

Composite skin carotenoid concentration is related to macular pigment volume: The Pharmanex BioPhotonic Scanner

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Introduction

- Carotenoids are a group of phytonutrients that play an important role in human health via their antioxidant and anti-inflammatory properties.
 - Three carotenoids lutein (L), zeaxanthin (Z) and meso-zeaxanthin (MZ) are exclusively found in the central part of the macula where they are commonly referred to as macular pigment (MP) [1]. Recent studies have also shown that L and Z are also present in the brain [2].
 - Measurement of these carotenoids in humans is challenging, costly and time consuming.
- Invasive measurements include:
- Obtaining biological samples (blood, skin biopsies) for High Performance Liquid Chromatography (HPLC) analysis.
- Minimally invasive measurements include:
- MP measurements using dual-wavelength autofluorescence.
- With improvements in technology there is now the potential to non-invasively measure carotenoid status in the skin. Devices such as the Nu Skin Pharmanex S3 scanner measure total carotenoid concentration using Raman Spectroscopy.
 - This work compares a non-invasive skin carotenoid score (SCS) to macular pigment volume (MPV) measurements.



Figure 1: Invasive blood sample for HPLC carotenoid analysis



Figure 2: Macular Pigment assessment requiring retinal dilation



Figure 3: Non-invasive skin carotenoid score using Nu Skin Pharmanex S3 scanner

Method

- Demographic, lifestyle and health variables from 75 subjects recruited at the Nutrition Research Centre Ireland (NRCI) were used for this investigation.
- SCS was measured using the Pharmanex BioPhotonic Scanner.
- MP was measured using the Heidelberg Spectralis HRA+OCT Multicolour system.

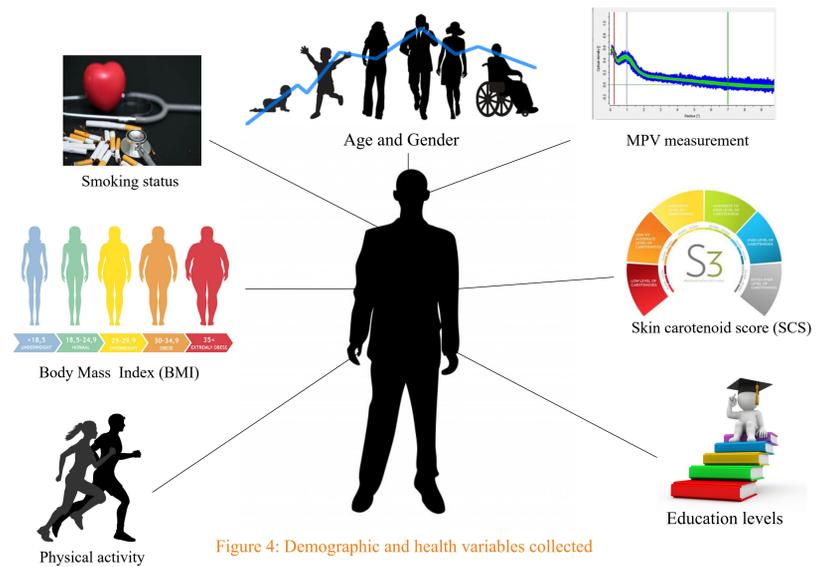


Figure 4: Demographic and health variables collected

Raman skin spectroscopy

- Raman spectroscopy (RS) takes advantage of the conjugated backbone common to all carotenoids. Upon exposure to blue light, vibrational energy known as Raman scattering is created.
- The intensity of the Raman scattering creates a spectral fingerprint, that is directly proportional to the concentrations of carotenoids present [3]. Lycopene and beta-carotene make up the majority of skin carotenoids, beta-cryptoxanthin, L and Z are also present in smaller concentrations [4].
- RS technique generates a SCS by measuring skin carotenoid concentrations between the maximal and distal palmar creases, directly below the fifth finger of the right hand.



Figure 5: Nu skin Pharmanex S3 scanner quantifies carotenoid concentrations using RS technique and generates a SCS

Results

- SCS was positively and significantly correlated to MPV ($r=0.339$, $p<0.005$, Figure 6).
- SCS was positively and significantly correlated to education level (in years) ($r=0.382$, $p<0.005$, Figure 7).
- SCS was inversely and significantly correlated to BMI ($r=-0.358$, $p<0.005$, Figure 8).
- Age, gender, smoking status and physical activity were not significantly correlated to SCS ($p>0.005$).

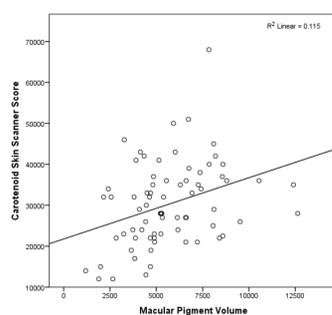


Figure 6: Scatter graph representing MPV and SCS

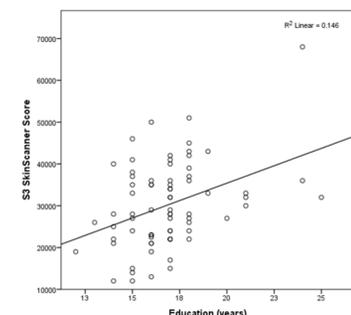


Figure 7: SCS correlates positively to education level (in years)

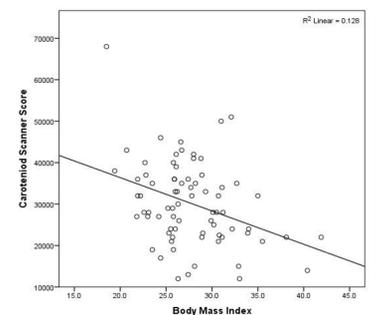


Figure 8: Significant inverse correlation between SCS and BMI

Conclusion

- Although the S3 scanner measures the total tissue concentrations of carotenoids, our research shows that it correlates well to MPV measurements.
- The SCS is advantageous when estimating total carotenoid levels as it is easy to use, quick (less than 60 seconds) and cost effective.
- This is particularly useful when dealing with vulnerable populations (e.g. patients with Alzheimer's disease) where invasive assessments are difficult to perform.

References

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Acknowledgement

We would like to thank Nu Skin Enterprises, who provided the S3 scanner and funding for this conference. Also we would like to acknowledge The Howard Foundation for their ongoing sponsorship of this research.

