

Serum Markers of Fruits and Vegetables are Lower in Low-Income Adults in the United States

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Abstract

The phlebotomy sample from the United States National Health and Nutrition Examination Survey (NHANES) 2003-2004 was analyzed to study the relationship between poverty and markers of fruit and vegetables consumption. Data from 10,952 adults, comprising 5,478 men, and 5,474 women were analyzed for this study. Results showed that adults living below poverty line had significantly lower serum concentration of α -carotene (3.3 ± 0.1 vs 4.2 ± 0.7), β -carotene (13.4 ± 0.3 vs 16.6 ± 0.2), lutein (8.8 ± 0.1 vs 10.6 ± 0.1) and lycopene (19.4 ± 0.2 vs 21.7 ± 0.2) (all $p < 0.001$), compared to adults living above poverty line. After adjusting for predictors, adults living below poverty line were more likely to have serum concentrations that were below the median (OR; 95% CI): α -carotene (1.77; 1.41-2.25), β -carotene (1.62; 1.28-2.04), lutein (1.52; 1.12-2.17), and lycopene (1.42; 1.13-1.79), all $p < 0.001$. It was concluded that poverty curtailed the consumption of carotenoid-rich foods such as fruits and vegetables, with concomitant decreases in serum carotenoid concentration. Food assistance to low income adults should include options that improve consumption of carotenoid-rich foods.

Introduction

Poverty and food insecurity alter food habits due to coping adaptations. Those living below the poverty line may experience decreased consumption of fresh fruits and vegetables with corresponding decreases in serum concentrations of their component carotenoids. About 12.3% of Americans are living in poverty according to the US Census Bureau (ASPE, 2017). The reported preference for calorie dense, sugary and fatty foods to the detriment of nutrient dense foods in low-income groups may be elucidated by examining the serum concentrations of carotenoids as markers of fruits and vegetables consumption. Adequate consumption of fresh fruits and vegetables could mean adequate serum concentrations of carotenoids most of which are precursors of vital nutrients and potent antioxidants.

Objectives

The objectives of this study were: 1) To estimate the serum concentrations of selected carotenoids in the American population.

2) To estimate the serum concentrations of carotenoid markers of fruits and vegetables for low- and high-income groups. 3) To test differences in serum concentration of carotenoid markers of fruits and vegetables between low and high income groups.

Methods

Multiple regression models were used to examine associations between income level and serum carotenoid concentrations while controlling for predictors. The following serum carotenoid markers were used to indicate consumption of fresh fruits and vegetables: α -carotene, β -carotene, lutein, and lycopene. They were examined by income level, expressed as poverty-income ratio (PIR) provided by the U.S. Census Bureau. To examine the relationships, participants were categorized into two groups, 1) low-income, and 2) high-income. Those categorized as low-income had PIR $< 130\%$ of the federal poverty threshold, whereas those categorized as high-income had PIR $\geq 130\%$. The poverty cut-off of 130% applied was based on that used for income-based food assistance eligibility (Food and Nutrition Service, 2018). In this analysis, the high income category was the referent. To improve the reliability and validity of the analyses, the following predictors of serum carotenoid concentration were controlled: age, body weight, education, ethnicity, marital status, and smoking. Statistical significant differences were tested at $p < 0.05$.

Results

Mean values of α -carotene (2.5 ± 0.06), β -carotene (16.1 ± 1.0), lutein (10.2 ± 0.3), and lycopene (22.5 ± 0.3) were observed for this sample. Low-income adults had significantly lower serum concentration of α -carotene (3.3 ± 0.1 vs 4.2 ± 0.7), β -carotene (13.4 ± 0.3 vs 16.6 ± 0.2), lutein (8.8 ± 0.1 vs 10.6 ± 0.1) and lycopene (19.4 ± 0.2 vs 21.7 ± 0.2) (all $p < 0.001$), compared to high income adults. After adjusting for predictors, Low-income adults were more likely to have serum concentrations that were below the median (OR; 95% CI): α -carotene (1.77; 1.41-2.25), β -carotene (1.62; 1.28-2.04), lutein (1.52; 1.12-2.17), and lycopene (1.42; 1.13-1.79), all $p < 0.001$.

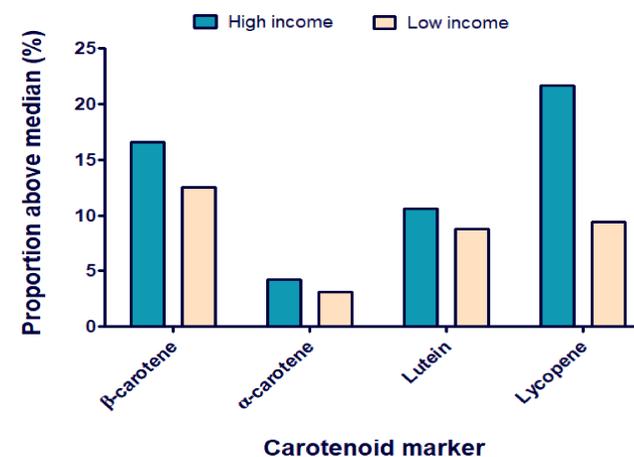


Figure 1. Serum carotenoids concentrations as markers of fruits and vegetables consumption grouped by income level. Low-income persons had significantly lower concentrations, all $p < 0.001$.

Table 1. Likelihood of having below median concentration of carotenoids by income level

	Income level	
	High (n=7,648)	Low (n=3,304)
β -carotene	1.00 (ref)	1.62 * (1.28-2.04)
α -carotene	1.00 (ref)	1.77 * (1.41-2.25)
Lutein	1.00 (ref)	1.52* (1.12-2.17)
Lycopene	1.00 (ref)	1.42* (1.13-1.79)

*Significantly likely to have below median concentration than high income group, $p < 0.001$

Conclusions

Low-income persons have lower serum concentration of α -carotene, β -carotene, lutein and lycopene compared to high income persons. Based on the concentrations of these serum markers, it is inferred that low income persons consume less fruits and vegetables.

Implications

Adequate consumption of fresh fruits and vegetables could mean adequate levels of carotenoids most of which are precursors of vital nutrients and potent antioxidants. α -Carotene and β -carotene are pro-vitamin A sources and together with lutein and lycopene are potent antioxidants against major cancers and macular degeneration.

Recommendations

Food assistance to low income adults should include options that improve consumption of carotenoid-rich foods which are fruits and vegetables. Nutrition and health education among low income adults should promote increased consumption of carotenoid-rich sources.

References

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