Biomonitoring for Phthalate and Arsenic Exposure in Hawai'i (Revised Title)

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All test samples were de-identified to

were noted when provided. Toenails were collected

over a period of three months from February-April

2013 from volunteers living on the island of Oahu.

Samples of urine were collected by a local area clinic

Materials and Methods

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Revised Abstract

In a concerted effort to battle a myriad of diseases associated endocrine disrupting chemicals, we have focused our efforts on two sources of concern; phthalates and arsenic. It is possible that Hawai'i's residents may be at increased risk to phthalate exposure because products have usually been packaged for long distance shipping, and are often stockpiled for long periods of time, allowing for phthalates to leach from packaging into consumable products. We have collected de-identified clinical samples stratified by age and sex to examine for phthalates and their metabolites, however those data are too preliminary to report. Consequently, the biomonitoring focus of this poster is on long-term and overall arsenic exposure of a small sample of O'ahu residents by measuring the total arsenic (As) concentration in toenails and urine.

Introduction

Despite testing for arsenic in soils, foods and local water supplies, information about levels of long-term arsenic exposures for people living in the state of Hawai'i is limited. While chronic exposure to arsenic compounds cause peripheral and central neurotoxicity, low-level/ long-term exposure is of growing concern due associations with cancer, cardiovascular disease and endocrine disruption.(1) High arsenic exposure of the Hawai'i residents may be a contributing factor to the increasing incidence of childhood obesity and diabetes. Toenails are a useful specimen for measuring long-term arsenic exposure due to their slow growth rate (12-18 months).(2)

In the news

- Department of Agriculture (USDA) tests soil arsenic levels (3)
- Food and Drug Administration (FDA) tests foods (4)
- Environmental Protection Agency (EPA) set a maximum of 10 part per million (ppb) inorganic arsenic in drinking water.
- · For food stuffs the FDA has not set a maximum level, but has suggested 1 part per million (ppm) for total arsenic.



Figure 1. Railroad sprayer used at Kiluea, Kaua'i (left, credit: State of Hawai'i HEER office)a Cane cutting girls in the Puna sugar cane fields circa 1920's. (above_credit: Citizens of Pahoa)

Arsenic in Hawai'i

- · Inorganic sodium arsenite was applied as herbicide in sugar production between 1915-1950's.
- · Widespread use of chromated copper arsenate (CCA) pressure treated lumber for termite control.



		Hawai'i,	United S	tates		
	Oʻahu	Kea'au ^b	Mainlan	d [♭] (NHA	NES ^c)	
Year	2013	2005	2009	2007	2005	2003
п	56	30	2860	2605	2675	2557
Mean total						
urine arsenic						
(ppb)	34.9	83.7	9.3	8.1	9.3	8.3

Discussion

For the toenail samples tested (n=22), 40% (n=9) contained detectable total arsenic levels above the limit of quantitation (Table 1). The mean for quantified samples is 1350 ppb, which is clearly higher than for similar studies on US mainland populations (see Figure 4). Samples were analyzed on a PerkinElmer Elan II DRC Inductively However, small sample size limits our ability to draw statistically valid

> Approximately 95 % of the urine samples tested contained donors living on arsenic contaminated soils on Hawai'i island.(5) The urinary total arsenic of people living on O'ahu is higher than reported for US mainland populations (6) from 2003-2009 (Table 2).

Conclusion

These results provide initial reference values for examining long-term arsenic exposure and background levels in Hawai'i residents. Our investigations suggest additional biomonitoring for arsenic exposure is warranted, in particular, due to the relatively high level of total arsenic found in toenails, urine and hair (7) of general and non-exposed populations living on Oahu. Several factors may contribute to the total arsenic exposure of the Hawai'i residents including dietary intake, exposure to natural and anthropogenic sources. Future work will be directed toward arsenic speciation analysis.

Acknowledgments

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(6) Fourth National Report on Human Exposure to Environmental Chemicals 2012. (7) Haves, D.: Pollack, S.: Stephen Bailey: Mealey, M.: Romero, Y.: Brooks, B. Biomonitoring pilot study hair arsenic levels in clients attending the special supplemental nutritional program for women, infants and children (WIC) program, Hawaii State Department of Health 2013. a State of Hawai'i Hazard Evaluation and Emergency Response Office

National Health and Nutrition Examination Survey

Clean maintain donor privacy. Age and sex of sample donors (scrape, ultrasonic bath) Rinse (water, methanol) Л Drv (overnight) Acid diges

Toenail Clippings





Figure 3. Common inorganic and organic arsenicals. Of these arsenicals the

Table 1. Total toenail arsenic concentrations in participants on O'ahu (110/ko)		
n	9	
Mean	1350	
Median	1050	
Maximum	2910	
Limit of quantitation	160	

Figure 4. Mean total toenail arsenic reported in low exposure studies

and hospital from donors living on the island of Oahu (see acknowledgements). Urine samples were collected the first week of February 2013 and stored at -20°C (nitric acid, 36 hours) until the time of sample preparation and data collection. IJ, This work has Institutional Review Board approval. Dilute



Urinary Sample (deionized water) (analysis)

Analysis Coupled Plasma Mass Spectrometer (ICP-DRC-MS) with oxygen as the reaction conclusions from these comparisons. gas. Instrument calibrants were matrix matched using a pooled toenail digest or urine. For toenail samples, standard additions method is used for quality control, detectable total arsenic levels above the LOO. Samples contained Instrument parameters were optimized and set prior to analysis. Quality control significantly lower mean total arsenic than were found in studies of samples were run with each batch as measure of drift and inter day variability.



Monomethylarsonic

inorganic forms, As(III) and As(V), are considered the most toxic.

Table 1. Total toenail arsenic concentrations in participants on O'ahu				
(μg/kg)				
n	9			
Mean	1350			
Median	1050			
Maximum	2910			
Limit of quantitation	160			