Associations between dietary quality and inflammation among Bhutanese refugee adults eligible for the Supplemental Nutrition Assistance Program

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Introduction

Immigrants and refugees from the Indian subcontinent and specifically from refugees from Bhutan have higher rates diet related chronic diseases such as cardiovascular disease and type 2 diabetes mellitus than whites and even other minority communities[1-4] These disparities along with the rapid growth of the Bhutanese refugee population in the United States increase the importance of understanding behaviors in this community that may contribute to cardiometabolic risk and incidence of chronic disease.[5] Because cardiovascular disease and type two diabetes progression has been linked to diet and chronic inflammation, we proposed to examine how Bhutanese refugees residing in New Hampshire are eating and how this may impact their inflammatory burden.[6-8] This work will improve our ability to design effective and culturally relevant nutrition education.

Objective

To quantify the associations between adherence to U.S. dietary guidelines and inflammation among Bhutanese refugee adults who are eligible to receive SNAP (Supplemental Nutrition Assistance Program) benefits..

Methods

Participants:
- Participants consisted of 53 adult Bhutanese refugees eligible for SNAP.
- Convenience sample recruited by a bi-cultural community health worker
- Exclusion criteria: planned to move during the study, pregnant, took antibiotics within the past 6 months

Study Design:
- Cross-sectional design to measure association between dietary intake and biomarkers of inflammation
- Survey and dietary data collected by a trained community health worker
- Blood samples collected by a trained phlebotomist
- Approved by University of New Hampshire IRB

Measurements:
- Diet quality determined by the Healthy Eating Index 2015 and its components using dietary data from three 24-hour recalls processed by the Nutrition Data System for Research
- Interleukin-6 and tumor necrosis factor alpha measured from fasting plasma samples using enzyme-linked immunosorbent assay (ELISA)
- A variety of demographic and health information such as age, sex, physical activity, years living in the U.S., education, smoking status, type 2 diabetes status, and cardiovascular disease

Data Analysis:
- ANCOVA to compare mean differences in circulating IL-6 and TNFα between tertiles of diet quality by HEI2015 and its components
- Covariates: Age, type 2 diabetes status
- Analyses conducted using SAS version 9.4

Subject Characteristics

Table 1. Demographics by Tertiles of Healthy Eating Index 2015

Diet Quality	Demographic	Tertile 1 n=17	Tertile 2 n=18	Tertile 3 n=18	$P_{1 vs 2}$	$P_{1 vs 3}$	P-trend
HEI2015	Age (years)	43.7 ± 3.5	42.4 ± 3.5	55.3 ± 2.6	0.96	**0.04**	**0.02**
HEI2015	Gender (% female)	82%	83%	83%	1.00	1.00	0.94
HEI2015	Physical Activity Level	28.3 ± 0.8	28 ± 0.8	28.8 ± 0.8	0.96	0.88	0.62
HEI2015	Years in US	7.47 ± 1.4	7.47 ± 0.5	8.44 ± 0.7	1.00	0.75	0.46
HEI2015	Smoker	6%	6%	11%	1.00	0.84	0.56
HEI2015	High School Completion	6%	11%	22%	0.89	0.34	0.16
HEI2015	Type 2 Diabetes	35%	22%	67%	0.69	0.13	0.06
HEI2015	Cardiovascular Disease	6%	17%	6%	0.53	1.00	0.96
HEI2015	Daily Calories	1220 ± 84	1290 ± 89	1290 ± 76	0.80	0.80	0.53
HEI2015	Body Mass Index	27.8 ± 1.2	28.1 ± 1.0	28.9 ± 1.1	0.97	0.73	0.45
HEI2015	Household Size	3.47 ± 0.3	3.44 ± 0.4	4.50 ± 0.4	1.00	0.13	**0.05**

Results:
## Nutrient Intake by Hours of Video Games Played

Table 2. Inflammatory Biomarkers by Diet Quality Tertiles

Inflammatory Biomarker	Dietary Variable	Tertile 1 n=17	Tertile 2 n=18	Tertile 3 n=17	$P_{1 vs 2}$	$P_{1 vs 3}$	P-trend
Interleukin 6 (pg/mL)	HEI2015	3.06 ± 0.47	2.38 ± 0.41	2.03 ± 0.48	0.64	0.13	**0.05**
	HEI1 (Total Fruit)	2.92 ± 0.42	2.86 ± 0.51	1.64 ± 0.40	1.00	0.06	**0.03**
	HEI2 (Whole Fruit)	2.86 ± 0.41	2.7 ± 0.52	1.85 ± 0.45	1.00	0.12	**0.05**
	Total Vegetable (cup eq./1000 kcals)	2.44 ± 0.50	2.73 ± 0.48	2.27 ± 0.41	0.64	0.75	0.48
	Greens and Beans (cup eq./1000 kcals)	3.28 ± 0.52	1.51 ± 0.30	2.73 ± 0.45	0.09	0.99	0.98
	HEI5 (Whole Grains)	2.9 ± 0.51	2.26 ± 0.38	2.31 ± 0.49	0.73	0.93	0.67
	HEI6 (Total Dairy)	3.49 ± 0.44	1.57 ± 0.32	2.45 ± 0.50	0.03	0.40	0.19
	HEI7 (Protein)	2.34 ± 0.50	2.5 ± 0.44	2.6 ± 0.46	0.74	0.98	0.90
	HEI8 (Sea & Plant Protein)	2.49 ± 0.45	2.52 ± 0.48	2.46 ± 0.46	0.96	0.99	0.88
	HEI9 (Fatty Acid Ratio)	1.95 ± 0.49	3.2 ± 0.65	2.57 ± 0.34	0.13	0.26	0.17
	HEI10 (Refined Grains)	2.77 ± 0.37	2.59 ± 0.59	1.98 ± 0.48	0.98	0.18	0.11
	HEI11 (Sodium)	2.7 ± 0.50	2.22 ± 0.34	2.55 ± 0.54	0.79	0.32	0.15
	Saturated Fat (% kcals)	2.72 ± 0.49	2.53 ± 0.40	2.21 ± 0.50	0.88	0.35	0.16
	Added Sugar (% kcals)	2.94 ± 0.49	2.28 ± 0.44	2.25 ± 0.45	0.34	0.35	0.17
	Total Fiber (grams/1000 kcals)	2.71 ± 0.51	2.28 ± 0.37	2.48 ± 0.50	0.92	0.99	0.90
Tumor Necrosis Factor Alpha (pg/mL)	HEI2015	7.68 ± 1.65	14.2 ± 3.22	7.33 ± 1.15	0.98	0.94	0.78
	HEI1 (Total Fruit)	8.02 ± 1.67	11.9 ± 2.65	10 ± 2.81	0.86	0.96	0.77
	HEI2 (Whole Fruit)	10.1 ± 2.59	12.8 ± 2.7	7.03 ± 1.22	0.72	0.80	0.54
	Total Vegetable (cup eq./1000 kcals)	8.72 ± 1.54	12.2 ± 3.22	8.36 ± 1.75	1.00	0.94	0.73
	Greens and Beans (cup eq./1000 kcals)	11 ± 2.37	6.36 ± 1.21	12.3 ± 3.02	0.55	0.93	0.66
	HEI5 (Whole Grains)	10.3 ± 2.54	11.7 ± 2.88	7.3 ± 1.1	1.00	0.87	0.62
	HEI6 (Total Dairy)	12.2 ± 2.54	9.04 ± 2.81	8.18 ± 1.33	0.24	0.79	0.49
	HEI7 (Protein)	9.06 ± 2.21	11.2 ± 2.83	8.73 ± 1.34	0.91	0.99	0.84
	HEI8 (Sea & Plant Protein)	7.56 ± 1.47	12.9 ± 3.91	9.65 ± 1.73	0.74	0.46	0.24
	HEI9 (Fatty Acid Ratio)	10 ± 2.84	6.98 ± 1.89	10.8 ± 1.91	0.95	0.94	0.69
	HEI10 (Refined Grains)	8.79 ± 1.85	15.7 ± 5.56	8.64 ± 1.13	0.21	0.54	0.19
	HEI11 (Sodium)	8.09 ± 1.1	12.1 ± 3.01	9.08 ± 2.39	0.88	0.34	0.16
	Saturated Fat (% kcals)	7.09 ± 1.93	10.9 ± 2.27	11.3 ± 2.73	0.50	0.31	0.14
	Added Sugar (% kcals)	8.78 ± 1.92	8.15 ± 1.52	12.6 ± 3.27	0.99	0.93	0.71
	Total Fiber (grams/1000 kcals)	10.4 ± 2.43	10.2 ± 2.75	8.76 ± 1.77	0.97	0.81	0.54

Broader Context

Fruits such as bananas, apples, pears, and mangos, which are the five most consumed fruits in this population, could be used to tailor future nutrition education interventions for Bhutanese refugees across the U.S. Improved nutrition education and dietary behaviors in this community are critical because of the large health disparities seen in the Bhutanese compared to whites. .

Inflammation by Diet Quality
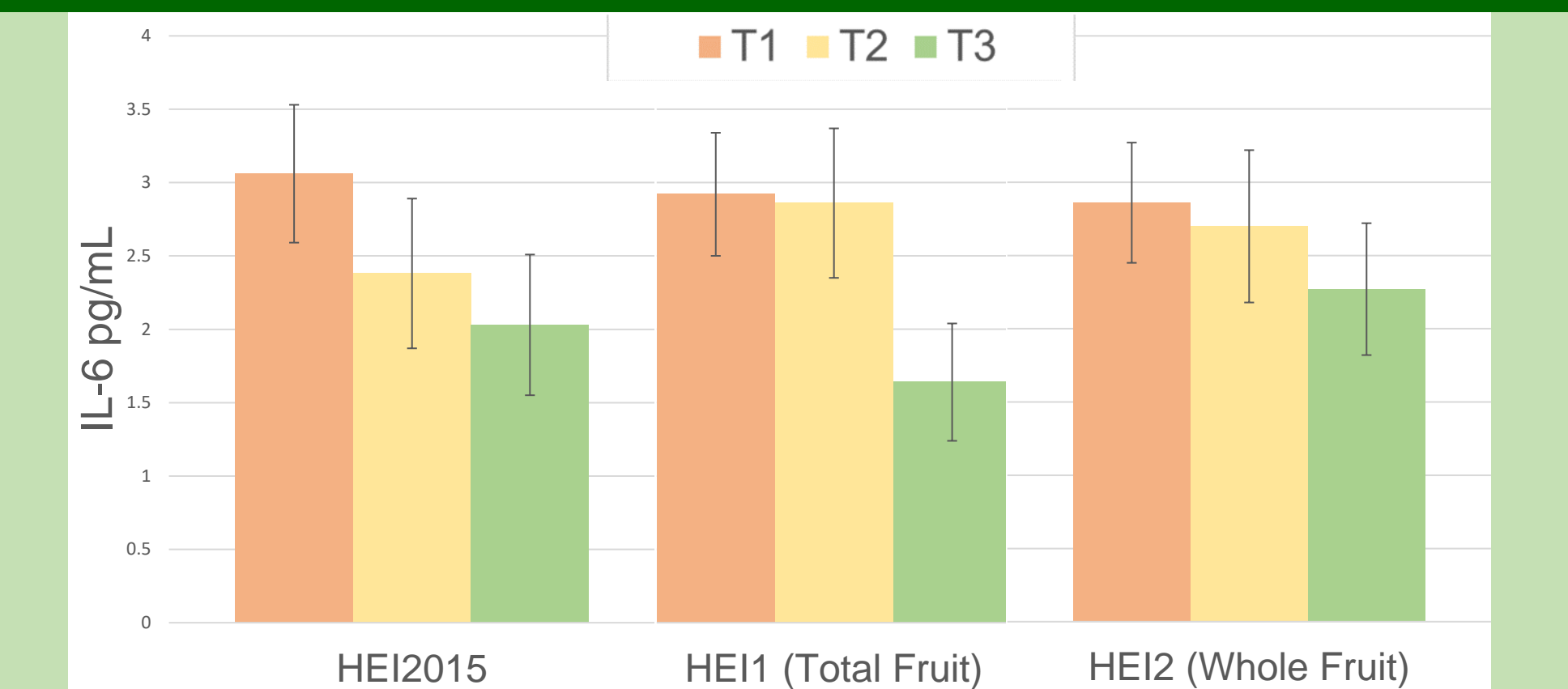
Conclusions

- In adult Bhutanese refugees, lower circulating plasma interleukin-6 levels are associated with higher:
  - Overall diet quality by HEI 2015
  - Total fruit consumption by HEI 2015 component 1
  - Whole fruit consumption by HEI 2015 component 2
- This population has significantly higher prevalence of type two diabetes than the U.S. average with a prevalence of over 40%
- Integration of fruit-based lessons in nutrition education may be a way to improve diet and health outcomes

Strengths & Limitations

Strengths:
- Examination of an under researched population
- 24-hour recalls conducted by a trained, bi-cultural community health worker in the participants preferred language
- Objective measures of inflammation used (IL-6, TNFα)

Limitations:
- Cross-sectional studies cannot rule out reverse causation
- Self-reported diet data can have varying accuracy
- Results may not be generalizable to populations outside of Bhutanese refugees in America

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