Self-reported skin colour and erythemal sensitivity versus objectively measured constitutive skin colour in an African population with predominantly dark skin

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Abstract

Background: Skin colour is an important factor in skin-related diseases. Accurate determination of skin colour is important for disease prevention and supporting healthy sun behaviour, yet such data are lacking for dark skin types.

Methods: Self-perceived, natural skin colour and sun-skin reaction were compared with objectively-measured skin colour among an African population with predominantly dark skin. Unexposed skin of 556 adults (70.1% Black) was measured with a reflectance spectrophotometer to calculate an Individual Typology Angle (°ITA). Participants reported self-perceived skin colour and erythemal sensitivity.

Results: There was a strong, positive monotonic correlation between self-reported and measured skin colour (Spearman $\rho=0.6438$, $p<0.001$), but only a weak correlation between self-reported erythemal sensitivity and measured skin colour (Spearman $\rho=0.2713$, $p < 0.001$). Self-report biases in under- and over-estimation of skin colour were evident. Many participants with 'dark brown' and 'black' skin had difficulty classifying erythemal sensitivity.

Conclusions: In Africa, self-reported skin colour could potentially be used in lieu of spectrophotometer measurements, but options for questions on sunburn and tanning require suitable adjustment. Our study provides evidence of range in °ITA values among residents in Africa and reinforces previous results that self-report may be reliable for determining skin colour, but not erythemal sensitivity, for dark skin individuals. (word count: 199 excluding section headings)

Keywords: skin colour, erythemal sensitivity, spectrophotometer, self-report, Africa.

Introduction

The biological consequences of exposure to solar ultraviolet radiation (UVR) differ depending on skin pigmentation. Positive health impacts include endogenous production of plasma 25-hydroxyvitamin D, which is influenced by skin colour (1). Detrimental effects, where nature and extent of damage is influenced by skin colour, range from erythema to photoageing and skin cancer (2). To estimate risk, assessment of constitutive skin colour may be made either by dermatologist's expert opinion, reflectance spectrophotometry or self-report – for example, through questionnaire items based on Fitzpatrick Skin Phototype (FSP) classifications of natural untanned skin colour and tendency to sunburn / tan. Accurate skin colour classification as well as an understanding of skin colour self-perceptions can help

guide tailored health promotion and sun awareness advice about how best to protect skin and maintain health.

In Africa, Black individuals with dark skin can experience adverse health effects from excess solar UVR exposure, including sunburn and some skin cancers - although not all such lesions are associated with sun exposure. These effects are influenced by the degree of natural pigmentation, which can be wide-ranging (3). Despite this evidence, sun protection advice is generally limited to high-risk sub-populations, for example, those with fair skin or oculocutaneous albinism (4). Personal perceptions of skin colour and erythemal sensitivity comprise key components of understanding the possible need to moderate excess sun exposure. Dermatologist-diagnosed skin colour-related risk is unlikely for most Africans, given the present shortage of dermatologists in Africa, cost of such consultations and perceived lack of need to know one's skin colour. Self-reported skin colour and erythemal sensitivity are, therefore, important measures for assessing individual potential risk.

Comparisons of perceived skin colour and erythemal sensitivity with objectively-measured skin colour have been carried out internationally (5-8) and among African-Americans (9) living in the United States, but not in Africa. When compared with those who have skin with a lower melanin content, people with dark skin tend to perceive that their natural skin colour provides protection against sunburn and skin cancer and those with relatively 'fair' types of dark skin may fail to use adequate sun protection (10). In general, information on darker skin types is lacking, but documenting such information is important, given that dermatologists are likely to see an increase in patients with dark skin as these population groups afford access to specialised dermatological services (11) in Africa and elsewhere, as well as the increasing incidence of skin diseases among African people with HIV/AIDS (12).

The aims of the research reported here were twofold, namely, among an African population with predominantly dark skin, to compare self-perceived: 1) natural untanned skin colour and 2) skin reaction to sun exposure with objectively-measured constitutive skin colour. Such findings will help guide the preparation and tailoring/targeting of skin health promotion messages and inform future epidemiological studies in Africa.

Materials and methods

Sample selection and location. A convenience sample was drawn from participants of a wellness screening programme offered to employees of the Council for Scientific and Industrial Research (CSIR), Pretoria (25° 45.317' S; 28° 16.606' E), South Africa. Sample size calculations were based on the following equation:

$$n = \frac{((z)^2 \times p(1-p))}{(me)^2}$$

Where n equals the required sample size, z equals a confidence level at 95% (standard value of 1.96), p equals the proportion of interest in our study area (unknown for this study so p is set to 0.5), and a margin of error of $\pm$5% margin of error, so a value of 0.05 was used. Under these conditions a sample size of at least 385 participants was needed. Any cluster effects were assumed to be negligible.

Procedures. All participants were treated by following a standard protocol. Procedures were pre-tested and piloted for practicality and acceptability. Sampling took place 6-10, 14-16 and 21-22 October 2014. Participants attended the wellness screening first and were then recruited to participate. Information about a participant's skin phototype, to be sent in a follow-up email, was an incentive. Participants were provided with an information sheet and informed consent form, and a researcher verbally explained the purpose and procedures

and answered questions. Consenting participants were assigned a unique identifier code, asked to wipe the inner forearm and upper arm of their non-dominant arm with a wet wipe to remove residual skin products, and answered an eleven-question questionnaire. A skin colorimeter was used to assess inner, upper arm skin colour. Three measurements were taken for each participant and their average was recorded. The instrument was cleaned with a dry tissue between participants.

Data were transferred from instrument output to a standardised datasheet with a unique participant identifier code. Once sampling was complete, data were entered into an Microsoft Excel (2010) spreadsheet, using double data entry, before being imported into STATA 10.01 (StataCorp, 2013, Stata Statistical Software: Release 13, College Station, TX). The CSIR Researcher Ethics Committee approved the protocol (79/2013) and the study was supported by CSIR Human Resources.

Measures. Self-reported information was collected via a written questionnaire. Population group was defined according to the Statistics South Africa 2011 Census categories of Black, Indian/Asian, White, Coloured and Other (Table 1). Participants were asked whether they were a South African citizen or permanent resident, their gender, their age, the two languages predominantly spoken in their household while they were growing up (eleven official languages), and their eye colour (Table 1). Participants were asked three questions about their skin (Table 2): (1) how would they describe their natural, untanned skin colour, for example, under the upper arm at the end of winter; (2) if they went out in the sun without protection in summer for 30 minutes during the middle of the day, whether their skin would 'just burn and not tan afterwards', 'burn first, then tan afterwards' or 'not burn at all, just tan'; and (3) whether or not they had used a sunbed or applied spray-on tan lotion in the past 7 days.

Table 1. Sample characteristics by ITA mean, median, inter-quartile range, standard deviation and range

	n	%	°ITA value						
Response item			Mean	Median	IQR		SD	Range	Range
Gender:									
Male	267	48.02	0.96	-11.33	-23.67	20.33	33.13	-48.33	72.66
Female	289	51.98	6.48	-1.33	-11.33	16.00	25.66	-38.33	72.33
Census population group:									
Black	390	70.10	-11.51	-12.00	-21.33	-2.00	14.73	-48.33	31.66
Indian/Asian	51	9.17	13.88	13.33	1.33	24.00	16.54	-22.00	54.66
White	99	17.81	56.22	56.67	51.33	62.00	8.12	29.33	72.66
Coloured	16	2.88	21.63	17.00	7.00	45.50	22.54	-18.66	51.33
Natural untanned skin colour at the end of winter:									
Very light/very fair	44	7.91	33.02	49.83	0.67	62.20	31.04	-27.00	72.33
White	59	10.61	54.76	55.33	51.00	60.67	10.83	-4.66	72.66
Intermediate/medium/light brown	157	28.24	6.58	1.00	-11.67	19.33	24.55	-35.66	67.33
Olive	9	1.62	9.85	11.33	5.00	14.33	13.78	-13.66	35.00
Brown	205	36.87	-8.78	-10.33	-19.33	0.00	15.08	-41.66	42.00
Dark Brown	58	10.43	-21.61	-21.33	-30.33	-12.33	10.93	-48.33	-2.66
Black	24	4.32	-25.88	-26.67	-37.50	-19.17	15.44	-46.66	23.33
Skin response to unprotected sun exposure in midday summer sun for 30 minutes:									
Just burn and not tan afterwards									
Burn first, then tan afterwards	104	18.71	11.99	4.67	-12.67	45.83	32.05	-48.33	72.66
Not burn at all, just tan	222	39.93	10.59	-1.83	-14.33	47.00	31.80	-43.33	72.33
Not applicable/Don’t know	212	31.13	-5.14	-9.83	-18.33	5.83	22.54	-46.66	62.00
	18	3.24	-21.19	-20.83	-32.33	-18.33	15.02	-46.33	16.00
Age group (in years):									
18-25	66	11.87	1.83	-6.33	-17.0	10.7	27.62	-39.66	69.33
26-35	234	42.09	-1.82	-7.00	-18.70	8.00	26.08	-46.66	72.33

36-45	152	27.34	5.79	-2.12	-17.00	22.50	30.49	-48.33	72.66
46-55	67	12.05	6.38	-8.00	-19.33	42.00	33.13	-37.66	67.33
56-65	33	5.94	28.80	44.00	-1.33	53.70	29.80	-19.33	67.00
Older than 65	4	0.72	44.00	48.80	34.20	53.80	14.42	23.33	55.00
Eye colour:									
Light blue/grey/green	25	4.50	53.10	58.70	51.30	63.00	19.92	-30.00	67.33
Blue/Grey/Green	36	6.47	53.00	54.30	49.80	60.80	15.66	-27.33	72.66
Hazel or Light brown	68	12.23	21.70	15.50	-5.50	54.30	33.30	-35.66	72.33
Dark brown	372	66.91	-5.68	-9.33	-19.30	3.50	20.94	-48.33	69.33
Black	55	9.89	-8.59	-10.33	-19.70	5.33	18.80	-46.33	35.00
*Two languages predominantly spoken at home:									
Afrikaans	101	18.16							
English	280	50.35							
IsiNdebele	25	4.49							
IsiXhosa	48	8.63							
IsiZulu	85	15.28							
Sepedi	113	20.32							
Sesotho	46	8.27							
Setswana	64	11.51							
SiSwati	11	1.97							
Tshivenda	22	3.95							
Xitsonga	34	6.11							
Other	56	10.07							

*Percentages add up to more than 100% as participants could choose more than one language.

Skin colour was measured using an Electronic GmbH Skin Colorimeter CL 400 WL (Courage+Khazaka, Germany). The colorimeter has a core measuring area of ø 5 mm and an illuminated area of 17 mm ø. The skin colorimeter (accuracy of ± 5%) was calibrated each morning against a standard reference. The battery-operated probe was connected wirelessly to

Table 2. Distribution of participant self-reports by Del Bino °ITA value and colour categories.

Del Bino °ITA value category	Del Bino colour description	Self-report skin colour	Participants by Del Bino category		Participants by self-report skin colour	
			n	%	n	%
≥55°	Very light	Very light / very fair	58	10.43	44	7.91
≥41° to <55°	Light	White	46	8.27	59	10.61
≥28° to <41°	Intermediate	Intermediate/medium/ light brown	13	2.34	157	28.24
≥10° to <28°	Tanned	Olive / Tanned	53	9.53	9	1.62
≥-30° to <10°	Brown	Brown	348	62.59	205	36.87
<-30°	Dark	Dark brown / Black	38	6.83	58 24	10.43 4.32

a receiver which connected via USB to computer. Measurements are based on the reflection of light from eight LEDs arranged circularly and for which the range of emitted wavelengths of light is 440-670 nm. L*a*b* index values are provided as output and the L* and b* values are converted immediately to Individual Typology Angle (°ITA) scores. The °ITA is calculated according to Del Bino (2) as:

$$°ITA = \tan^{-1}\left(\frac{L^* - 50}{b^*}\right) \times \frac{180}{\pi}$$

where L* is the difference along the lightness-darkness axis and b* is the difference along the yellow-blue axis. Six different skin classifications are defined using the °ITA values (Table 2) based on colour. The skin colorimeter-derived °ITA categories were compared to self-reported skin colours.

The colorimeter measuring area was held against each participant's skin on the inner upper, the anatomic site recommended for assessing natural, untanned skin colour in a non-

invasive way and used in previous studies (13,14). Three replicate measurements adjacent to each other were made and an average was calculated to determine a single °ITA value as an objective measure of constitutive skin colour.

Analysis. Objective skin colour was a continuous variable expressed as an °ITA value and categorised according to the Del Bino colour classification system (2,16). To compare self-reported skin colour to objectively-measured °ITA values, a box and whisker plot was constructed to show distributions of objective skin colour for each self-reported skin colour category. The percentage of participants for whom °ITA values fell above or below the Del Bino cut-off values for each category was calculated for each self-reported skin colour group to assess possible self-reporting bias . Spearman's correlations were run to assess the relations (in each case, by population group and gender) between: 1) ITA-derived Del Bino skin colour categories and self-reported skin colour and; and 2) ITA-derived Del Bino skin colour categories and self-reported erythemal sensitivity.

Results

Of approximately 2500 CSIR employees, 556 (22.24 %) participated in this study. Since no participants reported having used a sunbed or applied a spray-on tan lotion in the past 7 days (both of which behaviours may affect natural skin colour), no participants were excluded. The distribution of participants by questionnaire response items, with corresponding values for the °ITA mean, median and inter-quartile range (IQR), is presented in Table 1.

The sample demographic distribution within the 20-65 year age group (i.e. of employable age) differed from that of the South African national population which was reported in Census 2014, namely, Black 78.12%; Indian/Asian 2.91%; White 9.44%; and Coloured 9.53%) (15). A chi-square goodness of fit test was performed to compare the observed frequency of the four population groups with the expected frequency based on the

Census. Although the sample distribution differed significantly from the general South African population (χ^2 =146.5, 3df, p<0.001), the sample was representative of the CSIR employee base (*personal communication*, CSIR Human Resources Unit Internal Database). Only 12 participants had neither South African citizenship nor permanent residence.

S*elf-reported skin colour and objective skin colour*. Table 2 gives the distribution of participants by objective °ITA value-associated skin colour category (column 4) and self-reported skin colour (column 5). There was a strong, positive correlation between self-reported skin colour category and measured °ITA value / colour category (Spearman ρ=0.6438, n=556, p<0.001). Figure 1a shows the range of participants' °ITA values for each self-reported skin colour category. For participants who classified themselves as having very light/very fair skin (n=44), 59.09% did not have very light/very fair skin according to their categorised °ITA value. Similarly, those who classified themselves as white (n=59), 61.01% did not have white/fair skin and 55.93% estimated that they had very light/very fair skin. For participants identifying with the intermediate category (n=157), 80.25% fell into the measured Del Bino °ITA-derived tanned, brown and dark categories, hence underestimating the darkness of their skin colour. Most participants who stated that their natural skin colour was brown were objectively classified as brown (82.43%). For participants identifying with dark brown and black, 74.13% and 62.50% underestimated their skin colour, respectively.

With respect to the relationship between self-reported skin colour and °ITA colour categories by population group (Table 3), there were weak correlations for Blacks (Spearman ρ=0.3557, n=390, p<0.001) and Whites (Spearman ρ=0.3394 , n=99 , p<0.001) and a moderate correlation for Indian/Asians (Spearman ρ = 0.5780 , n=51 , p<0.001). There were strong and moderate correlations between self-reported skin colour and °ITA skin colour when compared by gender for males (Spearman ρ = 0.6827, n=267, p<0.001) and females (Spearman ρ = 0.5837, n=289, p<0.001), respectively.

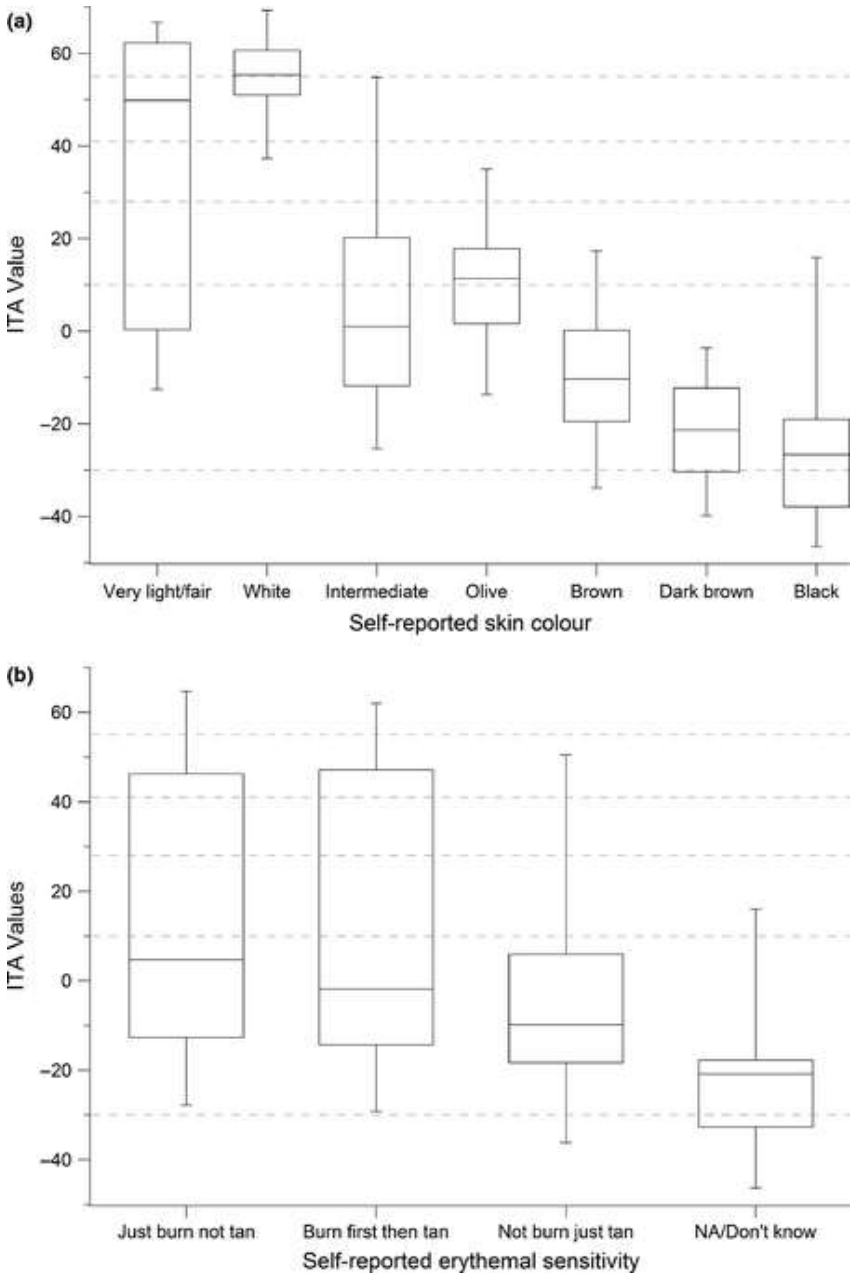

Figure 1. Distribution of participant °ITA values (average of three ITA readings on the inner upper arm) versus (a) self-reported skin colour and (b) self-reported erythemal sensitivity. The upper whisker is the 95th percentile, the upper box line is the 75th percentile, the middle line in the box is the median, the lower line of box is the 25th percentile and the lower whisker is the 5th percentile. (Word count = 68)

Table 3. Frequencies for self-reported skin colour with Del Bino skin colour categories (using objectively measured °ITA value ranges) by a) population group and b) gender

	Del Bino °ITA category	Self-reported skin colour						
a) Population group		Very light/very fair	White	Intermediate / medium / light brown	Olive	Brown	Dark brown	Black
Black	Very light	0	0	0	0	0	0	0
	Light	0	0	0	0	0	0	0
	Intermediate	1	0	1	0	0	0	0
	Tanned	5	0	11	0	9	0	1
	Brown	14	1	97	2	155	40	15
	Dark	0	0	1	0	14	15	8
Indian/Asian	Very light	0	0	0	0	0	0	0
	Light	0	1	2	0	0	0	0
	Intermediate	0	1	4	1	1	0	0
	Tanned	0	0	12	3	6	0	0
	Brown	0	0	3	2	11	3	0
	Dark	0	0	0	0	0	0	0
White	Very light	18	33	7	0	0	0	0
	Light	5	20	11	0	1	0	0
	Intermediate	0	1	3	0	0	0	0
	Tanned	0	0	0	0	0	0	0
	Brown	0	0	0	0	0	0	0
	Dark	0	0	0	0	0	0	0
Coloured	Very light	0	0	0	0	0	0	0
	Light	0	2	3	0	1	0	0
	Intermediate	0	0	0	0	0	0	0
	Tanned	0	0	0	1	4	0	0
	Brown	0	0	2	0	3	0	0

	Dark	0	0	0	0	0	0	0
b) Gender								
Male	Very light	5	21	6	0	0	0	0
	Light	2	15	7	0	1	0	0
	Intermediate	0	1	4	1	0	0	0
	Tanned	2	0	7	1	8	0	0
	Brown	4	1	44	2	65	26	11
	Dark	0	0	1	0	14	12	6
Female	Very light	13	12	1	0	0	0	0
	Light	3	8	9	0	1	0	0
	Intermediate	1	1	4	0	1	0	0
	Tanned	4	0	16	3	11	0	1
	Brown	10	0	58	2	104	17	4
	Dark	0	0	0	0	0	3	2

Self-reported erythemal sensitivity and objective skin colour. Figure 1b shows distribution of participants' °ITA values for each self-reported response option to the tan/burn question. There was a weak but statistically significant correlation between self-reported skin photosensitivity (tan/burn question) and actual skin colour (Spearman ρ=0.2713, n=556, $p < 0.001$).

There were weak and very weak statistically significant correlations between self-reported erythemal sensitivity and °ITA colours for Whites (Spearman ρ= 0.2414, n=99, p=0.016) and Blacks (Spearman ρ = 0.1756, n=390, p<0.001), respectively (Table 4). Similarly, there were weak statistically signification correlations between self-reported erythemal sensitivity and °ITA skin colour for males (Spearman ρ = 0.2922, n=267, p<0.001) and females (Spearman ρ = 0.2370, n=289, p<0.001).

Table 4. Frequencies for self-reported erythemal sensitivity with Del Bino skin colour categories (using objectively measured °ITA value ranges) by a) population group and b) gender

	Del Bino °ITA category	Self-reported erythemal sensitivity			
a) Population group		Just burn, not tan	Burn first, then tan	Not burn, just tan	N/A
Black	Very light	0	0	0	0
	Light	0	0	0	0
	Intermediate	1	1	0	0
	Tanned	8	8	10	0
	Brown	55	120	137	12
	Dark	3	9	21	5
Indian/Asian	Very light	0	0	0	0
	Light	0	2	1	0
	Intermediate	1	2	4	0
	Tanned	2	8	11	1
	Brown	2	7	10	0
	Dark	0	0	0	0
White	Very light	20	33	5	0
	Light	5	25	7	0
	Intermediate	1	2	1	0
	Tanned	0	0	0	0
	Brown	0	0	0	0
	Dark	0	0	0	0
Coloured	Very light	0	0	0	0
	Light	2	3	1	0
	Intermediate	0	0	0	0
	Tanned	3	1	1	0
	Brown	1	1	3	0
	Dark	0	0	0	0

b) Gender					
Male	Very light	10	18	4	0
	Light	4	17	4	0
	Intermediate	2	1	3	0
	Tanned	3	5	10	0
	Brown	26	43	75	9
	Dark	3	9	18	3
Female	Very light	10	15	1	0
	Light	3	13	5	0
	Intermediate	1	4	2	0
	Tanned	10	12	12	1
	Brown	32	85	75	3
	Dark	0	0	3	2

Discussion

The two aims of this study among an African population with predominantly dark skin were to compare: 1) self-perceived, untanned skin colour and 2) skin reaction to the sun, with objectively-measured constitutive skin colour. For the first aim, when we compared self-reported skin colour to the Del Bino categories derived from colorimeter °ITA values, there was a strong, positive correlation confirming that self-reported skin colour could potentially be used in lieu where reflectance spectrophotometer measurements of skin colour are not feasible (17,18). Upon examination of self-reported skin colour versus Del Bino °ITA colour categories, we found that many of the self-defined ‘very fair’ group considered themselves to be darker than their respective Del Bino categorisation, yet many of the ‘white’ group considered themselves lighter; whereas all in the ‘intermediate’ and ‘olive’ groups considered themselves darker; the ‘brown’ group fitted reasonably well within the broad bounds of their respective Del Bino category; the ‘dark brown’ group and most of the ‘black’ group

considered themselves to be lighter. Similar findings were reported by Reeder et al. (17), and such self-perception biases may, at least in part, help explain the relatively slow pace of change in skin cancer preventive behaviours, especially in countries where sun awareness campaigns are sparse.

The South African Census classifies people according to colour and/or race. Other studies have discussed how stratifying populations according to colour may not be useful for determining population structure in admixed populations (19); this approach may also play a role in skewing perceived skin colour, at least from a sun-related, epidemiological perspective. For example, an individual of admixed ancestry may be classified according to the South African Census as 'Black' and, therefore, intuitively consider their skin colour to be black but which, when it is measured objectively, may be dark brown. Nevertheless, such an individual may not take heed of sun protection messages aimed at African people with brown or dark brown skin. The mismatch between actual and perceived skin colour may be complicated by racial identity, so objective measures of analysing skin colour to reduce subjective influences of race in assessing photosensitivity are needed (13). In Africa, where resources are limited and electricity supply is not guaranteed, alternatives to reflectance spectrophotometry, such as visual colour observations charts (20), may be required.

The second aim of this study was to compare self-perceived skin reaction to the sun with objectively-measured constitutive skin colour. There was only a weak statistically significant correlation between self-reported skin erythemal sensitivity and measured skin colour, with no significant population group or gender differences. Typical descriptors of erythemal sensitivity, expressed in the FSPs, do not have the same meaning for people of different skin colours (5). Unlike an earlier study (13) in which associations between race and subjective measures of FSP strengthened among patients with darker skin, our study found that a large proportion of people with black and dark brown skin had difficulty answering

questions derived from the FSP sun sensitivity classification. Rephrasing the burn/tan question using different descriptors, such as ‘skin irritation’ or ‘skin tenderness’ for burn and ‘skin becoming darker’ or ‘skin changing colour’ for tan, may be more suitable for people with darker skin colours. During our study, we recognised that several participants, who self-reported as being part of the Black population group, did not understand the burn/tan questions, so we verbally described sunburn as ‘skin becomes irritated or sensitive following sun exposure’ and tan as ‘skin becomes darker’. On the final two days of the study, we quantified that 39 out of 96 Black participants understood the burn/tan question when we applied our explanations; and 12 wanted an additional option which stated that ‘the skin does not burn and does not get darker’, i.e. ‘not applicable’. This finding was similar to Eilers et al. (5) where participants with dark skin, only after receiving an explanation of the words ‘burn’ and ‘tan’, were able to answer the question as readily as a participant with lighter skin. Had we used the revised descriptors and a fourth ‘not applicable’ option in the questionnaire from the study start, results may have differed. In general, participants’ responses from ‘just burn, not tan’ to ‘not burn, just tan’ followed a decreasing trend in °ITA values as skin colour gets darker, with the median °ITA value being lowest of all self-reported erythemal sensitivity categories in line with majority of the participants answering ‘not applicable/don’t know’ being of the Black population group with lower °ITA values. Another possible reason for poor correlation between self-perceived skin reaction to the sun with objectively-measured constitutive skin colour may be that other health issues, such as HIV/AIDS, tend to be at the forefront in Africa, and public health education targets these diseases. Less health promotion is focussed on diseases associated with excess sun exposure, such as skin cancer and cataracts, hence people living in Africa, independent of skin colour, are less familiar with sun exposure terms.

No participants provided a positive response to the questionnaire item asking whether or not in the past 7 days they had used a sunbed or applied spray-on tan lotion. However, an interesting observation was how many participants asked for clarification of terms ‘sunbed’ and ‘spray-on tan’. Several participants thought that spray-on tan was sunscreen, and many people did not know what a sunbed was. A question on skin bleaching or lightening, a popular traditional and cosmetic practice in Africa (21), would likely have been more relevant among a predominantly Black population. Instead of asking a question about the use of skin lightening products, we used the typical FSP questions, which do not include skin lightening. Willis and Earles (22) suggested a new skin classification system relevant to people of African descent that included propensity to develop post-inflammatory hyperpigmentation and this adapted classification system, following additional research, may be useful in Africa.

While at least one study suggests using a spectrophotometer alone (and excluding hair colour, eye colour, response to tan/burn question and ethnicity) to measure skin colour and thereby deduce FSP (8), in Africa, a spectrophotometer may not be affordable, there may be no computer to which to connect it and no reliable electricity supply, hence one may need to rely on self-reported skin colour and FSP questions. Furthermore, how people protect themselves depends on, among other factors such as sun-related knowledge and attitudes, their perceived skin colour and level of natural protection against the sun. While Eilers et al. (5) states that dermatologist-determined FSP is more accurate than self-report for FSP III through VI, we did not use dermatologist-determined skin colour and FSP. There are only approximately 170 dermatologists in South Africa; hence it was not possible to obtain a dermatologist’s involvement in the three-week sampling period. Furthermore, it is likely that other clinicians and general medical practitioners may be involved in determining skin colour in South Africa and other countries in Africa, hence the need for credible, self-report

measures of skin colour and erythemal sensitivity determined using appropriate definitions tailored for Africans (5), especially people with dark skin.

In conclusion, this study has provided some evidence, described as necessary by Eilers et al. (5), of the relationships between objectively-measured skin colour, self-reported skin colour and erythemal sensitivity among population groups in Africa. At least in Africa, self-reported skin colour could be used in large, epidemiological studies in lieu of reflectance spectrophotometer measurements of skin colour, however, there is a need for suitable response options to FSP-type questions on sunburn and tanning adjusted specifically for people with dark skin and limited exposure to sun awareness public health advice. (Word count = 3145)

Acknowledgements: We acknowledge North-West University for the loan of the colorimeter and the participants for taking part. We also thank Riëtha Oosthuizen and Victoria Nurse for assisting with fieldwork.

Financial support of authors: Dr Wright received support for this project from CSIR Parliamentary Grant funding, the National Research Foundation Rated Researcher funding and the Cancer Association of South Africa ad-hoc grant. Associate Professor Reeder and the Cancer Society Social and Behavioural Research Unit receive support from the Cancer Society of New Zealand Inc. and the University of Otago. This material is based upon work supported by the National Science Foundation Graduate Research Fellowship Program under Grant Number NSF DGE-1144153 to Marcus Wilkes and an international travel allowance co-funded through the Graduate Research Opportunities Worldwide (GROW) and United States Agency for International Development agencies. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

Conflict of interest: None to declare.

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