May 7th, 11:00 AM - 1:00 PM

Predictive Validity of a New Self-report Measure of Individual Skin Type Through Characterization of Skin Melanin Using Reflectance Photospectroscopy

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Predictive validity of a new self-report measure of individual skin type through characterization of skin melanin using reflectance photospectroscopy

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Abstract

In the realm of research and dermatology, the Fitzpatrick Skin Type scale (FST) has been the gold standard of measurement to classify sun sensitivity for human's skin. This scale is based on an individual's dermal reaction to ultraviolet exposure (Parrish, et al., 1974; Fitzpatrick, 1975; Pathak, et al., 1976; Fitzpatrick, 1988). It was assumed in science as well as popular culture that individuals with darker skin were less susceptible to issues related to UV damage of their skin. More recent research (Eilers, et al., 2013) suggests that while melanin affords some skin protection, damage can still occur that may result in disparities of darker skin individuals getting diagnosed with skin cancer later when the disease is more advanced and deadly. This phase of the *Let's Get Healthy!* sun sensitivity project compares a revised self-administered survey with objective reflectance photospectroscopy to determine if an individual's melanin content correlates with FST. Validation of the self-administered survey will enable better characterization of individuals and guide tailored recommendations of sun protection behaviors that may reduce their risk of skin cancer.

Materials and Methods

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Cancer Risk Knowledge, attitude and behavior assessment related to skin, lung, and breast cancer risk
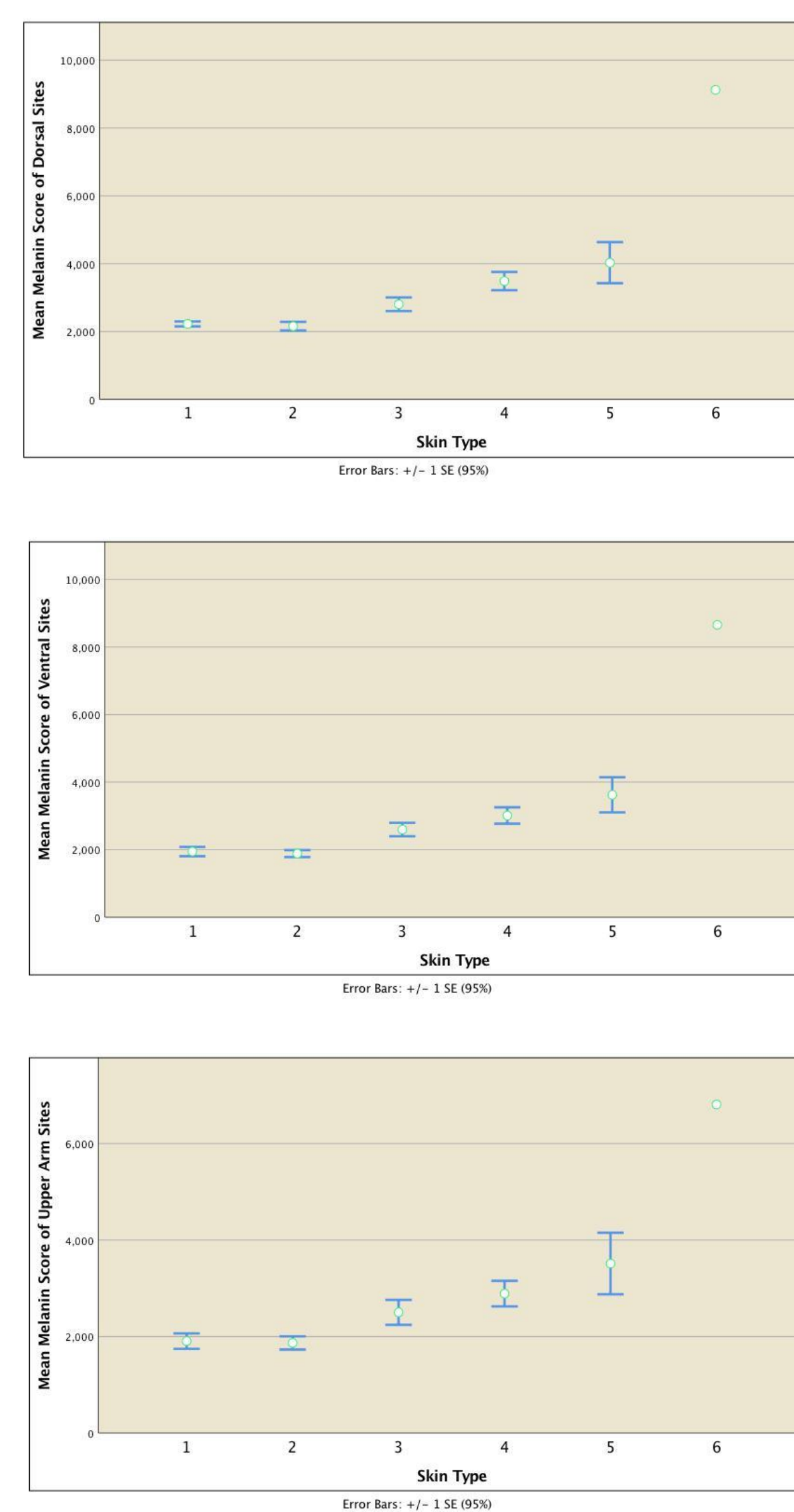
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- Phase I of the project consisted of a pilot project using paper surveys with Eilers' original language for the convenience surveys.
- Phase II of the project again used paper surveys using the revamped question stem using more concise and culturally sensitive language for the convenience surveys. Both paper surveys were conducted using a barcode identifier to anonymize participants.
- Phase III was conducted using a paper survey system which automatically created an anonymous barcode for each participant. This portion of the study used an expanded and more clear follow up question in the survey and was broadcast using social media and surveyed using a convenience sample.

Reflectance photospectroscopy was developed by Samatham and Jacques (2017) at OHSU, based on initial research by Kollias and Baqer (1985) and used to collect participants' melanin content using reflectance from skin when shone with light from fiber optic device. This information was fed back to an Ocean Optics FLAME-S-VIS spectrometer and recorded into a custom plugin for MatLab. This averaging of melanin content gives an accurate reading of a participant's melanin content.
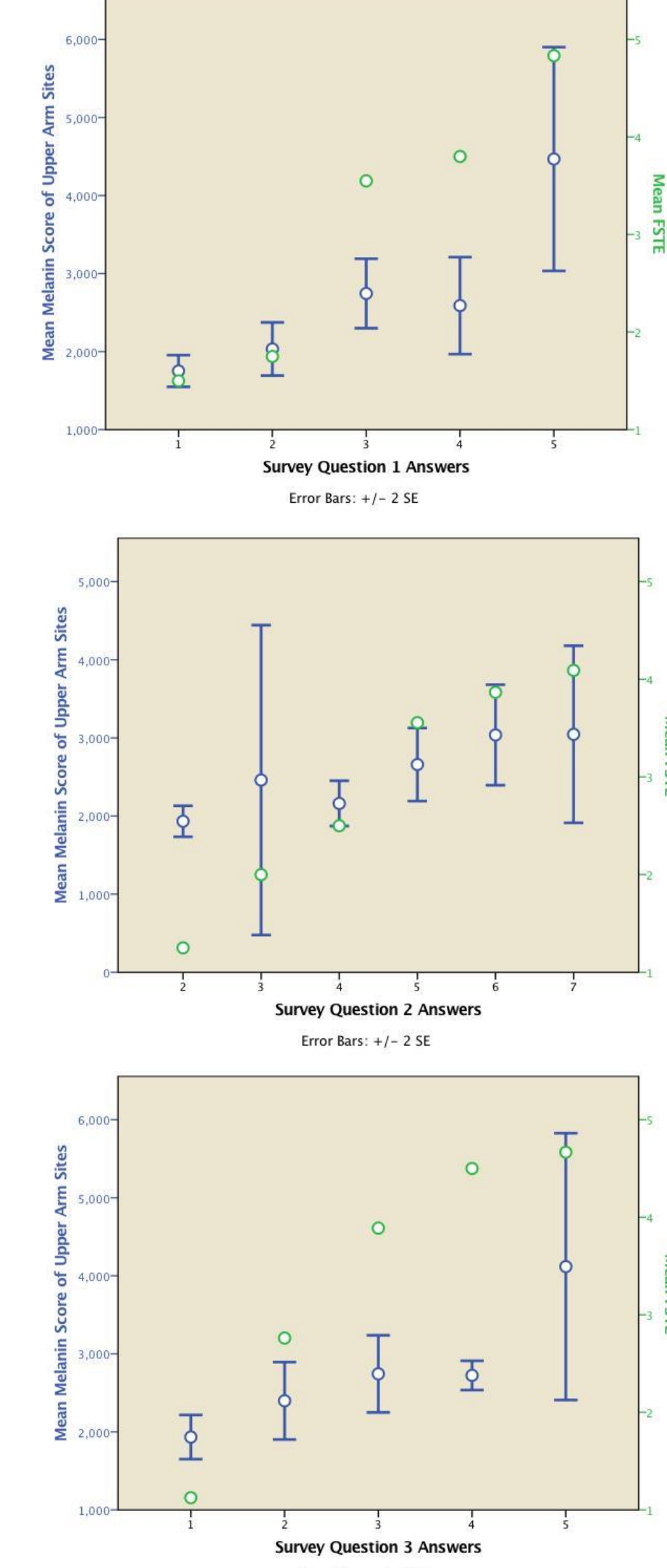
Measurement locations: Three locations (dorsal forearm, ventral forearm and ventral upper arm) measured in triplicate to ensure correct melanin content. This information was compared with a participant's self-reported survey scoring to assess skin type range fitting.

Data cleaning and analysis. Once the data was collected and the survey was ended the data had to be cleaned to ensure completeness and comprehension by the participants. Upon finalizing the data it was analysed in IBM SPSS v25 using a one-way ANOVA with a 95% confidence interval.
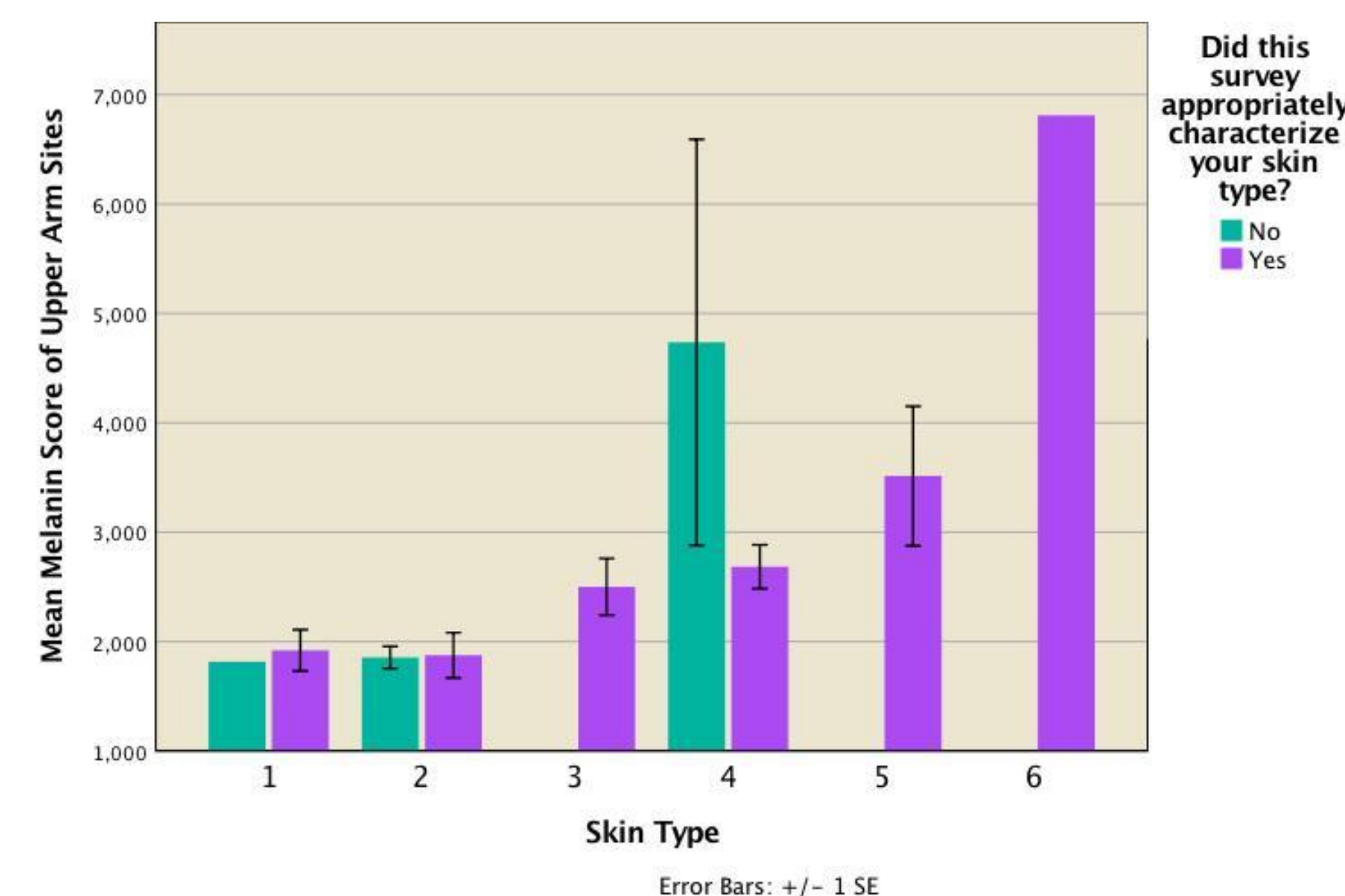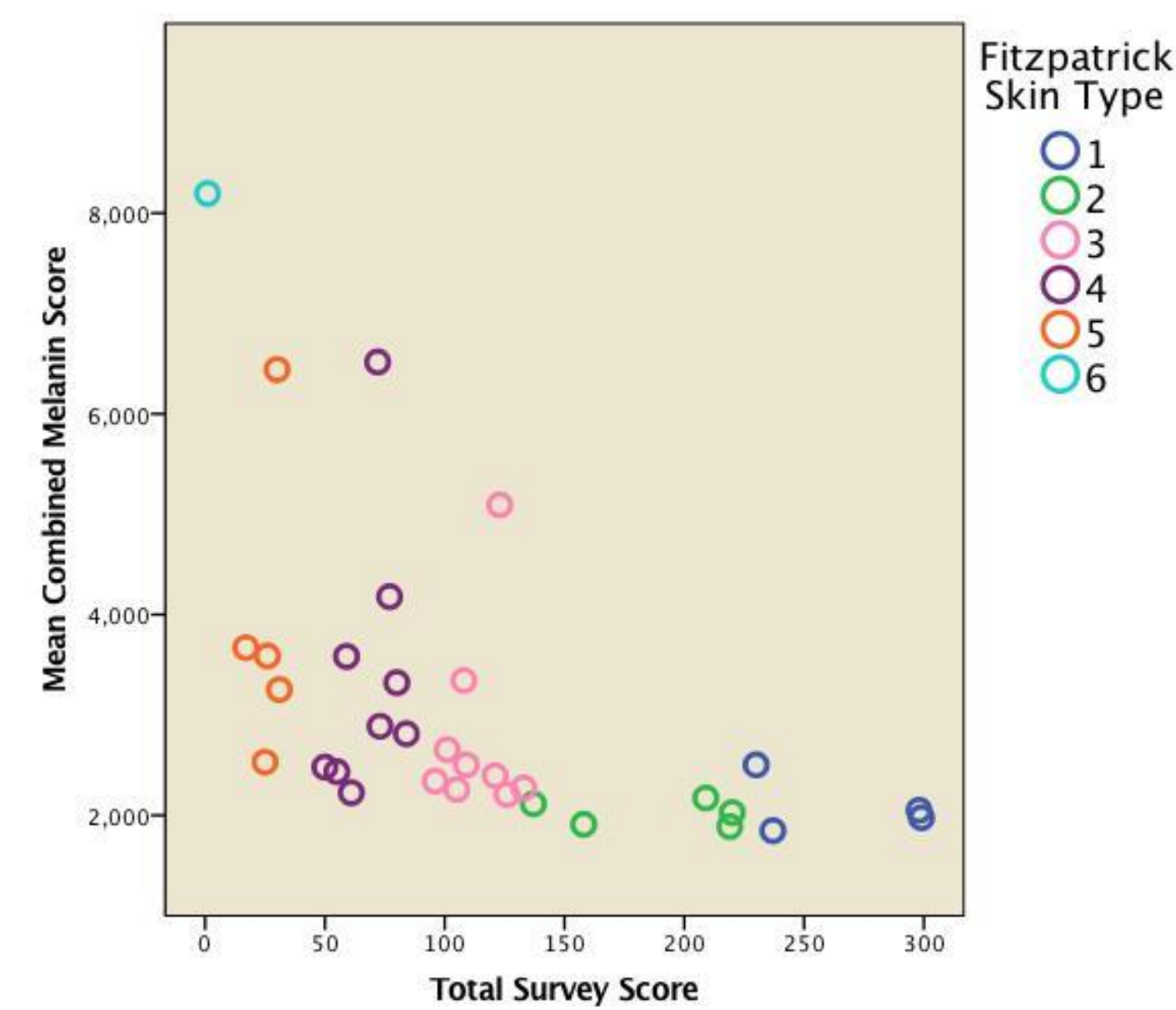
Melanin Content by Skin Site

Error Bars: +/- 1 SE (95%)

Participant Melanin Score by FST-E Score

Survey Question 1 Answers — Error Bars: +/- 2 SE
Survey Question 2 Answers — Error Bars: +/- 2 SE
Survey Question 3 Answers — Error Bars: +/- 2 SE

Multiple Comparisons

Bonferroni Post-Hoc

Dependent Variable	(I)	(J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
μ Dorsal Sites	1	2	67.47	485.27	1.000	-1356.46	1491.40
		3	-580.10	445.75	1.000	-1888.06	727.87
		4	-1262.95*	422.87	0.043	-2503.79	-22.11
		5	-1803.99	535.72	0.015	-3375.97	-232.02
	2	1	-67.47	485.27	1.000	-1491.40	1356.46
		3	-647.57	411.41	1.000	-1854.76	559.63
		4	-1330.42	386.51	0.012	-2464.55	-196.29
		5	-1871.46	507.51	0.005	-3360.65	-382.28
	3	1	580.10	445.75	1.000	-727.87	1888.06
		2	647.57	411.41	1.000	-559.63	1854.76
		4	-682.85	335.55	0.471	-1667.45	301.75
		5	-1223.89	469.86	0.120	-2602.61	154.82
	4	1	1262.95*	422.87	0.043	22.11	2503.79
		2	1330.42	386.51	0.012	196.29	2464.55
		3	682.85	335.55	0.471	-301.75	1667.45
		5	-541.04	448.22	1.000	-1856.25	774.17
	5	1	1803.99	535.72	0.015	232.02	3375.97
		2	1871.46	507.51	0.005	382.28	3360.65
		3	1223.89	469.86	0.120	-154.82	2602.61
		4	541.04	448.22	1.000	-774.17	1856.25
μ Ventral Sites	1	2	59.85	441.34	1.000	-1235.18	1354.89
		3	-652.15	405.40	1.000	-1841.71	537.41
		4	-1066.86	384.59	0.077	-2195.38	61.65
		5	-1679.98*	487.23	0.011	-3109.65	-250.30
	2	1	-59.85	441.34	1.000	-1354.87	1235.18
		3	-711.99	374.16	0.627	-1809.91	385.92
		4	-1126.71	351.52	0.023	-2158.17	-95.25
		5	-1739.82	461.56	0.004	-3094.19	-385.45
	3	1	652.15	405.40	1.000	-537.41	1841.71
		2	711.99	374.16	0.627	-385.92	1809.91
		4	-414.71	305.17	1.000	-1310.18	480.75
		5	-1027.83	427.33	0.198	-2281.73	226.08
	4	1	1066.86	384.59	0.077	-61.65	2195.38
		2	1126.71	351.52	0.023	95.25	2158.17
		3	414.71	305.17	1.000	-480.75	1310.18
		5	-613.12	407.64	1.000	-1809.26	583.03
	5	1	1679.98*	487.23	0.011	250.30	3109.65
		2	1739.82	461.56	0.004	385.45	3094.19
		3	1027.83	427.33	0.198	-226.08	2281.73
		4	613.12	407.64	1.000	-583.03	1809.26
μ Upper Sites	1	2	37.04	516.57	1.000	-1478.743	1552.817
		3	-595.88	474.50	1.000	-1988.211	796.455
		4	-984.32	450.15	0.334	-2305.200	336.567
		5	-1608.19	570.28	0.068	-3281.562	65.191
	2	1	-37.04	516.57	1.000	-1552.817	1478.743
		3	-632.92	437.94	1.000	-1917.980	652.150
		4	-1021.35	411.44	0.164	-2228.637	185.930
		5	-1645.22*	540.24	0.037	-3230.464	-59.982
	3	1	595.88	474.50	1.000	-796.455	1988.211
		2	632.92	437.94	1.000	-652.150	1917.980
		4	-388.44	357.19	1.000	-1436.549	659.672
		5	-1012.31	500.17	0.482	-2479.956	455.340
	4	1	984.32	450.15	0.334	-336.567	2305.200
		2	1021.35	411.44	0.164	-185.930	2228.637
		3	388.44	357.19	1.000	-659.672	1436.549
		5	-623.87	477.13	1.000	-2023.916	776.178
	5	1	1608.19	570.28	0.068	-65.191	3281.562
		2	1645.22*	540.24	0.037	59.982	3230.464
		3	1012.31	500.17	0.482	-455.340	2479.956
		4	623.87	477.13	1.000	-776.178	2023.916

*. The mean difference is significant at the 0.05 level.

Melanin Content Readings Support Self-Reported FST-E Survey

The melanin content findings show a well matched relationship with the scores from the FST-E revised surveys. We still feel there are changes that could be made to this survey to better appropriate the language to include all cultures with their sun safety behaviors.


Fitzpatrick Skin Type: 1, 2, 3, 4, 5, 6

Did this survey appropriately characterize your skin type? No / Yes
Error Bars: +/- 1 SE

Findings
from 57 adults in two day collection period

1 The comparison of melanin content with the self-reported skin type scores show a close relationship.
The shape fit of the data suggest the revision of the survey have yielded positive results combined with an objective measurement.

2 There are strong correlations between the FST-E scores and melanin scores.
The mean combined melanin scores and FST-E self-reported survey scores are clustering well. The outliers are likely confused somewhat in wording or intent of the survey.

3 The survey is scoring well and appropriating the correct skin types to individuals.
Less than 10% of participants felt the survey scored their skin type incorrectly. This shows improvement over prior versions and that the survey works for the vast majority of participants. More guidance or comprehension is necessary by reviewing the results and feedback.

4 The photospectroscopy is showing similarity in melanin content across all three sites among participants.
Shown above in the degrees of freedom are the differences between groups using post-hoc analysis. The group of skin type 6 was removed due to only having one participant categorized.

5 Melanin content and self-reported skin type scores are highly related
The data is showing consistent increase of melanin score across the FST-E scores which shows the appropriate categorization based on the melanin score ranges.

Future Project Considerations

Increased Participant Count For Refinement

Longitudinal Studies
Years Old — 25 35 45 50 65 80
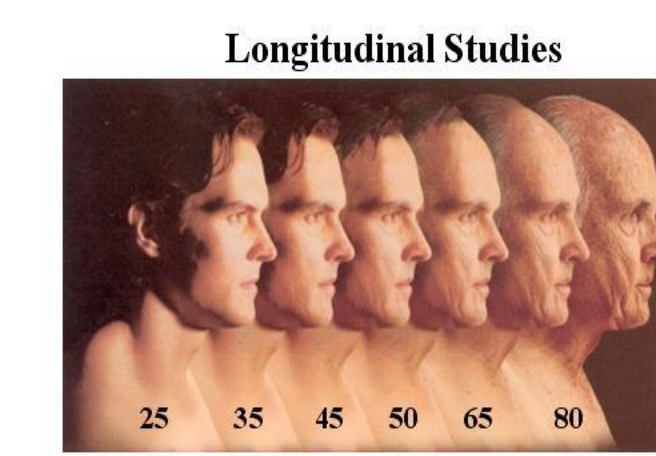
Future Possibilities
It will be more of a refined analysis if a greater sample is collected of participants to show well-defined melanin scores for the six skin types. This will help to determine a true validity of a skin rating system that's applicable for all skin types.

Individualized Sun Safety Behaviors

Personalized Reports
With the advent of the photospectroscopy combined with the self-reported survey we will be able to offer a more personalized set of suggestions for sun protection behaviors which will help an individual.

N=367
Mean age = 31.78
Age range = 18-81
Female = 267 – 71.1%
Male = 88 –
Non-binary = 12 –

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