

Sun Exposure in Children: Balancing the Benefits and Harms

Abstract

There is a common belief among the laity and even physicians that sun exposure is a useful source of vitamin D. However, despite the fact that sun exposure occurs almost throughout the year in India, vitamin D deficiency is widely prevalent. Although several authors have reported on the duration of sun exposure required to synthesize adequate amounts of vitamin D in the human body, they have not followed a standard and uniform protocol for measurement of sun exposure and vitamin D synthesis. For these and many other reasons, the results are difficult to interpret. The American Academy of Pediatrics (AAP) has clearly stated that infants should be protected from the sun as much as possible and vitamin D requirements should be met through diet and fortified foods rather than deliberate sun exposure. However, this recommendation is frequently ignored in clinical practice. This review aims to summarize the available literature on benefits and harm of unprotected sun exposure in infants and children with a focus on skin phototype IV to VI. Dermatologists and pediatricians in India should counsel parents about the need for sun protection, especially in fair-skinned infants and children.

Keywords: Children, infants, sun-protection, ultraviolet rays, vitamin D

Introduction

It has been a common belief among the laity and medical professionals that sun exposure is the principal source for the synthesis of vitamin D in human body.^[1] Vitamin D synthesized in the skin by ultraviolet (UV) rays of the sun has been considered to meet nearly 90% of the daily requirement.^[2] It has been suggested that sunlight exposure for approximately 15–30 min twice or thrice a week is sufficient to produce the required amount of vitamin D.^[3] However, there is little or no corroboration for this fact. Several other important aspects related to sunlight exposure (e.g., photo-aging, predisposition to skin cancer, cataract, retinal injury, and autoimmune diseases) have largely been overlooked. Recent reports on vitamin D status in India have suggested that majority of the population (including neonates, children, adolescents, adults, and pregnant women) has deficient levels.^[4–7] This is probably a reflection of dietary deficiency rather than lack of exposure to sunlight.

In this review, we have highlighted these dilemmas in detail.

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What are the Types of UV Radiation?

The UV radiation is classified into three different types based on its wavelength.

1. UV-A (wavelength 320–400 nm) is most abundant of all types of UV radiation, but it causes relatively less skin damage. UV-A rays are potentially carcinogenic
2. UV-B (wavelength 290–320 nm) is also found in the solar spectrum of the earth. The UV-B rays are erythemogenic and potentially carcinogenic. The daily body exposure to UV-B rays is much less than that of UV-A rays
3. UV-C rays (wavelength 200–290 nm) are most dangerous, but fortunately, UV-C rays are absent in the solar spectrum of the earth because of effective filtration by the ozone layer.

What are the Harmful Effects of UV Rays?

UV rays are immunosuppressive. UV-B rays damage the dendritic cells in the skin and stimulate the regulatory T cells to produce the immunosuppressive cytokine, IL-10.^[8] UV radiations lead to DNA strand breaks and pyrimidine dimerization. UV rays also lead to the externalization of

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nuclear antigens on the cell surface and the synthesis of neoantigens that may flare autoimmune diseases like lupus.^[9-12] Photo-aging is another complication of prolonged UV rays exposure. Various epidemiological studies have shown that sunlight exposure is one of the main risk factors for melanoma and nonmelanoma skin cancer (NMSC) development.^[13,14] This risk is highest in the white population, thus, suggesting the protective effect of melanin.^[15] It has also been found that the risk of developing skin cancer is higher when there is exposure to UV rays during childhood as compared with the risk when exposure occurs in older age group.^[16] Targeting children through school-based education and policy strategies for sun protection are being increasingly advocated for melanoma prevention. It has been hypothesized that exposure to UV rays in early age group can damage the DNA of melanocytes, and these melanocytes have the potential of malignant transformation later in life.^[17-19] However, studies advocating childhood sun protection for prevention of melanoma and NMSC were in individuals with skin phototype I–III. Currently, such data about the risk of photodamage, predisposition to develop melanoma and NMSC, and risk reduction with advocacy of childhood photoprotection in pigmented skin phototypes IV–VI is lacking.

What are the Beneficial Effects of UV Rays?

- a. Sun exposure and vitamin D synthesis
- b. A feeling of well being
- c. Treatment of certain dermatosis like vitiligo and psoriasis.

How Much Sun Exposure is Sufficient to Synthesize Daily Requirement of Vitamin D in the Body?

The amount of sun exposure needed to synthesize adequate vitamin D depends upon the type of skin,^[20] time of the day, the month of the year, and the latitude.^[14] The duration needed in an individual with dark skin is about 10 times that in fair-skinned individuals. It has been suggested that exposure to sunlight for 5 min to 5 h per day (depending upon the above-mentioned factors) may be sufficient to synthesize our daily requirement of vitamin D.^[21-24] However, these studies have serious methodological issues and, consequently, the conclusions that have been drawn may, in fact, be somewhat erroneous.

A recent study from India measured the serum levels of vitamin D in infants who were intentionally exposed to sunlight (before and after 6 months of sun exposure).^[25] A positive correlation was found between the duration of afternoon sunlight exposure and infant's vitamin D level. It was concluded that >30 min/week of afternoon sun exposure to at least 40% body surface area of infants is likely to increase the vitamin D level to sufficiency range. However, it is important to note that despite an intense

sun exposure, 90% of infants continued to have vitamin D insufficiency and needed supplementation.^[26] This fact is often not emphasized. A similar study from New Delhi, India that was carried out in school-age children found no increase in vitamin D levels, 4 weeks following sun exposure.^[27]

Farrar *et al.* (2013) published a study from the United Kingdom (UK) that included volunteers from South Asian countries (India, Pakistan, and Bangladesh) staying in the UK and exposed 35% of their body surface area to variable doses of UV rays in a controlled environment for 6 weeks.^[24] It was found that vitamin D levels rose significantly after UV exposure. However, a significant proportion of subjects still remained vitamin D insufficient. A similar study carried out in the UK by Farrar *et al.* (2011) found that UV exposure may correct vitamin D deficiency in white skin individuals but not in South Asian individuals.^[28,29]

The results of these studies suggest that the amount of sun exposure required for synthesis of adequate serum levels of vitamin D among Indian children (skin phototype IV–VI) is much higher compared with lighter skin phototypes. This can be attributed to sun-protective action of epidermal melanin, which is abundant in pigmented skin types. Therefore, sun exposure alone may not be an adequate source of vitamin D in Indian children.

What is the Importance of Sunlight Exposure in Children?

Vitamin D deficiency and rickets have always been an important issue for pediatricians. The commonest cause of rickets in children, especially in developing countries, is “nutritional deficiency.” This nutritional deficiency should not be construed to be equivalent of “sun exposure deficiency.” To the best of our knowledge, no amount of sun exposure can substitute for a diet grossly deficient in vitamin D.

Should Infants Ever be Exposed to Sunlight?

It is a common practice in India to expose neonates and infants to sunlight, and pediatricians may often encourage it under the mistaken notion that this may help in facilitating the resolution of neonatal jaundice. Though exposure of infants and children has advantages (as listed above), there is some evidence that this practice may be associated with long-term risk of developing skin cancers and the risk is greatest if such exposure occurs in very young children and infants with fair skin.^[16]

Do We Need to Apply Sunscreen During Air Travel?

There are no recommendations for the application of sunscreen during air travel. However, there is very high exposure to UV rays in flights primarily because of high

altitude. Hence, it may be advisable to use sunscreen throughout the period of air travel, especially, among the frequent travelers and airline crew.

What Does the American Academy of Pediatrics Recommend?

- Excess exposure to UV rays (both natural and artificial tanning sources) in children and adolescents may lead to increased risk of skin cancers and some of these may be fatal^[30]
- Morbidity and mortality resulting from UV exposure are completely preventable^[30]
- Exposure to excess UV rays should be avoided^[30]
- Supplemental vitamin D (either from diet or through medicinal preparations) should ideally be given to all children^[30]
- Pediatricians and dermatologists have an important role in educating parents so that they can teach their children about ways of sun protection from very early on in life. Photo-protection behavior counseling should be included at least once among the many counseling sessions between parents and caregivers^[30]
- Infants less than 6 months old must be protected from UV rays as much as possible and should preferably be kept away from sunlight^[30]
- In fact, the American Academy of Pediatrics (AAP) has stated that “*Use of deliberate sun exposure to maintain vitamin D sufficiency is not recommended*” and “*Infants younger than 6 months should be kept out of direct sunlight as much as possible.*”

There are very strict recommendations on photoprotection in Australia. Under “No hat, no play” policy, children cannot play outdoors if they are not wearing a hat.^[31]

What are Various Methods of Sun-Protection in Children?

There are many ways by which one can prevent excessive exposure to UV rays.

1. Sunscreen- Use of sunscreen is perhaps the least cost-effective and is the commonly used method to avoid UV rays. Sunscreen is a product designed to protect or shelter viable skin cells against the potentially harmful effects of UV radiation, such as sunburn and skin cancer. Almost all sunscreens have a combination of an organic compound (usually, liquid preparation that absorbs UV rays and dissipates it in the form of heat) and an inorganic compound (usually, minerals that protects from UV rays by reflecting from the surface). The proportion of organic and inorganic compounds in sunscreen lotions varies from preparation to preparation. However, because of the cost and compliance issues, the effective use of sunscreens on Indian patients cannot be generally ascertained. Therefore, avoiding direct sunlight as detailed in the following section becomes important

2. Avoiding the sun using shades-UV rays are maximally present during the day time (from 10 am to 4 pm); hence, it is recommended to avoid sun exposure during this time. Shades (by using an umbrella or standing under a tree) prevent the direct exposure to sunlight but reflected UV rays can still reach the skin. Moreover, using shades also reduces the heat effect of sunlight, thereby, giving a false sense of security from UV rays. Avoidance of sunlight as much as possible, especially during the peak hours, and use of protective shades is a cost-effective measure for protection against UV rays
3. Use of appropriate clothing, hats, and sunglasses-The UV protection provided by clothing depends upon the texture and porosity of cloth and whether the cloth is dry or wet. Denim has a much higher protection factor as compared to cotton. The wetness of cloth reduces its UV protection capacity and a stretched cloth is less protective than a shrunken one. The protection of a hat for the face and neck depends on the width of the brim. Sunglasses protect against the harmful effects of UV rays on the eyes.

Principles of Use of Sunscreen

The UV protection provided by sunscreen depends upon the sun protection factor (SPF). A sunscreen with an SPF less than 15 is not considered safe for photoprotection. Most sunscreens in clinical use have an SPF between 15 and 50.

Sunscreen has to be applied around 30 min prior to anticipated sun exposure. The action of the sunscreen lasts not more than 2 to 3 h and if exposure to UV rays is continuing then it should be reapplied. Sunscreen should be applied after taking a bath or after heavy sweating if sun exposure is anticipated. For best protection, sunscreen should be applied even on a cloudy day as UV rays can penetrate through cloud cover. It should be applied to each uncovered body part, and the amount should be liberal enough to make a protective layer. The recommendation is to apply 2 mg of sunscreen per cm² of body surface area. Approximately half a teaspoon of sunscreen should be applied over the face and neck and each arm. Approximately one teaspoon of sunscreen should be applied on each leg, chest, and back.

What is so Special About Photoprotection in Indian Children?

1. Exposure to bright sunlight occurs virtually throughout the year
2. The risk of skin cancer is believed to be low in India because of increased melanin. For the same reason, the dose and duration of UV exposure required to synthesize vitamin D are at least 10 times higher than that in white population
3. There is a high prevalence of vitamin D deficiency in India

4. UV rays have a multitude of potential side effects on the skin and hair that have never been evaluated in Indian population
5. Counseling for photoprotection has not been a priority for dermatologists in India.

What is the Way Forward?

1. All parents must be explained the risk of excess exposure to sunlight. Moreover, schools must advocate providing a “sun-safe” environment and routines for children, including keeping children indoors during peak sun damage hours and avoiding sports practice during these hours
2. Photoprotection as per AAP recommendation can be suggested to infants and children, especially to those with skin phototype II and III and in children with blue/green irises, fair skin, and light hair color
3. While it may not be appropriate to recommend the use of sunscreen in all healthy children, due to lack of evidence, excessive exposure to sun should be avoided by prudent use of shades, hats, full sleeve clothes, and sunscreens
4. Caution should be observed while exposing infants, especially neonates, to excess sunlight
5. Exposure to sunlight is probably not enough for meeting the daily requirements of vitamin D in children. Dietary supplementation of vitamin D is necessary.^[32] This fact cannot be overemphasized
6. Wholesome information, education, and communication activities involving parents, teachers, and others involved in child-rearing should be carried out to effectively deliver information regarding the ill effects and benefits of sunlight and easily available vitamin D-rich foods
7. There is a need to generate data on the ideal supplemental daily dose of vitamin D in Indian children. Till that time, it may be appropriate to continue with the recommendations of prescribing 400–600 IU of vitamin D daily.^[33]

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Conflicts of interest

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