RESEARCH ARTICLE

ADEQUACY OF ULTRAVIOLET PROTECTION OF CHILDREN'S SUNGLASSES

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Abstract

Background: The American Academy of Pediatrics cautions against excessive exposure to ultraviolet (UV) radiation because of known long-term risks for skin cancer and eye disease such as macular degeneration and cataracts. For this reason, the AAP recommends that children wear sunglasses that protect against 97%-100% of UV-A and UV-B rays. In previous studies, many children's sunglasses failed to provide adequate UV protection and/or had inaccurate labeling; however, these studies were conducted more than 25 years ago. The objective of the present study is to examine the extent to which children's sunglasses provide adequate UV protection and have accurate labeling regarding UV protection.

Methods: 126 distinct pairs of children's sunglasses reflecting varying styles/manufacturers were purchased from national retailers in the United States (price range: $1-$32; 94% ≤$10). UV transmission for the right and left lens of each pair of sunglasses was independently measured using two different calibrated photometers designed for opticians/optometrists: a Vision UV-400 Meter and a Digital Light Meter 4000.

Results: All 126 pairs of sunglasses transmitted 0% UV radiation. No differences were noted between right/left lenses or between the two UV meters. In terms of labeling, 107 pairs (84.9%) stated they provide 100% UV protection, 17 (13.5%) indicated UV protection but no other details, and two (1.6%) had no information regarding UV protection.

Conclusion: In contrast to previous studies of children's sunglasses, all sunglasses tested blocked 100% of UV radiation and no inaccurate labels were identified. Our results suggest even the least expensive children's sunglasses now meet the recommended safety criteria for filtering UV radiation and that parents can trust labeling claims regarding UV protection.

Key words: sunglasses, ultraviolet light, ultraviolet radiation, prevention, eye health

1. Introduction:

Children and adolescents are particularly vulnerable to the harmful effects of ultraviolet (UV) radiation. The American Academy of Pediatrics (AAP) cautions against excessive exposure to UV radiation in order to prevent skin cancer and eye disease.[1] UV radiation is hypothesized to contribute to the formation of oxygen radicals, which precedes future eye disease.[2,3] Studies performed in recent years have found associations with short term effects (e.g., photokeratitis) as well as long term effects (e.g., cataracts, macular degeneration).[1] In a study by Cruickshanks et al. (1992), men who had greater UV-B exposure were 1.36 times more likely to have severe cortical opacities.[4] The heightened susceptibility of children and adolescents to UV radiation is evidenced by studies of people who migrated from areas of lower to higher ambient solar radiation. Individuals who arrived in childhood or adolescence had a similar melanoma risk as those who were native-born, whereas those who migrated at older ages experienced lower risk.[5,6]

Sunglasses are intended to protect the eyes from UV radiation to prevent damage to photosensitive biological molecules.[7] To minimize the risk of later eye disease in children, the AAP recommends that children wear sunglasses that protect against 97%-100% of UV-A/B rays.[8] The American National Standards Institute guidelines for recreational sunglasses recommend that UV radiation transmittance not exceed 2-3%.[9] A study conducted by Segre et al. (1981) concluded that the use of sunglasses that do not meet standards may increase exposure of the eyes to UV radiation by causing pupil dilation. As such, these sunglasses may be more harmful than no sunglasses at all. Furthermore, individuals wearing sunglasses that do not meet guidelines may spend more time outside assuming that their eyes are protected.[10]

Studies of adult sunglasses have demonstrated mixed results in terms of UV protection. Rosenthal et al. tested 32 pairs of sunglasses (priced less than $7) purchased from drug stores in Baltimore using two different detectors. These sunglasses were found to transmit 0.8%-14.1% of UV radiation.[11] Similar results were reported by Leow et al. (1995); out of 34 pairs of sunglasses tested using UV-A/B fluorescent bulbs and a spectroradiometer, only 21 pairs (61.8%) provided adequate UV protection.[12] Researchers in India and Nigeria tested 16 and 20 pairs of adult sunglasses, respectively, and found that approximately half, in both studies, transmitted over 5% of radiation between 200-400nm.[13,14] More recently, Trang et al. (2018) evaluated 207 sunglasses in the Canadian market and determined that 99% of sunglasses met Canadian standards for light transmittance, which permit sunglasses to transmit 8-40% of UV-A and 1-5% of UV-B.[15]

Only two studies have examined UV protection provided by children's sunglasses. In a 1985 Australian study, Dain et al. found that 36% (4/11 pairs) of children's sunglasses failed to provide adequate UV protection to the lens and retina.[16] In 1991, Werner tested 40 pairs of children's sunglasses; 52.5% of the pairs transmitted more than 3% of UV radiation. Moreover, product labeling was ambiguous in some cases and misrepresentative in others.[9]

The lack of recent studies evaluating children's sunglasses is particularly problematic since UV exposure is cumulative and approximately 22% of an individual's lifetime sun exposure occurs before the age of 18.[17] Children are especially vulnerable because they spend more time outside and because the properties of their crystalline lens allow more UV radiation transmission.[9] Given the risks associated with UV radiation and given prior research findings regarding children's sunglasses, our objective was to assess whether children's sunglasses that are now commercially available provide adequate UV protection and are accurately labeled.

2. Methods:

Investigators purchased one pair of every style of children's sunglasses available for sale at 8 major retail chains in the New York metro area (Target, Walmart, Sears, Kohl's, buybuy BABY, Babies "R" Us, CVS, and Dollar Tree). UV transmission was measured using calibrated photometers designed for opticians/optometrists to quantitate percent UV transmission of optical lenses. Separate UV transmission measurements were taken for the right/left lens of every pair of glasses. Transmittance was initially assessed using a Vision UV-400 Meter (Hilco); all measurements were obtained by the same investigator under the supervision of a licensed optometrist. A second set of measurements (both lenses, all pairs of glasses) was obtained using a Digital Light Meter 4000 (Action Services); measurements with this second photometer were all performed by a different licensed optometrist. Both photometers were calibrated prior to testing and then re-calibrated after every 3 pairs of sunglasses. This study was determined to not include human subjects by the Institutional Review Board of Northwell Health.

Figure: Action Digital Meter 4000 (left) and Hilco U.V. 400 Digital Light Meter (right)

3. Results:

126 distinct pairs of children's sunglasses were tested (price range: $1-$32; median price $5.99; 94% ≤$10) reflecting a broad selection of styles/manufacturers. According to measurements by both photometers, each of the 126 pairs of sunglasses tested transmitted 0% of UV radiation. No differences were noted between the right/left lenses or between the two photometers. In terms of product packaging, 107 pairs (84.9%) stated that they provide 100% UV protection, 17 (13.5%) indicated UV protection but no other details, and two (1.6%) had no UV protection information.

4. Discussion:

This study is the first in more than twenty five years to assess UV protection by children's sunglasses. Each pair tested indeed blocked 100% of UV radiation at a wavelength of ~400nm. With respect to product labeling, all but two (124/126) pairs had accurate claims about UV protection. Although the amount of information provided on the packaging varied, no instances of inaccurate information were found.

These findings are in sharp contrast with those reported by Dain et al. (1985) and Werner (1991), both of whom found that many children's sunglasses failed to meet UV filtering standards.[9,16] The most likely explanation for our results is the shift from non-polycarbonate to polycarbonate plastic lenses with UV blocking agents added. Although industry standards regarding UV protection are optional, these treated polycarbonate formulations are now very inexpensive and provides 100% protection from UV-A/B radiation across the spectrum.

Our results suggest that even the least expensive children's sunglasses now meet the recommended safety criteria for filtering UV radiation and that parents can trust the labeling regarding UV protection. Of note, our methodology only tested transmittance at ~400nm, not all UV wavelengths. Recognizing this limitation is important as different UV wavelengths penetrate through different parts of the eye. While the cornea absorbs wavelengths < 295nm, wavelengths between 295-400nm can cause damage to the crystalline lens.[18]

Studies evaluating outdoor sunglasses use by children and adolescents suggest that there is substantial room for improvement. A national population-based telephone survey conducted by Cokkinides et al. (2001) found that only 32% of youth aged 11-17 years in the U.S. reported wearing sunglasses on sunny days.[19] In a pilot study of sun protection measures at a swimming pool in Honolulu, O'Riordan et al. noted that parent report of sunglass use was higher than what was observed; this was true for sunglass use by both children (20% versus 10%) and adults (70% versus 60%).[20] These low rates for sunglass use were replicated in a much larger observational study of adults and children in Honolulu. Overall, only 33% of the 5171 people in public recreational areas wore sunglasses, and children were much less likely to wear sunglasses than adults (12.3% versus 41.6%).[21] Similarly, Australian researchers from 1993-2002 directly observed adolescents and teenagers (n=42,207) in parks, beaches, and other locations on several warm weekends each year. Overall, 36.2% of subjects wore sunglasses; 14-20 year olds were half as likely to wear sunglasses compared to 20-50 year olds (18.9% vs. 43.2%).[22] In short, even though children are at increased exposure to harmful UV radiation, every study on sunglasses to date has found that most children and adolescents typically do not wear sunglasses when outdoors.

Given that the health risks related to UV exposure are cumulative and children are a vulnerable population, pediatricians should remind parents of the need for children to wear sunglasses and a hat with a three-inch brim facing forward when in the sun.[23] Furthermore, the positioning of sunglasses is important to consider; pediatricians should take the time to instruct children on the optimal position for wearing sunglasses. The study by Rosenthal et al. (1988) discussed above found that UV exposure was substantially higher when the sunglasses were placed 6mm from the forehead rather than touching the forehead.[11] Even though sunglass lenses may block direct UV radiation, the lenses do not protect against lateral rays entering from the side, which pose even greater risk through the Coroneo effect.[24] Thus, to reduce this risk, sunglasses with wider stem pieces and/or wrap-around frames are recommended.

5. Conclusion

Our study found that the lenses in children's sunglasses, regardless of price, fully filter UV radiation, likely because of the use of

polycarbonate lenses. Although it is possible that other retailers offer children's sunglasses that do not have polycarbonate lenses and thus may not provide adequate UV protection, every pair available for purchase at eight national retailers transmitted 0% of UV radiation as measured -- even those that were manufactured overseas and retailed for $1. For this reason, we believe pediatricians may counsel parents that children's sunglasses do provide protection against harmful UV exposure. However, pediatricians must continue to advise parents about the importance of wearing sunglasses when outdoors as well as other ways to limit UV exposure in order to protect against future skin and eye disease.

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