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Individual Typology Angle and Fitzpatrick Skin Phototypes are Not Equivalent in Photodermatology

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Letter to the Editor

Individual Typology Angle and Fitzpatrick Skin Phototypes are Not Equivalent in Photodermatology

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Dear Editor,

Fitzpatrick skin typing (FST) was created in 1975 to establish appropriate dosing of oral methoxsalen used in photochemotherapy based on skin type for the treatment of psoriasis. FST was originally designed to categorize Caucasian skin into four Fitzpatrick skin phototypes (SPT), I–IV. Later, skin type V and VI were added for brown and dark-skinned individuals, respectively (1). SPT has since been widely used in clinical applications ranging from estimating erythemal and maximum doses for the treatment of psoriasis with narrow band UVB to estimating unprotected skin minimal erythema dose(s) (MEDu) in sunscreen sun protection factor (SPF) testing to assessing skin cancer risk to guiding laser treatment for scar or hair removal (2–5). Furthermore, SPT has been utilized in studies of photobiology, although it is limited by its inherent subjective nature leading to recall and observer bias (1,6–9). Moreover, over the years SPT classification has transformed from a detailed questionnaire to multiple different versions of a more simplified questionnaire leading to highly variable results (10,11). Given these limitations, more objective skin typing classifications have been proposed such as individual typology angle (ITA) assessed by colorimetry (12). ITA is calculated using the equation: ITA = [arctan(L*-50)/b*)] *180/π, where L* represents luminance ranging from black (0) to white (100) and b* ranging from yellow to blue (12). The higher the ITA, the lighter the skin. ITA skin color types are classified into six groups, from Very Light to Dark skin: Very Light (>55°), Light (41° to <55°), Intermediate (28° to <41°), Tan (10° to <28°), Brown (−30° to <10°) and Dark (< −30°) (12).

The subjective nature of SPT has been partly suspected for the significant differences in measured SPF compared to the manufacturer claimed SPF (5,13). This has led to mandated use of ITA for determination of MEDu in SPF testing per ISO 24444 (14). The derivation of precise equations relating ITA to MEDu for SPT I-III were recently published. This would not be possible with SPT (15).

ITA measures constitutive pigmentation (16) while SPT categories are based on sun reactiveness (1). However, the association between the two ITA and SPT is yet to be established. Since both systems provide six categories (Table 1A and 1B.), recent studies have used ITA classifications as synonymous to SPT (17). This synonymous use warrants caution on the interpretation of the results of these studies.

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The study discussed in this letter is the first study investigating ITA ranges corresponding to SPT categories. Analysis of anonymized data from IRB-approved studies, performed in our photomedicine and photobiology unit, involving 115 subjects was performed. The SPT determination was performed based on subject responses to the Fitzpatrick SPT scale (Table S1). Colorimetry measurements were performed using Konica Minolta 2600d spectrophotometer (Konica Minolta, Osaka, Japan). Data were collected in triplicate from sun unexposed areas: subject's buttock or lower mid back. The average of the three measurements was used to calculate ITA (Tables S2–S7). The calculated ITAs were then associated to the SPT reported by the subject to determine ITA ranges for the study population.

ITA ranges as a scatter plot, along with the median ITA values for each SPT are shown in Fig. 1. As such the data demonstrates that colorimetric ITA ranges for each SPT could be associated with multiple ITA classifications instead of discrete categories. For example, in this analysis, subjects with SPT I had an ITA range from 32.5° to 55.4°, showing that SPT I subjects can be included in ITA skin classifications ranging from Very Light to Intermediate. This pattern was observed for all SPT groups.

Table 1A. Fitzpatrick classification.

Fitzpatrick skin phototype	Criteria
I	Always burn, never tan
II	Always burn, sometimes tan
III	Sometimes burn, always tan
IV	Minimal burn, always tan
V	Rarely burns, always tan
VI	Never burns, always tan

Table 1B. Individual typology angle (ITA) skin classification proposed by Chardon *et al* (12).

Reference ITA skin classification (12)	ITA° range
Very light	ITA° > 55
Light	41 < ITA° < 55
Intermediate	28 < ITA° < 41
Tan	10 < ITA° < 28
Brown	−30 < ITA° < 10
Dark	ITA° < −30

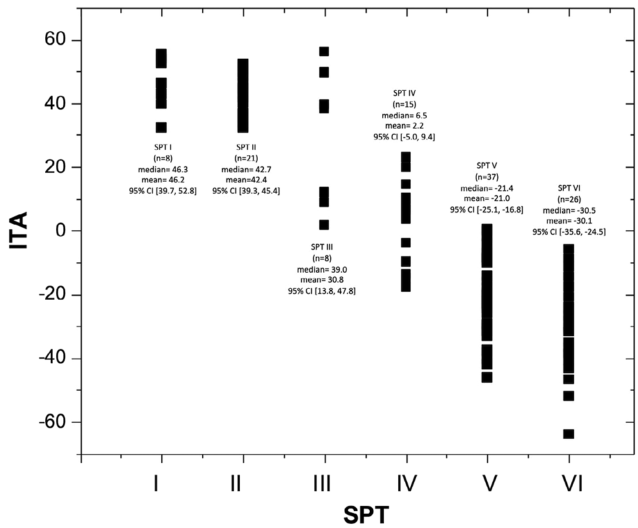

Figure 1. Scatter plot of individual typology angle (ITA) datapoints for each SPT reported showing wide variation and overlap of ITA ranges among different SPT categories.

The findings are supported by a study which showed Caucasian women were Light to Tan, African women were Intermediate to Dark, Hispanic and Brazilian women ranged from Light to Brown and Asian women ranged from Light to Dark in the ITA classification (16). This analysis revealed a heterogenous ITA distribution for a given geographical/ethnic population. Conversely, it highlights that SPT classification does not correlate perfectly with the ITA colorimetric classification.

In the initial work by Chardon *et al*. (12), ITA measurements were made on the lower backs; however, this was not the case in subsequent studies. Some studies made ITA measurements on the upper inner arm or the cheek (16,18,19). Assessment site to determine baseline SPT is important; it should be done in sun-protected areas to avoid seasonal variation throughout the year relative to the sun-exposed areas.

A recently conducted study on UVA1-induced molecular changes used both ITA and SPT as inclusion criteria (17). Specifically, 16 volunteers of Indian descent were recruited with inclusion criteria being 30°<ITA<15° and skin type IV or V. These ITA ranges used are slightly different than the ones originally proposed by Chardon *et al*. (12). Based on our analysis, ITA for SPT IV and V in our patient population ranged from −46.1° to 23.0°. This highlights that using SPT and ITA interchangeably and concurrently may exclude patients from studies who otherwise would be eligible. Furthermore, it makes comparison of results from different studies difficult.

Currently, SPT can be used in the clinical settings due to ease of administration and easy access to questionnaire. However, for research purposes, ITA should be more appropriate and preferred in photobiologic studies when determining MEDu for SPF determination (as shown recently) (15), and potentially to objectively standardize skin type classifications and predict skin responses for all SPTs.

To conclude, ITA and SPT are two separate methods for skin classification suited for constitutive pigmentation and sun reactiveness, respectively. The results indicate that these cannot be utilized interchangeably. While the present study provided the ITA ranges associated with SPT I-VI, one limitation was the small overall sample size. Additionally, certain SPT groups had lower participants compared to others. Therefore, in the future more comprehensive studies should be conducted to further elucidate the findings presented here. Despite these limitations, the results of this pilot study are crucial as they establish the need for caution when interpreting ITA and SPT and their concurrent use as inclusion criteria. In conclusion, poor correlation between the six objective individual typology angle categories and the subjective Fitzpatrick skin phototype categories was established along with highlighting ITAs potential in photobiologic studies and objective standardization of skin type classifications.

CONFLICT OF INTEREST STATEMENT

Indermeet Kohli is an Investigator for Ferndale, Estee Lauder, La Roche Posay Dermatologique, Unigen, Johnson and Johnson, Allergan, Bayer and received support from American Skin Association for vitiligo project with grant received by the institution. Indermeet Kohli has served as a consultant for Pfizer and Johnson and Johnson with fee and equipment received by the institution, respectively. Indermeet Kohli has received honorarium as a consultant from Beiersdorf (previously known as Bayer) and ISDIN. Henry W. Lim has served as investigator/co-investigator for research studies sponsored by Incyte, L'Oréal, Pfizer and PCORI; he has served as a consultant for Pierre Fabre, ISDIN, Ferndale, Galderma, La Roche-Posay and Beiersdorf; he has been a speaker on general education sessions for La Roche-Posay and Cantabria Labs. Iltefat Hamzavi has served as an advisory board member for AbbVie; a consultant for Incyte, Pfizer and UCB; a principal investigator for AbbVie, Allergan, Bayer, Clinuvel Pharmaceuticals, Estee Lauder, Ferndale Laboratories, Galderma Laboratories LP, GE Healthcare, Incyte, Janssen, Janssen Biotech, Johnson & Johnson, Lenicura, LEO Pharma, Pfizer, La Roche-Possay, Avita Medical, The Immune Tolerance Network and Unigen with funds paid to the institution; a subinvestigator for Amgen, Bristol-Myers Squibb, Foamix Pharmaceuticals, Pfizer, Incyte and Janssen with funds paid to the institution and co-chair of the Global Vitiligo Foundation.

AUTHOR CONTRIBUTIONS

IH, HL, IK contributed to conceptualization, methodology, resources and supervision; MO and IK contributed to data curation, formal analysis and validation and visualization; MO, IK, IH, HL contributed to formal analysis, investigation and writing—review and editing; IK contributed to project administration; MO contributed to writing—original draft preparation.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article:

Table S1. SPT Questionnaire Used.
Table S2. ITA Data (SPT I).
Table S3. ITA Data (SPT II).
Table S4. ITA Data (SPT III).
Table S5. ITA Data (SPT IV).
Table S6. ITA Data (SPT V).
Table S7. ITA Data (SPT VI).

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