



# The development and application of methylmercury-to-total mercury ratios for exposure assessment of methylmercury from the consumption of traditional foods

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# Introduction

- Mercury is often detected in traditional foods consumed by Indigenous Peoples.
- The main source of exposure to methylmercury (MeHg) is through dietary intake.
- Risk assessments and consumption advisories are typically based on total mercury concentrations.
  - $\text{MeHg} + \text{iHg} = \text{THg}$
- Assuming 100% MeHg may overestimation of risk.



## Research Objectives:

1. Quantify MeHg:THg ratios across important species and tissues
2. Develop conversion factors that can be used to adjust THg concentration for risk assessment
3. Validate ratios and explore variability in MeHg ratios

# Methods: Database Development

## 1. Identification of 85 important traditional foods

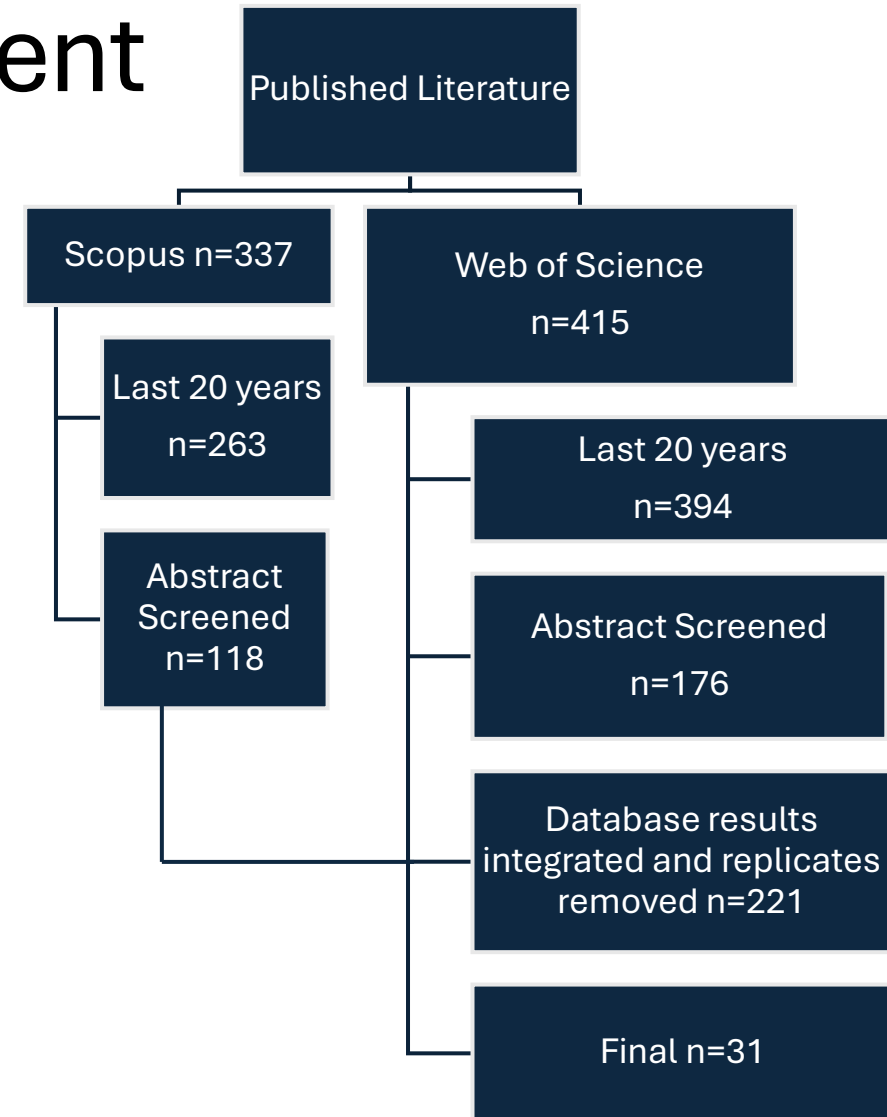
- Inuit Health Survey (Laird et al. 2013)
- First Nation Food Nutrition and Environment Study [FNFNES] (Chan et al. 2019)
- Consultations with an Expert Mercury Resource Group

## 2. Critical review of data

- Published and grey literature, government databases/ reports, private datasets
- **Inclusion criteria: 2000-2020, reported MeHg and THg, samples collected in Canada, no captive populations**

## 3. Database Development

- Data Extraction and Cleaning: Covert all dry weight concentrations to wet weight and standard error to standard deviation
- Metadata: Data dictionary



# Methods: Conversion Factor Development

## 4. Meta-Analysis (in R)

- Total n sample in group >19
- MeHg: THg ratio - species by tissue and species grouping by tissue
- Meta Package: metacont (individual ratio + SD) and metamean (group ratio + 95% CI)

## 5. Adjust conversion factor based on variability

- Upper confidence limits of the ratio + 10% - 20%
- Inclusive of maximum ratio from any of the individual samples

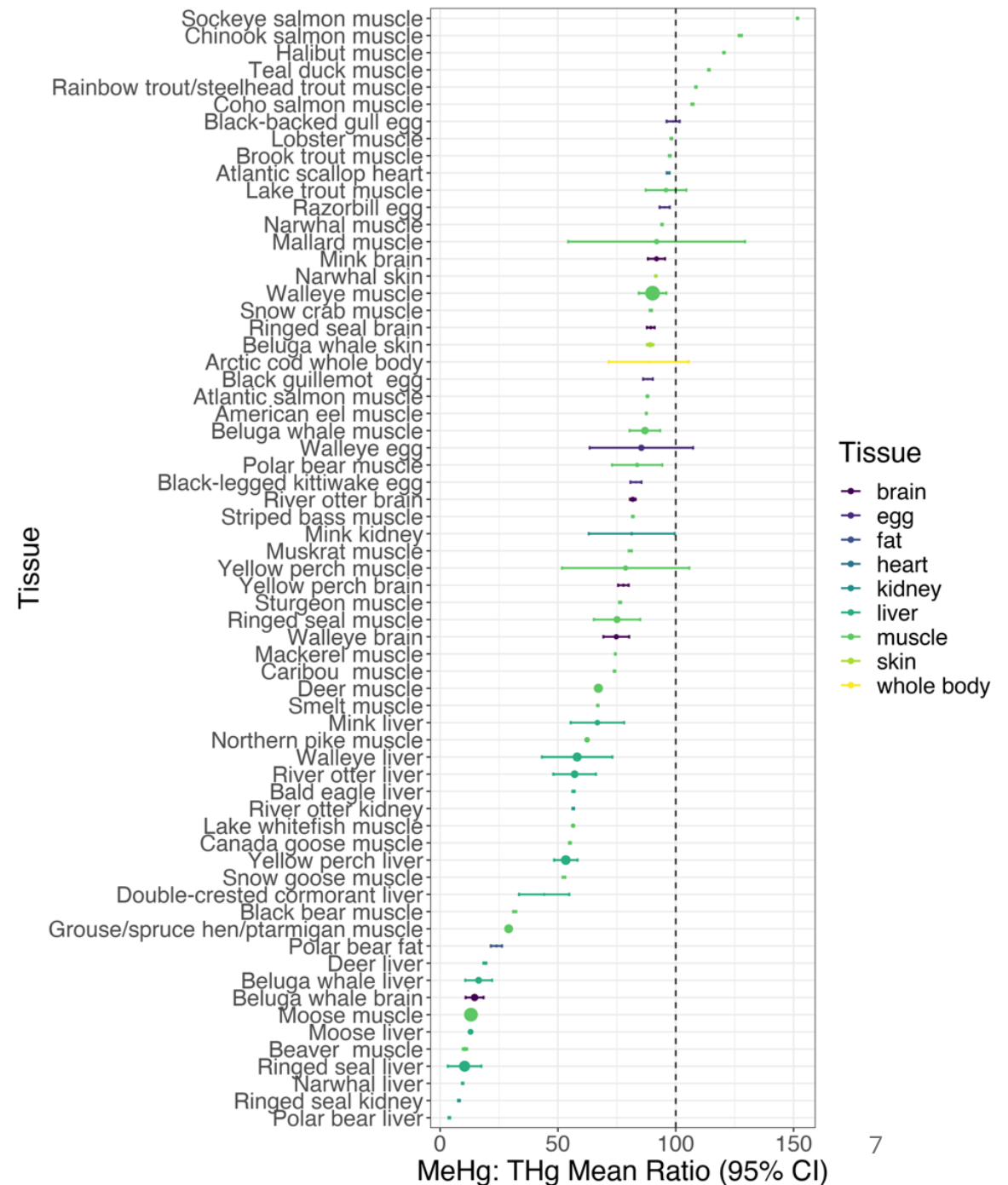
## 6. Validation of ratios and reassessment of rates of MeHg intake from traditional diets

# Results: Database Development

- 298 entries
- Includes 76% (29/38) of the targeted First Nations food items and 57% (27/47) of the targeted Inuit food items
- Over 70 data columns
  - Location
  - Sample Information
  - Species/tissue information
  - Biometrics
  - Analytical Methods/Quality Control
  - THg Concentration ( $\mu\text{g/g}$ ) and MeHg Concentration ( $\mu\text{g/g}$ )
  - MeHg:THg Ratio (%)

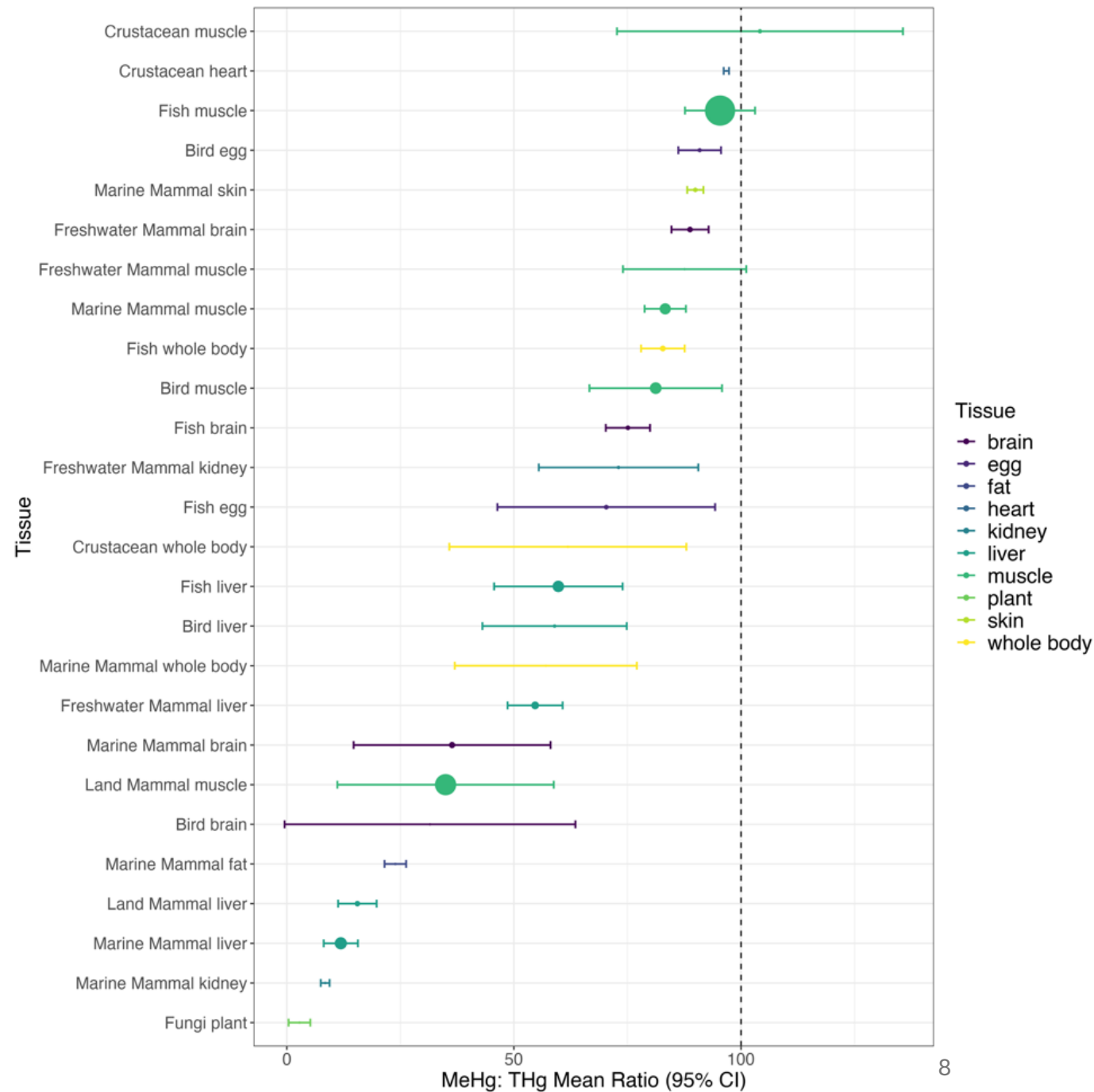
# Results: Species and Tissue-Specific Conversion factors

- 65 species-tissue groups with  $n > 19$ 
  - 27 species-tissues that had MeHg:THg equal to 100%
  - 38 species-tissue conversion factors were lower than 100%
  - Many of the organ tissues and land mammals have lower ratios



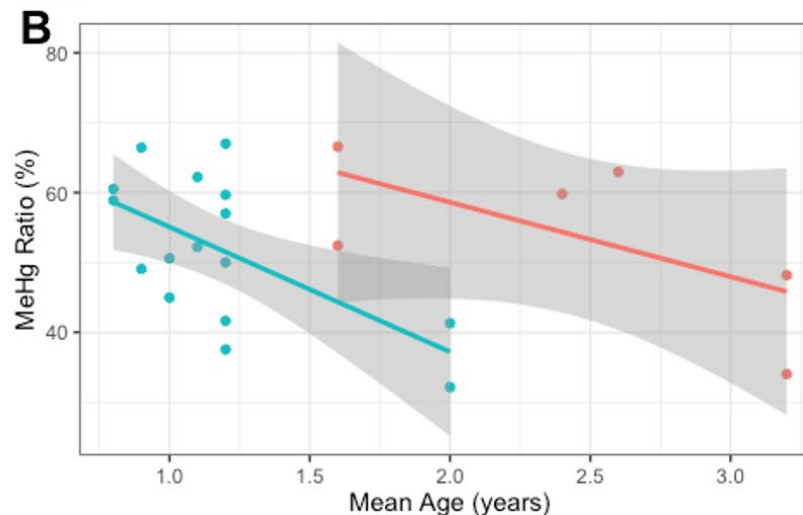
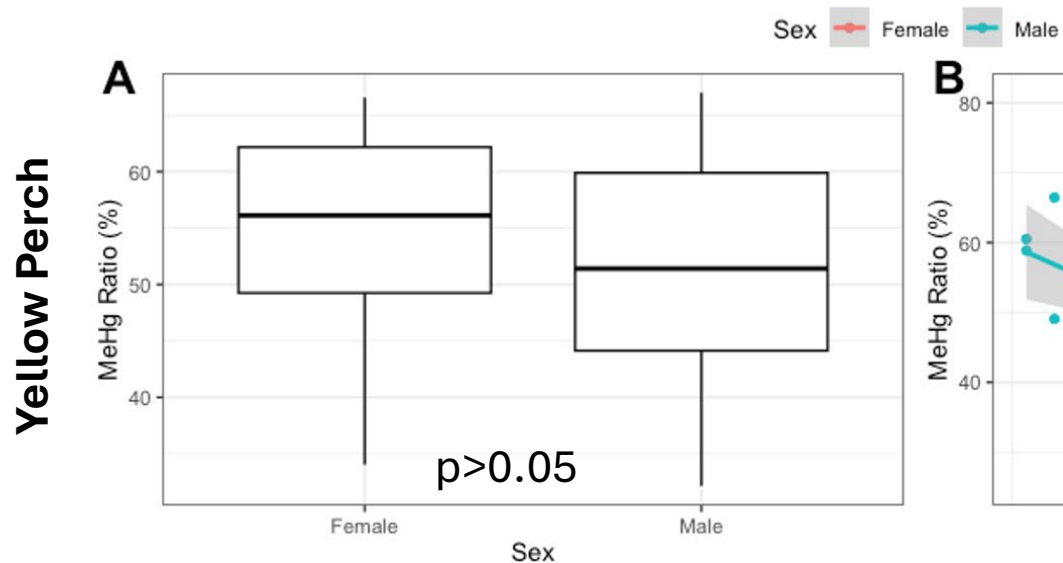
# Results: Species Type and Tissue Factors

- 27 species type-tissue ratios with  $n > 19$
- 14 species-tissues groups that had MeHg:THg equal to 100%
- 13 species-tissues groups had MeHg:THg less than 100%
- The lowest is marine and land mammal liver/ kidney and plants



# Discussions

- Some ratios have a lot of variability
  - Year of the study/ analytical methods (Direct MA, Cold Vapor Atomic Absorption, ICP-MS)
  - Local geography/ location – increasing latitudinal trend
  - Morphological: Body weight, Size, Age
- May relate to internal factors (detoxification potential) or external factors (Hg deposition patterns/ Hg bioavailability – pH, Se)
- We currently lack the data to fully investigate this



- 30% of the variance in MeHg ratio was explained by body weight
- Males: 19% decrease per year
- Females 13% decrease per year

# Conclusions

- Our result confirms that the conservative approach of assuming 100% MeHg would have overestimated the MeHg concentrations in some species and tissues.
  - In some cases by 10-fold
- These ratios can be used to generate more accurate estimates of MeHg concentrations in country foods when only THg concentrations are available.
  - May be able to revise existing consumption advisories - E.g., Advisory to women of childbearing age to limit the consumption of ringed seal liver in Nunavut



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