Monitoring dietary change in AK Native people using stable isotopes: a case study of traditional foods and vitamin D

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Photo by Stacy Rasmus
All food is the product of an ecosystem
Stable isotope ratios are ecosystem biomarkers

- Naturally occurring
- Naturally varying
  - can be used as tracers

<table>
<thead>
<tr>
<th>Element</th>
<th>Stable isotopes</th>
<th>Abundance (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrogen</td>
<td>$^1$H (H)</td>
<td>99.985</td>
</tr>
<tr>
<td></td>
<td>$^2$H(D)**</td>
<td>0.015</td>
</tr>
<tr>
<td>Carbon</td>
<td>$^{12}$C</td>
<td>98.892</td>
</tr>
<tr>
<td></td>
<td>$^{13}$C</td>
<td>1.108</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>$^{14}$N</td>
<td>99.635</td>
</tr>
<tr>
<td></td>
<td>$^{15}$N</td>
<td>0.365</td>
</tr>
<tr>
<td>Oxygen</td>
<td>$^{16}$O</td>
<td>99.759</td>
</tr>
<tr>
<td></td>
<td>$^{17}$O</td>
<td>0.037</td>
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<tr>
<td></td>
<td>$^{18}$O</td>
<td>0.204</td>
</tr>
<tr>
<td>Sulfur</td>
<td>$^{32}$S</td>
<td>95.0</td>
</tr>
<tr>
<td></td>
<td>$^{33}$S</td>
<td>0.75</td>
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<tr>
<td></td>
<td>$^{34}$S</td>
<td>4.21</td>
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<tr>
<td></td>
<td>$^{35}$S</td>
<td>0.014</td>
</tr>
</tbody>
</table>
Nitrogen isotope ratios (NIR) in foodwebs

- NIR is elevated in fish and marine mammals
- Great biomarker for traditional foods in YK Delta

$\delta^{15}N$:
- 18-20‰: 4° consumer
- 14-17‰: 3° consumer
- 11-13‰: 2° consumer
- 8-10‰: 1° consumer
- 5-7‰: 1° producers
Yup’ik Diets

• Mixed market (~78%) and traditional (~22%) diet
• Traditional diet is dominated by fish and marine mammals

Bersamin et al 2007 IJCH
NIR in blood and hair is strongly associated with traditional food intake
Biomarker reveals many health-related associations with Yup’ik traditional food intake

- Age
- Language
- Enculturation
- Blood lipids
- Blood pressure
- Insulin sensitivity
- Gene methylation
- Blood clotting
- Vitamin D status

- Vaughan et al. 2015. *Metabolism* 64: 689-697
Monitoring dietary change: the “Nutrition Transition”

• We know it has happened – is it still happening? When were the key times of change?

• How does timing relate to increased incidence of rickets in AN infants/children? (Singleton et al 2015)

• Used the Alaska Area Specimen Bank (CDC)
  • Serum specimens dating back to early 1960’s

• 20-29 y.o. women from YK Delta
  • N = 25 per decade
Quantifying the “Nutrition Transition”

Precipitous decline in fish/marine mammal intake from the 1960s → 1990s

Associated with poorer vitamin D status in young women

O’Brien et al. 2017 PHN 20:1738-1745
Vitamin D Deficiency in Prenatal Alaska Native Women

Current Interventions
1. YKDRRH consulted with vitamin D experts and developed guidelines to supplement routinely recommended prenatal vitamins (400 IU/day) with an additional 1000 IU of daily vitamin D and to monitor prenatal vitamin D levels.
2. The Alaska Native Medical Center (ANMC) changed from infant Trivisol (containing vitamins A, D, and C) to one drop of “Baby D drops” to improve adherence.

Summary

• Traditional food intake by young, YKD women dropped from the 1960’s through the 1990’s

• Associated with changes in vitamin D status

• Unprecedented record of dietary change spanning over 60 years
  • Ecosystem tools (stable isotopes) + biorepository

• Translated into public health policy

• We would love to apply these tools to other questions relating to dietary change
Established in 2001 to address Alaska Native health priorities through community-engaged research

- **Culturally relevant, strengths-based intervention research**
  - Tribally-driven suicide and substance abuse prevention
  - Programs to strengthen traditional food systems

- **Epidemiologic research**
  - How genes, diet and physical activity relate to risk factors for obesity, CVD, metabolic syndrome, and vitamin D deficiency

- **Methodological research**
  - Resilience, well-being and strengths-based approaches to the reduction of health disparities
  - Developing tools to monitor food systems and dietary change