An International Biomarker of Added Sugar in Adults

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Background:

- Accurate measurement of diet, especially added sugar intake, is crucial for understanding its role in chronic diseases
- Self-reported dietary assessment methods are prone to errors and biases, necessitating objective biomarkers
- Stable Isotope Ratios (SIR), particularly of Carbon ($\delta^{13}C$) and Nitrogen ($\delta^{15}N$), have natural variation in food and reliably incorporate into living tissues
- Cane sugar and corn-based sweeteners have distinctively higher $\delta^{13}C$ due to C4 photosynthesis
- Animal protein, especially from marine foods, have higher $\delta^{15}N$ values

Objective:

- To test the natural abundance $^{13}C/^{12}C$ ratio (CIR) as a biomarker for added sugar intake in diverse dietary contexts

Methods:

- International Atomic Energy Agency (IAEA) requested proposals from UN members states
- For each participating country:
  - Cross-sectional study with convenience sampling
  - Demographic and activity questionnaires
  - 24-hour dietary recall repeated 4 times
  - Serum samples for biomarker measurement
- CIR and NIR measured using continuous-flow isotope ratio mass spectrometry against international standard (‰)

$$\delta^{13}C_{TC} = \left(\frac{(13_C/12_C)_{sample}}{(13_C/12_C)_{std}} - 1 \right) \times 1000$$

$$\delta^{15}N_{TN} = \left(\frac{(15_N/14_N)_{sample}}{(15_N/14_N)_{std}} - 1 \right) \times 1000$$

International Participation:

Figure 1: Participating countries: Argentina (n = 80), Lebanon (n = 76), Mexico (n = 72), South Africa (n = 100) , India (data not included here)

Results:

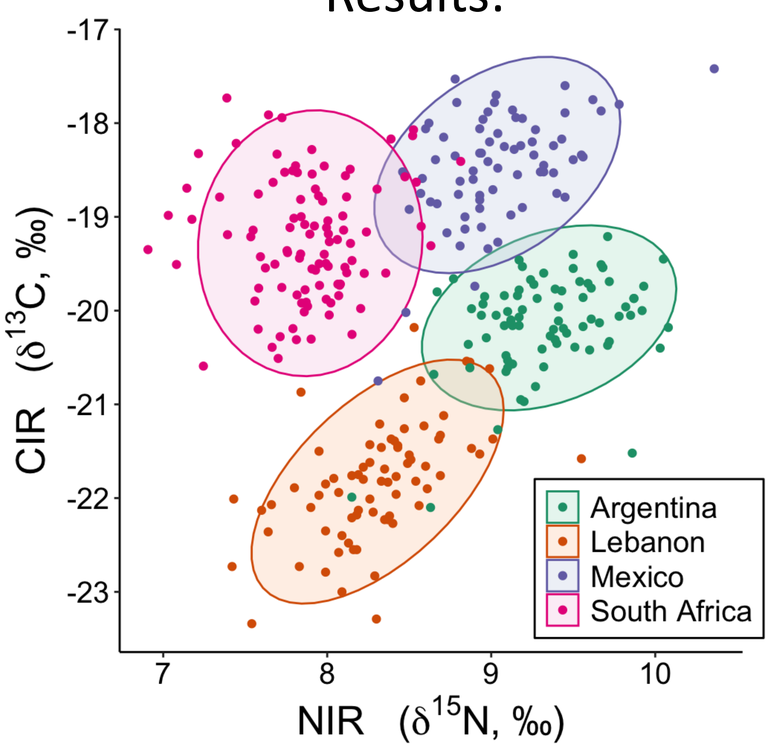

Figure 2: Serum Carbon Isotope Ratios (CIR) and Nitrogen Isotope Ratios (NIR) measured at UAF from 4 participating countries; ellipses represent 95% confidence intervals

CIR's and NIR's significantly different from each other based on one-way ANOVA

CIR: $F(3, 322) = 439.3$, $p = <0.001$ and post *hoc* comparisons

NIR: $F(3, 322) = 295.1$, $p = <0.001$ and post *hoc* comparisons

Conclusion and Next Steps:

- Significant difference between CIR and NIR for all countries
- Likely representative of diversity of global dietary patterns
- Determine dietary drivers of variation in CIR and NIR among countries
  - Association of SSBs (Sugar sweetened beverages), added sugar and CIR values.
- Future controlled and/or randomized feeding study using present biomarkers if warranted

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Literature Cited:

O'Brien, D. M. (2015). Stable isotope ratios as biomarkers of diet for health research. *Annual review of nutrition*, *35*(1), 565-594.

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