intervention, more individuals wore a hat, a cap, or a sun-safe hat. Although the variance between measurement points was in a positive direction and statistically significant, the effect size was small. However, for sunscreen use there was a large, positive intervention effect. Limitations: Although the sunscreen use was objectively measured by weighing them pre- and post-delivery, students could have used their own sunscreen, which may have impacted these findings. | Since intervention and control schools were both supplied sunscreen and the intervention school also received the fun wheelie but sunscreen use increased from baseline in both intervention and control schools, this suggests that the feasible strategy simply supplying sunscreen works but adding play equipment works better. Sustained investment may be required to change hat wearing behaviours. | The primary component of the intervention was the provision of 'fun wheelies' to intervention schools. These were large, mobile containers of play equipment to be used by students as a reward for wearing sun-safe hats and applying sunscreen. Negative association of stakeholders to 'No Hat, No Play', which is not recommended by SunSmart, may have impacted students' ability to enact hat wearing behaviours. Simply providing sunscreen resulted in higher sunscreen use but attaching the sunscreen to play equipment achieved large increases in sunscreen use. |

| Document Origin | Source (Author, date, title) | Intervention Type (behavioural, policy, environment, multicomponent) | Study Design (design, duration) | Participants (# teachers, #students, #schools, age range, % male) | Context (sociodemographic information) | Location and Setting (country, geographic region, setting type) | Intervention Details (main components, delivery mode, resources, stakeholder involvement) | NSW SunSmart policy recommendation area(s) ¹ | Effective or Impactful on outcomes. ² Limitations | Feasibility, Acceptability, and Equity Considerations | Mechanism(s) of Change (key factors to success or failure) |
|--------------------------|--|--|---|---|--|---|--|---|--|--|---|
| Source Documents | Harrison et al. (2016) Sun protection policies of Australian primary schools in a region of high sun exposure | Policy | Cross-sectional survey design with survey conducted after 17 years of policy implementation, 3 years. | 657 schools, 5-12 years | Non-governmental schools were slightly overrepresented in this sample. | Australia (QLD), Metro/Regional Primary School | The SunSmart Schools program has been operating for 17 years. Schools were evaluated on 12 criteria (5 behavioural, 2 environmental, 4 curriculum/planning criteria, and 1 criterion regarding the regularity of policy review) | Implementation and review | This was impactful. Although this cross-sectional study is not designed to test effectiveness or measure impacts, the survey found 90.9% of schools had a sun safety policy, suggesting SunSmart impacted policy implementation. However, the comprehensiveness scores of the sun safety policies were low and areas for improvement were identified. This study created a baseline for Queensland's SunSmart program impacts to be measured in future. Limitations: Information used in this analysis may not be fully up to date. As well, access to publicly available resources was limited, impacting the results of this study. | NR | The high proportion of schools with a written policy is most likely a consequence of it being a mandatory requirement for all government schools. |
| Searches | Miller et al. (2021) Sun protection changes among diverse elementary schoolchildren participating in a sun safety intervention: A latent transition analysis of a randomized controlled trial | Behavioural | RCT analysis, 4 years. | 3,710 students, 24 schools, 9.8 average years, 53% male | The proportion of students who self-reported Hispanic/Latino ethnicity was 69% | United States of America, Metro Primary School | The SunSmart intervention compared two sun safety intervention conditions (curriculum-only and curriculum plus science lab) to a control condition. Schools randomised to the curriculum-only condition received three one-hour lessons during regular class time taught by trained health educators. The curriculum covered the hazards of excessive UV exposure and methods to protect skin from risky sun exposure. Lessons were classroom-based and included both didactic instruction and interactive components to engage children's interest. Emphasis was placed on the use of barrier methods for UV protection such as sun protective clothing and shade as availability of sunscreen and cost may be a barrier for low-income children. Schools randomised to the curriculum plus science lab condition received the same curriculum plus an additional one-hour lesson in which children measured UV in teams in their playground, developed hypotheses about variability in UV index around the school, and read and interpreted graphs of their UV measurements. | Shade; Hats; Clothing; Sunscreen. | This was effective. A higher proportion of intervention group participants (31%) with low sun safe behaviours at baseline transitioned to higher sun safe behaviours compared to controls (0%). However, it is not possible to ascertain from the results the numbers of students in the intervention versus the control group shifting between different behaviours at the follow-up period since only the combined intervention and control group proportions for each category of sun safe behaviour at baseline are presented. This could mean that whilst the differences in these proportions between the intervention and control group are statistically meaningful, they may not be meaningful from a public health impact perspective if very few intervention group participants were in the low sun safe behaviour category at baseline. Limitations: Self-report questionnaires were used, increasing the potential for bias in participant responses. | Curriculum content was designed for children from ethnically and racially diverse backgrounds and with diverse skin phototypes, suggesting it considered racial and ethnic diversity as an equity concern. However, this may impact generalisability to the Australian context since the study was conducted in the USA. | The key mechanism of the intervention was adding an interactive science laboratory practical UV experiment to curriculum content. Children in the intervention transitioned to higher levels of sun safety and particularly barrier methods such as clothing and shade despite increases in seasonal temperature and subsequently higher UV. One explanation may have been the emphasis placed on the use of barrier methods in the intervention as "first line" methods of sun protection, which diverges from many sun safety interventions which emphasise use of sunscreen. |
| Secondary Schools | | | | | | | | | | | |
| Searches | Calco et al. (2023) A Systematic Review of Evidence-Based High School | Behavioural | Systematic Review (RCT, non-randomised) | 22,683 students | Most studies were conducted in high-income countries. | USA (n=13), Europe (n=5), Australia (n=4), Brazil (n=1), | Only studies involving a skin health-based curriculum delivered in schools with high | Curriculum, Engaging the school community. | This was effective. A total of 25 studies with 22,683 adolescent participants were analysed. Sixteen studies showed a significant increase | NR | The use of well-studied educational theories are important when looking to implement curriculum which aims |

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| | Melanoma Prevention Curricula | | controlled trial, prospective cohorts, cross-sectional, quasi-experimental). | | | Turkey (n=1), Iran (n=1) | school-aged adolescents (grades 9-12) as the target audience were included. | | in knowledge, twenty-one studies showed changes in behaviour, and fifteen studies showed significant changes in attitudes. Limitations: Self-report questionnaires were used, increasing the potential for bias in participant responses. Melanoma curricula was different between schools in knowledge, attitude, and behavioural, making it difficult to compare. | | to prevent skin cancer. This can help to provide consistent changes in skin cancer prevention. Interdisciplinary collaboration in educational public health interventions can also prove effective. |
| Searches | Cassel (2018) Adapting a Skin Cancer Prevention Intervention for Multiethnic Adolescents | Behavioural | Mixed methods design to test acceptability and preliminary efficacy of an adapted intervention, 1 year. | 208 students, 15-17 years | The ethnic distribution of the student population was 51.6% Asian, 30.4% Native Hawaiian/ Pacific Islander, 8.4% white, 3.5% Hispanic, 2.7% black, and 3.2% were of 2 or more ethnicities. | United States of America, Metro Secondary School | Initial key-informant interviews were conducted with 2 health education teachers and the principal to introduce them to the project. Following the interviews, students of an interviewed teacher were recruited to participate in one-hour guided discussions held during a health class. The purpose of the student discussions was to elicit input regarding modifications to SunSafe's intervention that would appeal to high school aged multiethnic students. The SunSafe intervention and resources were presented by the research team to the students for prior review to facilitate the subsequent discussions. These resources and materials included the following: (1) a set of 7 educational handouts and posters for student and their parents on UVR protection; (2) a slide presentation on sun safety containing 34 slides for delivery in the classroom; and (3) a set of interactive classroom activities to support experiential student learning. The modified SunSafe curriculum consisted of a pre-test, 30-minute presentation, modelling of sun protection apparel, a question-and-answer session, followed by a post-test. Branded resources were distributed and included a revised educational brochure, UV radiation-sensitive wristbands, and a message pen. | Engaging the school community | This was impactful. Significant increases in student knowledge, attitudes, and intended sun safety behaviours at post-test. The number of correct answers increased for questions about sunscreen absorption (p=0.023), lighter hair and skin having greater risk (p=0.000), likelihood of getting skin cancer from 2 weeks of sun (p=0.017), and effects of being in water (p=0.001). At 12 month follow up, answers to 6 behavioural knowledge questions sustained at higher than baseline levels of correct responses (that wearing shirts with sleeves, staying in shade, using sunscreen, wearing a hat, limiting outdoor time, and wearing sunglasses helps). Observed long sleeve wearing and shade use increased. Limitations: Only a select portion of the student population was involved in the pilot study. When measuring behaviours using the instrument these measurements were not limited to students who received the intervention. | Student involvement in co-adaptation of the program is likely to have increased its acceptability. All elements seem feasible to implement, although incorporating a lesson and interactive experiential activities into already crowded secondary schools curriculum would require high-level support. This intervention was modified for multiethnic school populations, which suggests ethnicity was an equity consideration. | Student involvement in co-adaptation of the program. The preliminary discussions created buy-in and power-sharing as students had an active role in the project's redesign. There was a lack of understanding surrounding tanned skin, specifically with regards to multiethnic skin tones. A shift in focus of messaging from safety to a more immediate concerns for teenagers of appearance, as evidence by changing the program branding from <i>SunSafe to Love Your Skin</i> . |
| Searches | Chaudhry et al. (2021) Sun Protection Outreach Teaching by Students (SPOTS)-Evaluating the Efficacy of Skin Cancer Prevention | Behavioural | Pre-post design, 2 years. | 1,142 students (pre-survey), 618 students (post-survey), 6 schools, average age of 13.5, 52% male | About 82% self-reported as having a white skin colour. | USA, Metro Secondary School | Sun Protection Outreach Teaching by Students (SPOTS) program is a community outreach program. This intervention has dermatology faculty train medical students to teach middle and high school students about skin cancer prevention and early detection. Designed for teenagers, the program implements an interactive multimedia curriculum. | Sunscreen; Engaging the school community. Delivery of curriculum by university students and messages and images focused on both appearance and health. | This was impactful. Number of students who reported using sunscreen increased. Belief that sunscreen is effective in preventing skin cancer increased and there was a 61% improvement in the belief that a tan is unhealthy (p<.001). The percentage of participants who preferred a natural skin colour | Using medical students helped keep the program cost-effective and sustainable. Whilst high-level support is required to implement curriculum into an already busy high-school curriculum, targeting early high- | The medical student-as-instructor model has a number of key strengths. First, medical students are closer in age to adolescents and may be more relatable yet credible enough to be taken seriously. Second, medical students provide an alternate and complementary voice for sun |

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| | Education for Adolescents | | | | | | Understanding that adolescents are highly driven by physical appearance, the SPOTS program uses both health-based and appearance-based motivators to encourage sun safety and tanning avoidance. The program incorporates a video of 2 teenagers describing their personal journey with melanoma and deploys young medical students as SPOTS instructors. | | increased (p<.001). Participant's understanding that tanning is associated with premature ageing of skin increased by 50%. There was an improvement for those who agreed or strongly agreed that tanning can cause facial wrinkles or dark spots (p<.001). Intention to wear sunscreen often/always in the upcoming summer months increased (p<.001). Limitations: There was no long-term follow-up period (only one month pre-post), and surveys were completed by students voluntarily. | school years, as this program does, may be more feasible than later high-school years. | safety in addition to parents, teachers, and physicians. |
| Source Documents | Clare et al. (2022) The Effects of Using the Sun Safe App on Sun Health Knowledge and Behaviors of Young Teenagers: Results of Pilot Intervention Studies | Behavioural | Quasi-experimental parallel-designed, placebo-controlled pilot study, 10 months.. | 57 (29 Intervention, 28 Control) year 7 and 8 students aged 12-13 years (mean age 12.8 years in Intervention and 12.7 in Control), Male 31% in Intervention and 29% in Control. Participants matched for age, gender and skin type. | Overall, more participants lived in postcodes of higher socioeconomic status (Socio-Economic Indexes for Areas, Index of Relative Socioeconomic Advantage and Disadvantage quintiles 4 and 5) with lighter skin types (i.e., Fitzpatrick skin types 1-3). | Almost all (98%) participants lived in the Perth metropolitan region in Australia. | The intervention group downloaded the SunSafe app to their iOS mobile device with features including: 1. A home page with that day's maximal temperature and UV index. 2. Predictive data on the maximal temperature and UV index linked to times when to use sun safety for that day and subsequent days, accessed through view this week button. 3. Educational content in learn feature. 4. Easy and hard quizzes in quiz feature. 5. Capacity to set daily notifications to check the UV index. 6. A reminder to reapply sunscreen set with a countdown, after which a notification is sent. The control group downloaded the SunDial app from the Australian Apple app store. While its focus is on the sun, no information is imparted related to sun health. Importantly, there is no in-app advertising and few privacy concerns related to using this app, which does not collect any data from the user's device and uses GPS and built-in algorithms to calculate sunrise and sunset times for notifications. | Scheduling outdoor activities; Shade; Hats; Clothing; Engaging the school community; Sunglasses. | Overall, this was impactful. The Sun Safe app was effective for increasing knowledge. Whilst it was not effective for reducing sunburn instance and time spent outdoors, the study was not powered to detect these behaviour changes since a follow-on confirmatory effectiveness study is planned. Participants who were given access to the Sun Safe (test) app demonstrated greater sun health knowledge than those in the placebo group (-6.2%, 95% CI -12.4% to -0.03%; P=0.049). There were no statistically significant differences in the number of serious sunburn events reported across the lifetime or any sunburn during the 6 weeks before the intervention between the groups. However, there were significantly more sunburn events reported by participants in the Sun Safe group during the 6 weeks of the intervention than those in the placebo group (RR=1.7, 95% CI 1.1-2.8; P=0.02). Within the Sun Safe group, these were mostly (10/13,77%) not bad sunburns. No statistically significant difference observed between groups in the number of bad sunburns (RR=0.5, 95% CI 0.1-1.2; P=0.27). There were no statistically significant differences in the time spent outdoors or the use of sunscreen either before or during the intervention period between the placebo and test groups. Limitations: Sample based towards females with fair skin from more advantaged neighbourhoods, although | Feasibility: Only 12% (3/24) of the participants stated that they would pay for the Sun Safe app, suggesting it needs to be free to be feasible for adoption. Acceptability: Across all areas of assessment except aesthetics, Sun Safe was rated significantly higher than the placebo app. Participants using Sun Safe were more likely to recommend it to others (P=.003; Mann-Whitney test) and use it more frequently in the next 12 months (P=.008) than those using the placebo app. There was a relatively low dropout rate (approximately 10% overall). Equity: The sample were mostly female, fair skinned and lived in relatively advantaged neighbourhoods and were from metropolitan Perth. Future intervention studies should aim to increase the diversity of participants recruited (considering gender, socioeconomic status, skin type, and residence | The objective measure of sun exposure showed that overall outdoor sun exposure reduced significantly in both the intervention and control groups during phases of the study impacted by COVID-19 'lock downs'. This suggests results for behavioural measures were impacted by the pandemic. The information the Sun Safe app delivered (e.g., the learn and quizzes tabs) was rated particularly highly by intervention participants, suggesting it was a key mechanism for achieving significantly greater outcomes for knowledge in the intervention group compared to the control group. However, the authors stated that further development may be required to improve user engagement, such as incorporation of gamification (which was suggested by users in the apps co-design process). |

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| | | | | | | | | | there were no differences in these biases between the intervention and the control groups. Validation of self-reported time spent outdoors via an objective measure was only done for the school pilot study, not the two community pilot studies. | beyond metropolitan Perth). | |
| Searches | Davis et al. (2015) Evaluation of Project Students are Sun Safe (SASS): A University Student-Delivered Skin Cancer Prevention Program for Schools | Behavioural | Pre-post design, 4 weeks. | 1,284 students, 39 teachers, 9 schools | No specific demographic info of participants were given, but school districts include large Hispanic populations | USA, Metro/Regional Secondary School | Project Students are Sun Safe (SASS) is a university student-led, media-based sun-safety program that is tailored to adolescents in the classroom setting. The university students receive specific training in presentation skills and sun-safety activities; they receive credit for this service-learning course and are required then to conduct specific hours of education to the community. The university students travel to participating schools to implement Project SASS in the classroom. The intervention lasts between 50-65 minutes and consists of a 25-min PowerPoint presentation and three interactive activities. The PowerPoint includes striking images of people with UVR damage and a video of an 11-year-old melanoma survivor. Following the presentation, students can look in a filtered UV skin analyser that shows UVR-damaged skin, learn how to be conscious sunscreen consumers, and use a UVR-detecting Frisbee to visualize sun protection afforded by specific types of fabrics. | Sunscreen; Role modelling of staff, families and visitors; Curriculum. Delivery of curriculum by university students who receive credit for the service-learning course and in-turn are required to deliver a set amount of hours for the credit. | This was impactful. Student participants perceived their risk of skin cancer during their lifetime as higher after the intervention (p=0.01). They did not report a change in their short-term sunscreen use (p=0.64), or their short-term tanning behaviours (p=0.17). However, after the Project SASS intervention, participants reported less appeal for tanned skin than before the intervention (p<0.001). Self-reported tanning behaviours did not show any change among high school students (p=0.84), but was statistically less among the middle school students (p=0.035). Limitations: Self-report questionnaires were used, increasing the potential for bias in participant responses. These interventions were only put in place for approximately 55 minutes, resulting in short pre- and post-surveys. | Student participants enjoyed the intervention. | Teachers thought peer-led instruction was a great approach to use for this age group. The teachers felt that different methods were used to educate the students, resulting in an effective presentation. Teachers spoke highly of the hands-on activities and felt that the intervention held the students' attention. Theoretically informed by the Health Belief Model – specifically cue to action and increase self-efficacy. |

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| Source Documents | Hanna et al. (2022) Effect of the SunSafe Student Ambassador Program on the attitudes, knowledge and behaviour of Australian high-school students towards sun safety: a prospective study | Behavioural | Pre-post design, 3 months. | 755 students attended, 2 schools, 11-16 years 503 students completed pre-survey, 10.1% male 274 students completed post-survey, 5.1% male 337 students completed 3 month follow-up, 14.3% male | The first school was a government-funded academically selective state school for girls, while the second school was a government-funded co-educational secondary school. | Australia (NSW), Metro/Rural Secondary School | This intervention begins with a comprehensive 1-day training session to educate student representatives from high schools on melanoma and its prevention and early detection. These student ambassadors are also taught presentation skills and they participate in a workshop to develop their own SunSafe presentation. Template PowerPoint slides are provided, as well as access to one-to-one guidance with an expert to optimise the performance of the ambassadors and to ensure the delivery of accurate and standardised information. The students then return to their schools to deliver their SunSafe presentation to their peers. | Engaging the school community; Implementation and review. | This was impactful. Immediately post-intervention, there was a significant increase in the number of students who correctly identified that the following factors increased the risk of melanoma: having many moles ($p < 0.001$), having atypical/odd-shaped moles ($p < 0.001$), getting sunburnt as a child ($p < 0.01$) and getting a blistering sunburn even once ($p < 0.001$). The total composite knowledge score showed very strong evidence for improvement ($p < 0.001$). For the behaviour questions, there was evidence for an improvement in wearing sunscreen daily ($p = 0.02$). After three months, there was strong evidence for an increase in the students' ability to recall the features that can indicate skin cancer ($p < 0.01$) and very strong evidence for measures to protect themselves from the sun ($p < 0.001$). The composite score (out of 18) of all knowledge questions improved ($p < 0.01$). Limitations: Self-report questionnaires were used, increasing the potential for bias in participant responses. Of the original 755 students present at the presentation, only 218 and 235 students could be matched for analysis. This may indicate that knowledge, attitude, and behaviour gains may be smaller than recorded. | The schools that participated were enthusiastic about the programme, as it potentially delivered outcomes for a number of issues. | The significant reach of educating a few students in a school to engage and present further education to the whole school is an efficient and impactful strategy for a sun-safety programme. Not only were there students being educated about sun safety and early detection of skin cancers, but in addition, the selected student ambassadors were given an opportunity to develop presentation skills by professional presenters. |
| Searches | Hubbard et al. (2020) Sun protection education for adolescents: A feasibility study of a wait-list controlled trial of an intervention involving a presentation, action planning, and SMS messages and using objective measurement of sun exposure | Behavioural | Feasibility study with a wait-list controlled trial with quasi-experimental design. Longitudinal, 4 months. | 487 students, 1 (385), C (102), 6 schools, 1 (5), C (1), 13-15 years, 48% male | The distribution of ethnic groups was similar in the intervention and control groups, with most participants being white. | Scotland Secondary School | A skin cancer nurse specialist delivered a 50 min presentation on one occasion during the school day in a classroom or hall after playing a 5 min film. A young adult skin cancer survivor gave a brief 5-min talk after the nurse-delivered presentation. The talk was about his personal experience of melanoma diagnosis at 16 years old, impacts on his life and his views on sunscreen use and SSE. A booklet with instructions to write sun safety and skin self-examination action plans was handed to students at the end of the presentation. Automated text messages were delivered on two days of the week for seven weeks after the presentation during the summer holiday period. | Engaging the school community. | This was impactful. The intervention impacted student's sun safety behaviours more than skin self-examination with no intervention component perceived as more impactful than another. The percentage of participants reporting more severe sunburn is lower post-intervention than pre-intervention. Limitations: This study was not appropriately powered to measure intervention effects. | Initially, eight out of 130 schools in Scotland indicated an interest in participating in the study. Three schools had difficulty in facilitating the study within the timetable. Some head teachers indicated that they were not in a position to participate because there was no space left on the school timetable to accommodate the research. Therefore, this feasibility study suggests that research teams may | Focus groups after the intervention were conducted. Adolescents did not perceive melanoma risk as a major issue for their age group and because of UK weather. Lack of perceived relevance may explain why the majority of adolescences in the study were neutral in their response to whether the intervention influenced their sun safety behaviours and self-examination. Students said they did not complete the action plans as some were unclear about the purpose. Students said listening to the personal story of the cancer survivor was the |

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| Searches | Jensen et al. (2022) Tailored Visuals, Implementation Interventions, and Sun Safe Behavior: A Longitudinal Message Experiment | Behavioural | A cluster randomised four-arm trial. Pre-post design, 1 month. | 654 students, 11 schools, 14-18 years, 52.30% male | Participants primarily identified as White, followed by Black or African American, Asian or Asian American, American Indian/Alaskan Native, other, or did not report. | United States of America Secondary School | Participants received one of 4 interventions (education-only, education + sunscreen efficacy demonstration, education + implementation intervention, and education + tailored UV photograph). Interventions were delivered in group settings (e.g., classrooms) with multiple students present during each session. All interventions included a 20-minute educational component. The education component was delivered by a public health educator using a PowerPoint presentation focused on sun safety. The PowerPoint presentation included stock UV photographs. The camera intervention required a system that included a UV camera, chin/head rest, computer monitor, and laser printer. The computer monitor can be positioned so that neither the individual being photographed, nor the rest of the class can see the screen. The implementation intervention also had participants write down what sun protective behaviours they intend to perform, when and where they will perform them, and action steps needed to help them successfully implement the behaviour. | Inform the school community. | This was effective. Compared with the implementation intervention, participants in the tailored UV condition reported increased fear and freedom threat and decreased appearance norms and benefits of tanning immediately following exposure to the intervention and decreased outdoor tanning 1 month after the intervention. Indirect effects also emerged with tailored UV exposure decreasing outdoor tanning via appearance benefits and increasing outdoor tanning when immediate fear triggered psychological reactance. See Wu et al. (2019) for a full quantitative description of the impacts of each intervention arm. Limitations: Self-report questionnaires were used, increasing the potential for bias in participant responses. | have more success in recruiting schools if head teachers are approached prior to the finalisation of timetables, which are often set a year in advance. Other studies recommend approaching a relevant teacher (e.g. a teacher responsible for personal, social and health education) rather than the head teacher and avoiding examination periods when students are either in exams or studying for exams. | best feature of the presentation. They believed that the message was more powerful coming from someone their age. Students said the texts were regular reminders to use sun protection. They preferred texts with specific advice about sun safety as opposed to information about UVR exposure dangers. |
| Searches | Jia et al (2020) Gamification improves melanoma visual identification among high school students: Results | Behavioural | RCT. | 271 students, I (136), C (135) | NR | United States of America, Metro Secondary School | The intervention was a matching game. In each of six rounds of the matching game, participants were asked to identify the correct melanoma image among three unlabelled skin lesion images. Each round concluded with educational feedback. Following the pamphlet (control) or game, | Engaging the school community. | This was effective. The accuracy in correctly identifying the images was significantly higher in the gamified cohort than the traditional ABCDE cohort (p < .0001). For future methods of skin-screening education, most | NR | Gamified forms of education may be more effective than traditional ABCDE pamphlets in training patients to identify worrisome lesions. |

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| | from a randomized study | | | | | | participants were asked to identify forty images, labelling each image as a melanoma or benign nevus. | | subjects preferred games, followed by pamphlets, social media, and lectures. Limitations: NR. This article is a brief report which does not include a lot of detail. | | |
| Searches | Loescher et al. (2019) Implementation of Project Students Are Sun Safe (SASS) in Rural High Schools Along the Arizona-Mexico Border | Behavioural | Feasibility study including process and impact evaluation. Pre-post-test repeat cross-sectional design, 7 months. | 220 students | Majority of the study consisted of Hispanic students. | United States of America, Rural Secondary School | Three training modules were developed by community partners, and a university team. Each module took no longer than 20 min to complete online. They were added into an online learning platform for students to complete. Six high school peer educators from each school were recruited completed online modules, visited the university, then participated in at least four peer presentations in groups of 3 at their schools over 6 months. Presentations included sun protective fabric, sunscreen ingredient, or skin analyser activities and lasted 40 mins. | Engaging the school community; Implementation and review. | This was impactful. For high school students receiving the peer educators' presentations, the overall correct score on knowledge items increased ($p < 0.001$). Number of sun protective behaviours increased ($p < 0.001$). Classroom participants showed sustained knowledge over 4 months for all items except for melanoma that causes more deaths each year than basal or squamous cell skin cancers and sunscreen ingredients. Sun protective behaviour improvements were also sustained at 4 months. Limitations: Short pre-tests and post-tests meant that behaviours, beliefs, and knowledge could not be fully discriminated. As well, only short-term sustainability could be assessed. | University partners adjusted the existing program to make it more culturally relevant. The peer educators agreed that the training was acceptable. The online training may not have been appropriate as the high schools' curriculum did not incorporate web-based courses. Some peer educators were not truthful about completing the modules. Participants somewhat-to-strongly agreed that, overall, they enjoyed the presentation, enjoyed participating in the activities, learned a lot about sun safety, thought that the peer educators were knowledgeable about sun safety, felt that the peer educators held their attention, and thought SASS should be continued in the school. | Peer educators were crucial for the success of this project. Using a community based participatory research framework may be a key to success for implementing a peer-to-peer, school-targeted skin cancer prevention interventions that result in risk-reducing behaviour change. This approach is particularly important when the target population is underserved and understudied. |
| Source Documents | McNoe et al. (2021) Effectiveness of Sun Protection Interventions Delivered to Adolescents in a Secondary School Setting: A Systematic Review | Behavioural; Environment | Systematic Review (RCT, non-randomised controlled trials, pre-post design). | 13-18 year olds participated in the interventions. 13 studies. | Skin colour or ethnicity was not well reported. Only 5 studies collected this information and it varied greatly by country. For most studies, approximately half were male. | Australia (n=3), Iran (n=3), USA (n=2), Brazil (n=1), China (n=1), Denmark (n=1), Spain (n=1), Turkey (n=1) | All but one of the interventions included didactic educational material on sun safety and the risk of sun exposure. Of the 10 studies for which information was provided on who delivered the intervention, half were delivered by the research team or a medical student, two were delivered in the classroom using online or video material, two by the classroom teacher, and one was an environmental intervention. In addition to lecture material, five interventions had an interactive component such as games, role playing, or appearance-focused apps or photograph. Some also specified that they | Shade; Hats; Clothing; Sunscreen; Curriculum; Sunglasses. | This was effective. Out of 13 studies none had a "strong" quality rating. From five rate "moderate" three were effective. Outcome measures similar: use of sun protection items (sunscreen, hats, clothing, shade, sunglasses), UVR exposure (intentional tanning, sunbed use), or physiological outcomes (sunburn). Limitations: In most of the included studies, self-report questionnaires were used, increasing the potential for bias in participant responses. As well, only published studies were included, introducing the possibility of publication bias. | Even if effective, education-based interventions resource-heavy and must be delivered with each new cohort. Requires high-level support to build it into curriculum to be feasible for adoption at scale. | Most sun safety interventions targeting adolescents are health-based, emphasising the association between UVR exposure and skin cancer. These have limited success in changing behaviour. Preferable interventions be theory-based to account for mediating factors that achieve behaviour change. The authors stated: <i>'The most promising interventions overall (including the pilot/uncontrolled studies) were those that moved beyond a pure health education</i> |

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| | | | | | | | included take-home materials such as brochures or magazines. | | | | <i>approach and used innovative approaches such as the provision of shade, or use of technology (e.g., appearance-based apps or real-time ultraviolet index (UVI) monitors).'</i> |
| Search | McNoe et al (2022). Photoaging Intervention Delivered to Adolescents in Secondary Schools: A Feasibility Study | Behavioural | Longitudinal feasibility study | 38 students, 13-14 years, 47% male | More than one ethnicity could be reported with most students (n=36, 95%) reporting that they were NZ European, six (16%) Māori, and three (8%) another ethnicity. | New Zealand, metro Secondary school | The intervention consisted of UV photographs, a PowerPoint presentation, and other UV radiation "experimental" activities. The UV camera took three black and white photographs of each student: the first under "white light," the second using a UV filter that displays signs of sun damage not visible to the naked eye, and the third using the same UV filter but with sunscreen applied to the participant. This demonstrated the comprehensiveness of sunscreen coverage and, by blackening the protected areas, visualises the effect that sunscreen has in blocking UV. A health promoter then viewed the three images with each student and talked about any evidence of skin damage and sun safety. Whilst this occurred with each student, other activities relating to UV were included to keep the remaining students occupied. A 1 hr PowerPoint presentation about the effect of UV radiation exposure on human skin, in particular, on light coloured skin types, was also delivered to student. The activities were divided into two sessions of approximately 60 minutes each. Session 1 was the PowerPoint presentation, and Session 2 included the UV photography, feedback, and filler activities | Engaging the school community. | Impactful: At the conclusion of the session, students were asked to recall two facts from the intervention. Interestingly, seven students mentioned skin cancer although this was deliberately not mentioned during the intervention. Only three of the 38 students gave factually incorrect information: one confused UV radiation with temperature, one gave an incorrect sun safety message, and one an incorrect skin cancer fact. Disappointingly, given the intended focus of the intervention, only one student specifically mentioned appearance. Most of the facts recalled were related to the sun safety messages and properties of UV radiation. | The UV photographic intervention was well received by students. The UV photographic equipment was impractical to set up and the quality of the photographs was not high. The students enjoyed seeing the real-life applications of UV light, particularly in relation to the passports and paper money. The tent blocked out all natural light and was very good at maximizing the visual appearance of UV. However, the maximum number of students that could be accommodated in the tent at one time was only five. | The head of science suggested that the intervention may be better placed in the physical education and health curriculum or that it be targeted at Year 8 students (aged 12 years) who receive the science curriculum as one core subject. The research team had not appreciated, until discussions with staff at the intervention school, that although science is still one curriculum topic at Years 9- 10, operationally, within many secondary schools, it is now separated and taught in its component parts. The intervention as it currently stands could not be delivered neatly in that environment. One alternative would be to target the physical activity and health curriculum, but there it would be competing with other health concerns, some of which have much more immediate consequences among youth than skin cancer. |
| Source documents | Nicholson et al. (2020), Teacher perceptions of sun protection practices in the secondary school settings: Barriers, enablers and recommendations for future Behavioural | Behavioural | Formative evaluation with a qualitative research design using focus group discussions, 4 months. | 18 staff representatives across 4 focus groups, with 3-4 participants per group, 39% male. Focus groups were made up of the following schools: P-12 (n= 7), secondary (n= 6), Middle 7-10 | The program being evaluated explored sun safety barriers and enablers in Victorian secondary schools and had been running for 9 years prior. Schools were metro (56%) or regional (44%) and mostly co-ed (83%). Of the 18 schools, 56% were Government, 33% | Australia, (VIC). Secondary schools or primary plus secondary schools. | This study did not involve the implementation of an intervention, but rather it focused on gathering information about the barriers, enablers, and potential strategies related to sun safety practices in secondary schools. The main components of the study included data collection through focus group discussions and subsequent thematic analysis of the collected data to identify key themes related to sun safety in the secondary school setting. | Shade; Hats; Role modelling. | This study was impactful. It identified key factors influencing sun safety practices and suggested practical strategies for improvement. It found that there is no standardised approach to sun safety in Victoria's secondary schools, with UV radiation not consistently recognised as a health risk. Leadership from school principals, student-led initiatives, and a whole-school approach were seen as key to promoting sun safety behaviours. Concerns about sunscreen use, peer norms, and the | This study identified a number of pragmatic, acceptable approaches, including student-led initiatives, staff and student role modelling initiatives, and increasing shade available for active and passive recreation. | The study shows that regulatory influences, particularly the recognition of UV radiation as a health risk and the regulation of sun safety policies, staff training, and shade implementation, are critical levers for change. The socio-cultural context of secondary schools, including the transition from primary school, peer norms, and competing health and well-being priorities, plays a significant role in shaping sun safety behaviours. Concerns |

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| | | | | (n= 1), Specialist 10-12 (n= 1), Specialist Development (n= 1), P-10 (n= 1), and Specialist P-10 (n= 1). | Independent and 11% Catholic. | | | | <p>transition from primary to secondary school were also identified as important factors influencing sun safety practices. UV radiation as a health risk and the regulation of sun safety policies, staff training, and shade implementation, were shown to be critical levers for change.</p> <p>Please note that this study is the qualitative component of Nicholson (2016) above.</p> <p>Limitations: small focus group size and recruitment was low (this may have led to potential selection bias), and reliance on self-reported data, which may have led to recall bias.</p> | | related to risk, such as liability and allergies, also impact decision-making. Effective leadership, with support from school principals and consistent staff action, is essential for successful sun safety policies. |
| Searches | Owen et al. (2018) The impact of an appearance-focused facial-ageing intervention on adolescents' attitudes toward sun protection | Behavioural | RCT, pre-post two group design, 2 days. | 237 students, 1 (60), C (176), 1 school, 11-14 years, 52.74% Male | All participants spoke and understood English at a native level. Students were Caucasian. | United Kingdom, Urban Secondary School | In the intervention group, the participants began by discussing their awareness and attitudes towards sun safety and UV exposure. The experimenter then took a photograph of each participant's face, and uploaded the photograph onto Age Progression Software. The experimenter explained that the photographs on the left-hand side of the screen would show their face aged if they had been using sun protection and not using sunbeds, and on the right-hand side of the screen they would see their face aged with UV exposure and no sun protection. The experimenter then clicked the play button on the screen, and the photographs moved through the ages from the participant's current age, in 2-year intervals, up to the age of 72 years, the maximum age. After all of the participants in the group had participated in the intervention, they took part in a brief discussion about the intervention. | Sunscreen; Engaging the school community. | <p>This was effective. Adolescents who had participated in the appearance-focused intervention had significantly greater intentions to use sun protection, significantly more negative sun risk beliefs, lower sun benefit attitudes and higher perceived sun damage susceptibility after viewing the information given than participants in the control group.</p> <p>Limitations: After completing the intervention/open-ended questionnaire, participants were able to chat with one another about the intervention/their answers. This could have skewed results.</p> | Given the time constraint, a smaller sample of individuals were able to partake in the intervention. The participants were Caucasian and as such, results are less generalisable. | <p>Photoaging software able to realistically demonstrate the impacts of not using sun protection versus using sun protection on appearance over time using participants' own photo (i.e., personalised).</p> <p>Intervention effects of appearance-based work was more effective for females who may place greater importance on their appearance.</p> |

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| Source Documents | Pettigrew et al. (2020) The potential of ultraviolet radiation meters in secondary schools as a sun protection intervention mechanism for adolescents | Behavioural; Environment | Quasi-experiment, pre-post with one intervention and one control school design, 2 months. | 2 schools, 2,479 students completed the intervention, I (1,331), C (1,148). 157 students completed the pre-survey; I (77), C (80). 106 students completed the post-survey; I (49), C (57), 12-18 years | The schools were located within 5 kilometres of each other and were quite demographically similar. | Australia (WA), Metro Secondary School | The intervention school received a UV radiation meter. A presentation was delivered to students at the intervention school. The presentation lasted approximately 15 minutes and explained the purpose of the UV index and the threshold of '3' as the reading at which the need for sun protection is indicated. Consistent with the information provided, a sign featuring a graduated call to action was attached to the meter at the intervention school. | Shade; Hats; Clothing; Sunscreen; Engaging the school community Sunglasses. | This was effective. Respondents from the intervention school exhibited significant improvements in awareness of (i) the purpose of the UV index and (ii) the UV index threshold for sun protection. When asked about the name of the weather forecast measure that indicates risk of sunburn (open-ended response item), the proportion of students who correctly identified the UV index increased in both schools, but the change was significant only for the intervention school (p=0.01). Large majorities reported that the meter was useful, important, informative, convenient, and worthwhile. Most indicated that they looked at the UV index reading on the meter at least once per day, and more than one-third reported looking at it multiple times per day. There were no significant changes in sun safety behaviours observed in either school. In the case of the intervention school, this lack of significant change was likely to be at least partially attributable to the very high proportion of students within the photographed area who stayed in the shade at baseline. Limitations: This intervention only lasted 10 school days. As well, using dosimeters with adolescents can be challenging, which may have skewed data. Finally, reliable UV radiation information with the use of polysulfone badges and the use of the camera in the sunny area at the control school was not attained. | In the context of this broad suite of initiatives, the location of UVR meters in places frequented by adolescents appears to be a potentially worthwhile means of supplementing other skin cancer prevention strategies in a manner that is low cost and highly acceptable to the target audience. The results of this exploratory study indicate that the provision of salient, real-time UV index information in schools may constitute a viable and acceptable means of ensuring adolescents have the information they require to make informed decisions about sun protection. | In addition to brief education of students, the prominently placed UV radiation meter may have been a visual cue which prompted knowledge recall. The use of dosimeters can be challenging, and the experiences in this study support the idea that establishing effective communication with individuals at multiple levels within participating schools can optimise protocol implementation. |
| Searches | Steele et al. (2020) "Live Sun Smart!" Testing the effectiveness of a sun safety program for middle schoolers | Behavioural; Multi-component | Non-randomised pre-post pilot with one group design, 3 weeks. | 57 students, 1 school, 11-12 years, 50.9% male | There was a slight male majority. This study was done in a private school with a high annual tuition, which may represent a discrete subpopulation of middle schoolers in the state. | United States of America, Metro Secondary School | The intervention included an in-class presentation and two weeks of sun safety electronic messages. The in-class component was a 30-minute interactive, educational presentation and a sunscreen application demonstration using a live-action UV camera. Students then received electronic messages with sun safety infographics three times a week for 2 weeks. | Shade; Clothing; Sunscreen; Sunglasses. | This was impactful. The intervention was associated with an increase in total knowledge score (p < .001), while total attitude and behaviour scores did not change significantly following the intervention. Respondents' disagreement with the statement, "when I am tan, I look healthier and more attractive" significantly improved after the intervention (p= 0.05). Limitations: This study did not use a validated measurement tool, and convenience sampling was used. | The use of technology facilitated program delivery. The resources that were available in this setting were used appropriately and acceptably. | Using technology in sun safety interventions can further engage students in multimedia education styles and can release sun safety programs from the time constraints on health education during school calendar days. One major success of this study was that the program was created for and tailored to both the age of the study population and the resources available in the setting. |

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| Searches | Sharma et al. (2022) Implementing a Skin Cancer Prevention Lesson to Enact Institutional Change: A Schoolwide Survey | Behavioural | Repeat cross-sectional, pre-post-post design, 1 month. | 1,025 students, 1 school, 14-18 years | This school was selected due to it being the largest high school in the study's city. | United States of America, Metro Secondary School | A skin cancer lesson presentation was created. This presentation consisted of a 4-min video outlining the incidence of risk factors, preventive measures, self-screening techniques, and treatment options for skin cancer. | Sunscreen; Curriculum. | This was impactful. Significant changes in knowledge gain, knowledge decay, and knowledge persistence throughout all grade levels were found. Behavioural changes included an increase in students wearing sunscreen 5-7 days per week ($p < 0.001$) and students examining themselves for changing moles ($p = 0.10$). Limitations: Dishonest test-taking was of a concern. As well, a 4-week follow-up may be considered a short amount of time to determine whether information was retained or not. | The brevity of the video may make it more feasible to deliver in schools. With the video lesson being narrated by a fellow peer, this may have made the information more acceptable. Some structural, legal, and governmental restrictions are placed on hats, sunglasses, and sunscreen use and should be changed for sun safety. | The four-minute educational video was narrated by a student at the study's school. |
| Searches | Tuong et al. (2014) Effect of appearance-based education compared with health-based education on sunscreen use and knowledge: A randomized controlled trial | Behavioural | RCT, 1 month. | 50 students, 1 school, 16-18 years, 16-24% Male | Majority of individuals were on a lunch program and were not White. | United States of America, Metro Secondary School | Individuals were shown a video. The videos were approximately 5 minutes in duration and guided by the Health Belief Model. This model predicts that individuals are more likely to adopt a new behaviour if they perceive: (1) a negative health outcome of not performing a behaviour to be severe, (2) themselves to be susceptible to the negative outcome, (3) the benefits to a behaviour to be high, and (4) the barriers to adopting a behaviour to be low. The health-based video discussed the growing incidence of melanoma among young people and the link between skin cancer and UV radiation. It also explained how sun protection could lower skin cancer risk. The appearance-based video discussed the contribution of UV light to premature cutaneous ageing and how sunscreen use could help delay signs of skin ageing. | Sunscreen | This was effective. Within-group analysis showed that the appearance-based group reported significantly higher mean sunscreen use at the 6-week follow-up period compared with baseline ($p < .001$). In contrast, the health-based video intervention group reported a mean sunscreen application frequency that was not significantly different from baseline ($p = .096$). Within-group analysis showed that the knowledge score of the appearance-based group was significantly higher immediately after watching the video ($p = .001$). The health-based group exhibited a significant improvement in sunscreen knowledge immediately after watching the video ($p < .001$). Limitations: N/A | Video was an effective medium for promoting change. Coupling the increased consumption and acceptability of digital media by youth with the promising results of appearance-based interventions, adolescents had their minds changed. | Appearance-based communication and education rather than health-based. A mixed-race actress, who was chosen to mirror the young and ethnically diverse target population. Computer-generated images, animations, popular culture references, and humour made the educational videos more relatable. Theoretically informed by the Health Belief Model. |
| Searches | Wu et al. (2019) A four-group experiment to improve Western high school students' sun protection behaviours | Behavioural | Repeat cross-sectional study with pre-post-post design and no control group, 4 months. | 1,573 students, 11 schools, 14-18 years, 50% Male | Most individuals were White or Hispanic. This research found that male students and rural students would be a better audience to this intervention. The sample included individuals from a geographic area that was more prone to melanoma. | United States of America, Metro/Rural Secondary School | There were four main interventions. The first, was a control group where a skin cancer education PowerPoint presentation was provided. This presentation included information on skin cancer incidence, risk factors, and causes of skin cancer strategies to prevent and screen for skin cancer, and common misconceptions about skin cancer and prevention strategies. The second was a UV photograph. Each student received a personalised UV photograph that showed their current facial UV skin damage caused by UV radiation exposure. The third intervention was a behaviour change worksheet aimed to increase self-efficacy | Scheduling outdoor activities; Shade; Hats; Clothing; Sunscreen; Engaging the school community. | This was impactful. All interventions were associated with significant improvements in sun safety. The photograph was superior in controlling intentional tanning and sunburn when compared to the behaviour change worksheet ($p < 0.05$). In contrast, the worksheet was associated with greater increases in sun safety use when compared with the photograph ($p < 0.05$). Limitations: The interventions were done very briefly. Self-report questionnaires were used, increasing | This was short-term intervention which was feasible and acceptable from a school implementation point of view. The groups of students that were assessed were mainly White and Hispanic. This may be hard to generalize to a more diverse, or different ethnic group. | A targeted rather than a universal approach. Participating children's parents had a history of skin cancer. Contacting administrators was the most effective way of implementing research. When planning specific interventions in classrooms, teachers were the best point of contact. Passive consent processes were used, which was believed to be an effective way to improve participation. Small group settings |

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| | | | | | | | for carrying out skin cancer prevention strategies and used an implementation intention setting framework, which draws on self-regulation and motivation theories. Students were asked to complete a worksheet that guided them through creation of a plan around their use of a sun safety behaviour. Students first selected a sun safety behaviour they were willing to commit to implementing in the next month. Then, they were asked to describe when and where they would use this sun safety strategy, and the steps they would take to implement that sun safety strategy. Students also viewed the educational presentation from the control condition. The last condition was where students used a UV-generating flashlight and UV sensor to test and record the amount of UV radiation detected when the light was blocked by sunscreens of differing sun protection factor levels (4, 30, 50, and 70). Students also viewed the educational presentation from the control condition. | | the potential for bias in participant responses. | | rather than large groups of students were preferred. Theoretical framework: Extended parallel process model — communicate health risk and prevention information by targeted individual's perceived threat and perceived efficacy. |
| Searches | White et al. (2019) Effectiveness of a theory-based sun-safe randomised behavioural change trial among Australian adolescents | Behavioural | RCT, 3 weeks. | 382 students, 12-17 years, 38.9% Male | Some schools were public and private. There was a good mix of urban, coastal, and regional areas in the control and intervention groups. | Australia (QLD), Metro/Regional Secondary School | The intervention was delivered by trained facilitators in three weekly 1-hour sessions, with each session containing an ice-breaker activity, main activity, summary of important "take home" points, and student feedback. Students were provided with a handbook and feedback forms in each session. Session 1 aimed to encourage sun safety-related attitudes and beliefs with discussion points centred around underlying beliefs about the long and short term effects of sun exposure and the advantages/disadvantages of using sun protection. Session 2 aimed to foster perceptions of normative support for sun safety with discussion points focused on beliefs about others' approval of their sun-safe behaviour including whether friends should try to influence each other's sun-safe behaviour. The session incorporated strategies to negotiate one's own sun safety decisions especially if others disapprove/disagree. Session 3 aimed to increase perceptions of control/self-efficacy over using sun protective measures with discussion points including consideration of what factors | Engaging the school community. | This was not effective. This intervention showed a positive change for adolescents' sun-protective behaviour during weekends, although significant effects were not detected for weekdays. Limitations: Self-report questionnaires were used, increasing the potential for bias in participant responses. The control and intervention arm of this study were imbalanced. More private schools were allocated into the control condition which may have caused confounds. | Vigilance of school staff was variable and impacted whether students complied to sun-safety measures. | Current findings indicate that the intention/behaviour link should be a focus in future sun-safe programme developments. The outcomes of this intervention showed that by strengthening students' accurate control perceptions, the target behaviour can be altered. |

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students have control over to be sun safe, their SunSmart goals, and the barriers that might prevent them from achieving these goals. The session concluded by encouraging confident sun-safe champions among the students by designing sun safety messages to communicate to others.

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| Searches | Hubbard et al. (2018) Promoting sunscreen use and skin self-examination to improve early detection and prevent skin cancer: Quasi-experimental trial of an adolescent psycho-educational intervention | Behavioural | Feasibility study with quasi-experimental design. Longitudinal, 6 weeks. | 455 students, I (376), C (79), 5 schools, I (4), C (1), 15-16 years, 54.9% male | Majority of participants were white, and 10.7% of participants had a close family member who had skin cancer. The sample consists of a small number of mainly white British adolescents selected from only five schools and so may not generalise to populations with different cultural background. | Scotland Secondary School | A practicing skin cancer nurse specialist delivered a 50-min presentation to students. Each presentation was delivered by the nurse on one occasion during the school day in a classroom. After playing a 5-min video, the nurse delivered the presentation with the aid of Microsoft PowerPoint slides and covered: personal experiences of skin cancer, incidence patterns, risk factors, associations between disease staging and survival, and benefits of skin self-examination. A young adult skin cancer survivor gave a brief 5-min talk after the nurse-delivered presentation. The talk was about his personal experience of melanoma diagnosis at 16 years old, impacts on his life and his views on sunscreen use and behaviour. A home-based assignment comprised a booklet with instructions. Adolescents were given an exercise to self-examine their skin and asked to complete an action plan for regular monthly sunscreen use and an action plan. | Sunscreen; Engaging the school community. | This was not effective. Results were weak and changes in intention to use sunscreen and to regularly conduct skin self-examination were insignificant. The number of adolescents talking to someone about skin cancer in the last month that received the intervention significantly increased after the intervention ($p < 0.001$), however this follow up was a month from the intervention and many likely said yes in reference to the intervention. The intervention group increased their skin self-examination, $p < 0.001$, however the intervention included conducting an SSE. After the intervention, adolescents believed more strongly that they had control to prevent skin cancer on a 0-10 scale ($p < 0.001$) but perceptions of painful effects of cancer treatment decreased ($p < 0.001$). Limitations: This study was done in the middle of winter, impacting the way in which participants would respond to sun exposure. Self-report questionnaires were used, increasing the potential for bias in participant responses. Objective measurement of sunscreen use and sunburn incidence was not used. | More than half of participants reported that they did not do the home-based assignment. Some adolescents did not do the home-based assignment because in contrast to other homework tasks, there was no date when it had to be completed by. Nonetheless, even if the home-based assignment was made compulsory, SSE is unlikely to be sustained. Some adolescents found the film was too contrived and patronising because it was trying to be too cool. | Adolescents could recall the personal stories from a peer because they were real, and emotional. Many adolescents said that the talk given by the young adult cancer survivor was the best feature of the presentation. Many adolescents expressed distaste for sunscreen because of its smell and texture. As well, the study was conducted during January to March when it is cold in the UK and when the population is less likely to think about use of sun protection. Whether the findings would be similar during the summer months is unclear. |
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| Document Origin | Source (Author, date, title) | Intervention Type (behavioural, policy, environment, multicomponent) | Study Design (design, duration) | Participants (# teachers, #students, #schools, age range, % male) | Context (sociodemographic information) | Location and Setting (country, geographic region, setting type) | Intervention Details (main components, delivery mode, resources, stakeholder involvement) | NSW SunSmart policy recommendation area(s) ¹ | Effective or Impactful on outcomes. ² Limitations | Feasibility, Acceptability, and Equity Considerations | Mechanism(s) of Change (key factors to success or failure) |
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| Searches | Truong et al. (2021) A Sun Safety Pilot Program Using a Tanning Myths-Focused Video Contest for Utah Adolescents: Cross-sectional Analysis | Behavioural | Cross-sectional study with post-intervention design and a control group, 3 years. | 109 students (22 intervention, 87 control) 56.9% Male | Majority of participants were either White or Hispanic. To participate in the video contest, access to recording devices would prove difficult for resource-limited households. | United States Secondary School | Designed and sponsored an annual statewide contest running from 2015 to 2018, in which Utah teenagers voluntarily created 1-minute public service announcement videos debunking tanning myths. Between three and 10 finalists and their families attended a celebratory event at the University of Utah Department of Dermatology each year where their videos were viewed, students' achievements were recognised, and the importance of sun-protective behaviours was stressed. A cohort of adolescents from high schools who participated in the video contest and a cohort of adolescents from the same high schools who did not participate were electronically surveyed about tanning intentions on sun-protective behaviours and understanding of tanning myths. | Sunscreen; Engaging the school community. | This study was impactful. Impacts: Although knowledge of skin cancer facts did not differ between video contest and non-video contest participants (p=0.14 and p=0.11, respectively), video contest participants were more likely to correctly identify 2 tanning myths and achieved significantly higher overall knowledge scores than control group participants. Limitations: This study lacked power due to the small sample size. | People of colour participated less in the video contest. Skin cancer is less likely in these groups, but its incidence is rising. | Getting youth involved in the creation of videos achieved some impacts knowledge. Video contest participants reported increased intentions towards sunscreen use. Traditional didactic classroom lessons are not effective in promoting behaviour changes amongst adolescents. |

Primary and Secondary Schools

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| Searches | Asdigian et al. (2023) Design and Effectiveness of the Youth Engaged Strategies for Changing Adolescent Norms! (YES-CAN!) Program for Reducing Skin Cancer Risk | Behavioural | Cross-sectional study with pre-post design, 10 weeks. | Participated: 146 students (26, 15-18 years and 120, 11-13 years) Completed surveys: 110 students (13, 15-18 years, and 97, 11-13 years) | The high school was in an area that serves a predominantly Hispanic/Latino student population. A large proportion of students receive free or reduced lunches and are English language learners. The primary school was mainly composed of White individuals, and a quarter of the school population received free or reduced lunches. | United States of America, Metro Primary and Secondary School | Curriculum (28-lessons) developed through a collaboration between public health researchers and secondary school teachers. Broad content areas linked across different curricula. Teachers were free to use or adapt the curriculum and toolkit in a way that aligned with student needs and their preferred teaching styles. Several guest speakers visited the class, including a young melanoma survivor, a melanoma oncologist, and a group of medical students who demonstrated how a UV camera is used to view skin damage invisible to the naked eye. Students received academic credit and a grade for completing the class. Throughout the program, students work in groups to develop concepts for short (3-5 min) videos that portray engaging stories about the use of sun protection or avoidance of excessive UV exposure, classroom-based presentations on skin cancer prevention that feature their videos along with (1) guided discussions about the key messages conveyed in the video, (2) additional information about skin cancer or prevention, (3) extension activities such as written reflection assignments or self-directed internet research and/or (4) a social media campaign that reinforces key messages from video. | Curriculum; Engaging the school community. | This was impactful for the primary school students, students reported at post-program they were significantly less likely to engage in outdoor tanning (p=0.002) and significantly more likely to use sunscreen (p<0.0001), wear a hat (p<0.0001), and wear a shirt with sleeves (p<0.0001). Middle school participants were less likely to report at post-program that they would join close friends who wanted to tan outdoors and more likely to report that they would use sunscreen and wear protective clothing and hats if their friends did. High-school students reported at post-program being significantly more likely to wear a hat outside in the summer (p=0.04). Post-test they were significantly less likely to report on the that they want to be as tan as their close friends (p=0.04) and significantly more likely to report they would wear sun-protective clothing if their friends did (p=0.02). A statistically significant increase was seen in the belief that sunburns can cause skin cancer. Limitations: Self-report questionnaires were used, increasing | A 28-lesson curriculum, although well-designed, may not be realistic in Australian schools. In these American schools, because of time constraints at participating schools, it was not possible for high school students to lead multiple educational sessions with middle school students or to implement the social media component of the program. Acceptability increased amongst adolescents via inclusion of peer-leaders. | This program provides more intensive training for peer leaders in the science of skin cancer. Peer leaders also receive comprehensive instruction in health communication for adolescents, narrative story development, and video production. Moreover, they create their own skin cancer prevention videos, educational materials, and discussion activities instead of using existing resources developed by adult professionals. The latter component capitalises on youths; creativity, their voice, and their lived experience to enhance the degree to which prevention messages resonate with and deeply engage younger youth. |
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| Document Origin | Source (Author, date, title) | Intervention Type (behavioural, policy, environment, multicomponent) | Study Design (design, duration) | Participants (# teachers, #students, #schools, age range, % male) | Context (sociodemographic information) | Location and Setting (country, geographic region, setting type) | Intervention Details (main components, delivery mode, resources, stakeholder involvement) | NSW SunSmart policy recommendation area(s) ¹ | Effective or Impactful on outcomes. ² Limitations | Feasibility, Acceptability, and Equity Considerations | Mechanism(s) of Change (key factors to success or failure) |
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| | | | | | | | | | the potential for bias in participant responses. | | |
| Source Documents | Buller et al. (2011) Motivating Public School Districts to Adopt Sun Protection Policies: A Randomized Control Trial | Policy | RCT, 5 years. | 112 districts, 8,121 students | Randomisation resulted in gender being equally divided between students, but most district staff were female (74%). Half of students were Caucasian due to randomisation and most district staff were Caucasian. Close to half of the students were on free/reduced lunch. | United States of America, Metro/Regional/Rural Primary and Secondary School | Policy program, Sun Safe Schools, focused primarily on adoption consisting of agenda-setting, matching, and adoption decision, although information was provided to help districts implement policy. Program staff attempted to meet with the key contact to discuss sun safety policies. During the in-person meeting, program staff provided key contact people with a binder of printed materials promoting sun safety policies, reviewed the districts current policies (or lack thereof), and discussed where policies would fit best. | Shade; Implementation and review. | This was effective. A total of 12 school districts in the intervention group and 6 districts in the control group made a change that adopted or strengthened a sun safety policy between baseline and 2-year follow-up. The percentage of districts who made any change was not statistically different by treatment group (p=0.142). However, school districts receiving Sun Safe Schools intervention had higher sun safety policy strength scores than control districts in the completer analysis of 100 school districts. Change in total score for strength of policies, p=0.035. Limitations: The program was only delivered in districts with dry climates and many sunny days. However, this is like NSW. It was only delivered in public schools. | NR | Districts may have hesitated to codify protective clothing and hats into policy because they are less commonly used than sunscreen, may interfere with dress code policies on display of gang colours, and may raise concerns about head lice transmission. Districts may have been reluctant to alter school schedules to avoid disrupting school day management, as implied by surveys with principals. Several circumstances may have undermined the effectiveness of Sun Safe Schools. Local administration can pose a concern. |
| Searches | Kouzes et al. (2017) Sun Smart Schools Nevada: Increasing Knowledge Among School Children About Ultraviolet Radiation. | Behavioural | Pilot study with pre-post design, 10 months. | 1,441 students, 7 schools, age and gender not specified | The sample included both private and public schools. | United States of America, Metro/Rural Primary and Secondary School | The program consisted of numerous essential elements but allowed participating schools flexibility in how best to implement these elements. Teachers were given an age-appropriate curriculum about sun safety to incorporate into their lessons, daily UV index announcements to broadcast over the intercom system, and guest speaker presentations to educate students about UV and sun safety. Each school was required to use an age-appropriate evidence-based curriculum. Schools were also asked to adopt a written policy for sun safety and were provided with sample policies and technical assistance. The policies required adopting at least one of the following strategies: promotion of sunscreen use, approval of sun protective clothing on campus, and access to shade. | Hats; Sunscreen; Sunglasses; Engaging the school community; Implementation and review. | This was impactful. For primary schools, there was an 8% (p=0.47) increase in affirmative responses to putting sunscreen on always or sometimes. There was an 18.5% (p=0.003) increase in reporting of wearing sunglasses post-intervention. For middle-schools, there was a 19.1% (p=0.003) increase in hat wearing and 29.5% (p<0.001) increase in long-sleeve shirt wearing during the middle of the day. Despite some negatively changed behaviours surrounding sun safety, there was a significant 7.1% decrease in children reporting that they felt they and their friends looked better with a suntan. For high-schoolers, there was an overall increase in practicing sun safe 14.9% increase (p = 0.04) in sunscreen use and a hat use increase. Despite this, attitudes about personal sun safety did not change much pre-to-post intervention. Limitations: The program itself was flexible, meaning interventions were varied – creating challenges in assessing the program's efficacy. Convenience sampling took place. | NR | The difference in effectiveness between age groups, and the fact that high school students maintain a positive attitude toward the appearance of tanned skin even when acknowledging the risk tanned skin represents, illustrates the conflict high school students may experience in desiring to adhere to social norms despite knowledge of risks. It also highlights a gap in the effectiveness of the existing curriculum to fully address social norm change. |

| Document Origin | Source (Author, date, title) | Intervention Type (behavioural, policy, environment, multicomponent) | Study Design (design, duration) | Participants (# teachers, #students, #schools, age range, % male) | Context (sociodemographic information) | Location and Setting (country, geographic region, setting type) | Intervention Details (main components, delivery mode, resources, stakeholder involvement) | NSW SunSmart policy recommendation area(s) ¹ | Effective or Impactful on outcomes. ² Limitations | Feasibility, Acceptability, and Equity Considerations | Mechanism(s) of Change (key factors to success or failure) |
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| | | | | | | | | | The follow-up period was a lot shorter than anticipated, meaning the program's effectiveness over time was not properly assessed. | | |
| Source Documents | Langford et al. (2015) The World Health Organization's Health Promoting Schools framework: a Cochrane systematic review and meta-analysis | Environment; Policy | Systematic Review and Meta-Analysis (cluster RCTs). | 67 studies, 4-18 years | 59 studies in high income countries, 8 studies in middle- or low-income studies | USA (n=27), Europe (n=19), Australasia (n=11), China (n=3), Canada (n=2), Mexico (n=2), India (n=1), Egypt (n=1), Tanzania (n=1) | Interventions are for overall health; Olson et al. (2007) was the only one focused on sun safety. Olson et al used an education intervention of a 30-minute presentation followed by each student viewing their skin's UV damage using a dermal scan using high frequency ultrasound. Other interventions included were for nutrition, physical activity, alcohol use, tobacco use, drug use, mental health, violence, and bullying. | NR | Effective. The only sun safety intervention included was effective - Olson et al (2007) found that after 2 years of intervention exposure, adolescents at the beach/pool in intervention communities were significantly better protected than those in control communities. From the 67 trials, they found positive average intervention effects for: body mass index (BMI), physical activity, physical fitness, fruit and vegetable intake, tobacco use, and being bullied. Intervention effects were generally small. On average across studies, they found little evidence of effectiveness for zBMI (BMI, standardised for age and gender), and no evidence for fat intake, alcohol use, drug use, mental health, violence and bullying others. It was not possible to meta-analyse data on other health outcomes due to lack of data. Limitations: In the studies included, self-report questionnaires were used, increasing the potential for bias in participant responses. As well, there was a lack of long-term follow-up and high attrition rates. | NR | This Cochrane review has found the WHO HPS framework is effective at improving some aspects of student health. The effects are small but potentially important at a population level. Stronger evidence is available for HPS effects on smoking and bullying. Students receiving HPS interventions were, on average, 23% less likely to smoke and 17% less likely to be bullied. Of note, is that there was a lack of sufficient data at present to determine the effect of this approach for several health outcomes, particularly mental health and sexual health. There was also an imbalance between which health topics were focused on at different ages. |
| Search | Lorenc et al. (2013) Resource provision and environmental change for the prevention of skin cancer: systematic review of qualitative evidence from high-income countries | Behavioural; Environment; Multi-component | Systematic review of qualitative studies. | A range of populations were included in the studies. Two were primary schools, one was primary and secondary, and two were with adolescents. | Studies were from high-income countries. | USA (n= 7), UK (n= 6), Australia (n=3), Canada (n=3), New Zealand (n = 3), Sweden (n = 1) | Majority of the interventions included in this systematic review aimed to look at sun-related behaviour and sun safety beliefs. The papers that were included that had an intervention were mainly school-based or policy-based in creating a SunSmart policy. | Shade; Role modelling of staff, families and visitors, Engaging the school community; Implementation and review. | Impactful. The findings of this review are consistent with what is known from the quantitative literature on attitudes and behaviours, which shows that higher levels of sun safety behaviour are associated with higher perceived risk and severity of skin cancer and greater perceived benefits of sun safety. The risk and potential severity of skin cancer are not seen as important concerns, and tanning which is not deliberate is seen as less dangerous. There are several social and practical barriers to the use of sun protection resources, including cost, inconvenience and social norms. Limitations: N/A | Very few data were located on differences between ethnic groups. Few data were located on socioeconomic status, although one study found that people from higher-socioeconomic groups were more aware of long-term health risks from sun exposure than those from lower-socioeconomic groups. | Decisions about sun safety depend on weather conditions and on individual exposure, with some participants more likely to use protection when they notice that they are already beginning to burn. Parents, particularly mothers, are an important source of influence. Teachers, lifeguards and coaches were also mentioned as sources of encouragement for sun protection. The effects of media messages were also mentioned by several participants. However, these were generally perceived to dissuade people from using sun |

| Document Origin | Source (Author, date, title) | Intervention Type (behavioural, policy, environment, multicomponent) | Study Design (design, duration) | Participants (# teachers, #students, #schools, age range, % male) | Context (sociodemographic information) | Location and Setting (country, geographic region, setting type) | Intervention Details (main components, delivery mode, resources, stakeholder involvement) | NSW SunSmart policy recommendation area(s) ¹ | Effective or Impactful on outcomes. ² Limitations | Feasibility, Acceptability, and Equity Considerations | Mechanism(s) of Change (key factors to success or failure) |
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| Searches | Miller et al. (2015) SunSmart: evaluation of a pilot school-based sun protection intervention in Hispanic early adolescents | Behavioural | Process evaluation (fidelity of delivery, impacts) with pre-post design, 6 years. | 1,049 students, 9-14 years, 46% male | This study explicitly studied Hispanic students. The intervention itself was not extensively culturally tailored to this population, due to lack of resources and data on motivators and barriers in Hispanic adolescents. | United States of America, Metro Primary and Secondary School | SunSmart was based upon a large-scale US sun safety intervention and further developed to target a predominantly Hispanic student population. The general lesson format and content of sun safety messages regarding risks of excessive sun exposure and measures of protection to reduce risks was adapted from the prior intervention. To adhere to school scheduling requirements, the revised curriculum comprised three 1-h lessons over 3 weeks. Of note, is that schools and classes within schools were selected based on existing relationships with the university. | Shade; Hats; Clothing; Sunscreen; Engaging the school community. | This was impactful. In univariate analyses, no significant differences were observed. No significant changes in sun protective behaviours during peak hours at school were observed. Self-reported sunburn in the past month decreased significantly from pre- to post-test in the full sample (p<0.001). Sun safety knowledge increased significantly from pre- to post-test for the full sample (p<0.001). In the full sample, students rating of tanning importance increased from pre- to post-test (p<0.001), indicating their belief that having a tan was more, rather than less, important. Students' sun protective attitudes significantly improved from pre- to post-test in the full sample (p<0.002). There was a significant increase in self-efficacy to use a sunscreen of SPF15 from pre- to post-test in the full sample (p<0.001). Limitations: Self-report questionnaires were used, increasing the potential for bias in participant responses. The questionnaires that were used had low alphas, making these measures less valid. | Something to consider was that this intervention was not extensively culturally tailored to this population, due to lack of resources and data on motivators and barriers in Hispanic adolescents. With regards to feasibility of delivery to just Hispanic students, the school-based format of this intervention necessitated broad delivery to all students. | protection by promoting the attractiveness of a tan. The role of acculturation and social environment on behaviour are important factors to be explored in addition to the unique barriers that Hispanic children might face in practicing sun safety. Tanning norms should also be examined. As well, some of the intervention instructors were Hispanic. This was not the majority, which may have caused the students to regard the information as not personally relevant. |
| Source Document | Reyes-Marcelino et al. (2021) School-based interventions to improve sun-safe knowledge, attitudes and behaviours in childhood and adolescence: A systematic review | Behavioural; Multi-component | Systematic Review (RCT, non-randomised controlled trial). | Majority of studies were done in elementary schools. | Many of the studies included in this review were assessed as high risk of bias. Majority were also in high-income countries. 23 studies focused on child/parent behaviour outcomes. 16 were done in elementary schools. | USA (n=27), Australia (n=12), UK (n=5), Canada (n=3), France (n=3), Brazil (n=3), Germany (n=2), Spain (n=2), Italy (n=2), Sweden (n=1), Switzerland (n=1), Lithuania (n=1), Colombia (n=1), Greece (n=1), China (n=1) | Most studies assessed measures of sun-safe behaviours, knowledge and attitudes (57, 48 and 33 studies, respectively), and observed improved sun safety behaviours and sun-safe knowledge, whereas few studies reduced time in the sun. | Shade; Hats; Clothing; Engaging the school community; Sunscreen; | The studies included were effective. This review revealed that most studies assessed measures of sun-safe behaviours, knowledge and attitudes, and observed improved sun safety behaviours and sun-safe knowledge. Few studies reduced time in the sun. Around half of participants experienced improved attitudes towards tanning desirability. Half of the studies that looked at sunburns and nevi spots recognized that there was a reduction. Limitations: In the studies included, self-report questionnaires were used, increasing the potential for bias in participant responses | NR | Educational interventions that took an active approach to learning improved attitudes. Multi-component interventions tended to have a greater effect on improving knowledge and behaviours. Repeated exposure of an intervention was also beneficial. Interventions should be tailored to different age groups. Lots of barriers to proper Sun Safety were often things that students could not control (i.e., shade availability). Refer to Cassel et al. (2018) for more detail. |

| Document Origin | Source (Author, date, title) | Intervention Type (behavioural, policy, environment, multicomponent) | Study Design (design, duration) | Participants (# teachers, #students, #schools, age range, % male) | Context (socioeconomic information) | Location and Setting (country, geographic region, setting type) | Intervention Details (main components, delivery mode, resources, stakeholder involvement) | NSW SunSmart policy recommendation area(s) ¹ | Effective or Impactful on outcomes. ² Limitations | Feasibility, Acceptability, and Equity Considerations | Mechanism(s) of Change (key factors to success or failure) |
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| Searches | Sim et al. (2021) The effectiveness of educational programmes in promoting sun protection among children under the age of 18: a systematic review and meta-analysis | Behavioural | Systematic Review and Meta-Analysis (RCTs, cluster RCTs, and controlled clinical trials). | A range of populations were included in the studies. | Studies were from high-income countries. This article did not look at socioeconomic circumstances that could confound sun safety outcomes. Majority of the study populations were of white or fair-skinned children. | USA (n=10), UK (n=5), Australia (n=3), Germany (n=2), Spain (n=1), Italy (n=1), France (n=1), Brazil (n=1) | 12 trials worked to report on sun safety knowledge. 10 trials reported on attitudes and beliefs towards sun safety. 20 trials reported on sun safety behaviour intentions and behaviours. | Hats; Clothing; Engaging the school community; Sunscreen. | This was effective. Small-to-moderate effects of educational programmes were observed across all sun safety outcomes of interest, but negligible effect sizes were demonstrated when specific outcomes were meta-analysed. A promising approach in the future may be to consider targeting children in secondary education with a digitally delivered interactive intervention. Limitations: The meta-analyses that were performed were underpowered. As well, the studies that were included in these analyses were of poor quality. | The population was mainly White. As such, its applicability to other populations is in question. | Educational programmes that recruited older children, utilised new media, and incorporated interactivity were considered to be more effective. Refer to White et al. (2019) and Owen et al. (2018) for more information. |
| Searches | Thoonen et al. (2020) Are Environmental Interventions Targeting Skin Cancer Prevention among Children and Adolescents Effective? A Systematic Review | Environment; Multi-component | Systematic Review (RCTs, quasi-experimental). | A range of populations were included in the studies, 0-18 years, 3 schools | Studies were done in high-income countries. | Australia (n=3), Canada (n=2), Germany (n=1), USA (n=1) | In four studies, an economic intervention (i.e., free sunscreen) was included in an intervention-arm. Shade supply was the intervention in three studies and one study provided sun-protective clothing. | Shade; Sunscreen. | Environmental interventions were effective in five of seven studies. Findings regarding the effects of economic interventions (i.e., free sunscreen) on nevi and sunburn incidence, such as free provision of sunscreen, were contradicting. One study found that children who received free sunscreen had developed less nevi at the end of the intervention period, whereas another study found no effects of free sunscreen provision on nevi incidence. Limitations: There were only a few studies that met inclusion criteria. As such, this review only speaks to a handful of relevant literature. | NR | Provision of shade is an accessible method of promoting sun safety. Free distribution of sun safety tools like sunscreen, UV-protective clothing, and dispensers were an effective way of promoting sun safety in most studies. Overall, the authors stated that shade provision showed the most promising and consistent results in increasing sun safety behaviours. |
| Community | | | | | | | | | | | |
| Searches | Acuna et al. (2020) Harnessing digital videos to promote cancer prevention and education: A systematic review of the literature from 2013-2018 | Behavioural | Systematic Review. | Participants were mostly adults. 11 studies (4 RCTs, 1 between-subject experiment, 1 quasi-experiment, 2 pre-post, 1 retrospective cohort study) | There were a wide variety of races included, as some studies specifically targeted marginalised populations. | USA (n=8), Netherlands (n=2), South Korea (n=1) | Interventions all had an online video component. Cancer risk reduction messages and education on Twitter, YouTube, and Facebook were compared for comprehension levels and changes in attitude. One study compared personalised and non-personalised videos, as well as videos with text-only information. | Sunscreen; Engaging the school community. | This was effective. Overall, most of the studies that had a study outcome of knowledge demonstrated that among participants who viewed online digital videos, there was an increase in awareness and understanding of the risk factors and screening procedures related to cancer. Additionally, results from the selected articles reported that digital videos should be incorporated in cancer treatment and that YouTube was the social media outlet preferred over Twitter and Facebook to disseminate information on cancer risk. Finally, behavioural modifications such as self-skin inspections and increased likelihood for obtaining lung | 87% of adult online users report the use of cellular phones to seek information as a preferred choice, so short digital videos could be used to provide quick, timely, and tailored health information on specific topics. From 2013 to 2017, the use of smartphones in households earning less than \$30,000 increased by 12%. Additional studies showed that enrolled participants | Even though most of the studies included in this review did not use social media sites to publish their cancer education videos, it is essential to disseminate critical cancer health digital videos using website pages to reach populations that are more diverse. Future research should focus on the development of online educational videos using popular social media sites such as YouTube, Twitter, and Facebook in order to educate and reach diverse populations. |

| Document Origin | Source (Author, date, title) | Intervention Type (behavioural, policy, environment, multicomponent) | Study Design (design, duration) | Participants (# teachers, #students, #schools, age range, % male) | Context (sociodemographic information) | Location and Setting (country, geographic region, setting type) | Intervention Details (main components, delivery mode, resources, stakeholder involvement) | NSW SunSmart policy recommendation area(s) ¹ | Effective or Impactful on outcomes. ² Limitations | Feasibility, Acceptability, and Equity Considerations | Mechanism(s) of Change (key factors to success or failure) |
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| | | | | | | | | | cancer screening increased after viewing online digital videos. Limitations: N/A | from hard-to-reach populations, and those of low incomes had access to smartphones ranging from 34 to 68%. | |
| Searches | Dobbinson et al. (2015) Continued Impact of SunSmart Advertising on Youth and Adults' Behaviors. | Behavioural | Monitoring study with repeat cross-sectional design, 24 years. | 11,881 participants, 14 to 69 years, 47% male | NR | Australia (VIC), Metro Community | A SunSmart mass media campaign in the form of TV advertisements were broadcast over the summer. | Hats; Sunscreen | This was impactful. Increased SunSmart TV advertisement audience sizes for the 4 weeks prior to interview were related to improvements in respondents' sun safety measures, specifically reduced mean body exposure and increased sunscreen use (p=0.018) with no evidence of diminishing returns. Sunscreen use had a stronger association with audience size for those aged 14-24 years compared to those aged 45-69 years. There was increased reduction in tan preference with increased audience size (p<0.001). Amount of time spent outdoors was not significantly related. Limitations: N/A | NR | These findings also provide evidence that the relationships with cumulative audience sizes generally apply to young people and the broader population, demonstrating that youth-focused campaigns can have positive population-wide effects. This may be related to a broad reach of youth-targeted media buys during summer TV programming (with many advertisements broadcast during major sporting events), or that the advertisements were generally developed to have a broad appeal to a wider audience not just the target audience. |
| Searches | Wu et al. (2018) A novel educational intervention targeting melanoma risk and prevention knowledge among children with a familial risk for melanoma. | Behavioural | Cross-sectional study with pre-post design, 2 months. | 18 families, 22 parents, 33 children. Children 8-17 years, parents 35-48 years. Children 54.5% male, parents 31.8% male. | Most participants had fair skin tones, and the mean family incomes of this study was \$85,000. | United States of America, Rural Community | The Melanoma Education and Risk Information Team (MERIT) intervention was delivered. It lasted approximately 30 min. MERIT provides information on melanoma risk and prevention, including foundational information on traits and the environment, DNA and genes, mutation, melanoma development, regulation of cell growth, genetic and environmental risk, and melanoma prevention and control. MERIT consists of visuals delivered through Power-Point and short videos, and the still visuals are accompanied by brief text. | Scheduling outdoor activities; Shade; Hats; Clothing; Sunscreen. | This was impactful. There was a significant increase of 0.66 points in parents' intentions to have children wear hats from immediately post-education to the 1-month follow-up (p = 0.03). There was a significant increase in parents' intentions to have children avoid peak UVR exposure hours from baseline to 1-month follow-up (p = 0.01). Limitations: Self-report questionnaires were used, increasing the potential for bias in participant responses. Sample sizes were also small, reducing the power of this study. | Future multi-site studies are needed that include more socioeconomically and racially and ethnically diverse populations and employ more rigorous designs. The educational program can be feasibly delivered to children and their parents. The program was acceptable and demonstrated initial evidence of benefit. | Educational health promotion interventions have been effective. Depending on the setting, preventive interventions targeting minor children could be delivered by health educators, social workers, or other healthcare providers, in person or via web-based strategies, or through more automated or self-paced formats. |

¹ORIMA (2021) (22)

²For example, a confirmatory RCT, quasi-experiment or longitudinal study with a control that achieved statistically significant results would be 'effective'. Whereas a small pilot study with short-term follow-up or a repeat cross-sectional observational study that showed an intervention achieved impacts on key outcomes would be 'impactful'.

Table B. Data extracted for studies from the grey literature

| Source (Author, date, title) | Intervention Type (Behavioural, policy, environment, multicomponent) | Study Design (design, duration) | Participants (# teachers, #students, #schools, age range, % male) | Context (sociodemographic information) | Location and Setting (country, geographic region, setting type) | Intervention Details (main components, delivery mode, resources, stakeholder involvement) | NSW SunSmart policy recommendation area(s) | Effectiveness and Impacts/Outcomes | Feasibility, Acceptability, Mechanism(s) of Change (key and Equity Considerations) | Mechanism(s) of Change (key factors to success or failure) |
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| Primary Schools | | | | | | | | | | |
| ORIMA Research (2021) SunSmart Program Evaluation Report | Behavioural; Policy | Pragmatic evaluation of reach, adoption, impact and maintenance. Mixed methods design, using questionnaires (Schools, Parents) and qualitative interviews (Principals) and focus group discussions (SunSmart coordinators and teaching staff), 1 year. | Survey participants: Primary schools (n=394), parents (n=806) with children in a NSW primary school. Qualitative interviews and focus group participants: Interviews with principals (n=10); five focus groups with non-principal staff (n=22) | School survey participants: From 2437 primary schools with available contact details in NSW 48% were current SunSmart members, 34% were lapsed members and 18% were never members. Amongst the 394 schools (16%) who responded, 67% were current members, 24% lapsed members and 9% never members. Parent survey participants: 40% of respondents had a child at a current SunSmart school, 39% attended lapsed member schools and 22% at never member schools. | Australia (NSW), Metro/Regional/Rural Primary School | The SunSmart program partners with primary schools, early childhood education and care, and out of school hours services across NSW to develop and implement a best-practice sun safety policy. This program provides recommendations to promote comprehensive sun safety measures. | Shade; Hats; Clothing; Sunscreen. | This was impactful. Some small but significant differences were observed in SunSmart member schools compared to non-member schools that might be expected to have a modest positive impact on sun safety outcomes in schools. Perceptions of SunSmart membership status are more strongly related to schools' self-assessed outcomes than is actual membership status. Parents' perceptions of school performance on sun safety were also much more correlated with actual membership status. The SunSmart program is likely to be making a modest but positive contribution to the long term impacts it is intended to influence. New South Wales primary schools and primary school parents exhibit a moderate-to-high value of sun safety, and though it is not an urgent threat, both groups believe that it should be a high priority for primary schools. Limitations: results refer to tests of statistical significance, yet analysis methods are not described. Unvalidated self-report questionnaires were used. The school survey response rate was low (16%) affecting generalisability. There was a higher proportion of participating schools who were current members (67%) than the proportion for all schools in NSW (48%), which may have biased the survey findings away from the null. These survey results were weighted by membership status, but logistic regression models which considered the limitations may have been more appropriate. | Individuals accept the program and are quite encouraging of its work. With that said, some factors that may be impacting the implementation of this program include the presence and seniority of program coordinators, staff with personal interest who act as a champion for the topic, the presence of people in the school community with experience of skin cancer, use of major events and key times to communicate sun safety messages, and the level of incidental reminders about sun safety. | The targets for SunSmart activity could be expanded to more actively focus on staff and encourage schools to engage more closely with parents both to increase parental knowledge and influence outside of school hours, but also to apply a subtle pressure on schools to improve their sun safety practices. As well, discussion of the SunSmart program as being contemporary is needed, and the use of broad and targeted communications is beneficial. |
| Secondary Schools | | | | | | | | | | |
| Nicholson (2016) Sun protective policies and actions in Victorian secondary schools | Behavioural; Policy | Cross-sectional design with mixed methods. Questionnaire and Qualitative Interviews. | 71 schools | Majority of schools were regional or remote. Regarding relative levels of social disadvantage, these were reasonably evenly distributed, although the most schools were in areas of higher relative social disadvantage. | Australia (VIC). First focus groups, 90 secondary schools (Metro, n=40; Regional, n=35). Second focus groups, 78 secondary schools, (Metro, n=60; Regional, n=18). Third focus groups, 18 schools, included 3-4 participants. | Established in 2006, SunSmart Victoria's Secondary School UV Program offers tailored advice and communication about sun safety policies and practices to Victorian secondary schools. In addition to the UV Program, SunSmart Victoria has also developed and promoted other secondary school specific forms of support, including curriculum resources, professional development and policy advice, which have been the focus of the program more recently. | Shade; Hats; Implementation and review/ | This was impactful. Not an effectiveness study. In terms of policy adoption impact, almost three-quarters of secondary schools surveyed reported that they have a written policy or guideline on UV sun safety. The qualitative findings showed that support of school principals is critical to successful implementation of sun safety policies and practices in the current context, in which there are no clear or mandated standards to uphold. Limitations: Self-report questionnaires were used, increasing the potential for bias in participant responses. There was a low response rate which may lead to sampling bias in findings. | Feasibility and acceptability were not investigated, yet the high policy adoption rate is promising. Equity: Majority of schools were disadvantaged, however, not marginally so. | Funding helped to facilitate sun safety practices. Some structural barriers to change were a lack of recognition that day-to-day exposure is a school responsibility, that there is a lack of shade requirements or policy, segregated approaches to health and wellbeing programs, and new and emerging health and wellbeing initiatives. Factors that facilitated sun safety included sun safety policies that were strongly supported, guidance to develop and review sun safety policies, staff professional development, programs that engage student leaders, freely available sunscreen, shade, and communication. Some other |

| Source (Author, date, title) | Intervention Type (Behavioural, policy, environment, multicomponent) | Study Design (design, duration) | Participants (# teachers, #students, #schools, age range, % male) | Context (sociodemographic information) | Location and Setting (country, geographic region, setting type) | Intervention Details (main components, delivery mode, resources, stakeholder involvement) | NSW SunSmart policy recommendation area(s) | Effectiveness and Impacts/Outcomes | Feasibility, Acceptability, Mechanism(s) of Change (key and Equity Considerations) | Mechanism(s) of Change (key factors to success or failure) |
|--|--|---------------------------------|---|--|---|---|--|---|---|--|
| Primary and Secondary Schools | | | | | | | | | | |
| Makin et al. (2018) Evidence Check: Targeted programs for skin cancer prevention | Behavioural | Rapid Review | 157 studies | NR | Australia (NSW). Primary and Secondary School | The NSW Skin Cancer Prevention Strategy which aims to reduce overexposure to ultraviolet (UV) radiation across three priority populations at greater risk of skin cancer, children aged 12 years or under, adolescents and young people aged 13-24 years and men aged 40 years or over. | Shade; Clothing; Sunscreen; Engaging the school community; Sunglasses. | Targeted programs were effective. In all settings, one-off educational interventions of short duration were shown to have some short-term positive effects on sun safety behaviours. In primary schools, the sole intervention trial of strong quality provided all participating fourth grade students with two wide-brimmed hats (one for school and one for home) and delivered four classroom education sessions on the benefits of sun protection with an emphasis on hat use. There were substantial increases in hat-wearing at intervention schools (p <.001). Two interventions using text message reminders were identified and resulted in significant positive changes in multiple sun safety behaviours. In secondary schools, educational interventions had mixed results. The number of students observed to use the shaded sites changed (p =.011). | The review concluded that the strongest evidence for the UV index as an instrument for promoting sun safety was for settings where sustained educational interventions and policy responses are feasible, in particular schools and outdoor workplaces. | Stronger results were achieved in most settings for sustained multicomponent interventions that included educational components alongside policy, formal recognition of skin cancer prevention efforts where appropriate, provision of sun protective equipment where appropriate, and behavioural reminders in settings where UV exposure is likely, including via mobile technology. |

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