Thinking Zinc — Béésh Dootl’izh Bantsáhákees

A study to assess how taking the recommended daily amount of zinc may help repair damage from harmful metals among Navajo Nation residents

Presentation to Diné Uranium Remediation Advisory Commission
September 9, 2021

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Funding, Disclaimer, Approvals

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**Approvals:**

*Human research is monitored and approved by UNM Human Research Protections Office (HRPO), the Navajo Nation Human Research Review Board (NNHRRB) and the New Mexico Cancer Care Alliance, as required by federal, state and Tribal law. UNM HRPO approved Thinking Zinc on December 11, 2018 (HRPO #18-381). NNHRRB approved the study on January 22, 2019 (#NNR-18.330T).*
Communities Participating in Thinking Zinc

2 Red Water Pond Road Community
   (Tółchį́' Siką́ Atiin)
   or
   Where the Meadows Meet
   Ahidaazdigai

3 Blue Gap-Tachee Chapter
   (Bis Dootlį́zh Nídeeshgiizh)
   (dirt, blue, spread apart)
Community-engaged responses to multi-generational exposures to uranium mining wastes

Red Water Pond Road Community, Church Rock Mining District (1968-86)

Blue Gap-Tachee Chapter, Black Mesa East Mining District (1954-68)

4 generations... nearly 50 years

A family’s pickup at a mine site

Ceremonial hogan represents goal to restore land to balance and health

1988: First chapter resolution calling for mine cleanup
Metals, Radionuclides in Mine Wastes

Claim 28, Blue Gap-Tachee Chapter

- Uranium
- Vanadium
- Cobalt
- Lead
- Gamma radiation
- Radium

Northeast Church Rock Mine, Church Rock and Pinedale Chapters

- Uranium
- Gamma radiation
- Radium
- Arsenic
- Lead
- Molybdenum

Elemental Content, ug g⁻¹

<table>
<thead>
<tr>
<th></th>
<th>Si</th>
<th>S</th>
<th>Al</th>
<th>Fe</th>
<th>Mg</th>
<th>U</th>
<th>V</th>
<th>Ca</th>
</tr>
</thead>
<tbody>
<tr>
<td>Native Soil</td>
<td>241,950</td>
<td>1,339</td>
<td>52,129</td>
<td>26,739</td>
<td>3,068</td>
<td>BDL*</td>
<td>BDL*</td>
<td>16,441</td>
</tr>
<tr>
<td>Mine waste1</td>
<td>235,563</td>
<td>223</td>
<td>69,533</td>
<td>15,259</td>
<td>181</td>
<td>2,248</td>
<td>15,814</td>
<td>855</td>
</tr>
<tr>
<td>Mine waste2</td>
<td>243,703</td>
<td>1,834</td>
<td>59,730</td>
<td>3,511</td>
<td>405</td>
<td>6,614</td>
<td>4,328</td>
<td>3,293</td>
</tr>
</tbody>
</table>

Graph showing elemental content in NECR Mine wastes and non-impacted soils.
Western Science Perspective
How can metals affect DNA repair?

- Normal repair function: “Go”
  - $\text{Zn} \, \text{is necessary for the repair process}$

- Repair function altered:
  - “Stopped” or “Slowed”
  - $\text{As or U} \, \text{disrupts the repair process by replacing zinc in key proteins}$

- DNA repair function restored: “Go”
  - $\text{Zn} \, \text{protects the key proteins from As or U and restores the repair process}$
Some metals, like uranium and arsenic, can damage your health. Here are some examples, along with their Navajo interpretations:

- **Kidney disease**
  - *Hatsá’áshk’azhî bąq dahaz’á yileehgo*
  - (Kidney, poor health, gets to be)

- **Cardiovascular Disease**
  - *Ajééh bąq bąq dahaz’á yileehgo*
  - (Heart, poor health, gets to be)

- **Immune Disorders**
  - *Ats’íís yich’áá yileehgo*
  - (Body, protect from, does not fully work, gets to be)

- **Cancers**
  - *Ats’íís bitł’óól dahdiníisééh áádóó ba’át’e’ hółó yileehgo*
  - (Body, cell growth, thereafter, bad behavior, gets to be)

- **Skin Problems**
  - *Haka’í yeenit’jih*
  - (Skin, affects)
Community Outreach, Support, Art, Language

Thinking Zinc — *Beesh Dootł’izh* Bantsáhákees
[metal + blue (the one that is) + thinking about it]

- Participating Communities: Red Water Pond Road Community Association, Blue Gap-Tachee Chapter
- Both communities impacted by uranium mine wastes
- Community members took part in development of study design, Navajo language interpretation
- Native symbology used to illustrate biological functions
- Presented in Navajo to NNHRRB in January 2019
- Enrollment and sample collections began in RWPRC May 2019; four community “collection events” held prior to pandemic shutdown in March 2020
- Plan is to restart in Blue Gap-Tachee and surrounding chapters in October 2021

*From “Code Talker” by Chester Nez and Judith Schiess Avila, 2011.

INTERESTED?
For more information or to participate, send email to zinc@sric.org, call 877-545-6775, or visit www.sric.org/Zinc
This painting shows how metals like uranium can damage DNA and cells, through the lens of Mallery Quetawki, a Zuni artist and biologist.
In this painting, Ms. Quetawki shows how DNA damage may be repaired, like re-stringing a broken bead strand. Zinc is necessary for this process.

Painting by Mallery Quetawki, Zuni Pueblo
Why take zinc?

- In the right amounts, zinc — a metal that comes from Mother Earth — is an essential nutrient that promotes good health.

- Studies have shown that many people do not get enough zinc in their diet to keep their body healthy, to achieve balance.

- Some Navajo women and men enrolled in the Navajo Birth Cohort Study were found to have insufficient levels of zinc.

- Taking a zinc pill is NOT a cure-all for all your ailments, and too much zinc may be harmful.

- Taking a zinc supplement at the recommended daily allowance of 11 milligrams zinc per day is considered safe.
Is zinc in our diets?

• Yes, but it might not be in high enough amounts

• Some Navajo foods that have higher levels of zinc include:
  • Lamb
  • Blue corn mush from juniper ash
  • Pinon nuts
  • Chicken
  • Beef
  • Eggs
Beesh Dootł’izh Bantsáhákees Eligibility*

Research volunteers needed
We are conducting research to understand if taking the daily recommended level of zinc protects our bodies from the effects of heavy metals in the environment.

*To be eligible, you must be
• 21-64 years of age
• Not diabetic
• Not allergic to zinc
• Not pregnant or nursing

You will:
• Have 4 study visits over 9 months
• Take a zinc supplement tablet
• Provide blood and urine samples
• Receive a gift card each visit

INTERESTED?
For more information or to participate, send email to zinc@sric.org, call 877-545-6775, or visit www.sric.org/Zinc

Your eligibility to be enrolled in the study will be determined at your first visit to a community collection event.
Thinking Zinc Study Timeline

0
Start of study

3 months later
(3rd to 4th month)

3 months later
(6th to 7th month)

3 months later
(9th to 10th month)

Baseline
- Education
- Eligibility screening
- Consent
- Collection of blood (1 tbs) & urine (3 tbs)
- gift card

Baseline/Zinc
- Education
- Continued eligibility
- Food frequency questionnaire
- Collection of blood (1 tbs) & urine (3 tbs)
- 3-month supply of 15 mg Zn tablets provided
- gift card

Zinc
- Education
- Continued eligibility
- Collection of blood (1 tbs) & urine (3 tbs)
- 3-month supply of 15 mg Zn tablets provided
- gift card

Last visit
- Education
- Continued eligibility
- Food frequency questionnaire
- Collection of blood (1 tbs) & urine (3 tbs)
- gift card

Our staff will contact you during the study to remind you to keep taking your zinc tablets and to attend the next visit.
Status and Progress

• Approvals
  • Navajo HRRB January 2019; UNM HRPO December 2018
  • Registration: Clinicaltrials.gov NCT03908736

• Continued Community Engagement (CEC/SRIC)
  • >50 community activities (i.e. chapter meetings, booths at events, collection days)

• Enrollment (37 of 80 goal as of February 2020)
  • 24 women, 14 men, ages 21-64, median 59
  • First enrollment, sample collection in Red Water Pond Road Community, May 2019

• COVID-19 study pause, March 2020-August 2021

• Sample analyses and data reports — in progress
  • Resuming study September 2021
Preliminary Data on Metals Levels in Urine

- **Data Table** – example of the detailed information comparing urine-metals levels in Thinking Zinc participants with national values and values in NBCS participants.

<table>
<thead>
<tr>
<th>Metal</th>
<th>PPB Median</th>
<th>Range</th>
<th>%&lt;LOD</th>
<th>%&gt;95th percentile NHANES/NBCS</th>
<th>NHANES 50th</th>
<th>NHANES 95th</th>
<th>NBCS 50th</th>
<th>NBCS 95th</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antimony</td>
<td>0.11</td>
<td>LOD - 0.398</td>
<td>5%</td>
<td>16.7%/8.3%</td>
<td>0.044</td>
<td>0.191</td>
<td>0.004</td>
<td>0.32</td>
</tr>
<tr>
<td>Arsenic</td>
<td>0.48 - 142.97</td>
<td>0%</td>
<td>3.3%/6.7%</td>
<td></td>
<td>5.74</td>
<td>49.9</td>
<td>3.6</td>
<td>16.9</td>
</tr>
<tr>
<td>Barium</td>
<td>1.53</td>
<td>LOD - 151.69</td>
<td>1.7%</td>
<td>5%/1.7%</td>
<td>1.17</td>
<td>5.39</td>
<td>2.375</td>
<td>16.25</td>
</tr>
<tr>
<td>Beryllium</td>
<td>LOD</td>
<td>LOD - 0.021</td>
<td>70%</td>
<td>30%/11.7%</td>
<td>LOD</td>
<td>LOD</td>
<td>0.008</td>
<td>0.01</td>
</tr>
<tr>
<td>Cadmium</td>
<td>0.20</td>
<td>0.029 - 1.27</td>
<td>0%</td>
<td>5%/11.7%</td>
<td>0.179</td>
<td>1.08</td>
<td>0.072</td>
<td>0.6</td>
</tr>
<tr>
<td>Cesium</td>
<td>3.87</td>
<td>0.99 - 24.84</td>
<td>0%</td>
<td>6.7%/11.7%</td>
<td>4.19</td>
<td>11.4</td>
<td>3.265</td>
<td>9.305</td>
</tr>
<tr>
<td>Cobalt</td>
<td>0.06</td>
<td>0.056 - 4.64</td>
<td>0%</td>
<td>6.7%/3.3%</td>
<td>0.403</td>
<td>1.41</td>
<td>0.61</td>
<td>2.3</td>
</tr>
<tr>
<td>Lead</td>
<td>0.149</td>
<td>LOD - 2.211</td>
<td>1.7%</td>
<td>3.3%/6.7%</td>
<td>0.22</td>
<td>1.38</td>
<td>0.22</td>
<td>0.0005</td>
</tr>
<tr>
<td>Manganese</td>
<td>0.126</td>
<td>LOD - 2.99</td>
<td>18.3%</td>
<td>21.7%/0%</td>
<td>0.13</td>
<td>0.28</td>
<td>0.21</td>
<td>3.985</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>32.95</td>
<td>LOD - 160.5</td>
<td>1.7%</td>
<td>6.7%/3%</td>
<td>35.9</td>
<td>124</td>
<td>37.7</td>
<td>140</td>
</tr>
<tr>
<td>Platinum</td>
<td>LOD</td>
<td>LOD - 0.122</td>
<td>63.3%</td>
<td>28.3%/28.3%</td>
<td>0.09</td>
<td>0.017</td>
<td>0.05</td>
<td>0.18</td>
</tr>
<tr>
<td>Strontium</td>
<td>127.27</td>
<td>9.67 - 1075.76</td>
<td>0%</td>
<td>23.3%/8.3%</td>
<td>97.5</td>
<td>299</td>
<td>110</td>
<td>500</td>
</tr>
<tr>
<td>Tin</td>
<td>1.04</td>
<td>0.067 - 55.30</td>
<td>0%</td>
<td>16%/8.3%</td>
<td>0.43</td>
<td>3.62</td>
<td>1.36</td>
<td>11.22</td>
</tr>
<tr>
<td>Tungsten</td>
<td>0.0345</td>
<td>LOD - 0.431</td>
<td>15%</td>
<td>1.7%/0%</td>
<td>0.056</td>
<td>0.321</td>
<td>0.093</td>
<td>0.69</td>
</tr>
<tr>
<td>Uranium*</td>
<td>0.022</td>
<td>LOD - 6.85</td>
<td>3.3%</td>
<td>36.7%/20%</td>
<td>0.005</td>
<td>0.031</td>
<td>0.011</td>
<td>0.07</td>
</tr>
<tr>
<td>Vanadium*</td>
<td>0.13</td>
<td>0.061 - 10.00</td>
<td>0%</td>
<td>------------</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>

*Median metal levels are shown for Visit 1 and Visit 2 samples (n=80) collected before zinc supplementation. Values are in micrograms per liter (ppb), and are uncorrected for creatinine to compare NHANES values. LOD: limit of detection. For reference, the 50th and 95th percentile levels are provide for NHANES values and participants in the NBCS including women, men and babies (N=1861-1782 for each metal). Metals results highlighted in blue represent those where more than 10% of samples had levels in excess of the NHANES 95th percentile values. Uranium levels for vanadium are not included in NHANES reporting. Nixon et al (2002) reported normal urine vanadium levels to be 0.24 ppb [Nixon DE et al. 2002]. 41% of participants had urine V levels > 0.24 ppb.

- **Some overall results** so far:
  - **Arsenic** is similar to national values
  - **Lead** is below national values
  - **Uranium** is about 4 times higher than national values

- **We will provide metals information for each participant**
Illustration on the left shows what we are seeing so far in urine-metals levels in participants:

- “Person 1” has small changes in metal levels between visits, and the levels don’t vary much.
- “Person 2,” however, has much bigger changes in metal levels between visits, and those levels vary considerably.

We will find out whether there are activities that might cause the differences so people can find ways to modify their exposure risk.

Upcoming: Report-back letters to each participant who completed 4 visits will be sent in Fall 2021.
Ongoing Research Activities and Goals

Measurements of “biomarkers” of metal effects

• Multiple markers of immune system function
• DNA damage
• Markers of inflammation, a process that contributes to many diseases

Goals

• Identify which metals and metal mixtures alter the measured markers
• Determine whether zinc supplements improve the measured markers
COVID Safe Practices

• UNM and SRIC policies – abide by Public Health Orders of the Navajo Nation and rules of the chapters, UNM, State of New Mexico

• ALL UNM and SRIC personnel must have proof of COVID-19 vaccination to have any contact with study participants or community members

• ALL UNM and SRIC personnel attending community events will wear masks, maintain physical distancing

• Tables for surveys will be spaced >6 feet apart; hand sanitizer and masks will be available for participants

• Outdoor enclosures (e.g., tents) will be used to maintain good airflow

• Will make appointments for participants
Ahéhee’ – Thank You!
Acknowledging Community Partners, SRIC Staff

Blue Gap-Tachee Chapter, Tachee Uranium Concerns Committee (Faith Baldwin, Nadine Begay, Sadie Bill, Johnny Naize, Christopher Nez, Helen Nez, Seraphina Nez, Marcus Tulley, Aaron Yazzie)

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*Individuals no longer with the METALS program.

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Blue Gap-Tachee Community Concerns

Disruption of Life Cycles in Blue Gap-Tachee Community, Navajo Nation

Johnny Naize, Aaron Yazzie, LaTasha James

Abstract

This research study, undertaken in the Blue Gap-Tachee community, examines the disruption of life cycles due to pollution from mining activities. The study has revealed significant impacts on both the environment and the community's well-being. The primary focus is on the disruption of life cycles, particularly in the context of mining activities. The study highlights the importance of understanding these disruptions for effective policy and action.

Overview of the Community

Blue Gap-Tachee is located in the heart of the Navajo Nation, with a population of 1,500 people. The community is known for its rich history and unique cultural traditions. The area is rich in natural resources, including minerals and water resources.

Disruption of Life Cycles – Community Experiences

The study found that the mining activities have significantly disrupted the community's life cycles. This disruption manifests in various ways, including changes in the community's health, the environment, and the economy.

Figure 1: Life cycle disruption

Community Recommendations

1. Incorporate community participation as an ongoing process into the mining activities
2. Implement strict regulations to ensure that the mining activities are conducted in an environmentally sustainable manner
3. Provide education and training to the community on how to mitigate the effects of mining activities

Research Conducted by

Navajo-Built Indian Health Service (IBHS) is committed to conducting research that addresses the needs of Indian communities. Dr. Navajo-Built Indian Health Service (IBHS) is a not-for-profit organization dedicated to improving the health and well-being of the Navajo Nation.

Acknowledgement

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L-R: Johnny Naize, LaTasha James, Aaron Yazzie

Presented at 10th International Conference on Metals Toxicity and Carcinogenicity, October 2018
Living with Uranium Wastes for 50 Years and Four Generations — A Navajo Community’s Perspective

Peter Beil, Becca Mee, Edith Hood with Teracita Keyanna, Jacqueline Belk-Jefferson, Debra Harris and Anna Bustaly

Presented at 10th International Conference on Metals Toxicity and Carcinogenicity, October 2018

L-R: Teracita Keyanna, Peterson Bell, Edith Hood