

Fruit and vegetable intake and skin colour amongst young Australian women

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A thesis submitted for the degree of PhD (Nutrition and Dietetics)

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Kristine B Pezdirc

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Conflict of interest

Kristine Pezdirc reports no conflict of interest.

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Glossary of common abbreviations

AGTHE	Australian Guide to Healthy Eating
BMI	Body mass index
CI	Confidence interval
CHD	Coronary disease
FFQ	Food Frequency Questionnaire
HPLC	High Performance Liquid Chromatography
IQR	Interquartile range
kg	Kilograms
mg	milligrams
RCT	Randomised controlled trial
ROS	Reactive oxygen species
RRS	Resonance Ramon Spectroscopy
SD	Standard deviation
UV	Ultra violet
WHO	World Health Organisation
α	alpha
β	beta
μg	micrograms

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Abstract

Higher fruit and vegetable intakes are associated with reduced risk of excess weight gain, type 2 diabetes, coronary heart disease, stroke and some specific cancers. Despite this, young women report low intakes of fruit and vegetables compared to Australian adults generally. Fruit and vegetables contain carotenoid pigments, which give them their bright colours. These accumulate in human skin, contributing to skin yellowness. There is some evidence to show that higher intakes of fruit and vegetables may have a beneficial impact on the appearance of health but the relationship between dietary intake and skin appearance has been studied infrequently.

The main aims of this research were to: 1) examine the association between fruit and vegetable intake and skin colour appearance in young women; 2) compare the consumption of high carotenoid fruit and vegetables versus low carotenoid fruit and vegetables on skin colour and plasma carotenoids in young women; 3) investigate Australian adult's perceptions of health using standardised facial images associated with carotenoid-based skin colour. To meet these aims a series of four studies were conducted.

The first was a systematic review of the evidence examining the association between dietary intake and appearance and to also determine the effectiveness of dietary interventions on actual or perceived appearance. Nine observational studies examined the relationship between dietary intake and appearance and studies found significant associations between fruit and vegetable intake and skin colouration. The majority of dietary interventions (n=16) evaluated the effect of various dietary supplements on skin appearance outcomes among women and found significant improvements. Only one study examined the effect of actual food. This intervention evaluated the consumption of vegetables high in β -carotene versus β -carotene supplements on skin colour appearance. Overall this systematic review demonstrated that there is currently insufficient evidence to determine the association between actual food and skin appearance. Further studies are required in representative populations that examine

actual food intake on appearance, using validated tools and well-designed high-quality randomised control trials.

A cross-sectional study was conducted to examine the association between fruit and vegetable intake and skin colour in young women (n=91, 18-30 years) from the Hunter region. Fruit and vegetable intake was assessed by a validated food frequency questionnaire, with skin colour measured using spectrophotometry. The results showed that women who reported higher fruit and vegetable intakes had significantly higher overall skin yellowness (b^*) ($\beta=0.8$, $p=0.017$).

The third study was the randomised cross-over trial conducted in young women (n=30, 18-30 years). This trial investigated whether consuming the same quantity of fruit and vegetables that were either high in β -carotene or low in β -carotene was associated with a difference in skin yellowness (b^*) and in plasma carotenoid concentrations over four weeks. Skin colour was assessed by reflectance spectroscopy (CIE $L^*a^*b^*$) and fasting plasma carotenoids were determined by high performance liquid chromatography, pre and post each four week intervention period. The results showed that there was a significantly greater increase in skin yellowness (b^*) ($p<0.001$) following consumption of high carotenoid fruit and vegetables, with no change in skin lightness (L^*) or redness (a^*), compared to the low β -carotene intervention. Significantly higher plasma α -carotene ($p=0.004$), β -carotene ($p=0.001$) and lutein ($p=0.028$) concentrations were found following consumption of the high carotenoid fruit and vegetables. Overall skin yellowness (b^*) correlated with α -carotene ($r=0.29$, $p<0.05$) and β -carotene ($r=0.35$, $p<0.001$).

The final study evaluated whether skin colouration attributed to fruit and vegetable consumption influences young adults perception of health. The results showed that Australian adults perceive facial skin colouration, associated with both carotenoid intake from fruit and vegetables and melanin as conveying the appearance of health. However carotenoid colouration was perceived as more important to health than melanin.

The body of research presented in this thesis provides further evidence that dietary intake, in particular fruit and vegetables, has an impact on skin yellowness. This skin colouration is was also shown to be perceived as conveying the appearance of health. As young adults, in particular women are motivated to change behaviour to improve their appearance, this research provides further justification for a behavioural intervention to improve fruit and vegetable intake that focuses on appearance.