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The Validity and Practicality of Sun-Reactive Skin Types I Through VI

The concept of sun-reactive "skin typing" was created in 1975¹ for a specific need: to be able to classify persons with white skin in order to select the correct initial doses of ultraviolet A (UVA) (in joules per cubic centimeter) in the application of the then newly developed technique for the treatment of psoriasis—oral methoxsalen photochemotherapy (PUVA).² The need arose as a result of experience with several patients who were a "dark" phenotype (brown or even black hair, and some with brown eyes) but, to our surprise, developed severe photo-toxic reactions following oral ingestion of 0.6 mg/kg of methoxsalen and then, two hours later, were exposed to 4 to 6 J/cm². These initial doses were obviously too high, and it was then understood that the estimation of the white-skinned person's tolerance level to oral PUVA could not be based solely on the phenotype (hair and eye color). A simple approach was necessary for the impending large-scale oral PUVA photochemotherapy trials in the United States in the mid-1970s.^{3,4} It was decided that a brief personal interview regarding the history of the person's sunburn and suntan experience was one approach to estimate the skin tolerance to ultraviolet radiation (UVR) exposure.

See also p. 885.

A simple working classification was proposed¹ (Table 1) based, not on the hair and eye color, but on what patients say their responses are to an initial sun exposure, ie, three minimum erythema doses (MEDs) or about 45 to 60 minutes of noon exposure in northern (20° to 45°) latitudes in the early summer. If two questions are asked about their responses to three MED exposures—"How painful is your sunburn (ie, intensity of erythema, edema, and discomfort) after 24 hours?" and "How much tan will you develop in a week?"—there are two groups of the white population with clear-cut answers. One group will reply: "I will have a painful burn at 24 hours and no tan at seven days." This is sun-reactive skin type I. Phenotypically, these are fair-skinned individuals with blue or hazel eyes, blond or red hair, and with skin that burns and peels easily, and their sunburn may last for several days. Some may, alas, also have dark hair and brown eyes. Another group will respond: "No burn at 24 hours and a good tan at seven days." This group is called skin type IV. There are, in addition, two subgroups of skin types I and IV. A subgroup of skin type I will answer: "A painful burn at 24 hours (the same as skin type I response)

and a light tan at seven days." This group is skin type II. These are fair-skinned individuals with blond, red, or brown hair, green or hazel eyes, and skin that burns and peels easily. These individuals tan slightly only after repeated exposures. Also, a subgroup of skin type IV will respond: "A slightly tender burn at 24 hours and a moderate tan at seven days." This is skin type III and is the largest group in the United States.

Individuals with skin type I have no inherent melanin pigmentation (ie, constitutive melanin pigmentation) and develop a marked tender sunburn or erythema following short exposures to UVR (sunlight or artificial ultraviolet B [UVB]) and are absolutely incapable of tanning (facultative melanin pigmentation). Persons with skin type I are keenly aware of their intolerance to sunlight and many give the same story: "I never go out in the direct sunlight, and when I did go out in my youth, I would only burn and peel. I have actually had severe blistering sunburns requiring bed rest for a couple of days. I never tan at all."

Persons with skin type IV, on the other hand, although exhibiting white skin with no clinical evidence of inherent melanin pigmentation, will usually say: "The sun is not a problem for me; I would burn if I stayed out several hours on the first day, but I never burn if I am out for an hour or less, even on my first exposure. I tan very well." Skin types I and IV are, therefore, quite easy to identify based on a short personal interview. Persons with skin types II and III are less clear-cut in their responses. Persons with skin type II most often say: "I am a sunburner and will only develop a light tan after several exposures." The "average" person with skin type III will develop some nontender sunburn after 45 minutes of initial sun exposure but can develop a quite dark tan.

Later, in addition to white-skinned persons, brown- and black-skinned persons were included in the classification by Pathak et al⁵ and Fitzpatrick⁶ (Table 2; Figure).

In Table 3, the doses of UVB (in millijoules per cubic centimeter) and UVA (in joules per cubic centimeter) are summarized for various skin types.⁷ It should be noted, for skin types III through VI, that for UVA the minimum melanogenic dose is 50% less than the MED. This is the basis of the claim by commercial solariums that UVA can "tan without a burn."

This system of skin typing, presented in Table 2, was used as a basis for selection of the initial UVA dose in two large oral PUVA photochemotherapy

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Skin Type*	Erythema and Tanning Reactions to First Exposure in Summer†
I	Always burn, never tan
II	Usually burn, tan less than average (with difficulty)
III	Sometimes mild burn, tan about average
IV	Rarely burn, tan more than average (with ease)

*Type I and type II persons all have pale skin color and often, but not always, have blue eyes, red scalp hair, and may or may not have freckling; however, some persons with dark brown hair and blue or green eyes have type I and type II sun-reactive skin. From Fitzpatrick.¹

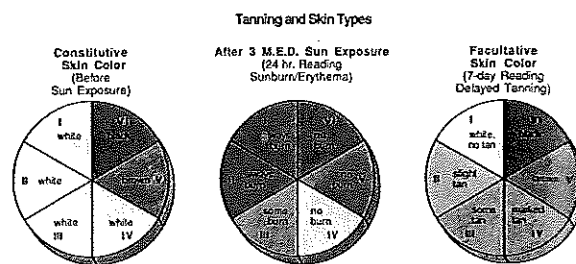
†Classification is based on what patients say their responses are to initial sun exposure of three minimal erythema doses (MEDs) (1 MED is equivalent to 15 to 30 minutes of noon exposure in northern [20° to 45°] latitudes or 30 mJ/cm²). Patients' ages ranged from 12 to 40 years.

Skin Color (Unexposed Skin)	Skin Type	Sunburn	Tan
White†	I	Yes	No
	II	Yes	Minimal
	III	Yes	Yes
	IV	No	Yes
Brown	V	No	Yes
Black	VI	No	Yes

*Based on verbal response regarding first, moderate (three minimal erythema doses) unprotected sun exposure for a period of 45 to 60 minutes. From Fitzpatrick.⁶

†The peoples of the world can be classified as white, brown, and black, and the ethnicity or "race" is only a cultural and political term with no scientific basis. Some Indians in southern Asia who are Caucasian have black skin, and there are blacks in North America who have light brown skin.

trials undertaken in the United States in a large population of 1678 patients with severe generalized psoriasis.^{3,4} In the protocol, the first treatment exposure dose was based on skin typing, and the patients were treated either twice or three times a week. Dose increments ranged from 0.5 to 1.5 J/cm² depending on erythema production and therapeutic response. Of 1139 patients entering the US Cooperative Clinical Trial (a 16-center study)³ using this protocol, 88.2% had their psoriasis clear completely and 3% failed to improve. Patients whose psoriasis cleared required a mean of 25.2 treatments over a period of 11.6 weeks. Two treatments per week cleared the skin with a lower number of treatments and a smaller cumulative UVA dose than did three treatments per week, but these results were skin type dependent. Fair-skinned patients showed a more rapid clearing with fewer exposures and lower total UVA doses as compared with dark-skinned patients.³ Similar results were obtained in another (14-center) study undertaken in the United States with 439 patients.⁴ Less than 2% of patients, all of whom were given initial UVA doses and increases based on their skin type, were required to stop therapy because of phototoxic reactions.⁴ Thus, the present system of skin



Tanning and skin types.

typing has appeared to serve a useful purpose in the photochemotherapy of psoriasis. Stern and Momtaz,⁵ however, in a small number of patients (76), showed that within each skin type the minimum phototoxic dose (MPD) and the MED varied greatly and, based on their findings, the recommended initial doses for oral PUVA photochemotherapy were "substantially lower" than the patients could safely tolerate. They recommended the MPD as the method of determining the initial dose of UVA. They were, however, able to show that while skin type was a relatively poor predictor of the individual patient's optimal initial exposure, skin type was a better predictor of a patient's relative risk of developing nonmelanoma skin cancer compared with other phenotypical characteristics (ie, hair and eye color).

Investigators in France, Amblard and associates,⁷ have studied individual variations in sunburn sensitivity in 303 volunteers and established that a statistically significant variation in the MED was a function of age, sex, complexion, hair color, and skin type. They present evidence to conclude that the MED is the best laboratory criterion for estimating the sunburn sensitivity, that the complexion (light, intermediate, and dark) best reflects sunburn sensitivity and, finally, that there is "a clear relationship between Fitzpatrick skin type and complexion." Sayre and coworkers¹⁰ had, previous to this study in France, demonstrated a statistically significant variation ($P < .001$) in MED between the different skin types.

In another study by Sayre's group,¹¹ of 1300 volunteers the average MED (as determined by artificial UVR) was lowest for skin type I and highest for skin type IV. They also demonstrated that 30% of skin type I persons did not show immediate pigment darkening at energy levels that were adequate to produce erythema, whereas all skin type IV persons had measurable immediate pigment darkening.

The "Fitzpatrick skin typing system"¹ has been used by the US Food and Drug Administration in its guidelines for sunscreen products for over-the-counter human use.¹²

In a study of 790 young adults reported in this issue of the ARCHIVES by Rampen and his group,¹³ there was no significant correlation between histo-

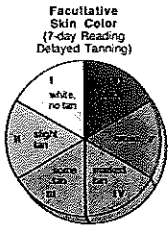


Table 3.—Minimal Erythema Dose and Minimum Melanogenic Dose for Skin Types I to VI*

Skin Type	UVB		UVA	
	MED, mJ/cm ²	MMD, mJ/cm ²	MED, J/cm ²	MMD, J/cm ²
I	20-30	...	20-35	...
II	25-35	15-25	30-45	15-20
III	30-50	17-25	40-55	20-30
IV	45-60	20-30	50-80	20-40
V	60-100	30-35	70-100	30-50
VI	100-200	40-80	>100	30-50

*UVB indicates ultraviolet B (290 to 320 nm); UVA, ultraviolet A (320 to 400 nm) radiation; MED, minimal erythema dose; and MMD, minimum melanogenic dose. From Pathak et al.⁵

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ries of burning and a subgroup of 190 persons. Rampen et al¹³ obtained sunburn/suntan responses by a self-reporting questionnaire completed by the young adult students in five vocational schools in the Netherlands. In our large series of patients with psoriasis, the skin type classification was obtained by personal interview and not by self-reporting. It is interesting that the correlation coefficients in the study of Rampen and coworkers "were somewhat larger for the self-reported tanning ability than for the burning tendency." Obviously, sunburning has a different meaning to different persons and, perhaps, can only be correctly elicited by personal interview. We agree with Rampen et al¹³ that the most accurate estimate of the initial dose of PUVA is obtained by performing an MPD, as was originally advocated by Wolff et al,¹⁴ and selection of UVA dose based on the MPD is now standard practice in our PUVA clinic at the Massachusetts General Hospital (Boston).

Finally, it should be mentioned that the Fitzpatrick-Pathak skin typing system¹⁵ is not a new concept; in 1956 Schulze¹⁶ separated the reactions to UVR in different persons, based on "early" and "late" responses. Schulze identified individuals with a skin type he called "E" who develop erythema but cannot tan (this is our skin type I), and individuals with a skin type "P" who respond with pigmentation only (this is our skin type IV). He regards these types (E and P) as the two extremes of a spectrum that includes a large variety of so-called E plus P types.

What is needed for an objective method of sun-reactive skin typing is a quantitative means of measuring the degree of the tanning response—none (ie, 0) for E persons (skin type I) and some number (eg, 1 to 10) for P persons (skin types II through IV, who can develop varying degrees of tanning). Two new devices, one simple and one elaborate, have recently been proposed for measuring melanin content in vivo. The simple device (Chroma/Meter CR-200, Minolta Corp, Ramsey, NJ) is a compact tristimulus color analyzer for measuring the reflected colors of surfaces and was used by investigators in Italy¹⁶ who compared an unexposed area (buttock) with exposed areas (forearm and cheek) as an index

of the person's pigmentation capacity. A much more elaborate apparatus and method reported by Kollias et al¹⁷ is the use of diffuse remittance spectroscopy. Data were obtained on skin types IV and V exposed to broadband UVB, and the tanning was measured at 3, 5, and 10 days following irradiation. The spectra showed a resonance absorption at 335 nm with a short-wavelength cutoff at about 300 nm.

The study by Rampen and associates¹³ was carefully performed and it serves to stimulate research and development of a more objective method that would replace this simple classification of skin types, which is based only on personal interview—but any new approach must be simple and practical. Up to the present, the sun-reactive skin type classification of I to VI we proposed has served us well.

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