

# Solar UV radiation in schools: Issues and risks for children and adolescents

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## **Abstract**

Teachers and students attending schools potentially face a harsh environmental solar exposure risk on a daily basis. Solar ultraviolet radiation is a known carcinogen, yet the realities of exposure to the sun are not often detected until years or even decades later, until the development of a skin cancer or cancers are noticed. Each new school year brings with it the potential for summer sunburn. Many individuals, teachers and school children included, would be aware of the need to cover up, use hats, apply sunscreen and seek shade where possible while outdoors, but are these strategies really enough to protect school children from the harmful effects of exposure to sunlight in the long run? The importance of these strategies are presented and the role schools can play in instilling lifelong habits that will minimise the future disease risks related to childhood exposures to sunlight are discussed.

## **Introduction**

Despite ongoing public education campaigns, reported incidence rates and mortalities continue to rise annually in the United States and in Australia which experiences the highest melanoma incidence rate in the world (1, 2). The incidence of melanoma in European populations has also been shown to be increasing, although mortality rates show some variation depending upon geographic distribution (3, 4). School children are likely to be at particular risk of developing skin cancer later in life as a result of exposure to natural solar ultraviolet received during childhood (5, 6, 7). Such skin cancer risks are due to high intensity exposure that causes a sunburning reaction but also due to cumulative intermittent exposures that accumulate during a lifetime (8). It is unfortunate that the school day happens to coincide with the time of daily peak ultraviolet intensity occurring at solar noon and remaining high between 9:00 am and 3:00 pm, yet potentially fortunate that much of a child's early susceptibility to damage from exposure to sunlight is spent in a controlled school environment in which exposures can be minimised by effective risk management strategies. It may seem strange, but effective risk management strategies do not involve completely eliminating exposure to sunlight. In fact, some exposure to sunlight is essential for the healthy synthesis of vitamin D, affecting calcium metabolism and bone development (9) and preventing diseases which include type I diabetes (10), multiple sclerosis (11) and potentially some other cancers (12, 13). Teaching effective sun safe strategies requires moderation of exposure, timing and above

all an awareness of the factors that cause variation in the solar ultraviolet that inevitably reaches the surface of the skin.

The factors that influence the intensity of the solar ultraviolet in school playgrounds are:

1. *Solar elevation* – the higher the sun is in the sky the greater the ultraviolet intensity. This is why summer exposures are more severe than winter exposures, and why exposures received around noon are greater than in the afternoon or morning.
2. *Ozone concentration* – this changes continuously, hour by hour and day by day but is generally lower in southern hemisphere latitudes compared with northern hemisphere latitudes;
3. *Earth to Sun distance* – the elliptical orbit of the Earth results in the Earth being slightly closer to the sun in the southern hemisphere summer. This also affects the northern hemisphere, but the higher summer solar elevation in the southern hemisphere enhances this difference. Some other factors are:
4. *Cloud* – affecting the number of sunshine days and daily temporal variations in solar ultraviolet intensity. Heavy cloud covering the sun reduces the ultraviolet reaching the surface of the Earth. Some clouds however can enhance the ultraviolet above clear sky levels when not directly covering the sun (14).
5. *Altitude* – height above sea level changes the level of ultraviolet scattering by the atmosphere. Subsequently, direct ultraviolet increases steadily with altitude. The solar ultraviolet received increases by approximately 8% for every 1000 metres in altitude (7).
6. *Surface reflection* – ground covers influence the solar ultraviolet once it reaches the playground (15). Water and concrete, often found in the vicinity of swimming pools are among the most reflective surfaces that can be found in school playgrounds. This results in high local surface reflections (16).
7. *Local Shade* – the greater the shade the greater the level of protection from direct solar ultraviolet. Standing in the shade does not however provide full protection from ultraviolet radiation (17). Part of the total solar ultraviolet incident in the playground comes from blue skylight. This is known as diffuse solar UV radiation. The diffuse solar UV varies depending upon solar elevation (18) and can make up more than half of the total solar UV received (19). This is because ultraviolet radiation is very effectively scattered by the atmosphere, even more so than the blue light we see in the sky. If you can see the sky while shaded from direct sunlight, you are still being burnt by solar ultraviolet radiation.

## **Minimizing Risks**

Understanding the factors that influence the solar radiation in a school playground can help to better plan the outdoor activities undertaken at school, but often teachers may rely on personal protection as the sole risk management strategy. Glanz et al. (20) recently highlighted the important role of employers in reducing exposure time in the sun.

Personal protection is the last line of defense when it comes to sun safe behaviour. If school children, both of young and adolescent age, need to be outdoors for any extended period they need to protect their skin. This is best done by avoiding peak periods of solar exposure within the time framework available to schools. Minimizing summer exposure is critical. No go timeframes between 10:00 am and 2:00 pm during the summer months of the year would avoid the worst of the annual playground ultraviolet intensity (21). Avoiding peak exposures and limiting personal risks are key messages. However, younger children tend to be more receptive to this message than adolescents (22). It is therefore important to continue strategic implementation of sun safe policy throughout a student's later schooling years. Lunchtime, no-hat no-play policies as already implemented in Australian primary schools help to minimize unnecessary peak daily exposures.

But what if students need to venture out into the sun? The type of hat used is particularly important. Broad-brimmed, legionnaires and bucket style hats are much better forms of protection than popular baseball style caps as these provide no protection to the ears and neck, sites known to be vulnerable to excess solar ultraviolet exposures (23). Additional forms of personal protection including clothing and sunscreen lotions are the other options. Shirts and rash vests are often better forms of protection than sunscreen, particularly where water is concerned. The use of specialised sun-protective swimming rash vests and wetsuit tops for school swimming carnivals makes a significant difference as these materials have a high Sun Protection Factor (SPF). Some loosely woven fabrics however often have low SPF ratings which can be reduced further when wet (24). However, physically covering up where possible as opposed to chemically covering up is often the better option.

Sunscreens should be applied in addition to clothing and not used as a replacement. This is for two reasons, the first being that the sunscreen may wash off or may not be applied correctly (25) according to the recommended application, typically  $2 \text{ mg/cm}^2$  (26), and becomes ineffective after a set exposure period requiring reapplication. Secondly, sunscreen lotions do not provide full solar spectrum protection. Sunscreens are very effective at preventing sunburn but may not be effective at preventing skin cancer (27). Unlike the human sunburning reaction, the exact solar wavelengths responsible for the development of human skin cancer, particularly melanoma are not known but can only be inferred from animal experiments and studies of personal histories (28).

## **Conclusions**

What then is the best solution for developing an effective risk minimization strategy? It is not a realistic option to hide students away from the sun altogether as that has the potential to lead to other serious disorders. In a position statement of the Australian and New Zealand Bone and Mineral Society, Endocrine Society, Osteoporosis Australia, Australian College of Dermatologists and the Cancer Council Australia the recommended levels of exposure to sunlight for the adequate production of vitamin D were stated to be a few minutes solar ultraviolet exposure either side of the peak ultraviolet period on most

days of the week in summer and two to three hours solar ultraviolet exposure over a week in winter (29). Such targets can be met by applying strict sun protection measures during lunch breaks and during extended periods outdoors. Incidental sunlight exposures received outside of those timeframes while at school such as those that may occur when a child moves from class to class or building to building are likely to result in the minimal vitamin D inducing exposures required (30). In high ambient UV climates, the risk of overexposure in summer is much higher as a noticeable sunburning reaction may occur in less than fifteen minutes, depending on the individual's skin type and location (31). What is needed is an approach that includes:

1. An understanding of the local environment
2. Effective planning to avoid peak exposure periods
3. A commitment to carry out an effective strategy

Teachers can play two roles in instigating effective sun safe behaviour. Firstly by modelling and monitoring behaviour in the playground, and secondly by teaching children about their local solar environment such that the students themselves develop an appreciation from a young age of the potentially harmful environment they live in. Teachers have the opportunity to teach the children in their care from a young age about the factors that influence the sunlight incident upon school playgrounds. A recent study (32) called for continuous and regular education programs, highlighting that teachers do not have appropriate knowledge about skin cancer. Improving a child's sun safe knowledge in school is also likely to benefit that child's attitude outside of school hours (33). Having an appropriate knowledge of the factors that influence the solar environmental health of school children in both the primary and adolescent setting must be seen as an important issue in reducing adverse public health outcomes related to exposures received at school and over the long term.

Active sun exposure prevention programs such as the SunSmart program implemented in many Australian primary schools (34) can make a significant contribution to the long term health of children and adolescents when applied across both primary and high school settings. Such programs require schools to adopt formal sun safe prevention and minimization policies, typically focusing on building design, providing regions of shade, and emphasizing the use of personal protective measures when students venture into the playground. Formalization of sun safe school programs commit schools to carrying out effective strategies. However, the education of youngsters must also be considered as important in developing better lifetime attitudes to solar health. Schools need to plan to avoid peak ultraviolet exposure periods while maintaining a minimum exposure to sunlight for healthy vitamin D synthesis. The complete solar safety message needs to be developed for each unique local environment and should ideally be incorporated into the learning and teaching of the school curriculum.

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