

Despite a delayed start, the study team successfully completed the aims of the project. A number of factors contributed to project delays. Progress towards completion of the project aims was considerably delayed because of the study's innovative approach to community engagement, in which individual results were returned to participants as part of the community's "right to know". The IRB of record, Cancer Prevention Institute of California, was not familiar with this increasingly central tenet of community-based participatory research, and required extensive education and familiarization with the approach. The IRB's concerns centered on the potential for alarm amongst participants with elevated levels of the target contaminants, the absence of clinical interpretation for body burden of the contaminants, and the ability of the study team to provide adequate reassurances regarding such contaminants that are not naturally occurring in humans. The study team offered testimony from the clinical practitioners on the community advisory board, and from Dr. Rachel Morello-Frosch, an expert in community-based participatory research, as well as a guidebook for IRBs in delivering individual results that was developed and published by the Silent Spring Institute. The study also benefited from the experience in participant feedback developed by the California Department of Public Health (CDPH) Biomonitoring Program. Furthermore, the study protocol received a full review and approval by the biomedical IRB of the University of Nevada, Reno. Because of the delay in receiving specific approval from the CPIC IRB, CBCRP initially provided partial funding and the study team received the balance of funding after year one activities. A second change in project activities, causing some additional delay, was that the UNR co-

Investigator (Dr. Rudy Rull) accepted a new position which required him to resign from participation in the present project. Project activities initially budgeted for UNR were re-allocated to CPIC, with associated re-budgeting.

For aim 1, we engaged the target community of Grass Valley and Nevada City initially by recruiting a community advisory board (CAB), consisting of a cancer survivor, a social issues activist, a city mayor, a young person who grew up in the area, a radiologist specializing in epidemiology, a public health nurse, an environmental activist, a tribal member, and a realtor. In part 1 of aim 1, we hosted two CAB meetings, focused on designing the study and planning for a community forum, which benefited greatly from the diverse perspectives brought by the CAB members. We hosted a community forum to introduce the study to the wider

**Table 1:** Demographics of participants.

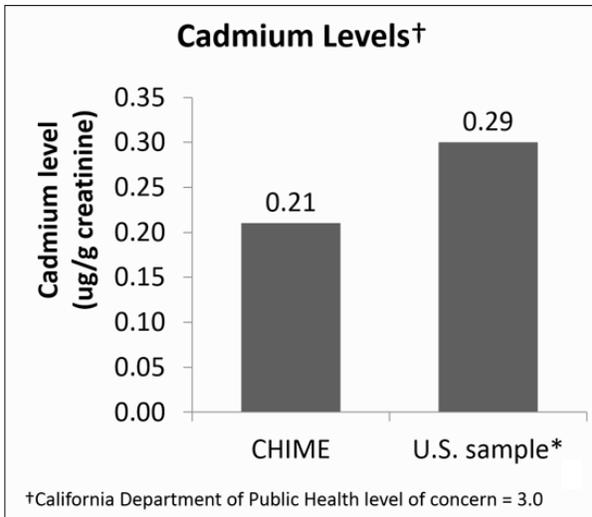
| Characteristic                                 | Study Subjects<br>N=60 |
|--|------------------------|
| Age  | range 22-80 years      |
| < 35 years                                     | 30 (50%)               |
| ≥ 35 years                                     | 30 (50%)               |
| Race/ethnicity                                 |                        |
| Non-Hispanic white                             | 56 (93%)               |
| Other  | 4 (7%)                 |
| Educational Level                              |                        |
| High school graduate or less                   | 4 (7%)                 |
| Some College or trade school                   | 20 (33%)               |
| College graduate                               | 36 (60%)               |
| Length of Residency in California Gold Country |                        |
| < 10 years                                     | 30 (50%)               |
| ≥ 10 years                                     | 30 (50%)               |
| Smoking Status                                 |                        |
| Current smoker                                 | 7 (12%)                |
| Former smoker                                  | 17 (28%)               |
| Never smoker                                   | 36 (60%)               |

community, and recruited sixty local women as participants. The women were randomly selected from 140 women who signed up, with half the women being over the age of 35, and half aged 18-35. Each age group was divided again, with half being recent arrivals to Gold Country (less than ten years) and half long term residents. In an effort to introduce the study to the community at large, we conducted three radio interviews on local and regional radio stations, submitted a press release to several local news outlets, and advertised on various social media forums. The response to the outreach was strikingly positive, with numerous women expressing their suspicions about the role of environmental contaminants in human health, their surprise that no human health studies have heretofore been conducted, and in particular, their gratitude that the investigation has begun, with a focus on community inclusion.

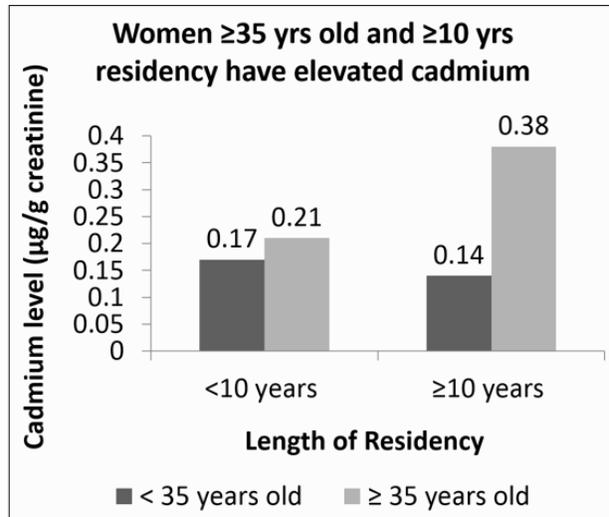
For part 2 of aim 1, we hosted a third CAB meeting to discuss participant and overall study results with an emphasis on how best to disseminate individual results to participants. We then sent out individual packets to each participant with their individual results and hosted a participant meeting to discuss the study results and how to interpret individual results. We invited representatives from Biomonitoring California of the California Department of Public Health, Environmental Health Investigations Branch to the participant meeting. Along with presenting information about interpretation of individual results, we included and disseminated information about limiting exposure to Arsenic, Cadmium, and other toxic metals found in legacy mining contaminates. There was considerable discussion about the results at the meeting and through a question and answer period, participants generally agreed they wanted to know their individual results and would participate in any follow up studies. In an effort to introduce the study to the community at large, we conducted two radio interviews on local and regional radio stations and hosted a public community presentation to present the overall findings of the study. Attendance at the community presentation was high with vast approval for continued studies. We also created an anonymous questionnaire to evaluate their experience in the study that which is being sent now to each participant, following recent IRB approval.

We were successful in completing Aim 2 by the recruitment and engagement of sixty women aged 18-80 as participants in the study. In July 2014, the women received a questionnaire, sampling kit and mailing materials. The completed questionnaires, identified with a unique study identification number, were returned in prepaid and preprinted mailers to CPIC, where study staff entered the data into a database for analysis. Characteristics of the 60 study participants are summarized in Table 1. Results from the questionnaire suggested that Cd levels were modestly elevated among women who reported living on a dirt road and owning an outdoor dog or cat. We also reviewed questionnaires for activities that might explain the high inorganic arsenic values, but did not find any strong associations.

Toenail samples were returned to CPIC with the surveys and are being stored for future analysis. Urine samples were delivered by participants to SSI's office in downtown Nevada City, and kept cool with icepacks attached to the sample bottles. Study staff picked up samples from a small number of women at their homes if they were unable to deliver them in person. Samples were stored in a dedicated refrigerator in SSI's chemical lab and shipped in batches to the California



**Figure 1:** Body burden levels of cadmium among CHIME participants vs. U.S. sample from NHANES.



**Figure 2:** Body burden levels\* of cadmium among CHIME participants by age group and length of residency in Gold Country

Department of Public Health Environmental Health Laboratory (EHL). SSI staff followed up with participants to ensure the timely return of all materials, and CPIC staff contacted participants for missing or unclear responses.

**Table 2.** Median body burden levels\* of cadmium among CHIME participants by age group and length of residency in Gold Country

| Age group      | Length of residency |           |
|----------------|---------------------|-----------|
|                | <10 years           | ≥10 years |
| < 35 years old | 0.17 mg/L           | 0.14 mg/L |
| ≥ 35 years old | 0.21 mg/L           | 0.38 mg/L |

\*urine creatinine normalized

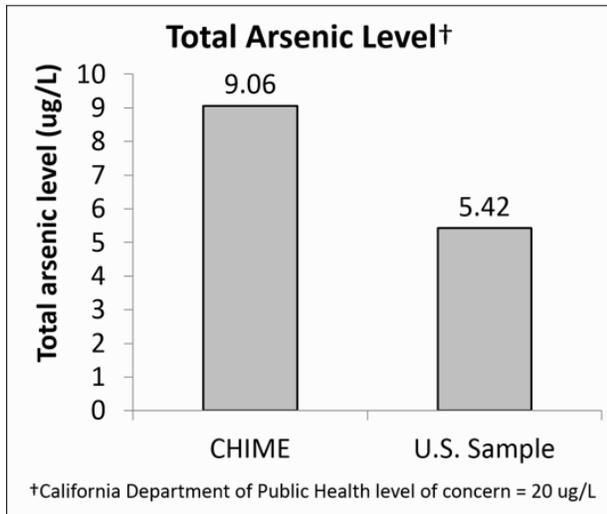
tungsten, and uranium. Average body burden levels of all chemicals appear to be consistent with reported levels for women in the National Health and Nutrition Examination Survey (NHANES) national sample conducted by the Centers for Disease Control and Prevention (Figure 1).

The urine samples were analyzed by the California Department of Public Health Environmental Health Laboratory

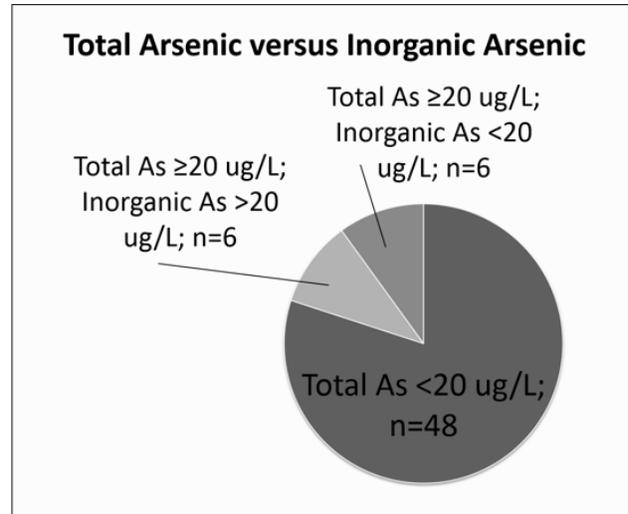
(EHL), which provided the opportunity to assess body burden for a full panel of metals, in addition to cadmium and arsenic as targeted by our initial inquiry. EHL has provided data for Cd, As, cobalt, lead, manganese, mercury, molybdenum, selenium, thallium,

However, when we examined levels by subgroup, older women with longer tenure in the community appear to exhibit significantly higher body burden levels of cadmium (p=0.006, Table 2; Figure 2). Because of the accumulative properties of Cd, higher levels would be expected with increasing age, but the observation of higher levels in older long term residents relative to older recent arrivals warrants further investigation. Additional preliminary analyses of the association

between Cd body burden and the residential, activity and diet variables in the survey suggest Cd levels to be modestly elevated among women who reported currently living on a dirt road and currently owning an outdoor dog or cat, but no association for other factors in the survey.



**Figure 3:** Body burden levels of arsenic among study participants vs. U.S. sample from NHANES.



**Figure 4:** Body burden levels of total arsenic vs. inorganic arsenic among study participants.

Arsenic levels in urine in the study participants were higher, overall, than for similarly aged women in U.S. (Figure 3). Total arsenic levels in 12 participants exceeded the CDPH level of concern (>20 ug/L). The twelve samples were speciated and among these, inorganic arsenic (a form more toxic than organic arsenic) exceeded the CDPH level of concern (>20 ug/L) in urine of 6 participants (Figure 4). A second urine sample was requested from these six women and upon retest, all were below level of concern. Arsenic levels were suggestively elevated among women who smoked and reported frequent and recent fish consumption.

Consistent with the high level of community interest in this project, 95% (57/60) of the women enrolled in the CHIME pilot study indicated a willingness to give a blood sample if asked to do so for further study. Although we saw little evidence for higher body burden than national averages for most metals, the significantly higher As levels and Cd levels in older women with long tenure in Gold County are observations that warrant follow-up. The finding of a lack of a strong association between body burden and any of the surveyed lifestyle variables except for length of residency is consistent with the ubiquity of the contaminant in Gold Country.

**Future activities:**

1. Two manuscripts for publication are in under way:
  - a. A process paper describing the community-research collaboration process,

- b. A results paper presenting the body burden findings from this study.
2. CBCRP funded second pilot study, “Cadmium Exposure in a Mining Impacted Community” (21AB-1600), with current participants having the opportunity to participate. Building on the findings in CHIME 1 the specific aims are:
  - a. Recruit new and follow-up with previously enrolled CHIME study participants to compare Cd body burdens in women with a history of breast cancer to those of women without breast cancer and
  - b. Measure Cd levels in household samples of soil, dust and water collected by participants trained as citizen scientists, with the goal of connecting residential environmental contamination to measured body burden levels.
3. Another proposal has been submitted to CBCRP in collaboration with a third institution, University of Arizona, “Dirt Alert: Legacy mining contaminant exposure in preschools”. The Dirt Alert project was developed in response to parents’, preschool teachers, and Sierra College Students concerns about whether soil in local preschool gardens is a safe place for children to grow and eat vegetables. Aims of the Dirt Alert project would address three arenas of activity:
  - a. *Community-Engaged Research and Citizen Science* - Develop a co-created citizen science program to measure the presence of cadmium and arsenic in the soils of preschool garden plots, most commonly grown produce, dust and irrigation water
  - b. *Environmental Exposure Assessment* - Develop and analyze a dietary questionnaire to determine what and how much locally grown food is consumed by the preschool children and combine this information with the environmental monitoring data (soil, produce, dust, water) to determine a child’s potential arsenic and cadmium daily dose via the following exposure routes: ingestion (drinking water, food consumption and incidental soil) and inhalation.
  - c. *Cultural Model of Environmental and Risk Communication* - Develop and evaluate appropriate reporting of study findings and outreach to the participants and the community at large regarding safe gardening and consumption practices