

Association between Fruit and Vegetable Dietary Intake Measured by Skin Carotenoids and Blood Pressure among Adults Attending Community Health Fairs

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BACKGROUND

- Elevated blood pressure affects nearly half (47.7%) of U.S. adults and is a major modifiable risk factor for cardiovascular disease.¹
- Diets rich in fruits and vegetables are associated with lower blood pressure.^{2–3} The Veggie Meter® uses reflection spectroscopy to non-invasively measure skin carotenoid levels, this objective biomarker of fruit and vegetable intake has been validated against plasma carotenoids.⁵
- Although skin carotenoid scores are useful for assessing dietary intake of fruit and vegetables, limited evidence exists on whether Veggie Meter® scores are associated with blood pressure among U.S adults in a community settings.
- Objective:** To examine the association between Veggie Meter® skin carotenoid scores and systolic (SBP) and diastolic (DBP) blood pressure among adults attending community health fairs.

METHODS

Design: Cross-sectional community-based study. (N = 219)

Participants: Adults aged ≥18 years who consented to research use of their screening data.

Data Sources: Prospective data were collected at farmers markets (n = 137), community health events, and Indiana University staff resource fairs. Retrospective data (n= 82) were obtained from existing rural community health-screening studies with comparable variables. The study was approved by the Indiana University Institutional Review Board (#29797).

Procedures: Participants completed a brief intake form, Veggie Meter® assessment, and blood pressure measurement. USDA nutrition education materials and a blood pressure management brochure were offered. Study procedures lasted approximately 5–10 minutes. Participants who consented to research participation were entered into a raffle for a \$20 gift card.

Measures

Skin carotenoid score: Assessed using the Veggie Meter® (Longevity Link, UT; range: 0–800) ; three consecutive readings were obtained and averaged.

Blood pressure: Measured using an automated sphygmomanometer (A&D Medical, San Jose, CA; Model UA-651); two readings were averaged.

BMI: Self reported height and weight.

Demographics: Age, gender, and race/ethnicity were collected using participant intake forms.

Analysis: Pearson correlations and multiple linear regression models examined associations between skin carotenoid scores and systolic and diastolic blood pressure. Models adjusted for age, gender, BMI, and race/ethnicity. Analyses were conducted in R version 4.5.2 with statistical significance was set at $p < 0.05$.

References

- Fryar CD, et al. *NCHS Data Brief*. 2024
- Appel LJ, et al. *N Engl J Med*. 1997
- Madsen H, et al. *Eur J Nutr*. 2023
- Jilcott Pitts SB, et al. *J Nutr*. 2022

The contents and findings of this poster are those of the author and do not represent the official views of the Centers for Disease Control & Prevention or Department of Health and Human Services.

RESULTS

Table 1. Sociodemographic Characteristics, Skin Carotenoid Scores and Blood Pressure Measures of Study Participants (N = 219)

	Total (N=219)	
	Mean ± SD or N (%)	
Age	47	(17.4)
Gender^a		
Female	157	(73)
Male	58	(27)
BMI (kg/m²)	29	(7.7)
Race/Ethnicity^b		
White	121	(58.5)
Black or African American	43	(20.3)
Asian	13	(6.3)
Hispanic or Latino	27	(13.0)
Other/Multiracial	4	(1.9)
Skin Carotenoid Score	281	(95.9)
Veggie Meter Categories		
Very Low (<200)	42	(19.2)
Low (200-300)	97	(44.3)
Room for Improvement (300-400)	52	(23.7)
Good (400-500)	19	(8.7)
Excellent (>500)	9	(4.1)
Blood Pressure		
Systolic Blood Pressure (mmHg)	127	(17.1)
Diastolic Blood Pressure (mmHg)	81	(9.7)
Blood Pressure Categories ^c		
Normal	62	(28.6)
Elevated	20	(9.2)
Hypertension Stage 1	74	(33.1)
Hypertension Stage 2	60	(27.6)
Hypertensive Crisis	1	(0.5)

^a Gender, n = 215; ^b Race/ethnicity, n = 207; ^c Blood pressure category, n = 217. Hypertension Stage 1 (130–139 or 80–89 mmHg); Hypertension Stage 2 (≥140 or ≥90 mmHg); Hypertensive Crisis (>180 and/or >120 mmHg). Percentages were calculated using the number of participants with non-missing data for each variable; denominators therefore vary.

Figure 1. Association between skin carotenoid score and systolic blood pressure.

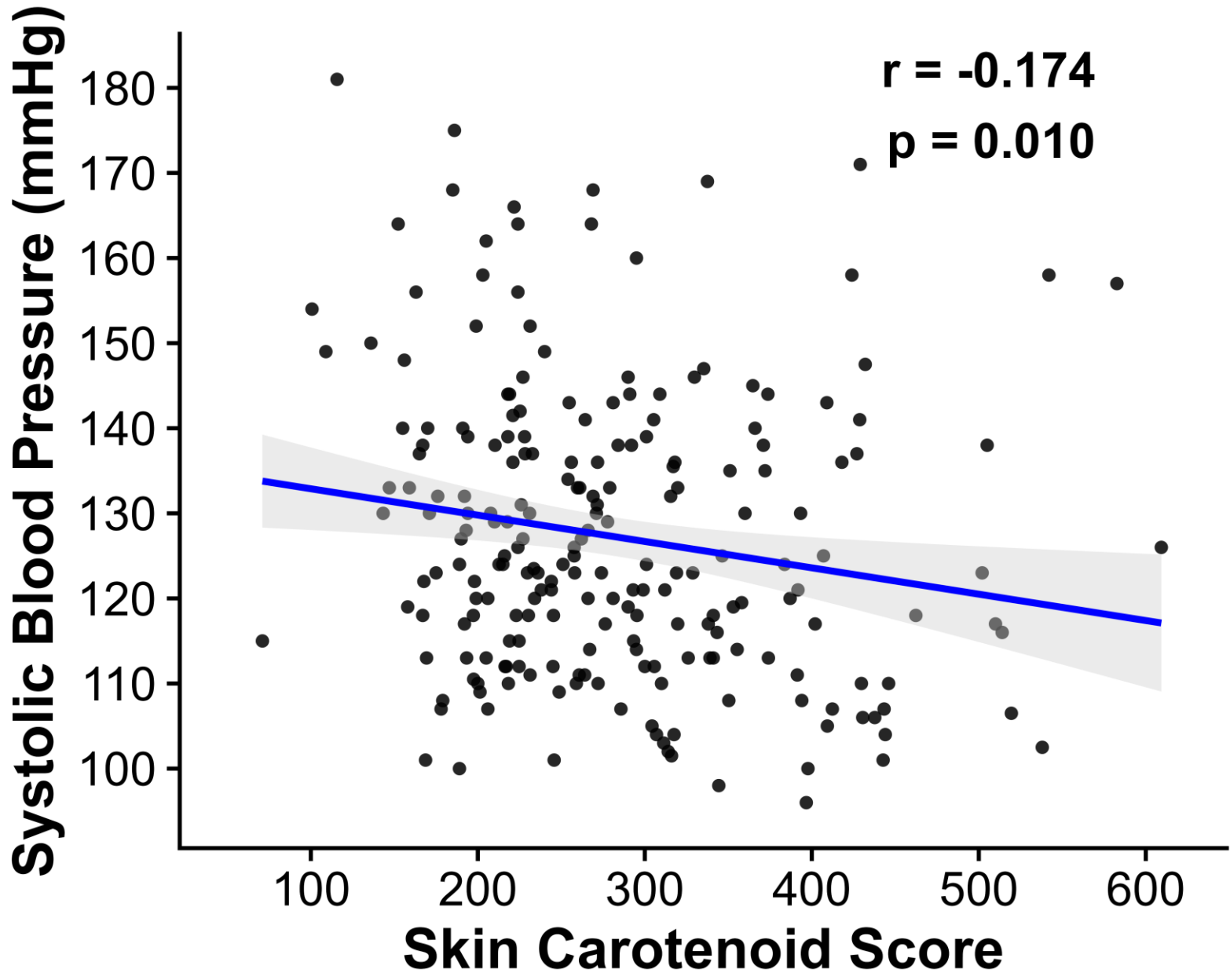


Figure 2. Association between skin carotenoid score and diastolic blood pressure

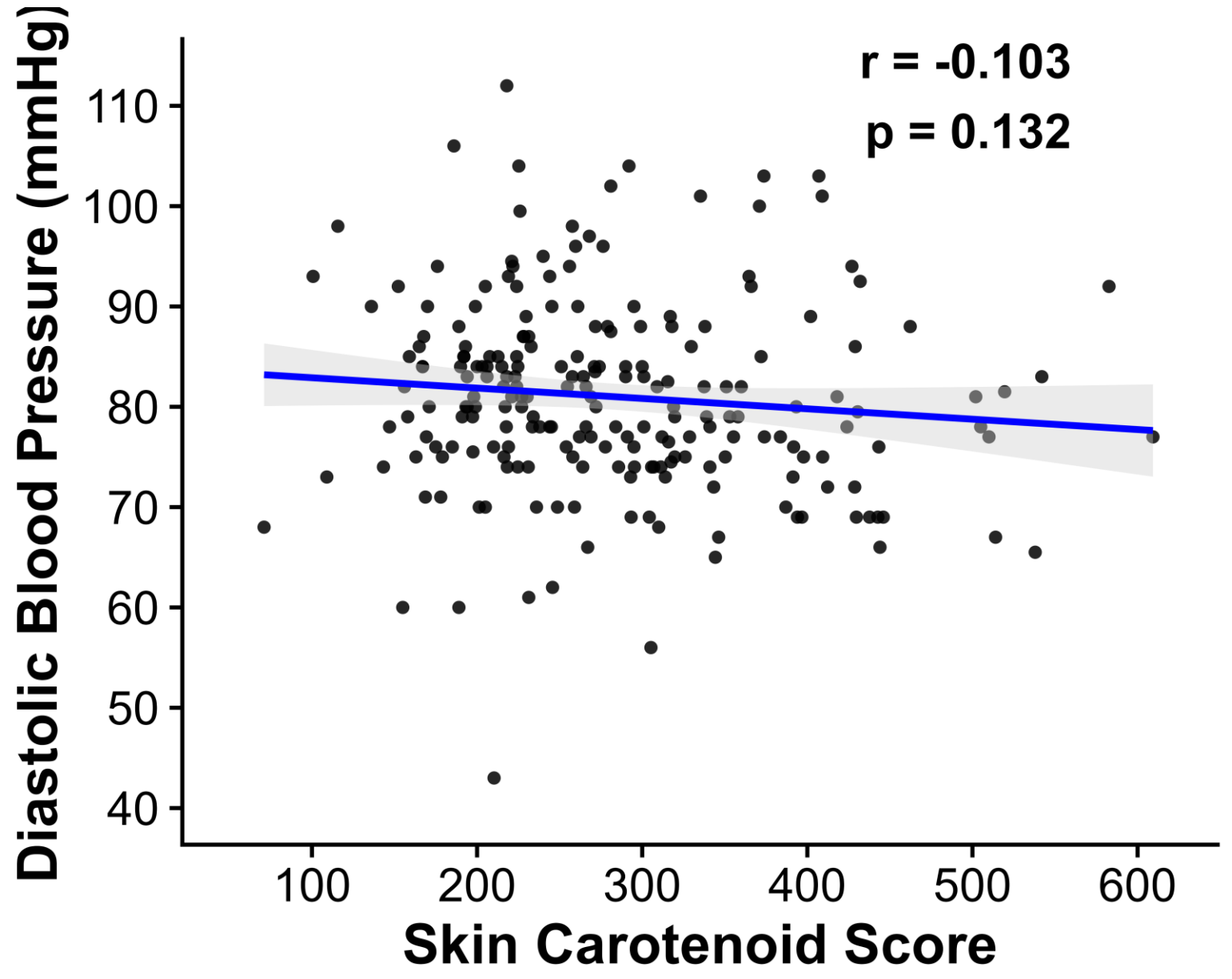


Table 2. Adjusted Associations Between Skin Carotenoid Score and Blood Pressure

Variable	Systolic Blood Pressure β (95% CI)	p	Diastolic Blood Pressure β (95% CI)	p
Skin carotenoid score	-0.02 (-0.04, 0.00)	0.063	-0.01 (-0.02, 0.01)	0.366
Age (years)	0.36 (0.24, 0.48)	<0.001	0.06 (-0.02, 0.14)	0.124
Female	-7.67 (-12.24, -3.10)	0.001	-1.74 (-4.77, 1.29)	0.280
BMI (kg/m ²)	0.36 (0.07, 0.65)	0.014	0.14 (-0.05, 0.33)	0.129
Black or African American	9.49 (4.11, 14.88)	0.001	3.17 (-0.29, 6.63)	0.120
Asian	-5.25 (-13.67, 3.18)	0.221	-3.15 (-8.67, 2.36)	0.261
Hispanic or Latino	-1.99 (-8.38, 4.41)	0.540	-4.11 (-8.30, 0.07)	0.054
Other/Multiracial	10.58 (-6.36, 27.52)	0.219	-0.16 (-10.93, 11.25)	0.977

Note. Linear regression models were adjusted for age, gender, BMI, and race/ethnicity. Reference categories were Male and White. SBP model: $n = 194$, R^2 adjusted = 0.309; DBP model: $n = 194$, R^2 adjusted = 0.076. Boldened values indicate significant covariate at $p < 0.05$

Findings: Although an inverse association tended towards significance, skin carotenoid score was not significantly associated with systolic or diastolic blood pressure after adjustment for age, gender, BMI, and race/ethnicity.

CONCLUSION

- **Skin carotenoid score was not independently associated with systolic or diastolic blood pressure after adjustment for age, gender, BMI, and race/ethnicity.**
- Age, BMI, and Black race/ethnicity were independently associated with higher systolic blood pressure.
- **Strength:** The study used the Veggie Meter®, a validated, noninvasive objective biomarker of fruit and vegetable intake, in a real-world community health screening setting.
- **Limitation:** The study enrolled 219 participants, below the a priori target sample size of 542, which may have limited the ability to detect modest associations.
- **Future directions:** Additional participant recruitment is ongoing to reach the target sample size and further evaluate the association between skin carotenoid score and blood pressure.