Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.20803

Mercury isotopes and methylmercury exposure in a birth cohort in rural China

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Background: Mercury isotopes undergo mass-dependent fractionation (MDF) during biological, chemical, and physical transformations, while certain odd mercury isotopes undergo mass-independent fractionation (MIF), during photochemical processes. Enrichment of hair MDF (relative to dietary sources of methylmercury) is thought to reflect methylmercury metabolism, while hair MIF has been used to distinguish methylmercury intake from rice versus seafood. We leveraged our birth cohort study in rural China to further investigate the utility of hair mercury isotopes as biomarkers of dietary methylmercury exposure.

Methods: Peripartum mothers were enrolled at the Maternal and Child Health Hospital in Daxin county, Guangxi province, China. Mercury isotopes and total mercury concentrations were analyzed in maternal hair corresponding to the second trimester (n=261 mothers). Polyunsaturated fatty acids were measured in maternal serum. Using multivariable regression, associations were investigated between hair MDF (defined as $d^{202}Hg$) and hair MIF (defined as $D^{199}Hg$) (dependent variables) and dietary methylmercury intake (independent variable). Proxies for dietary methylmercury intake included a) %methylmercury intake from rice, b) rice methylmercury intake and fish methylmercury intake (both log-transformed), and c) maternal serum n-3 and n-6 fatty acids. Models were adjusted for maternal age, maternal pre-pregnancy body mass index (kg/m^2), whether one parent was a farmer, maternal %calories from protein, maternal energy intake (kcal) (log-transformed), and maternal hair total mercury (log-transformed).

Results: In adjusted models, hair MIF was positively associated with maternal serum n-3 fatty acids, but not associated with the other two proxies for methylmercury intake. Hair MDF was not associated with dietary methylmercury intake; however, hair MDF was positively correlated with maternal age. Hair MIF was lower among farmers compared to non-farmers, which likely reflected lower fish consumption among farmers. Hair total mercury (log-transformed) was inversely correlated with both hair MIF and hair MDF.

Conclusions: Our results suggested that a biological measure of fish consumption (serum n-3 fatty acids) was more strongly correlated with hair MIF, compared to measures for methylmercury intake that were derived in part from a self-reported food frequency questionnaire. More research is needed to understand associations between hair MDF and maternal age, and between hair MDF and MIF and hair total mercury concentrations.