

Methylmercury: Epidemiology Update

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Reports in 2003/2004 . . .

- 1999-2000 NHANES organic blood Hg
- *Close association with fish intake in 1999-2000 NHANES examinees.*
- Confirmation of cord blood [Hg] : adult blood [Hg] in Japanese.
- *Estimate at least 300,000 newborns in US each year with in utero blood [Hg] greater than 5.8 µ/L.*

Reports in 2003/2004 (*continued*)

- Seychelles cohort update.
- *Methylmercury-associated adult neuro-psychological changes at hair [Hg] < 50 ppm.*
- Distribution of omega-3 fatty acids (EPA and DHA) in fish and shellfish vs. [Hg] in fish and shellfish.

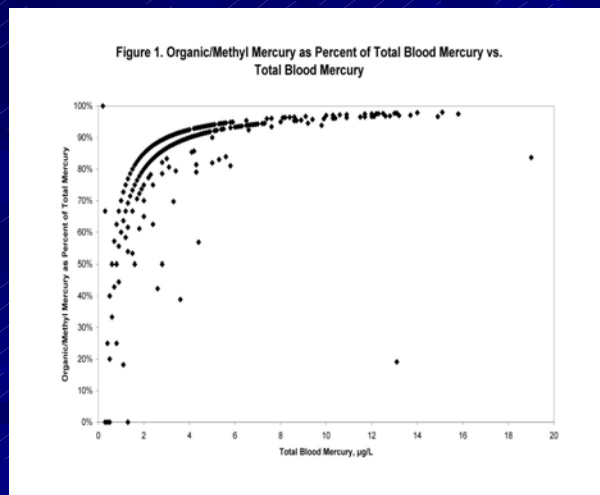
1999-2000 NHANES Blood Mercury

- Blood organic mercury (i.e., methylmercury) among 1709 women of childbearing age representative of US population.
- *Overall, 9% of women consumed fish at least once a week. Fish consumption higher among women over age 30 and among Asians and people of "Island" ethnicity.*

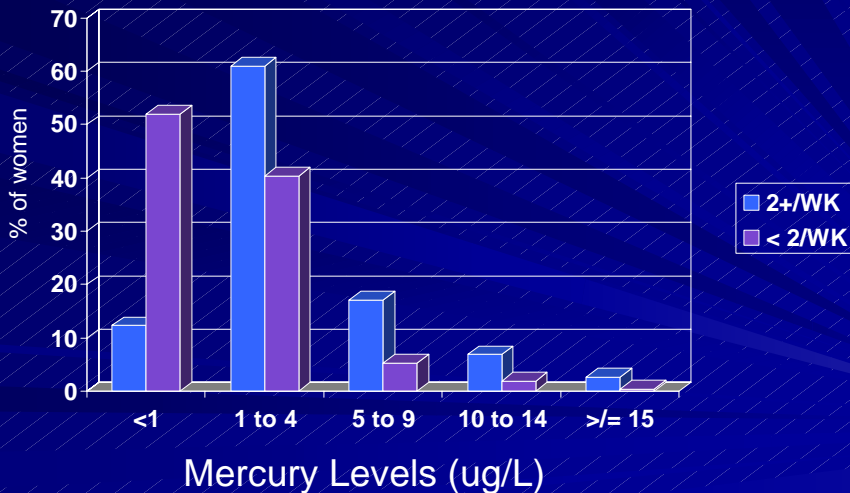
1999-2000 NHANES Blood Mercury

- Association: $R = 0.5$ to 0.6 between dietary total mercury and blood organic mercury (Mahaffey et al., 2003).
- Blood mercury concentrations were 7 X higher among women who reported eating 9+ fish/shellfish meals within past 30 days (i.e., 2 or more times per week) compared with women who reported no fish/shellfish consumption in the past 30 days (Mahaffey et al., 2003).

Methylmercury as a Percent of Total Blood Mercury: 1999-2000 NHANES Adult Women of Childbearing Age



Total Mercury Levels in Women, Aged 16-49 by Weekly Fish Consumption Levels



Basis for Uncertainty Factor of 10 in the Reference Dose for Methylmercury

Three-fold for toxicokinetics:

■ Basis for the UF of 10:

Variability and uncertainty in estimating an ingested mercury dose from cord blood mercury concentration.

Cord:maternal ratio for blood [Hg] ranges from > 3 to less than 1. Average ~ 1.7 to 1.8. New Japanese data indicate ratio of 1.6 for cord : maternal pairs.

Three-fold for toxicodynamics and uncertainty.

Estimated Number of Newborns with In Utero Methylmercury Exposures \geq RfD

- Number of US births in 2000: 4,058,814 (*National Vital Statistics Reports*).
- 1 : 1 ratio of cord to maternal blood [Hg], i.e., 5.8 cord to 5.8 maternal, 7.8% of women had total blood [Hg] \geq 5.8, ~ 300,000 newborns each year > 5.8 ug/L (Mahaffey et al., 2003).
- 1.7 : 1 ratio of cord to maternal blood [Hg], i.e. 5.8 cord to ~ 3.5 maternal, 15.7% of women had total blood [Hg] \geq 3.5 ug/L, ~ 630,000 newborns each years ≥ 5.8 ug/L cord blood. [Note: this estimate is preliminary in nature, and is based on recently available information about mercury in umbilical cord blood versus maternal blood. This new information was presented as part of an ongoing scientific dialogue on how best to understand mercury exposures. EPA is still reviewing these new studies and their potential implications. This recalculation does not impact or change the established Reference Dose (RfD); rather this work focuses solely on an exposure estimate.]

2003/2004 Reports on Neuropsychological Evaluations of Methylmercury Toxicity

- **Myers et al. 2003.** Seychelles cohort update (Lancet). Continued to observe no adverse effects of methylmercury exposure under the circumstances present in the Seychelles Islands.
- **Yokoo et al. 2003.** *Reduced function on tests of fine motor speed and dexterity and on tests of verbal memory among adult Amazonian villagers exposed to methylmercury.*
- **Beuter and Edwards, 2003.** Cree Indians. Additional studies among adults showed difficulty with accuracy and sharpness of visual fixation and pursuit in dynamic eye movements.

Emerging Question on Adult Neurotoxic Effects of Methylmercury Exposures

WHO proposed threshold for adult neurotoxicity based on 5% prevalence of paresthesias at 50 ppm hair mercury (1990).

No physiological basis to assume there are no effects at lower exposures

Dose-response at lower levels needs to be determined.

Mercury and Omega-3 Fatty Acids

- In 2003 additional epidemiology data raised more interest in mercury as a cardiac toxin.
- *Omega-3 fatty acids in fish frequently cited as a health benefit of fish and shellfish intake.*
- Key piece of information is that there are substantial species-specific differences in the distribution of mercury and of the omega-3 fatty acids.
- *Species high in mercury are not necessarily high in omega-3s and species high in omega-3s are not necessarily higher in mercury.*

Comparison of Mercury (ppm) and Omega-3 Fatty Acid (g/100g) in Fish Species

■ High Mercury Species

Tilefish: 1.6 Hg, 0.17 O-3s

Shark: 1.3 Hg, 0.07 O-3s

King Mackerel: 0.97Hg,
0.18 O-3s

Swordfish: 0.95 Hg, 0.58
O-3s

■ High Omega-3 Species

Mackerel: 0.08 Hg, 3.61 O-
3s

Salmon-sockeye: 0.03 Hg,
3.00 O-3s

Herring: 0.01 Hg, 2.34 O-
3s

Tuna, albacore: 0.26 Hg,
2.33 O-3s

Variation in Mercury and Omega-3 Fatty Acids in Fish and Shellfish

- Mercury concentrations range from < 0.02 ppm Hg in shellfish such as abalone to several ppm Hg in large predatory fish.
- *Omega-3 fatty acids (combined EPA and DHA) range from < 0.1 gram/100 grams of fish (e.g., shark species) to > 3.5 grams/100 grams of fish (mackerel species).*
- There is minimal association between the omega-3 fatty acid concentration in the fish species and the mercury concentration in the species.

Upcoming Meeting

- Meeting on medical issues related to mercury exposure.
- Orlando, Florida
- April – 2004
- Sponsored by US EPA and US HHS in conjunction with multiple medical associations.