

## **Fitzpatrick skin type, Individual Typology Angle and melanin index in an African population: taking steps toward universally applicable skin photosensitivity assessments**

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Calculation of Individual Typology Angle (ITA) based on spectrophotometric measurements has been used to classify skin types into physiologically relevant groups,<sup>1</sup> ranging from very light to dark skin.<sup>2</sup> This study directly compares ITA values with melanin index (MI), the latter frequently used in assigning Fitzpatrick Skin Type (FST),<sup>3</sup> in order to improve understanding of how these measurements correlate when used in a study that consists, primarily, of FST V and VI.

## Methods

Participants ( $n=556$ ) were drawn from the Council for Scientific and Industrial Research campus in Pretoria, South Africa, from October 6-22, 2014. All participants provided written consent, spoke English, cleaned their non-dominant arm with a wet wipe, and answered a short questionnaire, self-identifying their population group and skin reaction to sunlight.

Courage+Khazaka Skin Colorimeter CL 400 and Mexameter® MX 18 objectively determined ITA and MI respectively, by being held against the upper, inner non-dominant arm. ITA was categorized as previously described.<sup>1</sup> FST/MI values: FST I: 0-99.9; FST II: 100-149.9; FST III: 150-249.9; FST IV: 250-349.9; FST V: 350-749.9; FST VI: >750. Data were analyzed using STATA 10.0. The CSIR Research Ethics Committee approved the protocol.

## Results

The 556 participants self-identified either as Black (390), Indian/Asian (51), White (99) or Coloured (16). As the current procedure for assigning FST relies on perception of how skin burns and/or tans, participants identified whether their skin: (1) burned without tanning, (2) burned and then tanned, or (3) only tanned, following initial sun exposure. Participants from every ethnic group related to the different tan/burn options, demonstrating some level of sun photosensitivity even in ethnic groups frequently associated with darker skin pigmentation (Indian/Asian and African) (Table I).

**Table I. Frequency of responses by population group to the Fitzpatrick tan/burn questions.**

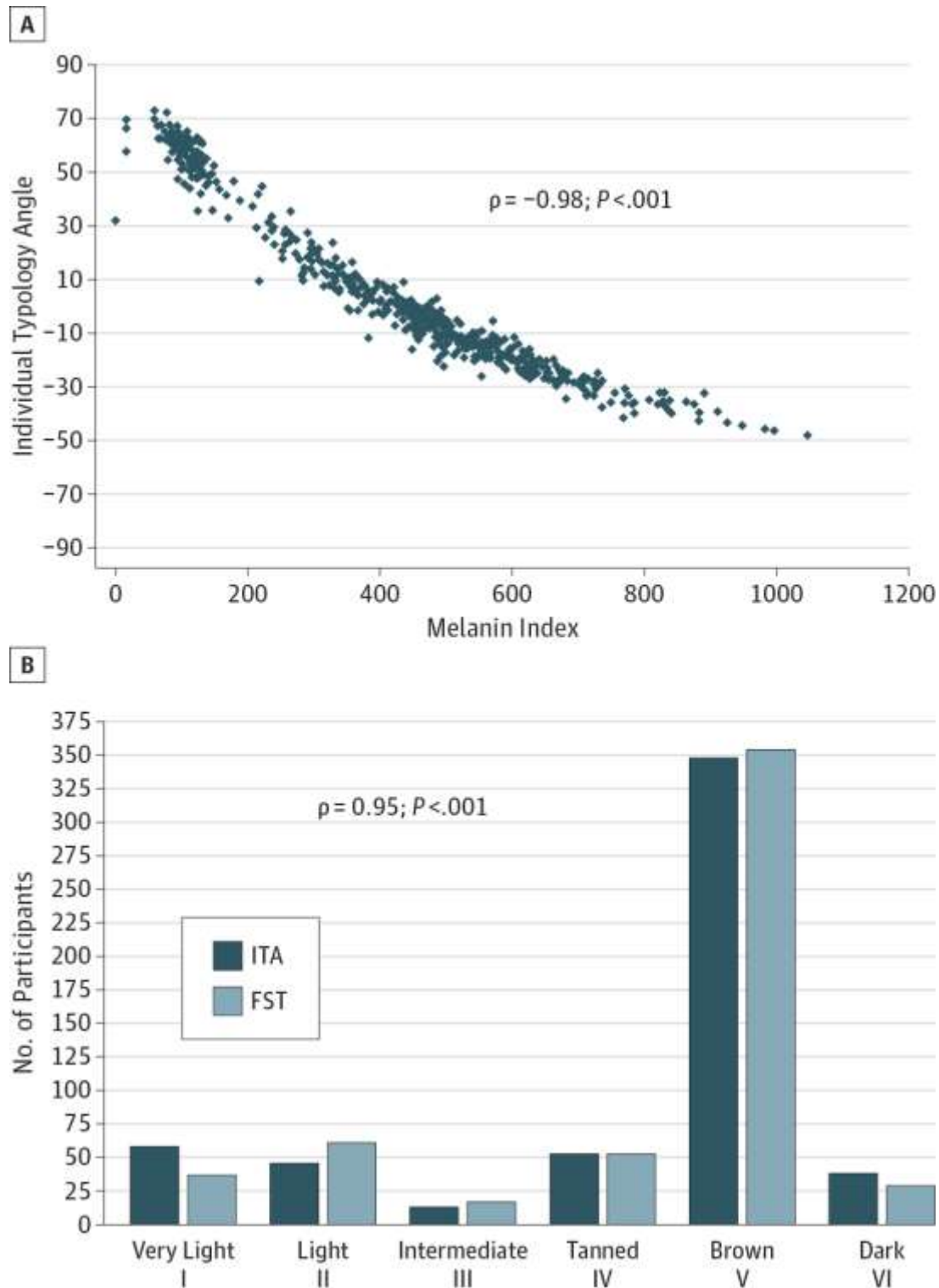
	Fitzpatrick Tan/Burn Questions									
	Only Burn		Burn then Tan		Only Tan		Not Applicable		Total	
Ethnic group	n	%	n	%	n	%	n	%	n	%
Black	67	17.2	138	35.4	168	43.1	17	4.3	390	70.1
Indian/Asian	5	9.8	19	37.3	26	50.9	1	2.0	51	9.2
White	26	26.3	60	60.6	13	13.1	0	0.0	99	17.8
Coloured	6	37.5	5	31.3	5	31.2	0	0.0	16	2.9

**MI vs ITA**

We compared our questionnaire findings to objective skin measurements, finding that participant melanin readings and ITA measurements demonstrate a very strong negative correlation (Spearman  $p=-0.9795$ ,  $p<0.0001$ ) (Figure 1A). As ITA values decreased, melanin values increased, monotonically. We then analyzed how these measurements correlated after raw values were categorized. Although both ITA and MI values place individuals into one of six skin types, these classification systems are currently unrelated, with no consensus about which values of MI belong to which Fitzpatrick group.<sup>4,5</sup> We found that by placing participants with melanin values  $>750$  in FST VI, we observed a very strong correlation between these unrelated classification systems (Spearman  $p=0.9547$ ,  $p<0.0001$ ) (Figure 1B,C).

**Discussion**

Determining skin type is necessary for understanding personal sunburn risk and, by extension, skin cancer. It is also important clinically as both the cosmetic and medical industries have increased their use of laser applications in recent years.<sup>6</sup> As FST questions are used in assigning skin type and determining laser-based treatment parameters, participants were asked FST



**Figure. Distribution of Participant Skin Classifications.** A, Higher melanin index (MI) values represent darker pigmented skin, whereas lower individual typology angle (ITA) values represent darker pigmented skin. The MI and ITA values demonstrate a strong negative correlation. B, Frequency of participants by spectrophotometer-derived Del Bino skin type category (ITA) and Fitzpatrick skin type (FST) derived from a pigment-measuring device. These unrelated classification systems demonstrate a strong correlation.

questions, and 538 (97%) identified that sun affected their skin in some way. Of the 390 Black participants, 373 (96%) acknowledged that they were photosensitive (Table 1). Only individuals who are not photosensitive are, typically, placed in FST VI, and our data confirm that most black participants should be placed in a FST other than VI.<sup>3</sup> As a result we defined the MI for FST VI to include only individuals with a MI >750. Strong correlation between MI and ITA values (Figure 1) suggests that either of these methods can be used to assess skin pigmentation depending on the relevance of the measurement outcome of the intended study. Recognizing this strong correlation will allow research by clinicians, biomedical scientists, and public health researchers to be more applicable and comprehensible across disciplines.

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Figure 1