



Sunbeds & UV radiation

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Level 2 - Details on Sunbeds

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The answers to these questions are a faithful summary of the scientific opinion produced in 2006 by the Scientific Committee on Consumer Products (SCCP):
"Opinion on Biological effects of ultraviolet radiation relevant to health with particular reference to sunbeds for cosmetic purposes"

The full publication is available at: <http://copublications.greenfacts.org/en/sunbeds/>
and at: <http://ec.europa.eu/health/opinions2/en/sunbeds/>

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- These answers are developed in more detail in Level 2.
- Level 3 consists of the Source document, the internationally recognised scientific opinion which is faithfully summarised in Level 2 and further in Level 1.

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1. Introduction on sunbeds

The cosmetic purpose of using sunbeds is to achieve a tan. A recent study showed that a significant tanning effect can be achieved after 6 exposures (over two weeks) and that the tan increases steadily with further exposures.

Commercial sunbeds were developed in the 1970s and came into widespread use in the 1990s. The full health effects of tanning with artificially produced UV radiation are not yet known and, because skin cancer takes a long time to develop, it will take several years before the role of sunbeds in inducing skin cancer becomes clear.

2. What are the health effects of solar UV radiation?

2.1 What are the benefits of solar UV radiation?

Vitamin D is produced when skin is exposed to a type of solar UV radiation (UVB). This vitamin, that many people do not produce sufficiently, is essential for maintaining healthy muscles and bones and a lack of it can result in rickets.

Vitamin D may also be important in other aspects of health, such as the prevention of autoimmune disorders and several internal tumours, and may help improve outcome from cancer. However, more data are needed to determine the actual role of vitamin D in those health aspects, and its association with exposure to UV radiation.

Exposure to sunlight may thus have widespread beneficial effects but it seems likely that these beneficial effects would also be achieved by eating foods rich in vitamin D or taking adequate levels of vitamin D supplements.

2.2 How can skin be damaged by solar UV radiation?

Short-term effects of skin exposure to UV radiation, particularly to UVB, include sunburn, which is most intense 24 hours later. Repeated exposure to UV radiation to obtain a deeper tan causes the epidermis to thicken, which results in the skin feeling dry.

Exposure to solar UV radiation can aggravate certain skin diseases and, when combined with some commonly used medicines and chemicals, can cause the skin to react abnormally to light. It can also affect the immune system, and this may play a role in skin cancer and some infectious diseases.

Long-term effects of skin exposure to UV radiation include skin cancer and photoageing. IARC classified solar radiation as "carcinogenic" to humans and UVA, UVB, and the use of sunbeds as "probably carcinogenic" to human.

UV radiation can cause two types of **skin cancer**:

- **Non-melanoma skin cancers** such as basal cell carcinoma (BCC) and squamous cell carcinoma (SCC) form the great majority of skin cancers and solar exposure is the main environmental factor in their development. The risk of developing these cancers depends strongly on skin type. It is highest in people who sunburn easily (skin types I and II), and lowest in people with low susceptibility to sunburn (skin types V and VI). SCC is associated with

continued long-term sun exposure and is more common in people who work outdoors whereas BCC is associated with intermittent exposure.

- **Melanoma skin cancer** is much less common than non-melanoma skin cancers, but is the main cause of death from skin cancer.

The risk of developing melanoma depends on skin type. It is very low in black skinned people and highest in pale skinned individuals. People at higher risk include those with a tendency to burn rather than to tan, those who have freckles, those with fair (particularly red) hair, as well as those with a large number of moles.

Family history is an important risk factor for melanoma. For instance, the risk is twice as high in the close relatives of anyone who has had melanoma compared to people with no family history of melanoma.

Sun exposure is the main environmental risk factor for melanoma, but the pattern of exposure is also important and the risk seems higher in people who are exposed to the sun intermittently. Sunburn, particularly in childhood, may also be a significant risk factor.

The presence of multiple risk factors in an individual increases the relative risk of melanoma.

Exposure of the skin to UV radiation also results in **photoageing**, which is characterized by the skin becoming loose, wrinkled and with flat brown spots. Photoageing is due in part to the degradation of collagen (the major structural protein of the skin) by UV radiation.

2.3 How can the eyes be damaged by solar UV radiation?

The eye is a complex organ with several layers that receives visible radiation on its innermost part, the retina. The layers in front of the retina – the cornea, the lens and the vitreous humor – protect the retina from ultraviolet damage by absorbing and attenuating a significant part of the radiation.

The only **short-term** health effect of UV radiation on the eye is a kind of “sunburn” of the eye known as photokeratitis, a painful but temporary inflammation of the cornea that appears typically 6 – 12 hours after exposure and usually resolves within 48 hours.

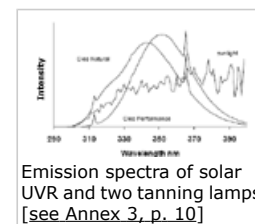
Long-term exposure to UV radiation from the sun, and particularly to UVB, increases the risk of several disorders of the lens of the eye, including cataracts. There is also evidence that solar UV radiation causes melanoma of the eye.

3. How can different types of ultraviolet radiation affect health?

3.1 Do natural and artificial UV radiation present different health risks?

There are no physical differences in UV radiation generated by the sun or by UV lamps. However, there are three types of UV radiation – UVA, UVB, and UVC – which have different wavelength ranges, and the intensity at each wavelength is distributed differently for the sun and for various artificial sources. Solar UV radiation at ground level, for instance, is primarily made up of UVA, with some UVB and no UVC, and varies with the season, latitude, and time of day.

The short-term risks of exposure to UV radiation are similar for natural and artificial sources. However, it is much more difficult to compare long-term effects which, in the sun, also depend on patterns of exposure. There are few data on the risk of skin cancer associated with artificial UV radiation sources compared with those related to sun exposure, and the existing studies often do not provide useful information because they involve few cases, and cannot estimate exposure doses accurately. In addition, people who use sunbeds often sunbathe frequently which may seriously affect the reliability of the data.



Artificially generated UV radiation is used to treat some skin diseases such as psoriasis, and the risk of developing cancer following treatment seems to be small, except when combined with the use of psoralen. However, the data are few and the doses of UV radiation to which patients are exposed are significantly smaller than those used in commercial sunbeds.

3.2 What are the health risks of UVA, UVB and UVC radiation?

UV radiation covers a range of wavelengths and is divided into three bands: UVA (315-400nm), UVB (280-315nm) and UVC (<280nm). More recently, the terms UVA-I and UVA-II have been introduced because UVA-I (340-400nm) and UVA-II (315-340nm) cause different biological effects.

In general, it takes much less UVB than UVA to produce **short-term effects** on the skin such as sunburn, delayed pigmentation (tanning) and damage to DNA. UVB reduces the immune response of the body but the role of UVA remains unclear.

Because it is completely absorbed by the ozone layer, UVC from solar UV radiation is not a health issue. UVC from artificial sources is unlikely to present a short or long-term hazard to human skin, but it is likely to cause a temporary inflammation of the cornea.

Regarding **long-term effects**, UVB is likely to be the main cause of photoageing and of SCC.

Sunburn, a marker for excessive UV radiation exposure, is a risk factor for melanoma. UVB is the main cause of sunburn but this does not necessarily mean that it is the prime cause of melanoma. Indeed, the relative roles that UVA and UVB play in causing melanoma are still not well known and, at present, it is advisable to restrict both UVB and UVA exposure in susceptible individuals.

UVC exposure is unlikely to damage the skin either in the short or long-term, but can cause severe short-term damage to the eye and should not be permitted at all from any sunbed.

4. What are the health and safety implications of sunbeds?

4.1 Can sunbeds harm health?

4.1.1 In addition to sunburn, the use of sunbeds has been associated with **short-term adverse effects** such as dark skin patches and a form of skin fragility. Sunbeds have also been reported to induce or aggravate the symptoms of systemic lupus erythematosus (SLE), an autoimmune disease affecting the skin and other organs.

Sunbeds can also cause adverse reactions in people who use certain medications or who eat plants or use aromatherapy products that contain certain chemicals that make their skin more sensitive and reactive to light.

Moreover, they can harm the immune function in humans. The role of UVB in reducing the human immune response is well known but that of UVA is less clear. It seems that UVA and UVB interact and that their combined effect on the immune system is greater than the sum of their individual impact.

4.1.2 There are very few studies on the risk of developing **non-melanoma skin cancer** as a result of using sunbeds and the conclusions are not consistent. A study in 2002 estimated that, for most people who may use sunbeds 10 or 20 times a year for 10 years or so in young adulthood, the lifetime risk of non-melanoma skin cancer is 10% higher compared with non-users.

There are few studies on the **melanoma** risk of sunbed use and the results vary. However, recent studies have generally found an association between sunbed use and melanoma.

The WHO deems that, based on data available, the risk of developing skin cancer in connection with the use of sunbeds is high in comparison to the “acceptable” risk of developing cancer from other consumer products.

There are no published studies on the **photoageing** effects of sunbed use but, since photoageing is associated with solar exposure, it is expected to occur as well with long-term use of sunbeds. Some studies have looked at the effect of repeated UVA and UVB exposure on human skin and have reported some changes associated with photoageing. As with the sun, sunbeds emit infrared radiation that may play a role in photoageing.

A recent study found “moderately strong” evidence that sunbed use results in melanoma of the **eye**, particularly for people who first used a sunbed before the age of 21. The incidence of melanoma of the eye was also found to increase with duration of sunbed use.

4.2 Can sunbeds improve health?

A recent study showed that people who used UVB-emitting sunbeds at least once a week for 6 months or more had levels of **vitamin D** nearly twice those of control groups and significantly higher hipbone mineral density. The study, however, has several flaws.

Many people claim to **feel better** after using sunbeds but studies using mainly UVA emitting sunbeds showed that these effects could not be attributed to mood-affecting serotonin, melatonin, or opioid peptides. UVB may help the body produce a type of endorphin responsible for sensations of pleasure, but this has yet to be investigated.

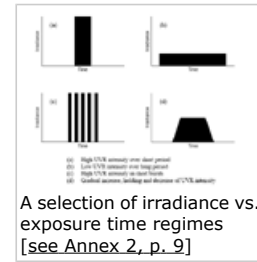
5. What limits should be set for UV radiation in sunbeds?

5.1 Does the health risk of UV radiation depend only on the total dose of exposure?

Some studies have tested whether the biological effects of UV radiation depend only on the total amount of radiation received during a tanning session, commonly referred to as total dose, independently from the intensity of UV radiation and from exposure time.

For instance, experiments were carried out to see if the effects of UV radiation at equal total dose are the same regardless of whether exposure is

- a. to high-intensity radiation for a short period of time,
- b. to low-intensity radiation for a long period of time,
- c. intermittent, with the light source being switched on and off repeatedly at regular intervals,
- d. to radiation that gradually increases in intensity, stays high for a specific period of time and then progressively weakens.



On the one hand, experiments carried out on human and mouse skin show that the **sunburn** effect (erythema) of UV radiation depends only on the total dose of UV radiation received and not on the intensity or duration of exposure.

On the other hand, experiments in which UV radiation was used to induce **cancer** in mice show that, for a fixed total dose, the risk of cancer increases when radiation is less intense but lasts longer or when radiation is intermittent instead of continuous.

5.2 What is the safe limit for UV radiation from sunbeds?

UV radiation covers a broad range of wavelengths and different wavelengths have different effects on the skin. For instance, UVB is much more effective than UVA in causing sunburn. To determine the maximum strength of radiation that is safe, it is necessary to consider not only the amount of radiation for each wavelength but also how effective each wavelength is at producing sunburn.

At present, suggesting safe exposure limits is only appropriate for short-term effects such as sunburn. It is not possible to suggest such limits for long term effects like skin cancer, especially melanoma.

When using a sunbed for cosmetic purposes, the UV radiation dose has to be large enough to produce **tanning** but not so large that it causes marked or severe sunburn. Experience has shown that the best results are obtained with an exposure approximately at or just below that to induce a just perceptible reddening of the skin 8 to 24 hours after exposure.

Regarding **sunburn**, the exposure dose that should not be exceeded on any single occasion depends on skin type and ranges from 100-300 J/m² for highly susceptible skin types I and II to 700 – 1200 J/m² for skin types V and VI with low susceptibility.

A classification of skin phototypes based on susceptibility to sunburn in sunlight
[see Annex 1, p. 9]

Since the biological effects of UV radiation depend only on the total amount of radiation received during an exposure session, regardless of whether exposure is to high-intensity radiation for a short period of time or to low-intensity radiation for a long period of time, the prescribed sunbed session should be no less than 10 minutes. This would limit the intensity of the associated radiation to a more moderate level. That way, the risk of sunburn which might result from exceeding the session time limit is minimized and the risk of melanoma hence possibly reduced.

The dose from each session should not be large enough to cause sunburn and the maximum intensity of the radiation used should not exceed 0.3 W/m². This is equivalent to a UV index

(UVI) of 12, which would be typical in summer in Darwin, Australia; and Colombo, Sri Lanka and which WHO describes as "extreme".

At present, it is not possible to give a safe limit for long-term effects such as the risk of **skin cancer**, especially melanoma, because there is no threshold dose below which cancer will not occur. Consequently, any recommendation about a limit value of total dose is arbitrary and subjective. Some institutions have set a limit of 20 sessions per year but others have set a limit which is nearly four times as high. Other agencies have simply advised against sunbed use and have not specified an "acceptable" maximum annual usage.

6. What comments were expressed on the findings of this assessment?

Interested parties were invited to comment on the findings of this assessment by the European Commission Scientific Committee on Consumer Products (SCCP).

Twenty-three comments were received from Europe and the USA, mainly from public health bodies and the sunbed industry.

Some from public health bodies felt the SCCP committee had not sufficiently emphasized the health risks of sunbed use and those from industry felt that it had made too much of these risks.

There were several comments on vitamin D. Some said that bone health is the only proven benefit of vitamin D. Others said that the evidence for the other beneficial effects of vitamin D was stronger than it was stated.

Overall, there were many comments on detail, some of which have been addressed but none of which alters the overall conclusions.

7. Conclusion on UV radiation and sunbeds

Sunbeds were not in widespread use before the 1990-s and the full health effects of their use, including their role in inducing skin cancer, are not yet fully known.

The use of sunbeds may have **positive health effects**. For instance, UVB exposure may increase vitamin D levels in users. Many people also claim they feel better after using a sunbed but there is no evidence of a biochemical basis for this.

Potential **adverse health effects** from UV radiation include sunburn, inflammation of the eye, cataract formation, melanoma of the eye and different types of skin cancer. UV radiation can also reduce the functioning of the human immune system, which may be important in skin cancer and infectious diseases. The risk of developing a given type of skin cancer depends on the pattern of exposure.

The important biological **risk factors for malignant melanoma** are age, sex (in some populations), skin type (in particular types I and II), moles, freckles and family history. Behavioural or environmental risk factors include sunburning intermittently, especially in youth.

Natural and artificial UV radiation have the same physical and biological properties, but differences in the amount of UVA, UVB, and UVC emitted may have biological consequences. It is very difficult to compare their long-term effects. There is no need to specify different

dose limits for UVB and UVA and there is no justification for the presence of UVC in sunbeds. UVB is the most harmful type of radiation for both short and long term effects.

Safe limit values for exposure to UV radiation can only be given for short-term effects. There is no limit below which cancer will not occur. Consequently, any annual dose limits given are arbitrary. Maximum UV radiation intensity from sunbeds should never exceed 0.3 W/m^2 , the equivalent of tropical sun, which the WHO describes as extreme.

The **SCCP** is of the opinion that the use of sunbeds is likely to increase the risk of malignant melanoma of the skin and possibly eye cancer. Therefore, people with known risk factors for skin cancer, especially malignant melanoma, should be advised not to use sunbeds. For instance, sunbeds should not be used by individuals under the age of 18 years as the risk of melanoma seems to be particularly high at a young age. In addition, eye protection should always be worn when sunbeds are used.

Annex

Annex 1:

A classification of skin phototypes based on susceptibility to sunburn in sunlight

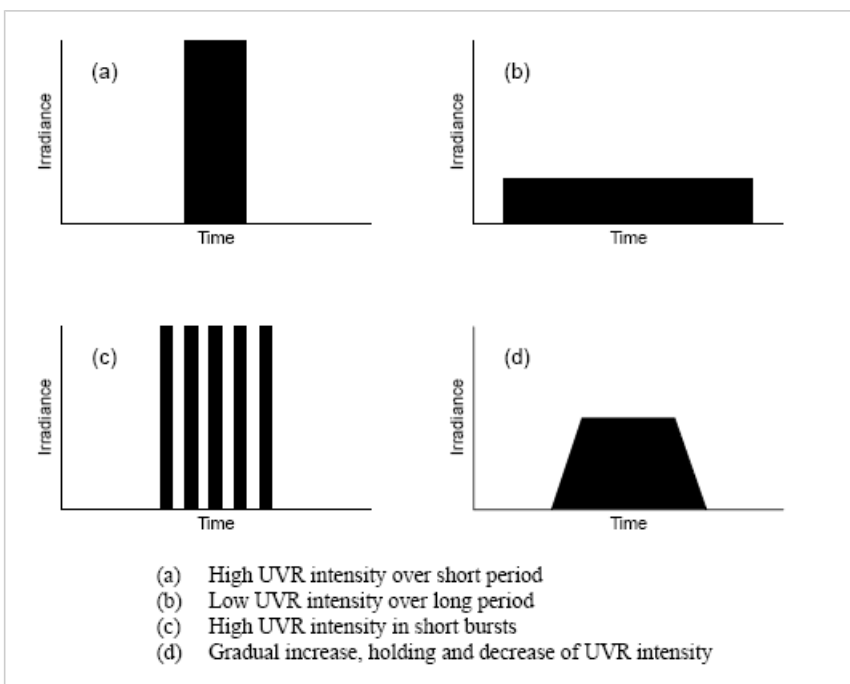
Skin Photo Type	Sunburn Susceptibility	Tanning Ability	Classes Of Individuals	No. in SED ³ for 1 minimal erythema dose (MED)
I	High	None	Melano-compromised	1 - 3
II	High	Poor		
III	Moderate	Medium	Melano-competent	3 - 7
IV	Low	Dark		
V	Very low	Natural brown skin	Melano-protected	7 - >12
VI	Extremely low	Natural black skin		

A classification of skin phototypes based on susceptibility to sunburn in sunlight, together with indicative MEDs that might be expected following UV exposure on unacclimatized skin.

Source: SCCP "Opinion on Biological effects of ultraviolet radiation relevant to health with particular reference to sunbeds for cosmetic purposes (2006)" 1.1.1 Acute, p. 7 [see http://ec.europa.eu/health/ph_risk/committees/04_sccp/docs/sccp_o_031b.pdf]

Annex 2:

A selection of irradiance vs. exposure time regimes

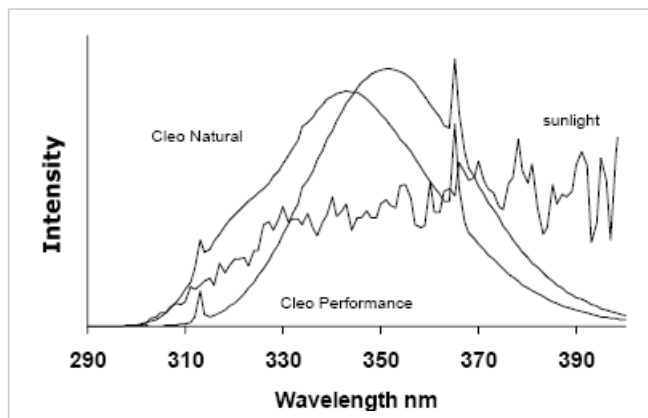


A selection of irradiance vs. exposure time regimes for testing the law of reciprocity in which the integrated areas (i.e. dose) for each exposure regime are identical. [...]

Source: SCCP "Opinion on Biological effects of ultraviolet radiation relevant to health with particular reference to sunbeds for cosmetic purposes (2006)" 2(b).2 Chronic Effects, p. 18 [see http://ec.europa.eu/health/ph_risk/committees/04_sccp/docs/sccp_o_031b.pdf]

Annex 3:

Emission spectra of solar UVR and two tanning lamps (i) Cleo natural and (ii) Cleo performance



Source: SCCP "Opinion on Biological effects of ultraviolet radiation relevant to health with particular reference to sunbeds for cosmetic purposes (2006)" 3.1.1.2, Chronic, p. 12 [see http://ec.europa.eu/health/ph_risk/committees/04_sccp/docs/sccp_o_031b.pdf]

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