

Young Bites, Big Questions: Unpacking Diet and Disparity among US Children

Introduction and Research Questions

Child dietary habits are emerging as a critical aspect of public health discourse. This project examines dietary consumption frequency in early and middle childhood (ages 2-12), where nutrition may play a pivotal role in shaping health outcomes later in life.^(1, 2) It asks:

1. How common is unhealthy consumption among US children?
2. How are socio-economic factors associated with unhealthy consumption patterns?

Data Management

This project analysed the National Health and Nutrition Examination Survey (NHANES),⁽³⁾ featuring dietary and socio-economic measures. Data management included:

Bash:

- Joining raw datasets
- Filtering data by age
- Recoding missing values

R:

- Data integrity checks
- Variable creation*
- Removing extraneous columns
- Creating visualisations and a shiny app.

*Dietary questions (e.g. “In the last year, how often have you eaten apples?”) contained responses from 1 (“never”) to 11 (“2+ times p/day”). These were grouped into fruit, vegetables or sugar and averaged to form *consumption indices*. Additionally, binary variables indicate whether any fruit/vegetable was consumed no more than each frequency (e.g. ‘fruit_1’ signifies *never* consuming fruit) – or, for sugar, *at least one* item at that frequency.

Visualisation Approach

First visualisation (research question one)

- Density plots: captures index distributions, utilising colour and shape for pattern perception.
- Overlapping plots: utilises ‘boundary perception’ principles for comparative analysis, highlighting differences in shapes/areas.⁽⁴⁾
- Transparency effect: prevents information loss by occlusion.

Second visualisation (research question one)

- Bar chart: groups data for response comparison among extreme-consumption groups.
- Faceting by food: shifts comparative focus from *cross-* to *within*-food groups.
- Data literacy considerations:

- Y-axis fixed at '50%' to avoid overinflating prevalence through exaggerated vertical scaling.
- Direct bar labelling provides precise quantitative insight.

Shiny dashboard (research question two)

Available at: <https://sammakesapps.shinyapps.io/YoungBites/>

Designed for policymakers, this dashboard allows users to undertake dimension selection / variable comparison of the data to identify vulnerable groups. Additional features focussed on ease-of-use for non-technical audiences, and include:

- Use of 'natural language' for selection options.
- A data table to offer a more precise quantitative assessment.
- A 'variable guide' to assist interpretability.
- A colour-blindness-friendly mode to enhance accessibility, aligning with principles for inclusive visual design.⁽⁵⁾

Results

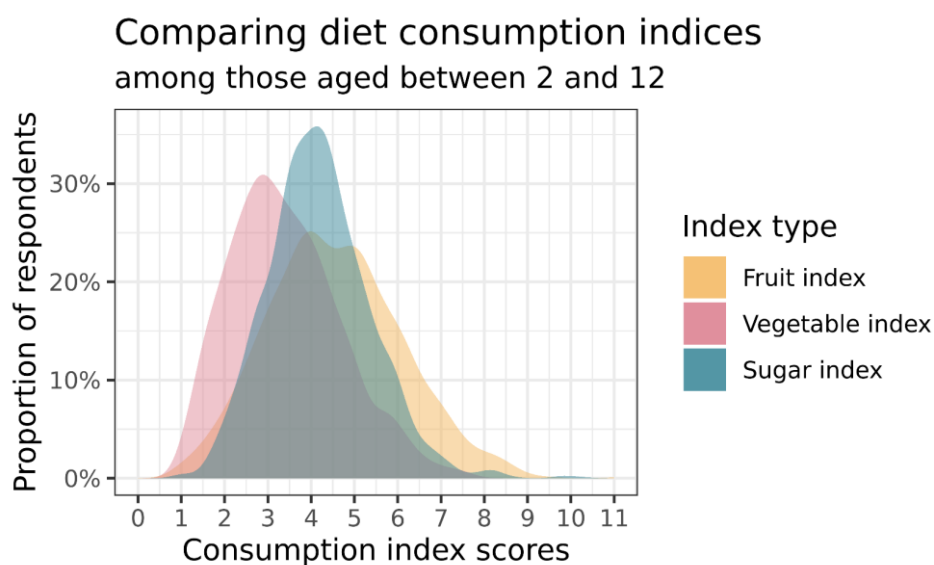


Figure 1: distribution of fruit, vegetable and sugar indices.

For sugar consumption, *Fig.1* reveals a mode (i.e. the most commonly occurring index score) of ~4, corresponding to a frequency of “once per month”. Notably, the distribution’s right tail indicates a small segment consuming sugar far more frequently.

The vegetable index sits most commonly at ~3, corresponding to just 7-11 servings yearly. The fruit index, however, shows much greater spread, suggesting a greater mix of high and low consumption.

Fig.2 outlines the ‘extremes’ of dietary consumption frequency. Remarkably, around 1 in 50 (1.9%) children consumed fruit no more than 1-6 times p/year – while a concerning 1 in 200 (0.5%) abstained from fruits and/or vegetables entirely. While this data reflects consumption *frequency*, not *quantity* – and so cannot directly indicate malnourishment – it does imply significant deviations from federal guidelines, recommending 1-3.5 cups of fruit/vegetables *daily* for children.⁽⁶⁾

Regarding sugar, a quarter (25%) consumed *any* high-sugar item 5-6 times weekly, with 1 in 20 (5.1%) consuming any item multiple times daily – a concerning high figure.

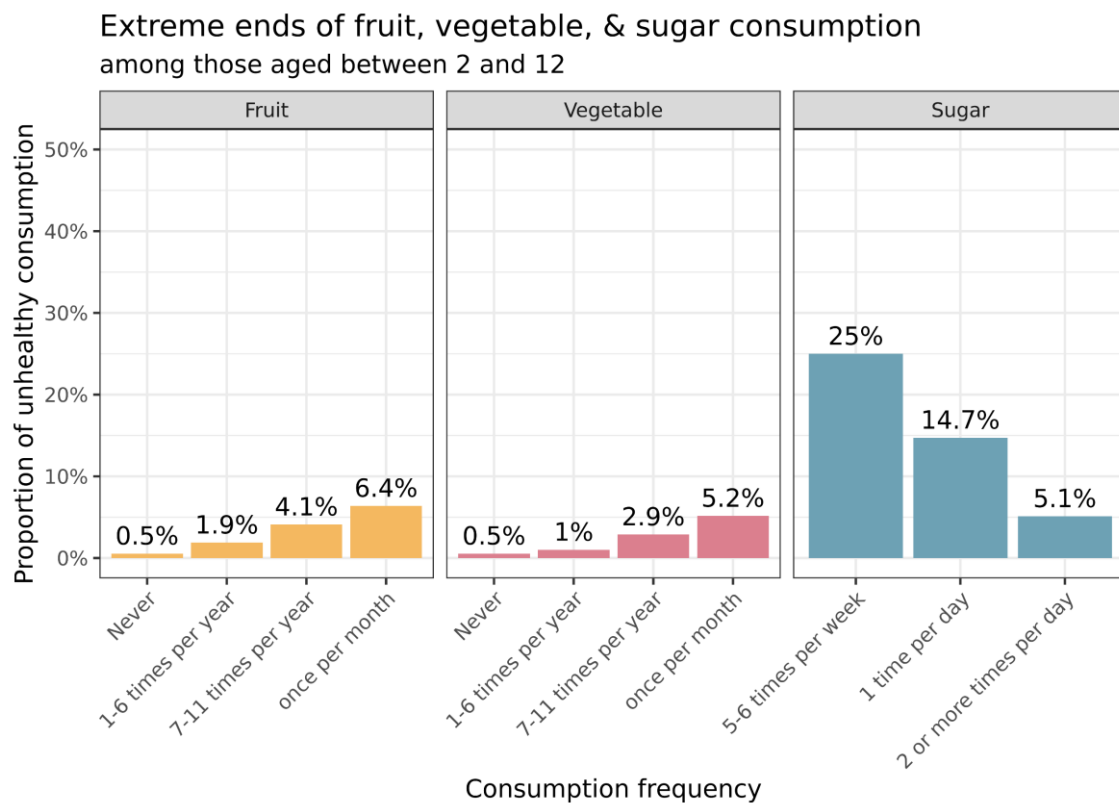


Figure 2: Proportion of respondents within 'extreme' frequency levels.

Shiny app

For brevity, this section discusses 'age' and 'household income'.

Dashboard data reveals an evolving dietary pattern across age groups. 9% of children aged 9+ exhibit low fruit consumption (consuming any fruit no more than 'once per month'), compared to 4% and 5.8% in the 0-4 and 5-8 age groups, respectively. This suggests a correlation between age and unbalanced dietary choices, possibly associated with increased dietary autonomy.

Interestingly, when considering economic factors, the data presents an unexpected deviation from previous literature: children in the top two income brackets exhibit lower median fruit/vegetable index scores – contrasting with cross-age studies associating lower income with less healthy food choices.⁽⁷⁾ This underscores the importance of recognising children as a unique demographic within nutritional epidemiology.

Analysis of both age and income reveals children aged 9+ in the \$45,000-\$64,999 bracket show notably lower fruit/vegetable index scores – with 14.6% and 12.5% showing low fruit/vegetable consumption, respectively. This pinpoints a specific demographic where targeted nutritional interventions could be greatly beneficial.

References

- [1] Kirolos A, Goyheneix M, Elias M K, Chisala M, Lissauer S, Gladstone M, Kerac M. Neurodevelopmental, Cognitive, Behavioural and Mental Health Impairments following Childhood Malnutrition: A Systematic Review. *BMJ Global Health*. 2022;7: e009330.
- [2] Lukomskyj N, Allman-Farinelli M, Shi Y, Rangan A. Dietary Exposures in Childhood and Adulthood and Cardiometabolic Outcomes: A Systematic Scoping Review. *Journal of Human Nutrition and Dietetics*. 2021;34(3): 511-523.
- [3] About the National Health and Nutrition Examination Survey. Centers for Disease Control and Prevention. Available from: <https://www.cdc.gov/nchs/nhanes-ls/index.htm> [Accessed 18th December 2023].
- [4] Healey C G, Enns J T. Attention and Visual Memory in Visualization and Computer Graphics. *IEEE Transactions on Visualization and Computer Graphics*. 2012;18(7): 1170-88.
- [5] Ellfattah M T A. Web Design for Color Blind Persons. *International Design Journal*. 2014;4(4): 37-46.
- [6] Dietary Guidelines for Americans: 2020–2025. US Department of Agriculture. Food and Nutrition Service. 2020. https://www.dietaryguidelines.gov/sites/default/files/2020-12/Dietary_Guidelines_for_Americans_2020-2025.pdf [Accessed 22nd December 2023].
- [7] French S A, Tangney C C, Crane M M, Wang Y, Appelhans B M. Nutrition Quality of Food Purchases Varies by Household Income: the SHoPPER study. *BMC Public Health*. 2019;19(1): 231.