Dermatology Practical & Conceptual

A Review of the Impact of Sun Safety Interventions in Children

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ABSTRACT

Introduction: In the United States, melanoma and non-melanoma skin cancers comprise the largest proportion of new cancer diagnoses every year. The prevalence of skin cancer can be largely reduced if proper preventative behaviors are adopted at an early age.

Objectives: We assessed the impact of various informational, economic, and environmental interventions on sun-protective behaviors, knowledge, attitudes, and sun exposure in the pediatric population reported in previous studies.

Methods: A systematic search for relevant articles was conducted using three databases. Studies were included if they met the following three criteria: study subjects less than 18 years old, clear, measurable interventions and outcomes, and publication in the English language.

Results: A total of 66 studies were included, of which 48 resulted in positive behavioral changes (i.e. increases in sunscreen application, use of hats and sun-protective clothing, shade-seeking, and avoidance of outdoor activities during peak UV radiation), 28 resulted in increased knowledge, 2 resulted in changes in attitudes towards tanning, and 10 resulted in decreased sun exposure effects (i.e. new sunburns, number of new nevi, and change in pigmentation of the skin).

Conclusions: It is crucial that children be educated on the importance and benefits of sun protection. Although a variety of interventions showed promise in achieving this goal, the challenges associated with adopting change were evident. This review provides direction for future interventions aimed at improving sun safety in children and illustrates the potential impact that early intervention can have on the incidence of skin cancer in future generations.

Introduction

In the United States, skin cancer is the most common malignancy and is estimated to affect one in five individuals in their lifetime [1]. The overall incidence of melanoma and non-melanoma skin cancers (NSMC), including basal cell carcinoma (BCC) and squamous cell carcinoma (SCC), has been increasing rapidly in recent decades. Melanoma is the most lethal type of skin cancer, and it is predicted that over 7,500 Americans will die from melanoma in 2022 [2]. Although NMSCs typically carry a more favorable prognosis, they place a large burden on the United States healthcare system, with an estimated annual cost of $4.8 billion [3]. The largest preventable risk factor for both melanoma and NMSC is ultraviolet radiation (UVR) exposure [4]. UVR is a risk factor for skin cancer at any age; however, children are at an increased risk of excessive UVR exposure [5]. Children spend a significant portion of their time outdoors at school when the UV index is highest, where activities such as recess and sporting events can result in extended periods of UVR exposure. In fact, sun damage is cumulative, and about 23 percent of a person's lifetime sun exposure happens by the age of 18 [6]. There is a strong relationship between total sun exposure and non-melanoma skin cancers, and there is a clear relationship between sunburns and the development of melanoma [7].

Interventions aimed at preventing excessive exposure to harmful UVR can decrease the incidence of skin cancer. The American Cancer Society provides several recommendations aimed at primary prevention of skin cancer: 1) seek shade when UV radiation is strongest (10:00 A.M. - 4:00 P.M.); 2) wear sun-protective clothing (i.e. long sleeved shirts and pants); 3) wear wide-brimmed hats; 4) apply sunscreen with a minimal SPF of 30; and 5) avoid tanning beds [8]. In addition to primary prevention methods, secondary prevention methods include regular skin self-examinations and professional skin examinations. Applying both prevention techniques has illustrated a decrease in the incidence, morbidity, and mortality of skin cancer [4].

Since childhood sun exposure increases the risk of skin cancer, it is essential to educate children about primary prevention measures as well as take action to promote sun-protective behaviors. In this review, we evaluated studies that aimed to either educate or change the behavior of children regarding sun safety. By doing this, we aimed to identify the techniques used and summarize them as an example for much-needed future educational efforts.

Methods

The following criteria were used to identify eligible studies: 1) study subjects must be less than 18 years old; 2) study must have clear interventions and outcomes (e.g. behavior or knowledge); and 3) study must be published in the English language.

The search for relevant articles utilized Ovid Medline, Ovid Embase, and Scopus to identify literature published through September 2020: The following MeSH terms were used: "adolescent", "child", "infant", "pediatric(s)", "students", "teen", "parent(s)", "mother", "father", "sunscreening agents", "sun protection factor", "sunburn", "skin neoplasms", "sunlight", "sun", "skin", "health education", "health promotion", "education".

Results

The initial literature search of Ovid Medline, Ovid Embase, and Scopus yielded 143 articles. After the articles were reviewed and duplicates excluded, 66 articles met the inclusion criteria [9-74].

Types of Interventions:

Most studies had an intervention that delivered sun-protective educational information to the study population (Figure 1). Of the 62 studies that focused on providing information, some of the most popular methods included giving a presentation, handing out newsletters or flyers, and implementing sun safety lessons in the school curriculum. In addition, 17 studies relied on economic intervention. From these studies, distribution of free sunscreen to children was the most popular provision. Other economic interventions included providing protective clothing, hats, and sunglasses. Lastly, 3 studies changed the physical environment by adding resources such as shaded structures for children to use during peak UV light hours (Figure 2).

Knowledge as an Outcome:

There were 32 studies that measured change in knowledge as an outcome after implementation of the intervention. Of those 32 studies, 27 assessed only for the child's knowledge, 4 assessed only for the parents' knowledge, and 1 assessed for both the child and parents' knowledge. Of the studies that focused only on measuring the change in the children's knowledge after intervention, twenty-six studies noted a significant increase in baseline knowledge and only one study revealed nonsignificant changes. Winnett et al. illustrated that even after intervention, the children still had minimal knowledge of appropriate sunscreen use and frequency [67]. Even though Hingle et al. showed a statistically significant overall increase in knowledge, it was primarily driven by knowledge about skin cancer types [27]. The rest of the knowledge-based questions related to UV radiation, precautions to take to avoid sunburn, and suntanning showed no significant changes. Of the four studies directed at only

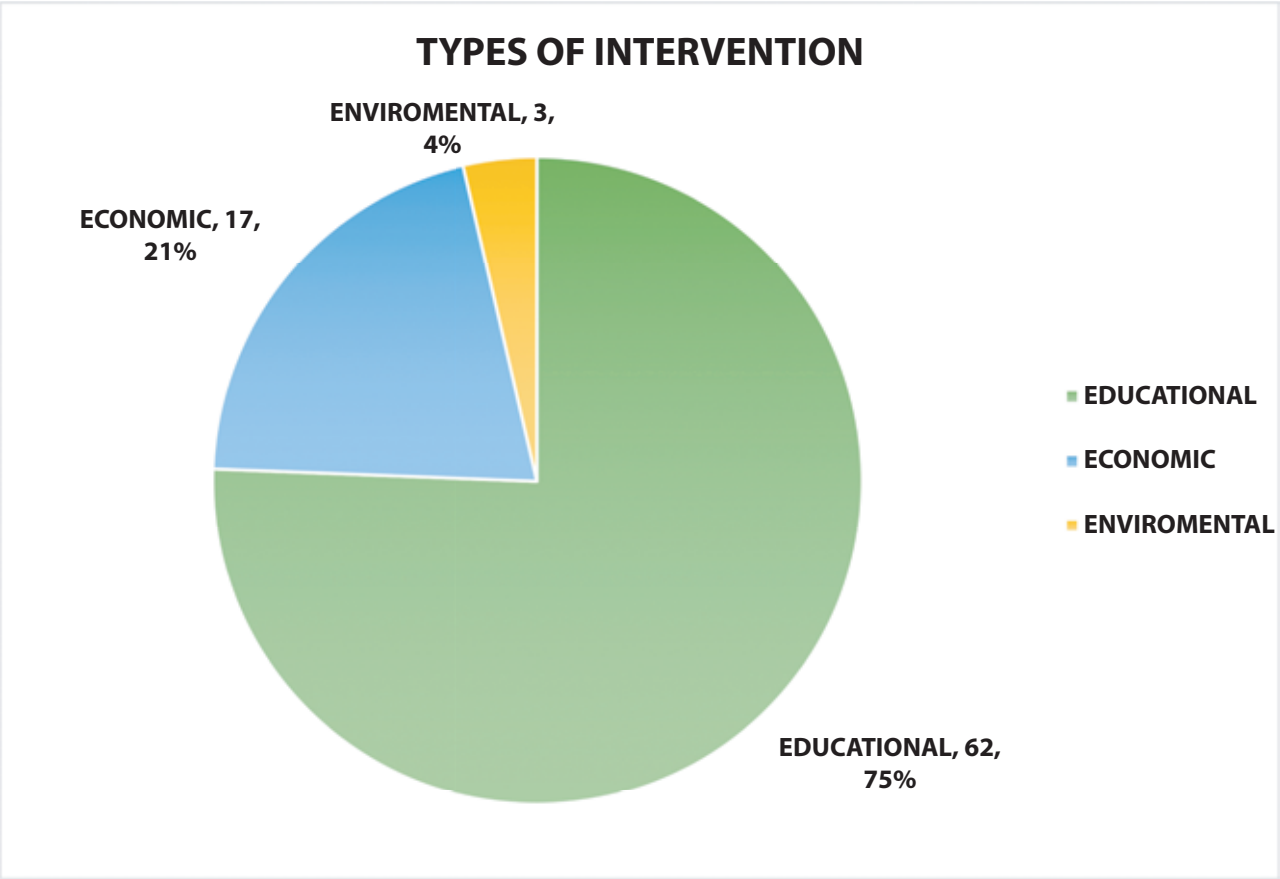

Figure 1. A pie chart illustrating the various methods of intervention used from all 62 studies.

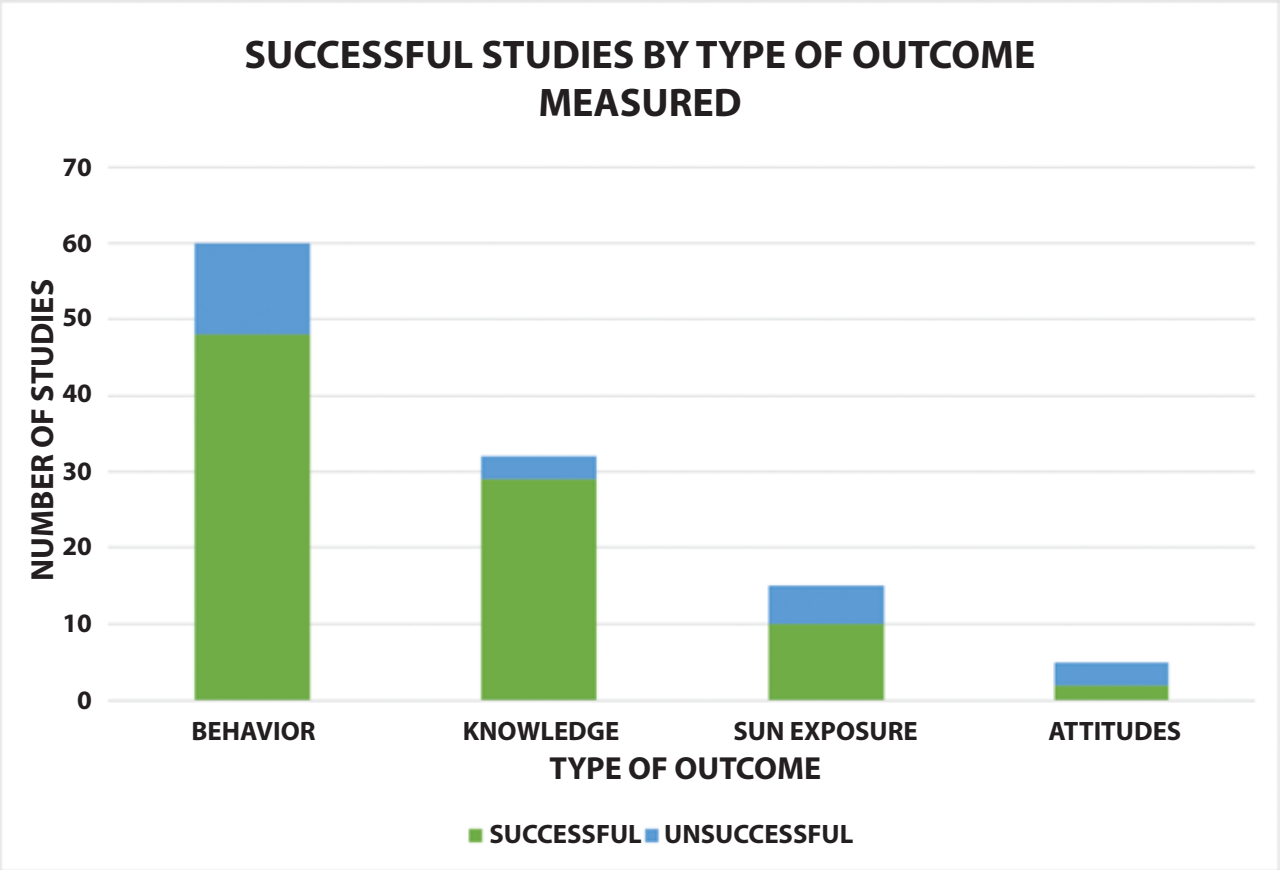

Figure 2. A bar chart comparing studies that were successful in improving the measured outcome to studies that were not successful in improving the measured outcome.

measuring the change in parents' knowledge, two of them did not result in an increase in the parents' knowledge. Glanz et al. used questions to create a knowledge index that was measured for the parents [14]. The knowledge index was relatively high at baseline and remained virtually unchanged in both intervention groups. Glanz et al. assessed the knowledge of parents and staff [53]. Although their knowledge scores were relatively high to begin with, they improved slightly; however, neither of the changes was statistically significant. In the study that tested both the children's and parents' knowledge, parents were reported to have decreased in knowledge, while elementary and middle schoolers had increased and high schoolers had no change [62].

Attitudes Toward Tanning as an Outcome:

Five studies assessed children's attitudes and perceptions of tanning before and after intervention. Three of the five interventions were considered failures. Kristjánsson et al. developed an educational tool kit about skin cancer prevention [74]. This tool kit included a manual for teachers, animated comic figures, a 7-minute video, and recommendations on how to behave in the sun. The students' attitude to refrain from tanning was not significantly changed. Regarding mid-day sun avoidance, most students only progressed from a pre-contemplation stage to a contemplation stage. Kouzes et al. utilized a sun safety curriculum which included teachers adopting sun safety into their lessons, UV index announcements on the speaker, and guest presenters on UV and sun safety [62]. Although elementary students and middle school students had improved perceptions, high school students maintained a positive attitude towards tanned skin. Buller et al. utilized an educational computer program on sun safety based on the "Sunny Days, Healthy Ways" sun safety curriculum [33]. This CD-ROM program did not improve attitudes toward sun-protective behavior. Barankin et al. enhanced an existing "Sun and the Skin" program by educating the parents about the program, providing supplemental information, and distributing sunscreen [28]. The students in the enhanced group illustrated improvement over the control and standard groups in their attitude towards tanning. David et al. included an educational presentation and interactive activities delivered by university students, who underwent rigorous training and volunteering as part of their undergraduate and graduate-level courses [32]. After the intervention, participants reported less appeal for tanned skin than before the intervention ($p<0.001$).

Behaviors as an Outcome:

There were 60 studies that measured change in sun-protective behaviors as an outcome after implementation of the intervention. Of those 60 studies, 48 had interventions that were successful at impacting at least one behavior relating to sun protection in either the children or their parents (Figure 3).

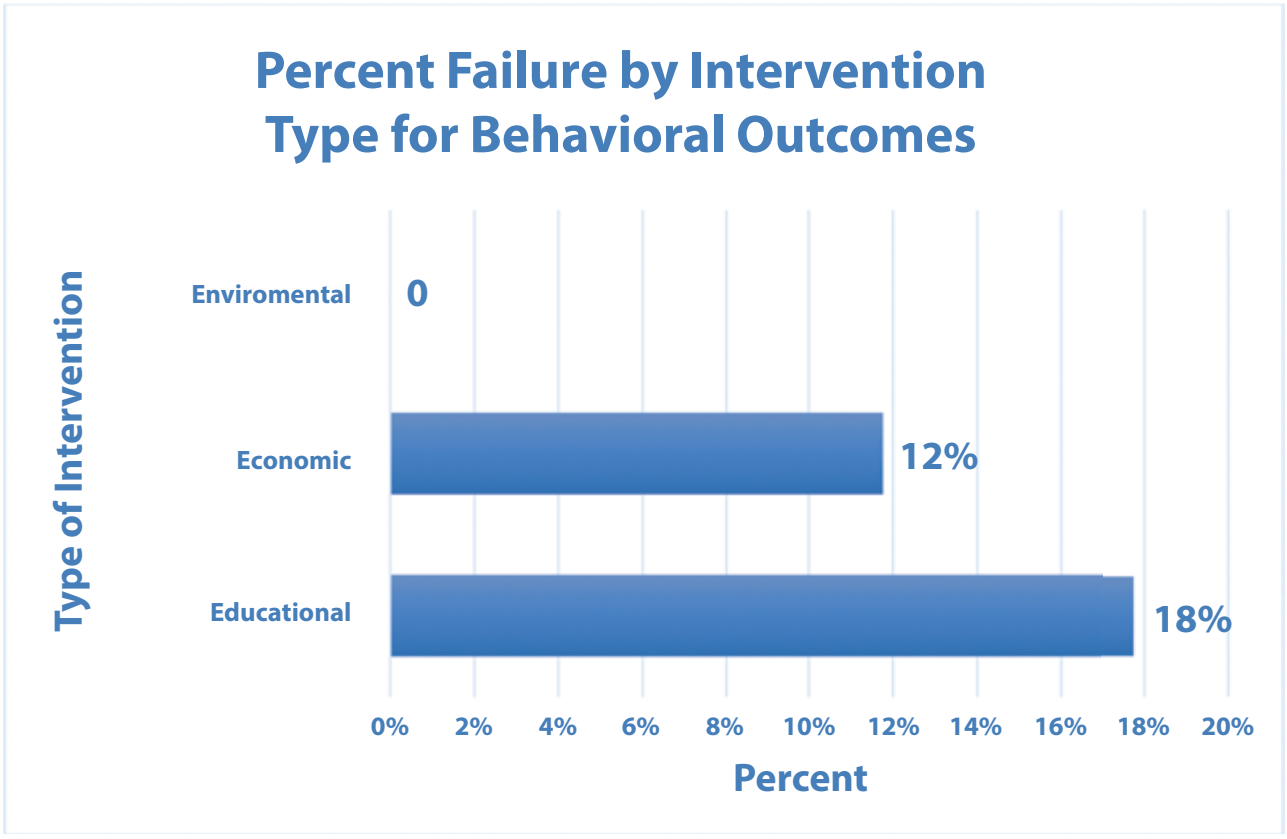

Figure 3. A bar chart illustrating what percentage of studies were unsuccessful in changing behavior based on the type of intervention.

A few commonly studied behaviors include frequency of sunscreen application, use of hats and sun-protective clothing, shade-seeking, and avoidance of outdoor activities during peak UV radiation. For example, Crane et al. is a randomized controlled trial that found changes in many behavioral outcomes after sending newsletters on sun protection and skin cancer to parents and their children over the course of three years [38]. Specifically, the post-intervention group demonstrated increased use of sunscreen, protective clothing, hats, shade-seeking, and midday sun avoidance compared to baseline; however, a statistically significant difference compared to the control group was only present for a few select behaviors and in certain years. Conversely, Bauer et al. is a randomized controlled trial in which parents were randomized to receive either educational material on sun protection, free sunscreen, or neither, and the results demonstrated no significant differences between the groups in sun-protective behaviors or the development of melanocytic nevi in the children [36].

Sun Exposure as an Outcome:

There were 15 studies that measured sun exposure via physical skin changes as an outcome after implementation of the intervention. A few commonly studied metrics include incidence of new sunburns, number of new nevi, and change in pigmentation of the skin. Of the 10 studies that measured incidence of sunburn as an outcome, 8 studies showed fewer sunburns as a result of the intervention, whereas one study showed no effect on sunburns and another study showed an increase in the number of sunburns despite the intervention [61]. Of the 6 studies that looked at increased pigmentation (i.e. tanning, melanin) as an outcome, only 2 studies demonstrated that their intervention decreased the level of skin pigmentation. Of the 3 studies that looked at development of new melanocytic nevi as an outcome, none of them showed a statistically significant difference in the development of new nevi post-intervention.

Discussion

The goal of this review was to evaluate the impact of various informational, economic, and environmental interventions on sun-protective behaviors, knowledge, attitudes, and sun exposure in the pediatric population. Targeting children is important because, theoretically, the earlier that sun-protective habits are formed, the earlier primary prevention methods from dangerous UV rays can be implemented and lower the burden of future skin cancer. As many of the techniques reviewed were successful in instilling knowledge and sun safety practices, this discussion highlights the interventions that failed to alter children's behaviors, knowledge, attitudes, and sun exposure. Using this information, future studies directed at the pediatric population can alter their interventions to be better suited to have a significant impact on these outcomes.

Children's knowledge about skin cancer and the importance of sun protection was improved in all but two studies [62, 67]. Kouzes et al. implemented a sun safety curriculum which included teachers incorporating sun safety into their lessons, UV index announcements on the speaker, and guest presenters on UV and sun safety [62]. The curriculums used differed based on grade level (preschool through first grade used CATCH Global Foundation's Ray and the Sunbeatables, grades kindergarten through eighth grade used the Environmental Protection Agency SunWise, and grades six through twelve used SunSmart U developed by the Skin Cancer Foundation). Knowledge was improved in elementary and middle schoolers; however, high schoolers did not have any change in knowledge of sun protection strategies. Knowledge deficits in older age groups could be attributed to inadequate use of the curriculum and could suggest that additional support may be needed from a statewide nonprofit organization dedicated to cancer control. Skonieczna et al. demonstrated the significance of partnerships within schools to create long-lasting sun safety programs, so such support could encourage increased participation [75]. Winnett et al. studied the effects of an intervention that included informational posters in prominent locations, a poster providing feedback about how many people are practicing the SafeSun program, a weekly lottery ticket for people wearing sun-protective clothing, and lifeguards modeling the SafeSun logo on their clothing [67]. Knowledge about skin cancer, its causes, and how to appropriately use sunscreen remained low. This intervention did not include formal information lessons, which could explain the lack of knowledge related to skin protection.

Several studies demonstrated positive attitudes towards tanned skin even after an intervention was implemented [33, 62, 74]. In the previously mentioned study by Kouzes et al., in addition to not showing improvements in knowledge, high schoolers also continued to value the appearance of tanned skin [62]. Despite acknowledging the risks associated with tanned skin, high school students still maintained a positive attitude towards tanned skin. This illustrates that because older children perceive tanned skin as desirable, they are willing to risk their health to fit into societal norms [76]. Another study provided a manual for teachers, animated comic figures, a 7-minute video, and recommendations on how to behave in the sun to adolescents [74]. The students' attitudes to refrain from tanning were not significantly changed. Previous studies have shown that when children reach adolescence, their appreciation of suntans increases [7, 77]. Therefore, it might be beneficial to start motivating attitude changes to sunbathing before adolescence. Lastly,

Buller et al. used a CD-ROM educational computer program based on a sun safety education program and also failed to improve children's attitudes towards sun protective behaviors [33]. Changing attitudes about suntanning is a challenging task in this population. Branstorm et al. surveyed 2615 adolescents and uncovered that the most frequent motive for sunbathing was that it made them feel more attractive [76]. Media influence plays a large role in affecting the desire to tan by promoting the idea that tan skin equates to looking healthy and attractive [78]. Changing the attitudes of children towards tanning and their motivation to intentionally tan will remain challenging as long as societal pressure and media influence promote tanned skin.

Many studies were able to demonstrate a positive effect on sun-protective behaviors; however, there were some that were unsuccessful. A common theme among several of the unsuccessful studies was the utilization of interventions that involved brief (30-60 minute), one-time lessons or presentations with or without periodic follow-up. As an example, Hubbard et al. involved a 50-minute presentation that addressed risk factors for skin cancer, personal anecdotes from individuals with skin cancer, etc., after which the children were given an informational booklet [60]. In the seven weeks following the presentation, motivational and informational text messages were sent twice weekly in an effort to influence summer behaviors. Similarly, Saridi et al. involved a 45-50-minute interactive educational session with follow-up one year after the intervention [17]. Unfortunately, these studies and several others with similar intervention strategies were unable to affect meaningful behavioral change in children. Among the three main types of intervention (i.e. economic, educational, and environmental), educational interventions were most associated with failure to impact sun-protective behaviors in children. Although educational interventions were utilized in many studies that were successful at modifying behaviors, those that incorporated additional economic (e.g. free sunscreen) or environmental (e.g. adding shaded areas at school) interventions were more likely to achieve change. It is not surprising that solely providing educational materials to children might not be very fruitful. Children might find this type of information uninteresting or forget about it shortly after the information is delivered. Furthermore, children who do wish to alter their behavior may not have the resources to do so. By directly providing sun-protective equipment to children and their families, as in the economic interventions, some of the barriers to obtaining sun-protective equipment are addressed, and parents can have a role in administering such materials to their child.

A few studies measured sun exposure via physical skin changes by evaluating the incidence of new sunburns, number of new nevi, and/or change in pigmentation of the skin. The incidence of new sunburns was the most commonly measured and impacted outcome compared to the others. In response to sun exposure, sunburns develop rather quickly and can develop after only one outdoor exposure, whereas skin pigmentation and nevi formation are processes that take time and require more chronic exposure to sunlight. Many of the studies that assessed skin pigmentation and nevi formation failed to demonstrate any significant change in these metrics, likely due to a lack of significant behavioral change and/or insufficient length of study. In the case of Bauer et al., educational and/or economic interventions were administered, and the number of incident melanocytic nevi was measured after a three-year period with no significant difference between groups [36]. In this particular study, the intervention failed to impact sun-protective behaviors, which likely directly affected the success of the intervention in impacting nevi formation. Of the studies that had a positive impact on sun-protective behaviors; a common theme was that changes in behavior were often transient or resulted in minimal change in the development of physical skin findings related to sun exposure. In this discussion of sun protection in children, our primary concern is whether early interventions can reasonably decrease a child's risk of developing skin cancer later in life. It is encouraging to see that children and their parents are able to adopt sun-protective behaviors with the right intervention; however, it is unclear if these behavioral changes will translate to physical changes in the skin and decreased incidence of skin cancer in the future.

Conclusion

It is crucial that children be educated on the importance of sun protection. Although a variety of interventions showed promise in achieving this goal, the challenges associated with adopting behavioral change were evident. This review provides direction for future interventions aimed at improving sun safety in children and illustrates the potential impact that early intervention can have on the incidence of skin cancer in future generations.

References

1. Prevalence of a History of Skin Cancer in 2007: Results of an Incidence-Based Model | Dermatology | *JAMA Dermatology* | JAMA Network. Accessed June 4, 2022. https://jamanetwork.com/journals/jamadermatology/fullarticle/209761
2. Siegel RL, Miller KD, Fuchs HE, Jemal A. Cancer statistics, 2022. *CA Cancer J Clin*. 2022;72(1):7-33. doi:10.3322/caac.21708
3. Rogers HW, Weinstock MA, Feldman SR, Coldiron BM. Incidence Estimate of Nonmelanoma Skin Cancer (Keratinocyte Carcinomas) in the U.S. Population, 2012. *JAMA Dermatol*. 2015;151(10):1081-1086. doi:10.1001/jamadermatol.2015.1187
4. Greinert R, Boniol M. Skin cancer--primary and secondary prevention (information campaigns and screening)--with a focus on

children & sunbeds. *Prog Biophys Mol Biol*. 2011;107(3):473-476. doi:10.1016/j.pbiomolbio.2011.08.008
5. Armstrong BK. How sun exposure causes skin cancer: an epidemiological perspective. In: Hill D, Elwood JM, English DR, eds. *Prevention of Skin Cancer*. Cancer Prevention — Cancer Causes. Springer Netherlands; 2004:89-116. doi:10.1007/978-94-017-0511-0_6
6. Godar DE, Urbach F, Gasparro FP, van der Leun JC. UV doses of young adults. *Photochem Photobiol*. 2003;77(4):453-457. doi:10.1562/0031-8655(2003)077<0453:udoya>2.0.co;2
7. Vitols P, Oates RK. Teaching children about skin cancer prevention: why wait for adolescence? *Aust N Z J Public Health*. 1997;21(6):602-605. doi:10.1111/j.1467-842x.1997.tb01763.x
8. Be Safe in the Sun. Accessed June 4, 2022. https://www.cancer.org/healthy/be-safe-in-sun.html
9. Dietrich AJ, Olson AL, Sox CH, et al. A community-based randomized trial encouraging sun protection for children. *Pediatrics*. 1998;102(6):E64. doi:10.1542/peds.102.6.e64
10. Wu YP, Parsons BG, Nagelhout E, et al. A four-group experiment to improve Western high school students' sun protection behaviors. *Transl Behav Med*. 2019;9(3):468-479. doi:10.1093/tbm/ibz021
11. Wu YP, Nagelhout E, Aspinwall LG, et al. A novel educational intervention targeting melanoma risk and prevention knowledge among children with a familial risk for melanoma. *Patient Educ Couns*. 2018;101(3):452-459. doi:10.1016/j.pec.2017.10.008
12. Crane LA, Deas A, Mokrohisky ST, et al. A randomized intervention study of sun protection promotion in well-child care. *Prev Med*. 2006;42(3):162-170. doi:10.1016/j.ypmed.2005.11.007
13. Norman GJ, Adams MA, Calfas KJ, et al. A randomized trial of a multicomponent intervention for adolescent sun protection behaviors. *Arch Pediatr Adolesc Med*. 2007;161(2):146-152. doi:10.1001/archpedi.161.2.146
14. Glanz K, Geller AC, Shigaki D, Maddock JE, Isnec MR. A randomized trial of skin cancer prevention in aquatics settings: the Pool Cool program. *Health Psychol Off J Div Health Psychol Am Psychol Assoc*. 2002;21(6):579-587. doi:10.1037/0278-6133.21.6.579
15. Dobbinson SJ, White V, Wakefield MA, et al. Adolescents' use of purpose built shade in secondary schools: cluster randomised controlled trial. *BMJ*. 2009;338:b95. doi:10.1136/bmj.b95
16. Gritz ER, Tripp MK, James AS, et al. An intervention for parents to promote preschool children's sun protection: effects of Sun Protection is Fun! *Prev Med*. 2005;41(2):357-366. doi:10.1016/j.ypmed.2005.01.007
17. Saridi MI, Rekleiti MD, Toska AG, Souliotis K. Assessing a sun protection program aimed at Greek elementary school students for malign melanoma prevention. *Asian Pac J Cancer Prev APJCP*. 2014;15(12):5009-5018. doi:10.7314/apjcp.2014.15.12.5009
18. Jones SBW, Beckmann K, Rayner J. Australian primary schools' sun protection policy and practice: evaluating the impact of the National SunSmart Schools Program. *Health Promot J Aust Off J Aust Assoc Health Promot Prof*. 2008;19(2):86-90. doi:10.1071/he08086
19. Crane LA, Schneider LS, Yohn JJ, Morelli JG, Plomer KD. "Block the sun, not the fun": evaluation of a skin cancer prevention program for child care centers. *Am J Prev Med*. 1999;17(1):31-37. doi:10.1016/s0749-3797(99)00031-8
20. Aulbert W, Parpart C, Schulz-Hornbostel R, Hinrichs B, Krüger-Corcoran D, Stockfleth E. Certification of sun protection practices in a German child day-care centre improves children's sun protection--the "SunPass" pilot study. *Br J Dermatol*. 2009;161 Suppl 3:5-12. doi:10.1111/j.1365-2133.2009.09443.x
21. Velasques K, Michels LR, Colome LM, Haas SE. Educational Activities for Rural and Urban Students to Prevent Skin Cancer in Rio Grande do Sul, Brazil. *Asian Pac J Cancer Prev APJCP*. 2016;17(3):1201-1207. doi:10.7314/APJCP.2016.17.3.1201
22. Tuong W, Armstrong AW. Effect of appearance-based education compared with health-based education on sunscreen use and knowledge: a randomized controlled trial. *J Am Acad Dermatol*. 2014;70(4):665-669. doi:10.1016/j.jaad.2013.12.007
23. Ho BK, Reidy K, Huerta I, et al. Effectiveness of a Multicomponent Sun Protection Program for Young Children: A Randomized Clinical Trial. *JAMA Pediatr*. 2016;170(4):334-342. doi:10.1001/jamapediatrics.2015.4373
24. Hoffmann III RG, Rodrigue JR, Johnson JH. Effectiveness of a School-Based Program to Enhance Knowledge of Sun Exposure: Attitudes Toward. *Child Health Care*. 1999;28(1):69-86. doi:10.1207/s15326888chc2801_5
25. White KM, Zhao X, Starfelt Sutton LC, et al. Effectiveness of a theory-based sun-safe randomised behavioural change trial among Australian adolescents. *Psychooncology*. 2019;28(3):505-510. doi:10.1002/pon.4967
26. Gritz ER, Tripp MK, James AS, et al. Effects of a preschool staff intervention on children's sun protection: outcomes of sun protection is fun! *Health Educ Behav Off Publ Soc Public Health Educ*. 2007;34(4):562-577. doi:10.1177/1090198105277850
27. Hingle MD, Snyder AL, McKenzie NE, et al. Effects of a short messaging service-based skin cancer prevention campaign in adolescents. *Am J Prev Med*. 2014;47(5):617-623. doi:10.1016/j.amepre.2014.06.014
28. Barankin B, Liu K, Howard J, Guenther L. Effects of a sun protection program targeting elementary school children and their parents. *J Cutan Med Surg*. 2001;5(1):2-7. doi:10.1177/120347540100500102
29. Reynolds KD, Buller DB, Yaroch AL, Maloy J, Geno CR, Cutter GR. Effects of program exposure and engagement with tailored prevention communication on sun protection by young adolescents. *J Health Commun*. 2008;13(7):619-636. doi:10.1080/10810730802412149
30. Reinau D, Meier CR, Gerber N, Surber C. Evaluation of a sun safety education programme for primary school students in Switzerland. *Eur J Cancer Prev Off J Eur Cancer Prev Organ ECP*. 2014;23(4):303-309. doi:10.1097/CEJ.0000000000000040
31. Lowe JB, Balanda KP, Stanton WR, Gillespie A. Evaluation of a three-year school-based intervention to increase adolescent sun protection. *Health Educ Behav Off Publ Soc Public Health Educ*. 1999;26(3):396-408. doi:10.1177/109019819902600309
32. Davis R, Loescher LJ, Rogers J, et al. Evaluation of Project Students are Sun Safe (SASS): A University Student-Delivered Skin Cancer Prevention Program for Schools. *J Cancer Educ Off J Am Assoc Cancer Educ*. 2015;30(4):736-742. doi:10.1007/s13187-014-0742-7
33. Buller DB, Hall JR, Powers PJ, et al. Evaluation of the "Sunny Days, Healthy Ways" sun safety CD-ROM program for children in grades 4 and 5. *Cancer Prev Control CPC Prev Controle En Cancerol PCC*. 1999;3(3):188-195. PMID: 10474766
34. Loescher LJ, Rawdin S, Machain T, et al. Implementation of Project Students Are Sun Safe (SASS) in Rural High Schools Along the Arizona-Mexico Border. *J Cancer Educ Off J Am Assoc Cancer Educ*. 2019;34(2):259-268. doi:10.1007/s13187-017-1296-2

35. Turrisi R, Hillhouse J, Robinson J, Stapleton J, Adams M. Influence of parent and child characteristics on a parent-based intervention to reduce unsafe sun practices in children 9 to 12 years old. *Arch Dermatol*. 2006;142(8):1009-1014. doi:10.1001/archderm.142.8.1009
36. Bauer J, Büttner P, Wiecker TS, Luther H, Garbe C. Interventional study in 1,232 young German children to prevent the development of melanocytic nevi failed to change sun exposure and sun protective behavior. *Int J Cancer*. 2005;116(5):755-761. doi:10.1002/ijc.21081
37. Steele C, Burkhart C, Tolleson-Rinehart S. "Live Sun Smart!" Testing the effectiveness of a sun safety program for middle schoolers. *Pediatr Dermatol*. 2020;37(3):504-509. doi:10.1111/pde.14141
38. Crane LA, Asdigian NL, Barón AE, et al. Mailed intervention to promote sun protection of children: a randomized controlled trial. *Am J Prev Med*. 2012;43(4):399-410. doi:10.1016/j.amepre.2012.06.022
39. Chao LX, Patterson SSL, Rademaker AW, Liu D, Kundu RV. Melanoma Perception in People of Color: A Targeted Educational Intervention. *Am J Clin Dermatol*. 2017;18(3):419-427. doi:10.1007/s40257-016-0244-y
40. Buller DB, Reynolds KD, Buller MK, et al. Parent reports of sun safety communication and behaviour for students in a randomised trial on a school policy implementation intervention. *Aust N Z J Public Health*. 2020;44(3):208-214. doi:10.1111/1753-6405.12987
41. Stanganelli I, Naldi L, Falcini F, et al. Parental Use and Educational Campaigns on Sunbed Use Among Teenagers and Adolescents. *Medicine (Baltimore)*. 2016;95(11):e3034. doi:10.1097/MD.0000000000003034
42. Thornton CM, Piacquadio DJ. Promoting sun awareness: evaluation of an educational children's book. *Pediatrics*. 1996;98(1):52-55. PMID: 8668412
43. Mayer JA, Lewis EC, Eckhardt L, et al. Promoting sun safety among zoo visitors. *Prev Med*. 2001;33(3):162-169. doi:10.1006/pmed.2001.0875
44. Hubbard G, Kyle RG, Neal RD, Marmara V, Wang Z, Dombrowski SU. Promoting sunscreen use and skin self-examination to improve early detection and prevent skin cancer: quasi-experimental trial of an adolescent psycho-educational intervention. *BMC Public Health*. 2018;18(1):666. doi:10.1186/s12889-018-5570-y
45. Horsham C, Ford H, Hacker E. Promoting sunscreen use in adolescents playing outdoor sports using UV detection stickers. *Prev Med Rep*. 2020;19:101166. doi:10.1016/j.pmedr.2020.101166
46. Gritz ER, Tripp MK, Peterson SK, et al. Randomized controlled trial of a sun protection intervention for children of melanoma survivors. *Cancer Epidemiol Biomark Prev Publ Am Assoc Cancer Res Cosponsored Am Soc Prev Oncol*. 2013;22(10):1813-1824. doi:10.1158/1055-9965.EPI-13-0249
47. Buller MK, Kane IL, Martin RC, et al. Randomized trial evaluating computer-based sun safety education for children in elementary school. *J Cancer Educ Off J Am Assoc Cancer Educ*. 2008;23(2):74-79. doi:10.1080/08858190701818267
48. Glanz K, Steffen AD, Schoenfeld E, Tappe KA. Randomized trial of tailored skin cancer prevention for children: the Project SCAPE family study. *J Health Commun*. 2013;18(11):1368-1383. doi:10.1080/10810730.2013.778361
49. Walkosz B, Voeks J, Andersen P, et al. Randomized trial on sun safety education at ski and snowboard schools in western North America. *Pediatr Dermatol*. 2007;24(3):222-229. doi:10.1111/j.1525-1470.2007.00390.x
50. Milne E, English DR, Johnston R, et al. Reduced sun exposure and tanning in children after 2 years of a school-based intervention (Australia). *Cancer Causes Control CCC*. 2001;12(5):387-393. doi:10.1023/a:1011294023498
51. Mayer JA, Slymen DJ, Eckhardt L, et al. Reducing ultraviolet radiation exposure in children. *Prev Med*. 1997;26(4):516-522. doi:10.1006/pmed.1997.0166
52. Criado PR, Ocampo-Garza J, Brasil ALD, et al. Skin cancer prevention campaign in childhood: survey based on 3676 children in Brazil. *J Eur Acad Dermatol Venereol JEADV*. 2018;32(8):1272-1277. doi:10.1111/jdv.14740
53. Glanz K, Chang L, Song V, Silverio R, Muneoka L. Skin cancer prevention for children, parents, and caregivers: a field test of Hawaii's SunSmart program. *J Am Acad Dermatol*. 1998;38(3):413-417. doi:10.1016/s0190-9622(98)70498-0
54. Glanz K, Lew RA, Song V, Murakami-Akatsuka L. Skin cancer prevention in outdoor recreation settings: effects of the Hawaii SunSmart Program. *Eff Clin Pract ECP*. 2000;3(2):53-61. PMID: 10915324
55. Stankeviciūte V, Zaborskis A, Petrauskiene A, Valiukeviciene S. Skin cancer prevention: children's health education on protection from sun exposure and assessment of its efficiency. *Med Kaunas Lith*. 2004;40(4):386-393. PMID: 15111755
56. Manganoni AM, Cainelli T, Zumiani G, et al. Study of sunbathing in children: the preliminary evaluation of a prevention program. *Tumori*. 2005;91(2):116-120. PMID: 15948536
57. Gooderham MJ, Guenther L. Sun and the skin: evaluation of a sun awareness program for elementary school students. *J Cutan Med Surg*. 1999;3(5):230-235. doi:10.1177/120347549900300502
58. Hughes AS. Sun protection and younger children: lessons from the Living with Sunshine program. *J Sch Health*. 1994;64(5):201-204. doi:10.1111/j.1746-1561.1994.tb03300.x
59. Cohen L, Brown J, Haukness H, Walsh L, Robinson JK. Sun protection counseling by pediatricians has little effect on parent and child sun protection behavior. *J Pediatr*. 2013;162(2):381-386. doi:10.1016/j.jpeds.2012.07.045
60. Hubbard G, Cherrie J, Gray J, et al. 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. *BMC Public Health*. 2020;20(1):131. doi:10.1186/s12889-020-8265-0
61. Duarte AF, Picoto A, Pereira A da C, Correia O. Sun protection in children: a behavioural study. *Eur J Dermatol EJD*. 2018;28(3):338-342. doi:10.1684/ejd.2018.3290
62. Kouzes E, Thompson C, Herington C, Helzer L. Sun Smart Schools Nevada: Increasing Knowledge Among School Children About Ultraviolet Radiation. *Prev Chronic Dis*. 2017;14:E125. doi:10.5888/pcd14.170202
63. Bruce AF, Cowan T. Sun-Protective Behaviors: An Educational Intervention With Hospital Staff Aimed at Skin Cancer Prevention in Children. *Clin J Oncol Nurs*. 2020;24(1):75-80. doi:10.1188/20.CJON.75-80
64. Olson AL, Gaffney C, Starr P, Gibson JJ, Cole BF, Dietrich AJ. SunSafe in the Middle School Years: a community-wide intervention to change early-adolescent sun protection. *Pediatrics*. 2007;119(1):e247-256. doi:10.1542/peds.2006-1579
65. Miller KA, Langholz BM, Ly T, et al. SunSmart: evaluation of a pilot school-based sun protection intervention in Hispanic early

adolescents. *Health Educ Res*. 2015;30(3):371-379. doi:10.1093/her/cyv011

66. Khani Jeihooni A, Moradi M. The Effect of Educational Intervention Based on PRECEDE Model on Promoting Skin Cancer Preventive Behaviors in High School Students. *J Cancer Educ Off J Am Assoc Cancer Educ*. 2019;34(4):796-802. doi:10.1007/s13187-018-1376-y
67. Winett RA, Cleaveland BL, Tate DF, et al. The Effects of the Safe-sun Program on Patrons' and Lifeguards' Skin Cancer Risk-reduction Behaviors at Swimming Pools. *J Health Psychol*. 1997;2(1):85-95. doi:10.1177/135910539700200109
68. Miller DR, Geller AC, Wood MC, Lew RA, Koh HK. The Falmouth Safe Skin Project: evaluation of a community program to promote sun protection in youth. *Health Educ Behav Off Publ Soc Public Health Educ*. 1999;26(3):369-384. doi:10.1177/109019819902600307
69. Olson AL, Gaffney CA, Starr P, Dietrich AJ. The impact of an appearance-based educational intervention on adolescent intention to use sunscreen. *Health Educ Res*. 2008;23(5):763-769. doi:10.1093/her/cym005
70. Miljković S, Baljozović D, Krajnović D, Tasić L, Sbutega-Milosević G. The impact of education on adolescents' sun behavior: experiences from Serbia. *Srp Arh Celok Lek*. 2014;142(5-6):330-336. doi:10.2298/sarh1406330m
71. Hunkin H, Pollock K, Scupham R. The National SunSmart Schools Program: Impact on sun protection policies and practices in Australian primary schools. *Health Promot J Aust Off J Aust Assoc Health Promot Prof*. 2020;31(2):251-257. doi:10.1002/hpja.291
72. Fork HE, Wagner RF, Wagner KD. The Texas peer education sun awareness project for children: primary prevention of malignant melanoma and nonmelanocytic skin cancers. *Cutis*. 1992;50(5):363-364. PMID: 1468258
73. Stölzel F, Wolff M, Fieber V, et al. UV protection for young athletes: using participatory program planning to develop a sports schools program. *Environ Health Prev Med*. 2020;25(1):39. doi:10.1186/s12199-020-00872-7
74. Kristjánsson S, Helgason AR, Månsson-Brahme E, Widlund-Ivarson B, Ullén H. "You and your skin": a short-duration presentation of skin cancer prevention for teenagers. *Health Educ Res*. 2003;18(1):88-97. doi:10.1093/her/18.1.88
75. Skonieczna J, Olejniczak D, Zakrzewska K, et al. "Assessment of knowledge about the effects of UV radiation on health behaviors associated with sunbathing in gymnasium students" - "Ocena stanu wiedzy gimnazjalistów na temat wpływu promieniowania UV na zdrowie oraz zachowania zdrowotne związane z opalaniem się." *Przegląd Epidemiol*. 2016;70:65-70, 141. PMID: 27344477
76. Bränström R, Brandberg Y, Holm L, Sjöberg L, Ullén H. Beliefs, knowledge and attitudes as predictors of sunbathing habits and use of sun protection among Swedish adolescents. *Eur J Cancer Prev Off J Eur Cancer Prev Organ ECP*. 2001;10(4):337-345. doi:10.1097/00008469-200108000-00007
77. Hughes B r., Altman D g., Newton J a. Melanoma and skin cancer: evaluation of a health education programme for secondary schools. *Br J Dermatol*. 1993;128(4):412-417. doi:10.1111/j.1365-2133.1993.tb00201.x
78. Holman DM, Watson M. Correlates of Intentional Tanning Among Adolescents in the United States: A Systematic Review of the Literature. *J Adolesc Health Off Publ Soc Adolesc Med*. 2013;52(5 0):S52-S59. doi:10.1016/j.jadohealth.2012.09.021