

SHORT REPORT

Mercury contamination in reproductive age women in a Caribbean island: Vieques

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Teratogenic amounts of mercury can avidly cross human placental barrier causing permanent neurological impairment to the developing fetus. A warning, from the USA Food and Drug Administration, advising reproductive age women to limit fish consumption, highlights the importance of this contaminating route.¹ Internal mercury exposure in fish consuming communities in the Caribbean Basin has not been evaluated. Our study assessed mercury internal exposure for reproductive age women in a heavily industrialised area of north eastern Puerto Rico (NEPR) and its island municipality of Vieques, spared from industrial activities.

METHODS

Women of ages 16–49, attending their primary physician, were invited to participate. The study was free to all participants. The general population of Vieques was informed of the study dates. Bonafide residence in towns from San Juan to Ceiba, for the NEPR cohort, or Vieques, during the year preceding the hair sample was confirmed. Women with chemically treated hair during the three months preceding the study were excluded. Demographic, medical, nutritional, occupational, religious, residential, and cosmetic information was individually obtained. Completion of the study's questionnaire and consent forms were prerequisites for hair sampling.

The study was in compliance with the Code of Professional Ethic Canons of the Board of Medical Examiners of Puerto Rico. During the period from 2000 to 2002, a proximal scalp hair sample of 1.5–2 cm was obtained from each participant. NEPR and Vieques samples were analysed simultaneously by inductively coupled plasma mass spectrometry and inductively coupled plasma atomic emission spectroscopy at either of two facilities. Both laboratories are licensed by the USA Clinical Laboratory Improvement Act.²

The margin of exposure (MOE) to mercury, 12 parts per million (ppm)/90th centile hairs (Hg), defined unsafe population exposure.³ Reference dose analysis (RfD), percentage of women exceeding the estimated daily mercury consumption that is likely to be deleterious during a lifetime for humans, was estimated for each cohort.⁴ The World Health Organisation criterion for hair mercury concentrations associated with adult mercurial toxicity (>10.0 ppm) was used

to define adult disease levels.⁵ Parametric variables were compared by unpaired *t* test. Non-parametric variables were analysed by Mann-Whitney's test. Spearman correlations were performed.

RESULTS AND DISCUSSION

Reproductive age women residing in the NEPR were compared with the analogous Vieques cohort (table 1). No difference was found in their average age. The participation rate was 20% for NEPR and 31% for Vieques. The mean hair (Hg) for the Vieques cohort was 4.4 (0.5–8.9) while that of NEPR was 0.4 (0.3–0.5). Vieques' cohort also had higher mercury 90th centiles than the NEPR counterpart (8.9 v 1.0) and than those reported for the United States 1.4 (0.9–1.7). Three of the 41 women of reproductive age in Vieques had hair (Hg) higher than 12.0 ppm (101.3, 25.3, and 15.4 ppm). None of the 45 women from NEPR nor the 702 women studied in the USA had such high mercury levels.³

The margin of exposure to mercury was unsafe for women of reproductive age in Vieques, 1.3, but was safe for women of reproductive age in NEPR, 12. Seafood consumption averaged 4.9 and 2.8 times per week for the Vieques and NEPR cohorts, respectively. Hair mercury concentration correlated positively with weekly consumption of local seafood for Vieques (Spearman correlation 0.47, *p* = 0.002).

Mercury concentrations did not correlate with age or BMI for either cohort. Occupational, medicinal, cosmetic, and religious practices failed to reveal other possible sources of mercury contamination. Based on hair (Hg), mercury RfD was exceeded by 26.8% of the Vieques and 6.6% of the NEPR cohort.

Mercury is among the 102 violations to effluent water quality parameters committed by the US Navy in the coast of Vieques.⁶ No other source of mercury contamination has been identified in that island. The volatility of mercuric sublimate, its incorporation, biomagnification, and persistence in aquatic habitats and Vieques dependence on marine protein, makes human mercury contamination feasible.

Abbreviations: NEPR, north eastern Puerto Rico; RfD, reference dose analysis; MOE, margin of exposure

Table 1 Mercury concentrations, seafood consumption frequency, and exposure assessment for reproductive age women in Vieques and Puerto Rico (2000–2002)

	Number	Age (SE)	BMI*	(Hg)		Margin of exposure†	Seafood consumption‡			% Of women exceeding RfD§
				Median¶	90th centile		Total *	Local**	Local fish	
Vieques	41	31.8 (1.3)	25.9 (0.9)	0.66	8.96	1.3	4.9	2.9	1.9	26.8
NE Puerto Rico	45	29.9 (1.2)	29.4 (1.2)	0.38	1	12	2.8	1.1	0.7	6.6
USA ^{3,4}	702	N/A††	N/A	0.20	1.4	8.6	N/A	N/A	N/A	7

*Arithmetic mean significant (*p* < 0.05); †MOE < 10 is unsafe mercury exposure; ‡average weekly frequency of seafood consumption; §RfD = 0.1 µg/kg per day; ¶medians significant (*p* < 0.05); **arithmetic mean significant (*p* < 0.01); ††data not available.

Key point

Women of reproductive age in the island of Vieques were exposed to mercury concentrations that are unsafe to their developing fetus.

This study may have some limitations. The participation rate was low for both groups. Unfortunately, the general population in Puerto Rico (and its Vieques island) is unaware of fish consumption as a possible route for mercury contamination. Unfamiliarity with hair testing, aesthetic reasons, and unwillingness to complete a questionnaire was mentioned by non-participants. Over representation of people concerned about contamination can always be present.

Selection bias in this cohort study could have occurred if disease status (mercury hair concentration) was known at the time of entering the study. As hair mercury determinations were done months after hair sampling, the participants and the researchers were not cognisant of the results.

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CONTRIBUTORS

Carmen Ortiz-Roque, MD, MPH, MS was responsible for design, funding, data collection, analysis, drafting, and approval of the final version. Yadiris López-Rivera, CT, MS(c) was responsible for design, interpretation, data analysis, and final drafting.

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Policy implications

Isolated civilian populations in the proximity of atypical industries, like the military, can be at increased risk of mercury exposure.

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