Risk Tradeoffs Associated with Traditional Food Advisories for Labrador Inuit

Ryan S.D. Calder [a,b*], Sabri Bromage [c], Elsie M. Sunderland [a,b]

[a] Department of Environmental Health, Harvard T.H. Chan School of Public Health, Boston MA, 02215, USA

[b] Harvard John A. Paulson School of Engineering and Applied Sciences, Cambridge MA, 02138, USA

[c] Department of Nutrition, Harvard T.H. Chan School of Public Health, Boston MA, 02115, USA

[*] Corresponding author current contact information: Department of Civil and Environmental Engineering, Duke Pratt School of Engineering. 1116 Hudson Hall, Box 90287, Duke University, Durham NC, 27708, USA. T: (919) 355-6876; F: (919) 660-5219; ryan.calder@duke.edu

Abstract

The traditional Inuit diet includes wild birds, fish and marine mammals, which can contain high concentrations of the neurotoxicant methylmercury (MeHg). Hydroelectric development may increase MeHg concentrations in traditional foods. Consumption advisories are often used to mitigate such risks and can result in reduced intake of traditional foods. Data from a dietary survey, MeHg exposure assessment and risk analysis for individuals in three Inuit communities in Labrador, Canada (n = 1,145) in 2014 indicate reducing traditional food intake is likely to exacerbate deficiencies in n-3 polyunsaturated fatty acids and vitamins B12 and B2. Traditional foods accounted for < 5% of per-capita calories but up to 70% of nutrients consumed. Although consumption advisories could lower neurodevelopmental risks associated with an increase in MeHg exposure (90th-percentile ΔIQ = -0.12 vs. -0.34), they may lead to greater risks of cardiovascular mortality (90th-percentile increase: +58% to +116% vs. +25%) and cancer mortality (90th-percentile increase +2% to +4% vs. no increase). Conversely, greater consumption of locally caught salmon mostly unaffected by hydroelectric flooding would lower all these risks (90th-percentile ΔIQ = +0.4; cardiovascular risk: –45%; cancer risk: –1.4%). We thus conclude that continued consumption of traditional foods is essential for Inuit health in these communities.

Keywords: fish advisory, methylmercury, indigenous health, dietary transition, nutrition

Funding sources

This work was supported by the Canadian Northern Contaminants Program, ArcticNet Inc., Tides Canada Oak Arctic Marine Fund Program, and the Nunatsiavut Government (NG). RSDC acknowledges support from a graduate fellowship from the Natural Sciences and Engineering Research Council of Canada (grant 575792). SB acknowledges support from National Institutes of Health (grant 5T32ES007069).

Research ethics approval

This work was carried out following the approval of the following research ethics authorities:

- Office of Human Research Administration, Harvard T.H. Chan School of Public Health (case IRB13-1483)
- Newfoundland and Labrador Research Ethics Board (case 14.004)
- Nunatsiavut Government Health Research Ethics Authority

1. Introduction

Traditional foods consumed by northern Inuit populations include locally caught fish, birds and marine mammals. These foods are critical sources of micronutrients and high-quality protein in regions that have limited access to other fresh foods. However, some traditional foods contain elevated concentrations of contaminants such as methylmercury (MeHg) that biomagnify in aquatic environments.[1] MeHg exposures among indigenous populations across Canada tend to be higher than the national average due to relatively greater consumption of fish and marine mammals.[2, 3] Fish consumption advisories are a common policy response to elevated environmental levels of MeHg.[4-7] However, even targeted food advisories can lead to decreased overall consumption of seafood.[8, 9] In indigenous populations, some food consumption advisories related to elevated MeHg levels have led to decreased overall consumption of seafood.[10, 11]

MeHg has a half-life of 50–70 days in the human body and thus dietary changes can alter exposures over shorter timescales than many other hydrophobic organic pollutants such as polychlorinated biphenyls (PCBs) that persist in the body for decades.[12, 13] Negative effects of MeHg exposure on the brain of the developing fetus and young children have been shown to persist into adulthood and this is the endpoint used by most regulatory agencies to establish risk threholds.[14-16] An association between elevated prenatal MeHg exposures and neurodevelopmental impairment has similarly been shown among Inuit children.[17, 18] MeHg exposure has also been associated with cardiovascular health risks for adults.[19-22]

Dietary advice to indigenous populations must balance the competing goals of minimizing contaminant exposures with ensuring nutritional sufficiency.[10, 11, 23] Thus, quantitative studies quantifying the likely health risks or benefits from different dietary interventions among indigenous populations are needed and are the focus of this work. Past studies have examined risk tradeoffs between increased MeHg exposure and n-3 polyunsaturated fatty acids (n-3 PUFAs) in seafood.[24-27] Cardiovascular and neurodevelopmental benefits of n-3 PUFAs can offset negative impacts of MeHg exposure.[27] The World Health Organization (WHO) and the Food and Agriculture Organization (FAO) have however recommended that risk-benefit evaluations for seafood consumption consider a broader suite of nutrients, including iron, zinc, and vitamins A, D, B2 and B12.[28]

Dietary changes exert changes on health endpoints through diverse, competing mechanisms. For example, red and processed meats increase cardiovascular risks by triggering the formation of proartherosclerotic trimethylamines and raise colorectal cancer risks through production of carcinogenic N-nitroso compounds in the gastrointestinal tract.[29-31] Conversely, fruits, vegetables and nuts are rich in compounds that reduce cardiovascular risks by inhibiting platelet aggregation and oxidation of arterial cholesterol (antioxidants and polyphenols), mediating glucose homeostasis (fiber) and regulating blood pressure (potassium and magnesium).[32-36] There is strong evidence that vitamin D exerts a generalized cancer-protective effect through the apoptotic and antiangiogenic properties of its metabolite $1,25(OH)_2D$.[37-39] The Global Burden of Disease study synthesizes the most well-established causal relationships between intake of various foods and nutrients and different cancers and cardiovascular diseases.[40, 41]

Here, we use results from a dietary survey and food subsidy data to better understand consumption preferences and the nutritional importance of locally harvested foods for three Inuit communities in the Lake Melville region of Labrador, Canada. In this region, local Inuit are concerned about potential increases in MeHg exposure from traditional foods following completion of a hydroelectric power facility upstream of their traditional hunting and fishing territory. Flooding of hydroelectric reservoirs leads to a pulse in MeHg production in the saturated soils, which can enter the overlying water and accumulate in fish and wildlife. In previous work, we estimated increases in MeHg concentrations of traditional foods at their peak due to the local hydroelectric development using a biogeochemical model.[42] Modeled peak increases in ranged from nine times 2014 levels for some freshwater species most affected by the hydroelectric development to zero for offshore marine species.[42]

In this study, we conduct a screening level analysis of potential risks associated with higher MeHg concentrations in traditional foods. We compare the estimated magnitudes of projected MeHg exposure risks to those attributable to changes in nutrient intake following a dietary transition away from traditional foods using established dose-response relationships. We conduct this analysis to better understand potential health implications of dietary consumption advisories for indigenous populations more generally.

2. Methods

2.1 Food frequency questionnaire and hair Hg analysis

We developed a food frequency questionnaire (FFQ) to measure intake of traditional foods and store-bought seafood among Labrador Inuit settled in three communities downstream from the Churchill River: 1) Happy Valley – Goose Bay, 2) North West River, and 3) Rigolet (SI Figure S1). We enrolled a total of 1,145 individuals, representing roughly 40% of the Inuit population in these communities (SI Table S1). Responses were weighted by demographic categories according to the 2011 Census to provide statistically relevant estimates for the whole population (SI Table S2).[43] A team of 26 trained research assistants recruited from the Inuit community administered the survey instrument.

The FFQ asked respondents to recall their intake of 64 traditional foods (locally caught seafood, land mammals, birds, plants and berries) and 24 store-bought seafood types over 24-hour, one-month and three-month recall periods. Foods measured by the FFQ are listed in SI

Tables S3 (locally caught seafood), S4 (other locally caught foods) and S5 (store bought seafood). The FFQ was administered across three seasons to assess seasonal variability in consumption preferences: Winter (March–April, $n = 231$), Spring (June–July, $n = 294$), and Summer (August–September, $n = 1{,}054$). Enrollment was maximized for the Summer survey period, which we use for risk calculations unless otherwise noted. Self-reported age, sex, height and weight was included in the survey. All FFQ respondents in the Spring and Summer periods were asked to provide hair samples. In total, 656 hair samples corresponding to 571 unique individuals were collected (157 in Spring and 499 in Summer).

All work involving human subjects (recruitment, survey design, data analysis and reporting) was reviewed and approved by the Office of Human Research Administration at the Harvard T.H. Chan School of Public Health, the Newfoundland and Labrador Health Research Ethics Authority and the Nunatsiavut Government Inuit Research Advisor. The Nunatsiavut Government provided input on all research plans and has assumed responsibility for disseminating research findings to community members and provincial and federal policymakers.[44, 45] Additional information on the FFQ design and implementation, participant recruitment and hair Hg analysis is provided in the SI.

2.2 Modeled MeHg exposures

We modeled MeHg exposures for all Inuit individuals in 2014 using dietary recall data for the 88 traditional and store-bought foods and associated MeHg concentrations (modeled as lognormal distributions). For locally caught foods, we directly measured MeHg concentrations in 22 species representing 81% of per-capita MeHg exposures from this category in 2014. All data sources for MeHg concentrations were originally reported by Li et al.[46]et al. and Calder et al.[42] and are provided in SI Tables S3 (locally caught seafood), S4 (other locally caught foods) and S5 (store-bought seafood).

To correct for overreporting bias associated with species-specific recall, we scaled reported species-specific intakes to match reported total consumption of three food categories (local seafood, store-bought seafood and other locally caught foods) following Lincoln et al.[47] We probabilistically simulated hair mercury concentrations (10,000 Monte Carlo trials) for each individual using the one-compartment model developed by the U.S. Environmental Protection Agency's (U.S. EPA), lognormal distributions for MeHg concentrations in food items (Tables S3–S5), and probabilistically distributed toxicokinetic parameters[48], following Li et al.[12]

The median ratio between measured hair Hg and simulated hair Hg was 0.96 in the larger-scale Summer survey period, suggesting that there is very little bias in the dietary model we developed (measured-to-modeled ratio close to 1). To ensure that population-wide MeHg exposures are not overestimated by the dietary model, modeled seafood intake was scaled such that simulated hair Hg matched measured Hg for all individuals with available hair Hg data. For others, seafood intake was scaled by the median bias (0.96).

2.3 Dietary intake of other foods

We estimated consumption of market foods other than seafood that have high nutritional content using sales data for the community of Rigolet for the same years as our dietary survey (2014-2015).[49] Data on the edible supply of foods have been successfully used to estimate dietary composition and caloric sufficiency in other populations.[50-52] Data were obtained from a Canadian federal subsidy program (Nutrition North), which subsidizes 42 nutrient-dense and perishable store-bought foods or food categories in remote communities.[53] We estimated population-wide intake of nutrient-dense store-bought foods based on the magnitude of food subsidies and by subtracting retail and consumer waste fractions[54] (SI Table S6). We assumed the composition of market foods sold in Rigolet was similar for the other two communities (Happy Valley-Goose Bay, Northwest River). Since traditional food intake was smaller in these communities in 2014, we allowed for proportionally greater consumption of store-bought nutrient-dense foods.

We used the relationship developed by Mifflin et al.[55] that has applied among indigenous populations[56] to estimate total energy expenditure (E) of each Inuit individual based on self-reported body mass, height, and age from survey data (eq. 1):

$$E = (9.99W + 6.25H - 4.92A + 166\alpha)\beta \qquad [1]$$

where W is body mass (kg), H is height (cm), A is age (years) and $\alpha = 1$ and $\beta = 1.7$ for men and $\alpha = 0$ and $\beta = 1.6$ for women. For each individual, the difference between estimated energy expenditure and the caloric intake accounted for by locally caught traditional foods (data from the FFQ) and nutrient-dense market foods (data from Nutrition North) was assumed to correspond to comparatively nutrient-sparse foods such as potato chips and sweetened beverages. There are very few foods that do not qualify for Nutrition North subsidies that have nutritional value and, in other Inuit populations, they are not widely consumed.[57]

2.4 Nutritional content of store bought foods

We used the Canadian Nutrient File[58] to estimate nutrient intake from store-bought nutrient-dense foods and traditional foods. Government nutritional databases include traditional and market foods consumed by Inuit populations and have been successfully used to estimate population-wide nutrient intake for other indigenous groups (e.g., Quebec Inuit).[59] Five foods with no data were matched to foods in the United States Department of Agriculture (USDA) Nutrient Database[60]. Nutrient contents were available for 90% of foods by calories. For other foods, the average nutrient content of similar food categories was used. For this purpose, we group all foods (traditional and store-bought together) according to the following food categories: dairy, egg, fish liver, fish muscle, fish roe, fowl/poultry, fruit, grain, marine mammal, processed meat, red meat, shellfish, terrestrial mammal and vegetables. The compiled database of nutritional information for all foods studied here is included in the SI (Excel file: Appendix A, SI Table S6). We consider that dietary supplementation has a negligible impact on population-wide nutrient intake because dietary supplement tends to be rare among indigenous populations.[61-63]

2.5 Traditional food substitution scenarios

We developed five traditional food substitution scenarios to bound the possible range of dietary changes that might occur in the future. These are: [1] Traditional foods are replaced by nutrient-dense store-bought foods subsidized by the Nutrition North program (SI Figure S2). [2] Traditional foods are replaced by processed meat as an alternative protein source. [3] Traditional foods are replaced by vegetables. This scenario was used to provide a lower envelope of nutritional risks. However, the Nunatsiavut Government identified this scenario as highly unlikely given current consumption preferences. We nevertheless include it as a best-case scenario for market-based food substitution. [4] Traditional foods are replaced by nutrient-sparse foods such as snack foods. [5] Traditional foods high in MeHg are substituted with Atlantic salmon. The Nunatsiavut Government identified Atlantic salmon as a preferred food item. We use this scenario to investigate the health impacts of traditional diet adaptation instead of replacement with store-bought foods. For all scenarios, caloric consumption is assumed to be constant at the estimated 2014 values based on Eq. 1 above.

2.6 Screening-level risk assessment

We quantified the magnitudes of neurodevelopmental, cardiovascular and cancer risks associated with the five dietary scenarios described above and compared them to those associated with projected future MeHg exposures at 2014 diet. Projected future MeHg exposures result from increased MeHg content in traditional foods as a result of upstream hydroelectric development calculated by Calder et al.[42]. The probabilistic projections of future MeHg levels in local traditional foods are included in SI Table S7. We do not consider cancer risks associated with MeHg in traditional foods because the U.S. EPA classifies MeHg as a possible human carcinogen, noting there is ‘no persuasive evidence’ for human carcinogenicity.[16]

Neurodevelopmental risks to children are expressed in terms of change in IQ and are modeled by considering diets of women of childbearing age (16–49 following McDowell et al.[64]). We retain the confounder-adjusted dose-response functions summarized in Table 1. We express cardiovascular and cancer risks as the relative risk (RR) of mortality compared to 2014, calculated from changes in intake of various foods and nutrients. A RR of greater than 1.0 represents an increase in risk, and a RR of less than 1.0 represents a decrease in risk.

Cardiovascular and cancer risks are quantified as the product of individual confounder-adjusted relationships following Fleming et al.[65]. RRs are presented in the literature corresponding to certain incremental doses. We assume these are proportional over the range of incremental changes explored here and scale RRs presented in the literature to changes in food substitution scenarios. We consider relative risks for cardiovascular and cancer deaths based on diet for all individuals over 25 following Forouzanfar et al.[66]. Dose-response functions for cardiovascular and cancer mortality are expressed in terms of risks of more specific causes of death (e.g., risk of cancer at certain sites). We consider the share of overall cardiovascular (Table 2) and cancer (Table 3) mortality represented by the outcome in each dose-response relationship in order to calculate net impacts on the risk of total cardiovascular and cancer mortality. A mathematical derivation (equations S1–S3) is presented in the SI.

Dietary dose-response functions for risk of cardiovascular and cancer death are based on the Global Burden of Disease study.[40] We excluded benefits related to increased whole grain consumption because we could not quantify the ratio of whole to processed grains in the baseline diet and intake of whole grains is small in similar northern indigenous populations. [61, 67] We account for cardiovascular risks associated with consumption of red and processed meats and benefits of fruits, nuts and vegetables as a function of intake of the whole food and thus do not separately consider constituent nutrients in these foods (e.g., sodium in red meat).There is strong evidence that vitamin D exerts a generalized cancer-protective effect, especially in northern populations.[37-39] We thus also consider a negative association between vitamin D and risk of cancer mortality[68] following earlier work by Grant et al.[69] who calculated cancer mortality in Canada attributable to vitamin D deficiency. This analysis is carried out using probabilistically distributed parameters for relative risk of cancer and cardiovascular effects and for IQ gains and decrements, allowing for explicit calculation of the uncertainties inherent to this analysis.

Table 1: Summary of dose-response relationships used for screening-level risk assessment of neurodevelopmental risk

Predictor	**Outcome**	**Dose-response function**[a]	**Reference**
MeHg	IQ points	1.07 per 0.5 g Hg g^{-1} hair (95% CI: 1.03–1.11)	Virtanen et al.[19]
n-3 PUFAs	IQ points	mode = +1.3; min = 0.8; max = 1.8 per g DHA day^{-1}	Cohen et al.[70]

[a] MeHg dose-response function is normal distribution and n-3 PUFA dose-response function is triangular distribution following the authors. Risks accrue to children born to mothers (females aged 16–49) with modeled intakes.

Table 2: Summary of lognormally distributed dose-response relationships used for screening-level risk assessment risk of cardiovascular mortality

Predictor	**Outcome**	**Median (95% CI) relative risk per change (+) in intake**	**Reference**
MeHg	SCD[b]	1.07 (1.03–1.11) per 0.5 g Hg g^{-1} hair	Virtanen et al.[19]
n-3 PUFAs[a]	IHD[c]	0.866 (0.792–0.943) per 0.1 g day^{-1}	Forouzanfar et al.[40], Chowdhury et al.[71]
Fiber	IHD[c]	0.754 (0.678–0.831) per 20 g day^{-1}	Threapleton et al.[29], Forouzanfar et al.[40]
Fruit	IHD[c]	0.867 (0.829–0.962) per 100 g day^{-1}	Wang et al.[32], Forouzanfar et al.[40]
Fruit	IS[d]	0.719 (0.604–0.8401) per 100 g day^{-1} (b)	Forouzanfar et al.[40], Hu et al.[72]
Fruit	HS[e]	0.868 (0.661–0.762) per 100 g day^{-1}	Forouzanfar et al.[40], Hu et al.[72]
Nuts	IHD[c]	0.944 (0.845–0.914) per 4.05 g day^{-1} (b)	Forouzanfar et al.[40], Afshin et al.[73]
Processed meat	IHD[c]	1.603 (1.022–2.271) per 50 g day^{-1}	Forouzanfar et al.[40], Micha et al.[74]
Trans fatty acids	IHD[c]	1.414 (1.281–1.567) per 2% energy intake[f]	Forouzanfar et al.[40], Mozaffarian and Clarke[75]
Vegetables	IHD[c]	0.96 (0.93–0.99) per 106 g day^{-1} (g)	Wang et al.[32]
Vegetables	IS[d] and HS[e]	0.89 (0.81–0.98) per 200 g day^{-1} (h)	Hu et al.[72]

[a] As DHA + EPA.

[b] Sudden cardiac death represents 27.4% of total cardiovascular mortality CDC [76].

[c] Ischemic heart disease represents 70% of total cardiovascular mortality CDC [76].

[d] Ischemic stroke represents 13% of total cardiovascular mortality CDC [76].

[e] Hemorrhagic stroke represents 6% of total cardiovascular mortality CDC [76].

[f] Total daily energy intake calculated from Mifflin et al.[55] as described in methods and assuming 9 kcal g^{-1} trans fatty acids [77].

Table 3: Summary of lognormally distributed dose-response relationships used for screening-level risk assessment of risk of cancer mortality

Predictor	**Cancer site (mortality)**	**Median (95% CI) relative risk per change (+) in intake**	**Reference**
Calcium	Colon/rectum[a]	0.729 (0.831–0.963) per 1 g day^{-1}	Forouzanfar et al.[40], WCRF and AICR [78]
Fiber	Colon/rectum[a]	0.809 (0.741–0.882) per 20 g day^{-1}	Forouzanfar et al.[40], WCRF and AICR [78]
Fruit	Esophagus[b]	0.867 (0.776–0.968) per 100 g day^{-1}	Forouzanfar et al.[40], Liu et al.[79]
Fruit	Trachea/ bronchus/lung[c]	0.929 (0.890–0.970) per 100 g day^{-1}	Forouzanfar et al.[40], Vieira et al.[80]
Milk	Colon/rectum[a]	0.898 (0.831–0.963) per 226.8 g day^{-1}	Forouzanfar et al.[40], WCRF and AICR [78]
Processed meat	Colon/rectum[a]	1.179 (1.092–1.267) per 50 g day^{-1}	Forouzanfar et al.[40], WCRF and AICR [78]
Red meat	Colon/rectum[a]	1.167 (1.033–1.309) per 100 g day^{-1}	Forouzanfar et al.[40], WCRF and AICR [78]
Sodium	Stomach[d]	1.18 (1.02–1.38) per 1 g day^{-1} (e)	Forouzanfar et al.[40], WCRF and AICR [78]
Vegetables	Esophagus[b]	0.840 (0.780–0.920) per 100 g day^{-1} (f)	Forouzanfar et al.[40], Liu et al.[79]
Vitamin D	General	0.69 (0.55–0.86) per 1,429 IU day^{-1}	Garland et al.[81]

[a] 9.1% of total cancer mortality. [82]
[b] 2.4% of total cancer mortality. [82]
[c] 26.6% of total cancer mortality. [82]
[d] 1.9% of total cancer mortality. [82]

3. Results and Discussion

3.1 Methylmercury exposures in 2014 among Lake Melville Inuit

Measured Hg concentrations in the hair of Inuit individuals participating in our survey ranged from 6.8 ng g^{-1} to 6,200 ng g^{-1}. We find that between 67% (spring) and 71% (summer) of all measured hair Hg samples fall within the modeled ranges of exposure (Figure 1, green circles). This is better than many recent surveys[47, 83-85] and may reflect lower inter-individual variability in pharmacokinetics among a relatively homogeneous survey population and the relatively smaller range of available fish with more consistent bioaccessibility.[12, 86] The Inuit Health Study (IHS) previously characterized MeHg exposures among Inuit in the community of Rigolet and other communities on the Labrador Coast but excluding Happy Valley – Goose Bay and North West River. The geometric mean blood Hg (3.2 µg L^{-1}) reported in the IHS is equivalent to approximately 0.8 µg g^{-1} hair [87, 88] and compares well to Spring and Summer mean hair levels (0.77 µg g^{-1}) measured in this study in Rigolet. MeHg exposures measured in 2014 are generally lower than other Inuit populations. For instance, the IHS reported geometric mean blood Hg equal to 9.0 µg L^{-1} for Inuit in Nunavut[89], while Dewailly et al.[90] reported a geometric mean of 10.8 µg L^{-1} for the Inuit of Nunavik (northern Quebec).

Exposures to MeHg of during the Summer survey period in 2014 were approximately double the median exposure of the general Canadian population.[2, 48] However, the majority of individuals in the survey population fall below the reference dose (RfD) for exposure established by the U.S. EPA of 0.1 µg kg^{-1} day^{-1} and Health Canada's provisional tolerable daily intake (pTDI) of 0.2-0.47 µg kg^{-1} day^{-1} (Figure 2, SI Table S8).[91] Across the three Inuit communities, only individuals above the 90th percentile of MeHg exposures had daily intake levels that exceeded the U.S. EPA's RfD (Figure 2). For example, the 95th percentile of MeHg exposures ranged from 0.10 µg kg^{-1} day^{-1} in Happy Valley–Goose Bay to 0.27 µg kg^{-1} day^{-1} in Rigolet, and

0.12 μg kg^{-1} day^{-1} when averaged across the three communities. In Summer 2014, the fractions of Lake Melville Inuit exceeding the Health Canada pTDI and the US EPA RfD were approximately 1% and 7% respectively (SI Table S8). For all survey periods, older individuals, men, and individuals residing in the community of Rigolet have higher MeHg exposures (SI Table S8). Therefore, in 2014, risks associated with MeHg exposures were generally low and concentrated among individuals at higher exposure percentiles.

Individuals with the highest MeHg exposures in 2014 had the highest intake of traditional foods. Per-capita, roughly 70% of all MeHg intake came from traditional foods. Among individuals with MeHg exposures ≥ 90th percentile, 90% of all MeHg intake came from traditional foods. In Summer 2014, individuals in the lowest quartile of traditional food intake (≤ 6.86 g day^{-1}) received 24% of their MeHg exposure from traditional foods compared to 80% among the highest quartile (>41.1 g day^{-1}). Median MeHg exposure was 0.043 μg kg^{-1} day^{-1} for individuals in the highest quartile of traditional food consumption compared to 0.003 μg kg^{-1} day^{-1} among individuals in the lowest intake quartile. Mean MeHg per-capita exposures in the Summer survey period (0.035 μg kg^{-1} day^{-1}) were significantly different from the Spring period (0.024 μg kg^{-1} day^{-1}, $p < 0.001$, Wilcox rank-sum test) but not the Winter (0.046 μg kg^{-1} $day^{-1}$$p$ >0.05). This mirrors trends in traditional food intake. Mean traditional food consumption was significantly lower in the Spring period (28.5 g day^{-1}) compared to the Summer period (36.52 g day^{-1}, p < 0.001, Wilcox rank-sum test). Mean traditional food consumption in Winter was 38.7 g day^{-1} but was not statistically different from either Spring or Summer. Therefore, while population-wide MeHg exposure risks are generally low, these risks are sensitive to the MeHg content of local foods.

Although locally caught Atlantic salmon is relatively low in MeHg (Table S3), it was the single greatest contributor to overall MeHg intakes in all three communities including among individuals with MeHg exposures ≥ 90th percentile (24–29% of overall per-capita intake across communities in Summer 2014). Other foods contributing more than 5% to overall MeHg intakes in Summer 2014 were brook trout, Atlantic cod, tern eggs, duck and seal muscle (locally caught) and fresh cod, canned tuna and fresh tuna (store-bought). Individuals with MeHg exposures ≥90th percentile had similar sources of MeHg intake as the study population as a whole. SI Figure S2 presents the breakdown of per-capita MeHg sources in Summer 2014 for all individuals in the three communities studied and for individuals in all communities with MeHg exposures ≥90th percentile.

3.2 2014 diet composition

Survey data from the summer of 2014 suggest 91% of the population consumes traditional foods. However, these foods are only account for approximately 2% of mean caloric intake and 11% for the 95th percentile consumer (Figure 3). Across the three communities, consumption of traditional foods is highest in Rigolet (mean = 4% of total calories) and lowest in Happy Valley–Goose Bay (mean = <1% of total calories) (Figure 3). Prior work has reported similar findings for other Inuit communities, with higher rates of country food consumption in more northern communities that have less access to market alternatives.[88]

Using food subsidy data, we estimate that store-bought nutrient-dense foods account for 25% of total per-capita caloric intake. SI Figure S3 presents the composition of this nutrient-dense store-bought food component of the diet. For store-bought seafood, dietary survey data agree to within 12% of estimates based on the food subsidy program data, providing partial validation of this method. The remaining fractions of all caloric consumption estimated from individual body weight must come from store bought food such as nutrient-sparse snack foods and sweetened beverages. We estimate that these other foods account for approximately 70% of all calories consumed across demographic groups. These findings agree with prior research that has reported Inuit populations consume traditional foods, fruits and vegetables only one third as frequently as foods with low nutrient content.[92]

Types of traditional foods consumed by individuals vary widely (Figure 4). On a per-capita basis across the three communities, 90% of the calories from traditional foods are derived from 24 foods. Some traditional foods such as berries and seal blubber contain negligible quantities of MeHg (Figure 4). Foods with negligible Hg account for 40% of the total calories from traditional foods for all individuals surveyed (Figure 5). On a per-capita basis, 11 of the 24 major traditional foods consumed contain negligible amounts of MeHg. Survey data indicate that the greatest diversity in traditional food consumption occurs among individuals with the highest MeHg exposures (Figure 2b). Among the most highly exposed individuals to MeHg (90th percentile), traditional foods with negligible MeHg content account for only 28% of total calories (nine foods). Among all individuals, including among individuals with MeHg exposures greater than the 90th percentile, the most widely consumed traditional foods with negligible Hg were berries, goose, partridge, moose, caribou, seal blubber and rabbit.

Consumption of traditional foods increases linearly with age, with each year of age associated with a 0.8 g day^{-1} increase in traditional food intake ($R^2 = 0.10$, $p < 0.001$). Traditional foods supply a significantly higher fraction of dietary calories for men (mean = 1.9%) compared to women (mean = 1.4%, $p < 0.001$, SI Table S9). Per-capita caloric significance is reported in the SI for locally caught traditional seafood (Table S3), other locally caught traditional food (Table S4), store-bought seafood (Table S5) and other store-bought nutritious foods (Table S6).

3.3 Importance of traditional foods for intake of nutrients

Despite their low contribution to total caloric intake, traditional foods are the predominant source of several key nutrients (Figure 5). Traditional foods supply approximately 70% of the n-3 PUFAs eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) across the population (Figure 5). They are an important source of vitamins D (35%), B12 (19%), B6 (6%), A (16%), B2, B3 and C and iron (7%), and zinc (5%). Baseline dietary analysis suggests that intake on average across the population of iron, n-3 fatty acids, vitamins A, B2 and B12 and zinc are currently below dietary reference values.[93, 94] Other studies have similarly found traditional foods are richer in these nutrients than the market-based components of indigenous diets.[95-98]

3.4 Nutritional impact of traditional food substitution scenarios

While 2014 MeHg exposures were generally low, these exposures are likely to increase as a result of upstream hydroelectric development.[42] Food consumption advisories are commonly used to control these risks but have unpredictable effects.[4, 10, 11] Here, we describe the nutritional impacts of several hypothetical responses to food consumption advisories.

Modeled dietary transitions to market foods, following the scenarios outlined above, generally exacerbate deficiencies in n-3 PUFA and vitamins B12, D, B2, A, iron and zinc intake among indigenous Inuit (Figure 5b). We find a small net gain in vitamin B-2 intake in the nutrient-dense foods replacement scenario. Modeled reductions as a fraction of daily recommended intake range from 1-2% for vitamin A to 37% for n-3 PUFAs. Replacement of traditional foods with an equivalent amount of locally caught Atlantic salmon has a mixed impact on nutritional sufficiency. Under the Atlantic salmon replacement scenario, average intake of n-3 PUFAs and vitamin D increases by 53% and 10% of recommended daily values respectively and leads to modest declines in intake of vitamins A and B-12, iron and zinc that are less 5% of daily values (Figure 5b).

3.5 Screening-level analysis of risks and benefits

In 2014, intake of traditional foods among Inuit women of childbearing age generally had a small net positive impact on child neurodevelopment due to relatively low MeHg levels in traditional foods and benefits from n-3 PUFA intake. The median IQ decrement attributable to present-day MeHg exposures from traditional foods is 0.02 points (95th population percentile: 0.14 points). After accounting for benefits from n-3 PUFAs in traditional foods, median (5th–95th population percentiles) net impact on IQ is a gain of 0.01 points (decrement of 0.014 to gain of 0.19) IQ points. Increased consumption of greater quantities of low MeHg traditional foods would further increase this net benefit.

Increased MeHg concentrations in local foods may pose neurodevelopmental and cardiovascular risks. As described above, increased exposures are likely to disproportionately impact individuals who already have high MeHg exposures and exceed regulatory reference doses. However, mitigating these risks with reduced consumption of local foods may also pose risks. Here, we present the results of our analysis comparing risks from increased MeHg exposures to risks from potential dietary transitions. We conducted a screening-level estimate of the risks (Figure 6) associated with peak forecasted increases in MeHg concentrations in traditional foods due to hydroelectric flooding by Calder et al.[42]. Even at peak MeHg concentrations, assuming the same magnitudes and species consumed as reported in the 2014 dietary survey, the population median IQ decrement for women of childbearing age is relatively low (0.06 points). However, among individuals with MeHg exposures greater than the 90th percentile, median impacts are much larger (loss of 1.4 IQ points). These estimates must be viewed as uncertain due to inter-individual differences in sensitivity to MeHg exposure and the toxicokinetics of MeHg absorption in the human body.[86, 99]

Substitution of traditional foods with store-bought alternatives represents a large reduction (70% per-capita) of n-3 PUFA intake (Figure 6). We estimate that this may also lead to small neurodevelopmental impacts for most individuals (median IQ decrement of 0.01 across substitution scenarios). However, replacement of traditional foods with locally caught Atlantic salmon results in estimated gains of 0.08 IQ points (population-wide median) and 1.2 points (>90th percentile MeHg exposures). This reflects a large increase in n-3 PUFA intake associated with additional Atlantic Salmon consumption that greatly outweighs minor increases in MeHg exposure (SI Table S9).

We estimate that cardiovascular risks associated with peak MeHg exposures in traditional foods are smaller than under any store-bought food replacement scenario (Figure 6). Across the population, median risk of cardiovascular mortality associated with projected increases in MeHg in traditional foods increases by 3% relative to present-day (RR = 1.03). For individuals with MeHg exposures at the 90th percentile or greater, estimated risk of cardiovascular mortality increases dramatically (RR = 1.5). While the magnitude of these impacts is highly uncertain due to variability in susceptibility to MeHg exposure across populations, this analysis provides a quantitative estimate for the potential difference in magnitude of risks from MeHg in comparison to dietary changes. If traditional foods are replaced by processed meat, median RR of cardiovascular mortality is 1.19 across the population and 3.14 for individuals with MeHg exposures >90th percentile. Median RR of cardiovascular mortality is 1.08 at the across the population when the dietary replacement is fruits and vegetables and 1.73 for individuals with MeHg exposures >90th percentile. The replacement scenarios for nutrient-dense market foods and junk foods fall within this envelope (Figure 6).

Replacement of high MeHg traditional foods by locally caught Atlantic salmon has the opposite impact of market foods on RR of cardiovascular mortality. This replacement scenario leads to greater net benefits for cardiovascular health than all store-bought alternative scenarios. Median RR of cardiovascular mortality under this scenario is 0.88 across the population and 0.55 for individuals with MeHg exposures >90th percentile (Figure 6, SI Table S10).

We estimate that replacing traditional foods with store-bought foods under all scenarios will increase the RR of cancer mortality. Greater than 95% of this effect for the nutrient-dense foods scenario is attributable to reduced intake of vitamin D. Median RR of colorectal cancer is 1.01 due to reduced fiber intake (75% of individuals) and increased consumption of red and processed meat. Gains in calcium intake for 95% of individuals and increased milk consumption do not offset these risks. Increased sodium intake (97% of individuals) results in a small increase in RR of gastric cancer (RR = 0.01 at the 95th percentile). Colorectal cancers account for more than three times as many deaths as gastric cancers in Newfoundland and Labrador[100], and so the increased risk of colorectal cancer is a relatively stronger driver of overall cancer risks. Replacement of the representative basket of traditional foods with locally caught Atlantic salmon provides small net reductions in overall cancer risks relative to present-day (median RR = 0.995; >90th percentile individuals: RR = 0.97) (Figure 6, SI Table S11).

3.6 Study strengths and limitations

To our knowledge, this study is the most comprehensive survey of Inuit diet and MeHg exposures (*n* = 1,145). We provide a detailed characterization of diet variability among Lake Melville Inuit evaluated with direct hair Hg measurements. Our dietary MeHg exposure model performed better than several other recent studies, likely reflecting the relatively homogeneous sources of MeHg across the population and the use of extensive local data. This study provides an assessment of the magnitude of projected risks associated with elevated MeHg exposures in comparison with the neurodevelopmental, cardiovascular, cancer and nutritional risks posed by possible dietary changes.

We were limited by the availability of intake data for store-bought foods (other than seafood, which we measured on the FFQ), which are available only on a per-capita basis for the community of Rigolet. Therefore, our characterization of present-day nutritional sufficiency and composition of store-bought foods could not describe interindividual variability. Dietary recall data is often biased, and although we designed the study so as to evaluate (with hair Hg measurements) and control for some biases (e.g., correcting for species-specific recall biases by asking redundant "total" recall questions) as described above, we are limited by the accuracy of the reports of survey respondents. Our evaluation of dietary model performance with respect to hair Hg and calculation of MeHg exposures from hair Hg measurements depends on self-reported measures of height and weight, which may be estimates. Although there was little evident bias in the larger-scale Summer survey round (Figure 1), these factors likely contributed to the random error observed.

Our analysis does not account for other possible second-order effects of traditional food substitutions. For instance, isocaloric dietary substitution is associated with a mean reduction in protein intake of 2–11% across dietary scenarios. While per-capita intake of protein continues to exceed the recommended daily allowance, increasing the proportion of calories from carbohydrates and fats may lead to overall greater caloric intake via reduced satiety and higher insulin production, thus increasing weight gain and obesity-related risks.[101, 102] Consumption rates of locally caught traditional foods in the Inuit communities studied here are lower than those for other indigenous communities across Canada. For example, British Columbia First Nations consume roughly three times the per-capita amounts reported here.[103] This implies health and nutritional impacts associated with dietary transitions may be greater in other populations.

We have not addressed the physical or psychosocial dimensions of hunting and fishing and the preparation and consumption of traditional foods. Hunting traditional foods represents vigorous physical activity, and loss of access to traditional foods has been linked to adverse mental and social outcomes, implying substitution of traditional foods may present additional risks to those quantified here.[104-106] Fruits and vegetables are not a significant part of the traditional Inuit diet[107], and our analysis suggests they account for roughly 2% of caloric intake at present day. Replacement of traditional foods with fruits and vegetables is acknowledged to be less likely than by other foods such as red meat or other snack foods. This scenario is included as a better-case scenario for store-bought alternatives.

3.7 Implications for risk mitigation strategies

Food consumption advisories are routinely used to mitigate potential risks from elevated contaminant exposures. However, these advisories have unpredictable effects and can lead to reduced overall intake of traditional foods among indigenous populations. This study is the first to calculate the plausible range of health impacts from elevated MeHg exposures as compared to potential outcomes of risk-mitigation strategies. Our analysis suggests that replacing traditional foods with store-bought alternatives may lead to increases in cardiovascular and cancer risks among Lake Melville Inuit. Conversely, we estimate that replacement with locally caught Atlantic salmon will lead to net benefits for neurodevelopmental and cardiovascular health and reduce cancer risks relative to the present-day diet. Atlantic salmon is already a large component of traditional diet of our survey respondents, accounting for approximately 25% of calories from traditional foods. These results reinforce the potential benefits of dietary advice that promotes nutrient-dense, low-MeHg traditional foods. We have shown that in the local diet, there are many commonly consumed (and therefore familiar) foods with negligible levels of Hg, intake of which could be promoted in order to maximize net health benefits of the traditional diet.

Reducing the diversity of traditional foods consumed has mixed impacts on nutritional sufficiency, which must be considered when making recommendations about dietary choices among indigenous populations. Nutrient shortfalls are common in indigenous populations, and our findings suggest that this is the case among Lake Melville Inuit. Therefore, independent of contaminant levels, there may be a role for dietary interventions that promote increased intake of nutritious foods and possibly dietary supplements. Taken together, findings presented here underline the importance of protecting northern food webs from environmental contamination and of promoting traditional foods among indigenous populations.

Acknowledgments

We thank Marina Biasutti-Brown, Tom Sheldon, Rodd Laing and Trevor Bell, as well as the research assistants hired by the NG, for their help in sample collection and development and administration of the dietary survey.

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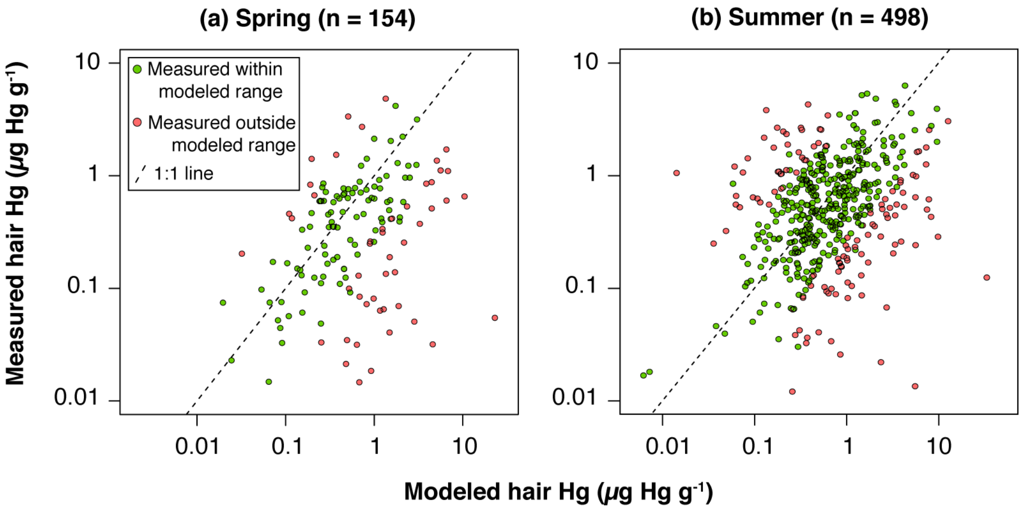

Figure 1. Comparison of measured and probabilistically modeled hair Hg concentrations for Labrador Inuit in the Lower Lake Melville Region during Spring and Summer survey periods. Green circles indicate measured values that fall within the modeled range. Red circles indicate measured values that fall outside the probabilistically modeled range of hair Hg concentrations. Individuals who did not report consuming seafood, birds or marine mammals (8 in Spring, median hair Hg = 0.036 µg g^{-1} and 26 in Summer, median hair Hg = 0.049 µg g^{-1}) are excluded. $R^2 = 0.13$ (Spring), 0.11 (Summer).

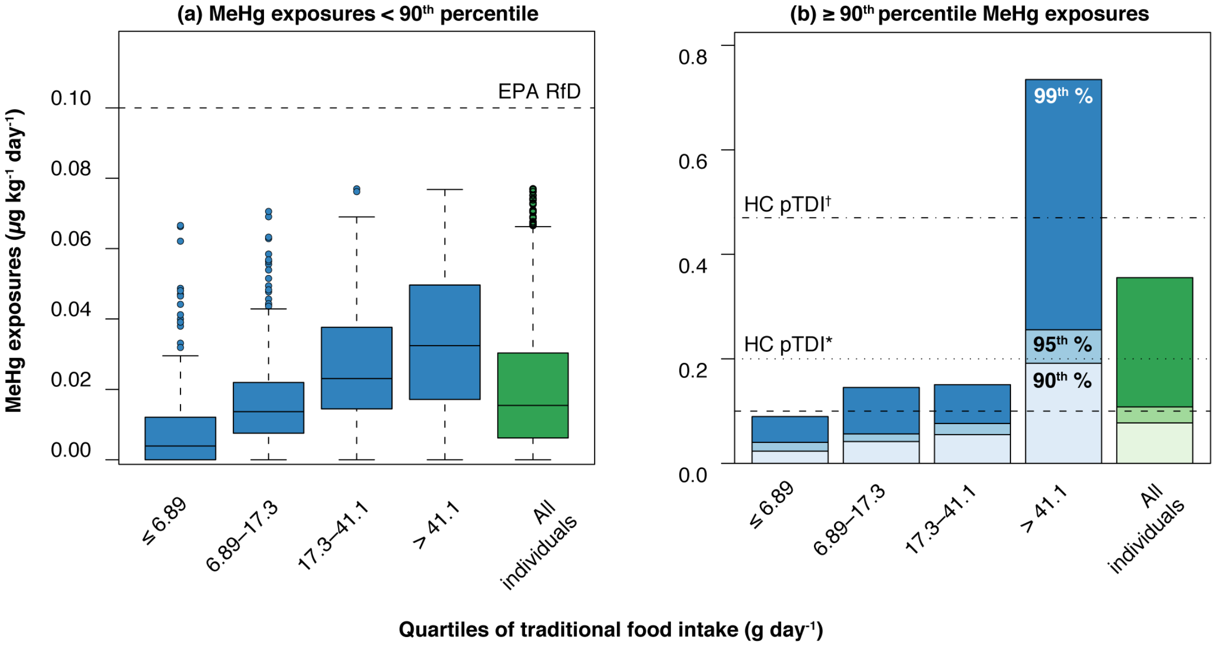

Figure 2. Distributions of MeHg exposures for Inuit in the Lower Lake Melville Region of Labrador by quartile of traditional food consumption (Summer 2014). Panel (a) shows values below the 90th percentile of MeHg exposures and Panel (b) shows the distribution for highly exposed individuals in the population (at or above 90th percentile of MeHg exposures). EPA RfD denotes the U.S. EPA reference dose for methylmercury and HC pTDI indicates the Health Canada provisional tolerable daily intakes for women of childbearing age and children (*) and for everyone else (†).

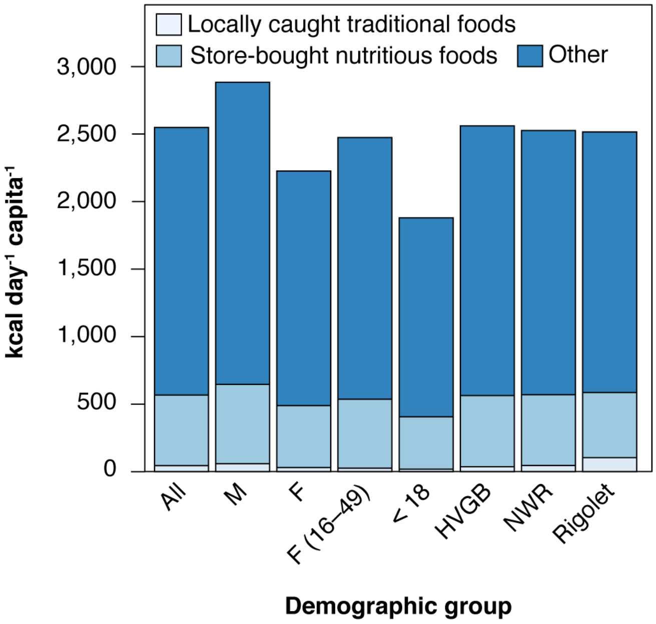

Figure 3. Estimated contributions of different food types to total calories consumed by Inuit in the Lower Lake Melville region of Labrador, Canada. M = male; F = female; HVGB = Happy Valley – Goose Bay; NWR = North West River.

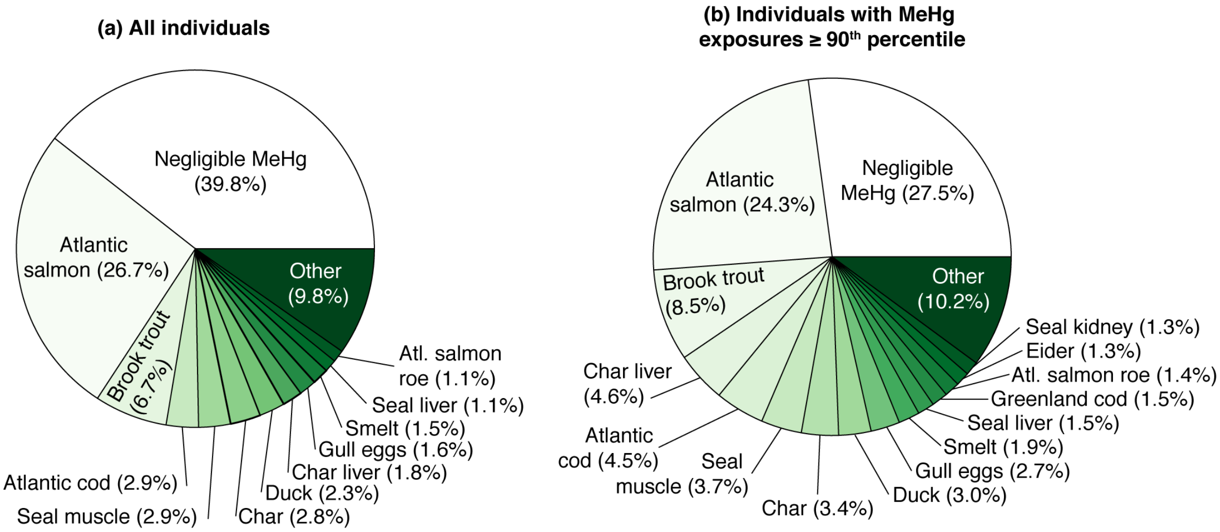

Figure 4. Fraction of caloric intake from traditional foods for top 90% of foods among Lake Melville Inuit for (a) all individuals and (b) individuals with MeHg exposures above the 90th percentile in summer 2014 (0.08 μg kg^{-1} day^{-1}). Dietary data from full-scale summer survey. Widely consumed foods (in the top 90% of contributors to overall calories from traditional foods) include berries, goose, partridge, moose, caribou, seal blubber and rabbit.

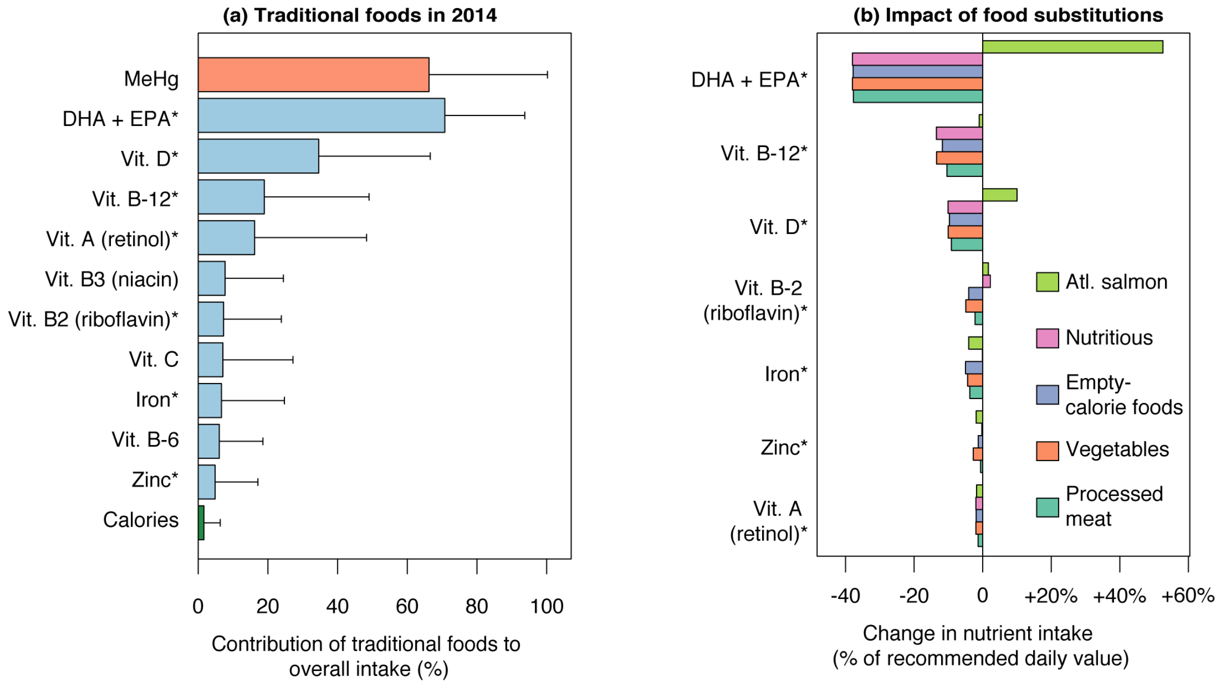

Figure 5. Role of traditional foods for nutrient and MeHg intake and impacts of traditional food substitution. Panel (a) shows the estimated proportion of MeHg and several key nutrients from traditional foods based on survey data for 2014. Panel (b) shows the modeled impact of traditional food substitution on intakes relative to recommended daily values assuming several hypothetical traditional food replacement scenarios. Substitution scenarios for traditional foods include: (1) locally caught Atlantic salmon, (2) nutrient-dense store-bought foods ("Nutritious"), (3) nutrient-sparse junk foods, (4) vegetables and (5) processed meat. Shaded bars represent per-capita averages, and lines represent the 5th–95th percentile individuals. * denotes per-capita intake below recommended daily values based on US FDA recommendations[94] and 500 mg day^{-1} for DHA + EPA[93].

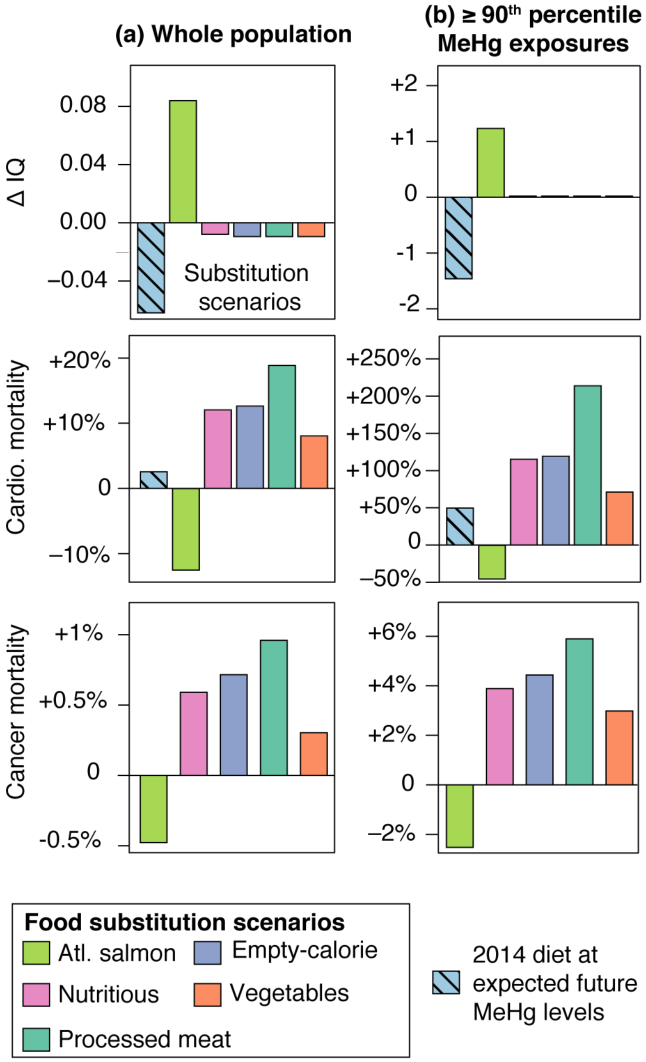

Figure 6. Comparison of neurodevelopmental, cardiovascular and cancer risks for traditional food substitution scenarios compared to risks associated with projected future MeHg levels in traditional foods from Calder et al.[42] Panel (a) shows median risks for the whole population. Panel (b) shows individuals at or above the 90th percentile of MeHg exposures in summer 2014 (0.08 µg kg^{-1} day^{-1}). Traditional food substitution scenarios include: (1) locally caught Atlantic salmon, (2) the representative basket of subsidized nutrient-dense store-bought foods ("Nutritious"), (3) nutrient-sparse junk foods, (4) vegetables and (5) processed meat. Excess cardiovascular and cancer mortality risks are presented as fractions of present-day risks (+0% corresponds to a relative risk of 1, meaning no change relative to 2014).

Supporting Information

Risk Tradeoffs Associated with Traditional Food Advisories for Labrador Inuit

Ryan S.D. Calder [a,b*], Sabri Bromage [c], Elsie M. Sunderland [a,b]

[a] Department of Environmental Health, Harvard T.H. Chan School of Public Health, Boston MA, 02215, USA
[b] Harvard John A. Paulson School of Engineering and Applied Sciences, Cambridge MA, 02138, USA
[c] Department of Nutrition, Harvard T.H. Chan School of Public Health, Boston MA, 02115, USA

[*] Corresponding author current contact information: Department of Civil and Environmental Engineering, Duke Pratt School of Engineering. 1116 Hudson Hall, Box 90287, Duke University, Durham NC, 27708, USA. T: (919) 355-6876; F: (919) 660-5219; ryan.calder@duke.edu

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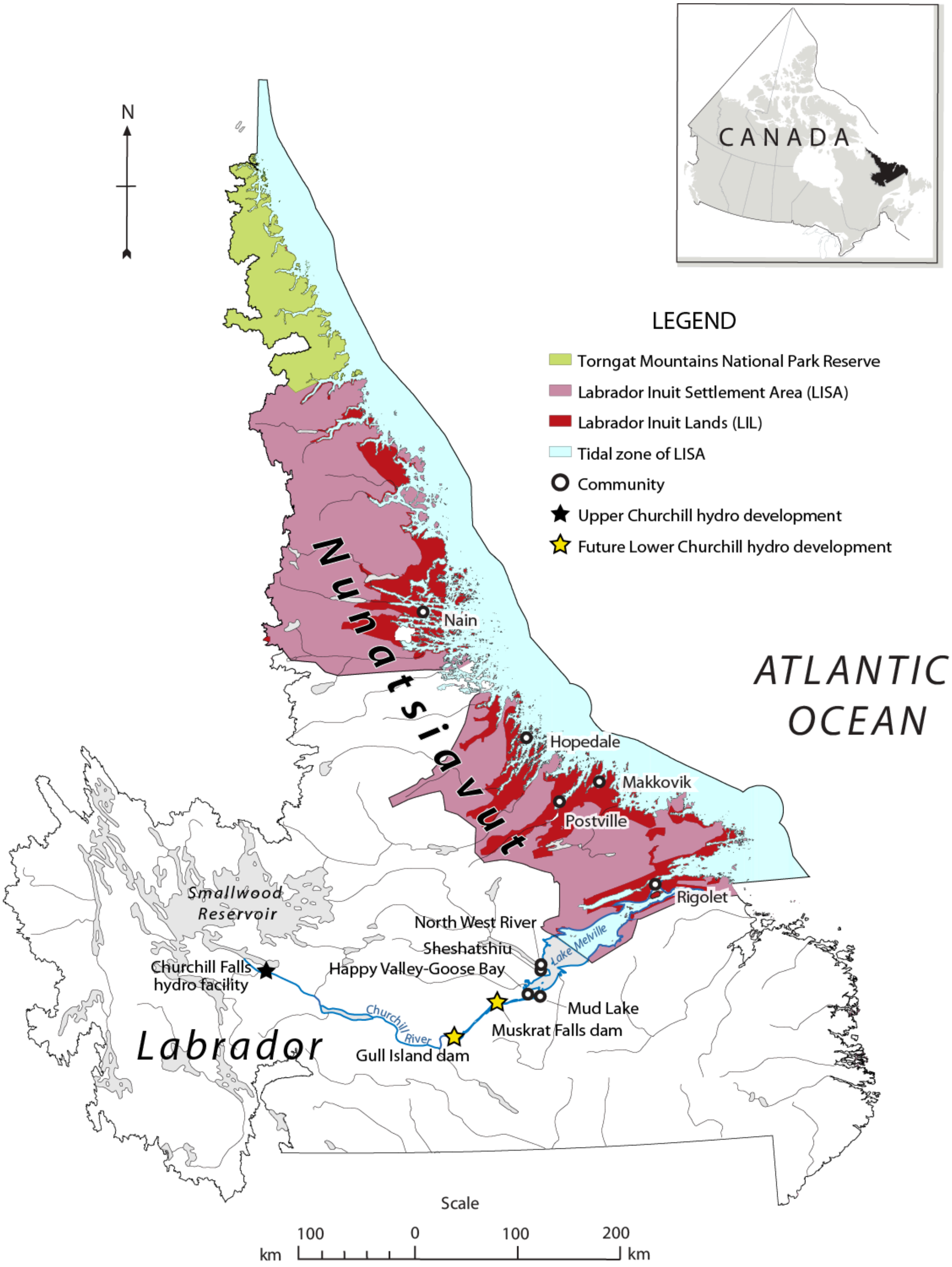


Figure S1: Map of the Labrador Inuit Settlement Area, existing and future hydroelectric developments on the Churchill River, and locations of indigenous communities. Source: Durkalec et al. (2016). Reprinted with permission from Nunatsiavut Government.

Table S1: Food frequency questionnaire data collected in March/April (winter), June/July (spring) and August/September (summer) 2014, adapted from Calder et al. (2016).

Demographic Group	Winter (*n*)	Spring (*n*)	Summer (*n*)	Total (*n*)	Unique individuals (fraction of Inuit population)[a]
All individuals	231	294	1054[b]	1579[b]	1,145[b]
Non-Inuit household[c] members	34	49	167	250	188
Inuit individuals	197	245	882	1324	952 (38%)
<u>Communities</u>					
Happy Valley-Goose Bay[d]	170	217	667	1054	745 (31%)
North West River	30	34	158	222	167 (43%)
Rigolet	31	43	229	303	233 (87%)
<u>Demographic Group</u>[e]					
Women of childbearing age (16-49)[f]	59	77	278	414	306
Children ≤12 years	55	59	166	280	179
Women of childbearing age (16-49) & children ≤ 12 in Rigolet	15	19	100	134	101
All male >12 years	74	108	387	569	406
All female > 49 years	28	37	191	256	200

[a] Data from some individuals are for multiple survey periods. Total Inuit population is based on the 2011 Census and National Household Survey (Statistics Canada 2012; Statistics Canada 2013).

[b] Total includes three individuals who did not report Inuit status.

[c] Non-Inuit individuals who share a household with a registered Inuit beneficiary identified by the Nunatsiavut Government were included in the survey.

[d] Includes the nearby community of Mud Lake ($n = 22$).

[e] Combined data for all three communities.

[f] As defined by the U.S. National Health and Nutrition Examination Survey (McDowell et al. 2004).

Table S2: Demographic breakdown of study participants in summer survey round vs. general population.

	Happy Valley-Goose Bay		North West River		Rigolet	
Male	Sample[a]	Population[b]	Sample[a]	Population[b]	Sample[a]	Population[b]
0–17	64	830	5	60	29	35
18–44	105	1,405	13	85	41	65
45–64	75	1,100	28	95	31	40
≥65	31	320	29	35	10	20
Female						
0–17	80	218	7	50	34	35
18–44	171	407	16	85	45	55
45–64	94	278	31	95	30	40
≥65	41	87	27	35	8	5

[a] Summer (August-September) survey round only. Excludes nine participants whose age was not recorded.

[b] Age bracket counts available for total (Inuit and non-Inuit) population only rounded to multiples of 5 (Statistics Canada 2013). Sample as a fraction of total Inuit population reported in Table S1.

Table S3: MeHg concentrations, dietary database information and per-capita caloric significance for locally caught traditional seafood

Food name (nutritional category)[a]	Name in nutritional database	Database code[b]	Baseline calories (%)[c]	MeHg Mean ± SD (ng g^{-1} ww)[d]
Arctic char liver (FL)	n/a		4.7	75.5
Arctic char muscle (FM)	Fish, arctic char, native, meat, raw	3230	4.9	62.4 ± 41.8
Arctic char roe (FR)	Fish, roe, mixed species, raw	3045	0.1	7.49
Atlantic cod muscle (FM)	Fish, cod (scrod), Atlantic, baked or broiled	3195	5.1	186 ± 57.4
Atlantic salmon liver (FL)	Fish, salmon, native, king or chinook, liver	5899	0.7	88.6
Atlantic salmon muscle (FM)	Fish, salmon, Atlantic, wild, baked or broiled	3156	46.9	73.2 ± 20.1
Atlantic salmon roe (FR)	Fish, salmon, native, eggs, raw	5928	1.9	8.78
Brook trout liver (FL)	n/a		0.8	95.2 ± 34.4
Brook trout muscle (FM)	Fish, trout, brook, raw	7234	11.7	105 ± 34.4
Brook trout roe (FR)	Fish, roe, mixed species, raw	3045	0.6	52.7 ± 22.4
Capelin muscle (FM)	Fish, smelt, rainbow (American, capelin), baked or broiled	3065	0.9	17 ± 2.24
Capelin roe (FR)	Fish, roe, mixed species, raw	3045	0.04	2.04
Clams (SF)	Mollusks, clam, mixed species, boiled or steamed	3111	0.2	10 ± 2
Flatfish (FM)	Fish, flatfish (flounder or sole or plaice), baked or broiled	3007	0.03	68 ± 41
Itiks (SF)	n/a		0.03	40
Lake trout (FM)	Fish, trout, brook, raw	7234	0.9	99 ± 46
Mussels (SF)	Mollusks, mussel, blue, boiled or steamed	3116	1.5	3.46 ± 0.5
Ouananiche (FM)	Fish, salmon, Atlantic, wild, baked or broiled	3156	0.02	150 ± 110
Porpoise blubber (MM)	n/a		0.02	~0
Porpoise liver (MM)	n/a		0	1,220 ± 870
Porpoise meat (MM)	n/a		0.02	600 ± 450
Rock cod liver (FL)	Fish, lingcod, native, liver	5888	1.0	225
Rock cod muscle (FM)	Fish, cod (scrod), Atlantic, baked or broiled	3195	1.5	186 ± 57.4
Scallops (SF)	Mollusks, scallop (bay and sea), cooked, steamed	5634	0.9	22
Sculpin liver (FL)	n/a		0	87.5 ± 86.4
Sculpin muscle (FM)	Fish, sculpin, native, raw	5919	0.1	231 ± 91.8
Seal blubber (MM)	Game meat, native, ringed seal, blubber, boiled	5781	4.1	~0
Seal liver (MM)	Game meat, native, ringed seal, liver, raw	5788	2.0	175 ± 119
Seal kidney (MM)	n/a		1.6	261 ± 74.5

[a] FL = fish liver; FM = fish muscle; FR = fish roe; MM = marine mammal; SF = shellfish.

[b] From Canada Nutrient File.

[c] Fraction of total per-capita calories from all locally caught traditional seafood (summer 2014).

[d] From Calder et al. (2016).

n/a: Data not available and values are calculated as average of other foods in same nutritional category.

Table S3 (cont'd): MeHg concentrations, dietary database information and per-capita caloric significance for locally caught traditional seafood

Food name (nutritional category)[a]	Name in nutritional database	Database code[b]	Baseline calories (%)[c]	MeHg Mean ± SD ($ng\ g^{-1}$ ww)[d]
Seal muscle (MM)	Game meat, native, ringed seal, meat, boiled	5783	5.1	172 ± 110
Smelt (FM)	Fish, smelt, rainbow (American, capelin), baked or broiled	3065	2.7	114 ± 49.2
Whale blubber (MM)	Whale, bowhead, skin and subcutaneous fat (muktuk)	35086*	0.06	~0
Whale muscle (MM)	Game meat, whale, raw	3648	0	75 ± 21
Wrinkles (SF)	Pacific surf, cooked periwinkle meat	45002474*	0.1	40

[a] FM = fish muscle; MM = marine mammal; SF = shellfish.

[b] Codes with * are from USDA Nutrient Database; other foods are from the Canada Nutrient File.

[c] Fraction of total per-capita calories from all locally caught traditional seafood (summer 2014).

[d] From Calder et al. (2016).

Table S4: MeHg concentrations, dietary database information and per-capita caloric significance for other locally caught traditional foods

Food name (nutritional category) [a]	Name in nutritional database	Database code[b]	Baseline calories (%)[c]	MeHg Mean ± SD (ng g^{-1} ww)[d]
Bakeapples (FR)	Cloudberry (bakeapple), native	5939	9.42	~0
Black bear (TM)	Game meat, native, bear, simmered	3566	0.9	~0
Caribou (TM)	Game meat, native, caribou (reindeer), meat, cooked	3578	7.7	~0
Duck eggs (EG)	Egg, duck, whole, fresh, raw	1138*	1.7	30 ± 3
Duck muscle (FP)	Duck, wild, native, cooked	5931	5.4	117 ± 75.7
Eider muscle (FP)	n/a		2.3	113 ± 33
Goose muscle (FP)	Goose, domesticated, meat only, roasted	672	12.5	~0
Guillemot eggs (EG)	n/a		0	210 ± 9.59
Guillemot muscle (FP)	n/a		0.17	270 ± 70
Gull eggs (EG)	n/a		3.6	59.5 ± 7.84
Gull muscle (FP)	n/a		0.01	230 ± 27.1
Labrador tea (FR)	n/a		0.06	~0
Loon eggs (EG)	n/a		0.03	900 ± 1,880
Loon muscle (FP)	n/a		0	846 ± 237
Moose (TM)	Game meat, native, moose, roasted	3588	9.2	~0
Okalik/Hare (TM)	Game meat, native, rabbit, wild, cooked	3596	0.4	~0
Owl muscle (FP)			0.01	~0
Partridge muscle (FP)	Spruce grouse, native, meat, cooked		10.5	~0
Polar bear meat (TM)	Game meat, native, polar bear, meat, boiled	5834	0.03	70 ± 50
Rabbit (TM)	Game meat, native, rabbit, wild, cooked	3596	2.3	~0
Red berries (FR)	n/a		12	~0
Sandpiper (FP)	n/a		0.4	70 ± 7
Snowbird (FP)	n/a		0	~0
Tern eggs (EG)	n/a		1.2	424 ± 107
Tern muscle (FP)	n/a		0.23	233 ± 246
Wild blackberries (FR)	Blackberry, raw		1.1	~0
Wild blueberries (FR)	Blueberry, raw		10.2	~0
Wild raspberries (FR)	Raspberry, wild, raw		5.6	~0
Other picked berries (FR)	n/a		2.2	~0
Other wild plants (FR)	n/a		0.6	~0

[a] EG = egg; FR = fruit; FP = fowl/poultry; TM = terrestrial mammal; FR = fruit.

[b] Codes with * are from USDA Nutrient Database; other foods are from the Canada Nutrient File.

[c] Fraction of total per-capita calories from all other locally caught food (summer 2014).

[d] From Calder et al. (2016).

n/a: Data not available and values are calculated as average of other foods in same nutritional category.

Table S5: MeHg concentrations, dietary database information and per-capita caloric significance for store-bought seafood

Food name (nutritional category)[a]	Name in nutritional database	Database code[b]	Baseline calories (%)[c]	MeHg Mean ± SD (ng g^{-1} ww)[d]
Battered cod (FM)	Sea Cuisine, breaded cod tender flaky fillets	4511–9629*	11.5	110.0 ± 64.7
Battered haddock (FM)	Gorton's, haddock breaded fish sticks	4504–5406*	0.9	59.1 ± 26.9
Brook trout (FM)	Fish, trout, brook, raw	7234	0.6	87.9 ± 41.0
Canned oysters (SF)	Mollusks, oyster, eastern (blue point), wild, canned, solids and liquid	3121	0.7	2.6 ± 2.9
Canned salmon (FM)	Fish, salmon, chum (keta), canned, drained, solids with bone, salted	3218	3.7	40.0 ± 19.5
Canned tuna (FM)	Fish, tuna, light, canned in water, drained, unsalted	3131	13.1	162.4 ± 136.8
Catfish (FM)	Fish, catfish (wolffish), Atlantic, baked or broiled	3170	0	40.1 ± 19.0
Clams (SF)	Mollusks, clam, mixed species, boiled or steamed	3111	1.5	10.0 ± 2.0
Crab (SF)	Crustaceans, crab, red, steamed	3238	3.1	60.1 ± 27.0
Fish sticks (pollock) (FM)	Fish, fish sticks, frozen, prepared	3006	3.7	18.7 ± 10.9
Fresh cod (FM)	Fish, cod (scrod), Atlantic, baked or broiled	3195	18.3	110.9 ± 66.0
Fresh pollock (FM)	Fish, pollock, Atlantic (Boston blue), baked or broiled	3152	1.5	19.0 ± 10.6
Fresh tuna (FM)	Fish, tuna, skipjack (aku), baked or broiled	3166	1.2	440.1 ± 246.1
Herring (FM)	Fish, herring, Atlantic, baked or broiled	3015	3.0	18.0 ± 10.2
Lobster (SF)	Crustaceans, lobster, American (northern), boiled or steamed	3210	3.4	36.0 ± 16.9
Mussels (SF)	Mollusks, mussel, blue, boiled or steamed	3116	8.7	24.0 ± 12.5
Rainbow trout (FM)	Fish, trout, rainbow, farmed, baked or broiled	3187	0.9	34.0 ± 17.5
Salmon (FM)	Fish, salmon, Atlantic, wild, baked or broiled	3156	8.7	42.0 ± 19.8
Sardines (FM)	Fish, sardine, Atlantic, canned in oil, drained solids with bone	3203	5.0	34.9 ± 17.5
Scallops (SF)	Mollusks, scallop (bay and sea), cooked, steamed	5634	4.7	22.1 ± 12.1
Shrimp (SF)	Crustaceans, shrimp, mixed species, boiled or steamed	3212	5.9	30.9 ± 15.7
Skate (FM)	n/a		0	118 ± 50.7
Sole (FM)	Fish, flatfish (flounder or sole or plaice), baked or broiled	3007	0.05	101.3 ± 39.8
Tilapia (FM)	Fish, tilapia, baked or broiled	5697	0.1	20.1 ± 10.8

[a] FM = fish muscle; SF = shellfish.

[b] Codes with * are from USDA Nutrient Database. Other foods are from the Canada Nutrient File.

[c] Fraction of total per-capita calories from all store-bought seafood (summer 2014).

[d] From Calder et al. (2016).

n/a: Data not available and values are calculated as average of other foods in same nutritional category.

Supplemental methods for dietary survey

Food frequency questionnaire design

We designed the food frequency questionnaire (FFQ) in collaboration with a committee of Inuit elders convened by the Nunatsiavut Government (NG). Through this collaborative process, we developed an exhaustive list of traditional foods eaten by Labrador Inuit. We also explored the feasibility of different ways of measuring food intake (recall, journals, etc.). It was decided that a self-reported recall instrument administered by trained interviewers was likely to maximize enrollment and consistency of results.

We designed standardized clay models for participants to use to describe their average serving size of each food they reported eating. These models corresponded to serving sizes ranging between approximately 115 and 290 g.

Participant recruitment

The NG enrolled participants in the study through bilingual (English/Inuktitut) informational posters dispersed through the communities, informational sessions organized by staff from the NG Environmental Division and informational phone calls to community members registered as NG 'beneficiaries' (Inuit with a demonstrated connection to the Labrador Inuit Land Claims Area). Participants were entered into two raffles for three prizes each ranging from 250 to 1,000 CAD to incentivize 1) participation in all three survey periods (n = 147) and 2) participating in the larger-scale summer period (n = 1,054).

Hair Hg analysis

Trained research assistants collected hair samples from all willing participants in the Spring and Summer survey periods. Hair was collected from the occipital region of the scalp and we analyzed the 2 cm proximal ends of each sample for total Hg as an indicator of MeHg exposure over the past two to three months. The analytical procedure for total mercury used thermal decomposition, amalgamation, and atomic absorption spectrophotometry following US EPA method 7473 on a Nippon MA-3000 or Milestone DMA-80 at Harvard University. One method blank and one sample containing certified hair reference material were tested every 10 samples and all recoveries were within certified ranges. The mean relative standard deviation of replicate samples was 8.6%.

Table S6: Dietary database information and per-capita caloric significance for store-bought nutritious foods

Food name (nutritional category)[a]	Name in nutritional database	Database code[b]	Baseline calories (%)[c]	Retail and consumer waste (%)[d]
All fresh fruits (FR)	Apple, Gala, raw, with skin	7216	6.1	40
All frozen fruits (FR)	Blueberry, frozen, unsweetened	1706	0.04	0
All fresh vegetables, except whole pumpkins (VE)	Brussels sprouts, boiled, drained	2379	4.8	40
All frozen vegetables (excluding French fries, etc.) (VE)	Broccoli, frozen, chopped, boiled, drained	2377	0.08	0
All-purpose flour, whole-wheat flour, rye flour and other semi-perishable flours (except cake flour and pastry flour) (GR)	Grains, wheat flour, white, all purpose, bleached	4501	0	29
Bacon (PM)	Pork, cured, back bacon, pan-fried	7219	4.8	15
Bread (except garlic bread) (GR)	Bread, white, commercial	4066	8.3	29
Bread products without filling or coating (GR)	English muffin, wheat	3906	2.9	29
Butter (DA)	Butter, regular	118	1.4	15.5
Cheese (including block cheese, shredded cheese and cottage cheese) (DA)	Cheese, cheddar	119	1.2	15.5
Chocolate milk (DA)	Milk, fluid, chocolate, whole	69	1.7	15.5
Combination foods (e.g., lasagna)	Lasagna with meat and sauce, frozen	5870	0.5	0
Cook-type cereals (e.g., oatmeal and porridge) (GR)	Cereal, hot, oats, porridge	1432	0.03	29
Cooking oils (e.g., canola, peanut, olive and linseed)	Vegetable oil, canola	451	1.0	0
Crackers, crisp bread, hard bread, Pilot biscuits, Melba toast, arrow-root biscuits and Social Tea biscuits (GR)	Snacks, rice cakes, crackers (include mini rice cakes)	5493	1.1	29

[a] Food name/category from the Nutrition North program; FM = FR = fruit; VE = vegetables; GR = grains; PM = processed meat; DA = dairy.

[b] From the Canada Nutrient File.

[c] Fraction of total per-capita calories from all store-bought nutritious foods (summer 2014).

[d] From Gustavsson et al. (2011).

Table S6 (cont'd): MeHg concentrations, dietary database information and per-capita caloric significance for store-bought nutritious foods

Food name (nutritional category)[a]	Name in nutritional database	Database code[b]	Baseline calories (%)[c]	Retail and consumer waste (%)[d]
Cream, sour cream, cream cheese (DA)	Cream, sour, cultured, 18% M.F.	152	1.2	15.5
Dried fruits (e.g., grapes, dates, cranberries and apricots) (FR)	Apple, dried, sulphured, uncooked	1490	0.2	67.2
Eggs and egg substitutes (EG)	Egg, chicken, whole, fresh or frozen, raw	125	4.4	15
Enriched soy milk	Plant-based beverage, soy, enriched, all flavours	6720	0.2	15.5
Fresh and frozen meat other than side bacon and products that are breaded, battered or in pastry (RM)	Beef, ground, lean, raw	2683	21.7	15
Fresh and frozen pasta (except combined foods containing pasta) (GR)	Pasta, fresh-refrigerated, plain, as purchased	4502	0	29
Fresh and frozen pizzas	Fast foods, pizza, cheese, meat and vegetable, regular crust, frozen, cooked	5862	4.9	0
Fresh and frozen poultry e.g., chicken, turkey, goose) other than products that are breaded, battered or in pastry (FP)	Chicken, broiler, breast, skinless, boneless, meat, grilled	7322	5.8	15
Fresh and frozen seafood, other than products that are breaded, battered or in a pie crust (FM)	Fish, tuna, white, canned with water, drained, salted	3084	Counted in Table S4	n/a
Fresh milk (DA)	Milk, fluid, partly skimmed, 2% M.F.	61	2.6 [e]	15.5
Frozen French fries, home fries and similar potato-based products	Potato, french-fried, frozen, shoestring, heated in oven	6517	5.3	0
Ice cream, iced milk, iced yogourt and sorbet (DA)	Dessert, frozen, ice cream, chocolate	4288	2.6 [g]	15.5
Individually wrapped unsweetened juice (all sizes)	Apple juice, canned or bottled, unsweetened, calcium and Vitamin C and D added	7419	0.8	0
Lard and shortening	Shortening, household, unspecified vegetable and animal oils	539	1.5	0

[a] Food name/category from the Nutrition North program; FM = FR = fruit; VE = vegetables; GR = grains; PM = processed meat; DA = dairy.

[b] From the Canada Nutrient File.

[c] Fraction of total per-capita calories from all store-bought nutritious foods (summer 2014).

[d] From Gustavsson et al. (2011).

Table S6 (cont'd): MeHg concentrations, dietary database information and per-capita caloric significance for store-bought nutritious foods

Food name (nutritional category)[a]	Name in nutritional database	Database code[b]	Baseline calories (%)[c]	Retail and consumer waste (%)[d]
Margarine	Margarine, tub, hydrogenated, canola oil	7575	1.5	0
Melted cheese spreads (e.g., Cheez Whiz)	Kraft Cheez Whiz Pasteurized Process Cheese Sauce	1188*	0.04	0
Peanut butter and other nut butters	Peanut butter, natural	6289	0.7	81.4
Perishable dips	Dip, cream cheese base	6786	0.5 [f]	0
Powdered and evaporated milk	Milk, evaporated, whole, canned, undiluted, 7.8% M.F.	140	0.02	0
Processed cheese (e.g., Velveeta)	Kraft Velveeta Pasteurized Process Cheese Spread	1191*	1.8	0
Ready-to-eat breakfast cereals (GR)	Cereal, ready to eat, Life, Quaker	1258	0.8	29
Salad dressing and mayonnaise	Salad dressing, mayonnaise type, commercial, regular	527	1.3	0
Tofu and other vegetable-based meat substitutes (e.g., vegetable patties and nut burgers)	Tofu, silken, firm	4911	0	0
UHT milk (DA)	Milk, fluid, whole, pasteurized, homogenized, 3.25% M.F.	113	1.0 [h]	15.5
Unsweetened nuts and grains (GR)	Nuts, mixed nuts, dry roasted with peanuts	2577	0.6	0
Yogurt and yogurt drinks (DA)	Yogourt, plain (2-3.9% M.F.)	6961	1.3 [f]	15.5

[a] Food name/category from the Nutrition North program; GR = grains; DA = dairy.
[b] From the Canada Nutrient File.
[c] Fraction of total per-capita calories from all store-bought nutritious foods (summer 2014).
[d] From Gustavsson et al. (2011).

Table S7: Probability distribution of peak MeHg concentrations in locally caught traditional foods following upstream hydroelectric development, first reported by Calder et al. (2016)

Species	Expected mean	75th percentile	90th percentile	95th percentile
Arctic char				
Muscle	0.41	0.51	0.78	1.0
Liver	0.49	0.58	0.70	0.80
Roe	0.05	0.06	0.07	0.08
Atlantic cod	0.41	0.50	0.65	0.76
Atlantic salmon				
Muscle	0.16	0.20	0.25	0.29
Liver	0.20	0.23	0.28	0.31
Roe	0.020	0.023	0.027	0.031
Black duck				
Muscle	0.44	0.55	0.83	1.1
Eggs	0.11	0.13	0.16	0.18
Brook trout				
Muscle	0.68	0.84	1.1	1.3
Liver	0.62	0.76	1.0	1.2
Roe	0.34	0.42	0.58	0.70
Capelin				
Muscle	0.04	0.05	0.06	0.07
Roe	0.01	0.01	0.01	0.01
Clams	0.03	0.03	0.04	0.04
Eider				
Muscle	0.20	0.24	0.30	0.34
Flatfish	0.17	0.22	0.32	0.40
Green sea urchin	0.10	0.12	0.14	0.16
Guillemot				
Muscle	0.68	0.82	1.0	1.2
Eggs	0.53	0.61	0.74	0.84
Gull				
Muscle	0.41	0.46	0.54	0.59
Eggs	0.15	0.18	0.21	0.24
Lake trout	1.0	1.3	1.8	2.2
Loon				
Eggs	5.6	5.7	13.3	20.9
Minke whale	0.07	0.09	0.10	0.11
Mussels	0.01	0.01	0.01	0.01
Ouananiche	1.5	1.9	3.0	3.9
Periwinkles	0.10	0.12	0.14	0.16
Porpoise				
Muscle	1.4	1.8	2.7	3.5
Liver	2.8	3.6	5.2	6.8
Rock cod				
Muscle	0.42	0.50	0.65	0.77
Liver	0.50	0.58	0.70	0.79

Table S8 (cont'd): Probability distribution of peak MeHg concentrations in locally caught traditional foods following upstream hydroelectric development, first reported by Calder et al. (2016)

Species	Expected mean	75th percentile	90th percentile	95th percentile
Scallops	0.06	0.07	0.08	0.09
Sculpin				
Muscle	0.54	0.66	0.88	1.0
Liver	0.20	0.24	0.42	0.58
Seal				
Muscle	0.66	0.82	1.3	1.6
Liver	0.67	0.84	1.3	1.7
Kidney	1.0	1.2	1.6	1.9
Smelt	0.29	0.36	0.48	0.58
Tern	0.41	0.50	0.86	1.2

Derivation of dose-response functions for cardiovascular and cancer risks

Overall relative risks for cardiovascular and cancer death for each scenario are calculated as the product of individual relative risk equations developed based on dose-response information from the literature. This is presented in Equation S1where RR is the relative risk for cancer or cardiovascular death (*i*) for all individual nutrients, foods and contaminants (*j*) considered and presented in Tables 2 and 3 in the main text.

$$RR_i = \prod_{j=1}^{n} RR_{ij} \qquad [S1]$$

Cause-specific relative risks of cancer or cardiovascular death (*i*) are calculated as a function of the change in dose (Δ) in nutrient, food or contaminant (*j*) in model dietary scenarios based on the relative risk calculated using the dose-response information the literature, scaling according to the magnitude of the dose of the substitution in the dietary model vs. the dose considered in the literature (Equation S2).

$$RR_{ij} = \exp\left(\log\left(RR_{ij}^{lit}\right) \times \frac{\Delta_{\mathrm{j}}^{model}}{\Delta_{\mathrm{j}}^{lit}}\right) \qquad [S2]$$

Dose-response information in the literature is often presented for specific causes of mortality (e.g., relative risk of death from ischemic stroke or from pancreatic cancer) (*k*). To express this in terms of relative risk of overall mortality (e.g., relative risk of cardiovascular death or cancer death) (*i*), we consider the fraction at baseline of more general mortality associated with the more specific causes of death (*f*) for which dose-response information is available, according to Equation S3.

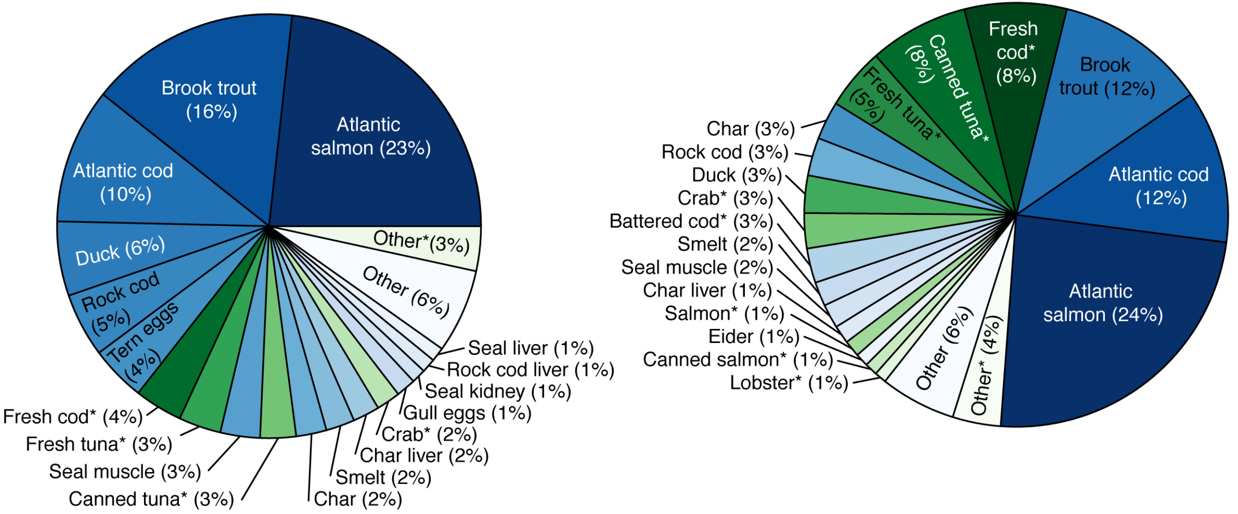
$$RR_{ij}^{lit} = 1 + \left(f_{ik}\left(RR_{kj}^{lit} - 1\right)\right) \qquad [S3]$$

Tables 2 and 3 in the main text present values for RR_{jk}^{lit}, f_{ik} and $\Delta_{\mathrm{j}}^{lit}$ for cardiovascular and cancer dose-response functions, respectively.

Table S8: Summary statistics for modeled population-wide MeHg exposures

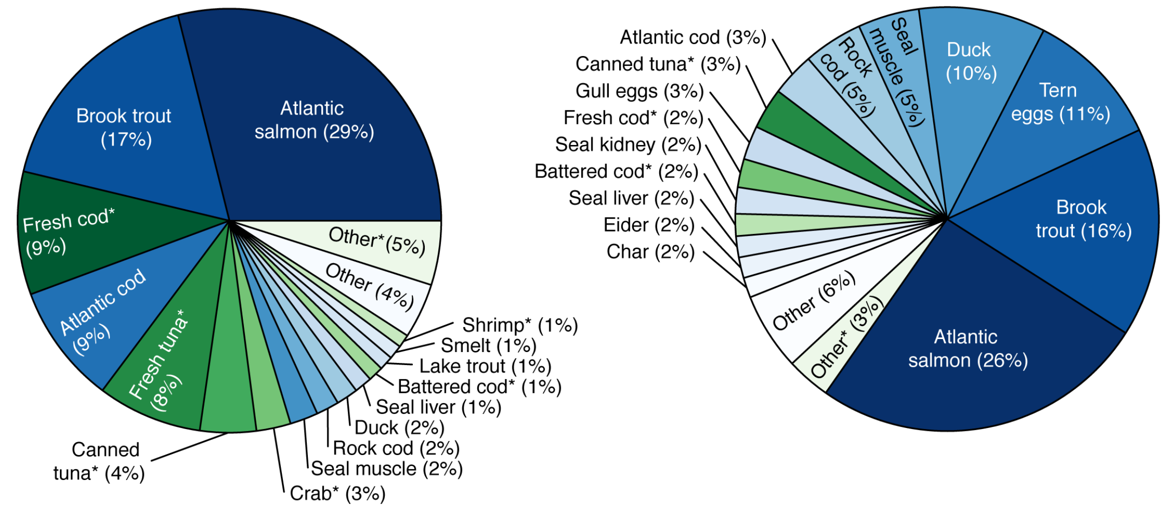
Demographic Group	**MeHg exposure percentiles (μg kg^{-1} day^{-1})**				**Fraction of population exceeding threshold**	
	50th (median)	90th	95th	99th	US EPA RfD (0.1 μg kg^{-1} day^{-1})	Health Canada pTDI[a]
Winter 2014						
All individuals	0.03	0.11	0.14	0.22	10.45%	1.24%
Spring 2014						
All individuals	0.01	0.05	0.09	0.16	4.29%	0.02%
Summer 2014						
All individuals	0.02	0.08	0.12	0.26	6.85%	0.89%
<u>Communities</u>						
Happy Valley-Goose Bay	0.02	0.07	0.09	0.21	4.88%	0.71%
North West River	0.02	0.07	0.09	0.19	3.90%	0%
Rigolet	0.05	0.2	0.27	0.5	24.38%	3.14%
<u>Males</u>						
All males	0.02	0.1	0.16	0.36	10.35%	1.35%
M 0–17	0.01	0.07	0.21	0.31	7.93%	3.68%
M 18–44	0.02	0.07	0.11	0.21	5.82%	0.15%
M 45–64	0.03	0.12	0.18	0.62	13.40%	1.42%
M ≥65	0.04	0.2	0.23	0.37	23.28%	0.36%
<u>Females</u>						
All females	0.02	0.06	0.08	0.14	3.42%	0.44%
F 0–17	0.01	0.06	0.09	0.17	4.70%	0.58%
F 18–44	0.01	0.04	0.06	0.16	2.28%	0.55%
F 45–64	0.02	0.06	0.07	0.13	2.87%	0.31%
F ≥65	0.03	0.09	0.1	0.16	6.93%	0%

[a] Tolerable daily intake = 0.2 μg kg^{-1} day^{-1} for women of childbearing age and children 12 and under; 0.47 μg kg^{-1} day^{-1} for others (Health Canada 2004; Health Canada 2007). Differences in the regulatory thresholds used by these two agencies mainly reflects variability in the uncertainty factor used to account for exposures of sensitive groups.[26] During the establishment of the RfD for MeHg by the U.S. EPA in 2000, it was acknowledged that, "It is also important to note that no evidence of a threshold arose for methylmercury-related neurotoxicity within the range of exposures in the Faroe Islands study."[16] A variety of epidemiological studies have since noted effects associated with exposures below the U.S. EPA's RfD.[90, 91]



(a) Individuals with MeHg exposures ≥ 90th percentile

(b) All individuals – Happy Valley – Goose Bay



(c) All individuals – North West River

(d) All individuals – Rigolet

Figure S2: Sources of per-capita MeHg intakes among Lake Melville Inuit for individuals in all three communities with MeHg exposures ≥ 90th percentile (a) and for all individuals in each community (b, c, d), Summer 2014. Foods in blue are locally caught. Foods in green with * are store-bought. Rock cod is the local name for *Gadus ogac* (Greenland cod).

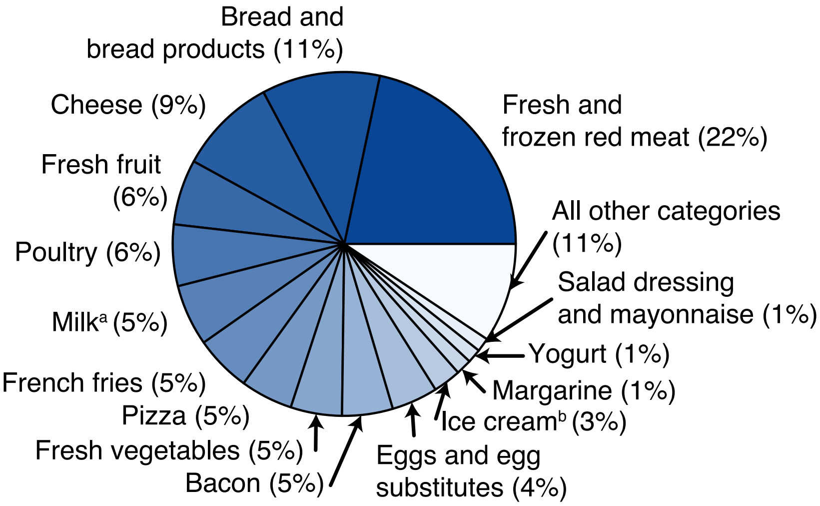


Figure S3: Main categories of store-bought nutritious foods as a fraction of total store-bought nutritious food intake at present day (by calories). [a] Includes soy, evaporated, powdered and chocolate milk. [b] Includes iced yogurt, iced milk and sorbet.

Table S9: Traditional food intake by season and demographic group

Demographic Group	**Traditional food intake percentiles (g day^{-1})**					
	25th	50th	75th	90th	95th	99th
Winter 2014						
All individuals	8.5	21.14	47.68	115.49	160.55	209.96
Spring 2014						
All individuals	5.14	11.62	29.79	77.83	125.95	229.23
Summer 2014						
All individuals	6.86	17.24	41.07	93.22	139.45	276.3
Communities						
Happy Valley-Goose Bay	6.38	14.11	33.5	85.8	121.8	237.25
North West River	10.38	21.96	41.06	87.79	127.48	183.57
Rigolet	16.8	41.32	91.96	180.04	226.56	421.92
Males						
All males	8.63	19.49	50.54	109.5	163.76	410.13
M 0–17	2.24	6.61	19.38	70.39	85.8	309.93
M 18–44	8.63	16.18	36.98	86.53	109.5	194.3
M 45–64	19.1	36.21	80.87	156.55	237.25	434.33
M ≥65	27.48	49.99	107.67	209.35	216.81	306.92
Females						
All females	6.61	14.06	30.28	82.14	110.5	173.09
F 0–17	4.39	6.84	14.19	42.53	82.14	117.07
F 18–44	6.37	11.56	25.42	56.77	99.21	146.18
F 45–64	10.94	20.45	45.02	90.94	130.84	189.08
F ≥65	16.77	32.73	74.48	136.98	196.34	230.9

Table S10: Modeled neurodevelopmental impacts (change in IQ, prenatal exposures, based on Summer 2014)[a]

Demographic Group	**Baseline diet, increased MeHg**	**Replacement of traditional foods**				
		Nutritious[b]	Empty-calorie	Processed meat	Vegetables	Atl. salmon
All individuals	-0.06 (0.04)	-0.01 (0.02)	-0.01 (0.02)	-0.01 (0.02)	-0.01 (0.02)	0.08 (0.02)
Communities						
Happy Valley-Goose Bay	-0.05 (0.03)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	0.08 (0.01)
North West River	-0.05 (0.03)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	0.1 (0.02)
Rigolet	-0.29 (0.18)	-0.04 (0.05)	-0.04 (0.05)	-0.04 (0.05)	-0.04 (0.05)	0.31 (0.06)

[a] Values presented are the modeled expected mean (SD) of medians for the whole population and for each community among women of childbearing age (16–49).

[b] Representative basket of nutritious store-bought foods (SI Figure S2).

Table S11: Modeled cardiovascular impacts (relative risk of cardiovascular mortality)[a]

Demographic Group	**Baseline diet, increased MeHg**	**Replacement of traditional foods with store-bought alternatives**				
		Nutritious foods[b]	Empty-calorie	Processed meat	Vegetables	Atl. salmon
All individuals	1.02 (0.01)	1.12 (0.05)	1.12 (0.05)	1.19 (0.06)	1.08 (0.05)	0.88 (0.04)
<u>Communities</u>						
Happy Valley-Goose Bay	1.02 (0.01)	1.1 (0.04)	1.1 (0.04)	1.14 (0.05)	1.07 (0.04)	0.9 (0.04)
North West River	1.03 (0.02)	1.15 (0.07)	1.16 (0.07)	1.25 (0.09)	1.12 (0.07)	0.85 (0.05)
Rigolet	1.12 (0.07)	1.28 (0.14)	1.3 (0.14)	1.54 (0.21)	1.2 (0.14)	0.68 (0.09)
<u>Males</u>						
All males	1.03 (0.02)	1.17 (0.07)	1.17 (0.08)	1.28 (0.1)	1.13 (0.08)	0.82 (0.06)
M 25–44	1.02 (0.01)	1.09 (0.04)	1.1 (0.04)	1.13 (0.04)	1.05 (0.04)	0.88 (0.04)
M 45–64	1.05 (0.02)	1.23 (0.1)	1.23 (0.1)	1.35 (0.12)	1.16 (0.1)	0.81 (0.06)
M ≥65	1.07 (0.05)	1.27 (0.13)	1.29 (0.14)	1.53 (0.21)	1.22 (0.13)	0.74 (0.08)
<u>Females</u>						
All females	1.02 (0.01)	1.08 (0.03)	1.09 (0.04)	1.14 (0.05)	1.06 (0.04)	0.91 (0.03)
F 25–44	1.01 (0)	1.04 (0.01)	1.04 (0.02)	1.06 (0.02)	1.02 (0.01)	0.93 (0.02)
F 45–64	1.02 (0.01)	1.12 (0.05)	1.12 (0.05)	1.18 (0.06)	1.09 (0.05)	0.9 (0.04)
F ≥65	1.05 (0.03)	1.16 (0.07)	1.17 (0.07)	1.29 (0.11)	1.11 (0.07)	0.84 (0.06)

[a] Values presented are the modeled expected mean (SD) of medians for the whole population and for each demographic group among individuals at least 25 years of age.

[b] Representative basket of nutritious store-bought foods (SI Figure S2).

Table S12: Modeled cancer impacts (relative risk of cancer mortality)[a]

Demographic Group	Replacement of traditional foods with store-bought alternatives				
	Nutritious foods[b]	Nutrient-sparse	Processed meat	Vegetables	Atl. salmon
All individuals	1.006 (0.002)	1.007 (0.002)	1.009 (0.003)	1.003 (0.002)	0.995 (0.002)
Communities					
Happy Valley-Goose Bay	1.005 (0.002)	1.006 (0.002)	1.007 (0.002)	1.002 (0.002)	0.996 (0.001)
North West River	1.007 (0.003)	1.009 (0.003)	1.012 (0.003)	1.004 (0.003)	0.995 (0.002)
Rigolet	1.017 (0.007)	1.019 (0.007)	1.024 (0.007)	1.011 (0.007)	0.986 (0.005)
Males					
All males	1.009 (0.003)	1.01 (0.003)	1.013 (0.003)	1.005 (0.004)	0.994 (0.002)
M 25–44	1.004 (0.001)	1.004 (0.002)	1.006 (0.002)	1.001 (0.002)	0.995 (0.002)
M 45–64	1.011 (0.004)	1.013 (0.004)	1.016 (0.005)	1.006 (0.004)	0.992 (0.003)
M ≥65	1.016 (0.006)	1.018 (0.006)	1.023 (0.007)	1.011 (0.006)	0.991 (0.003)
Females					
All females	1.005 (0.002)	1.005 (0.002)	1.007 (0.002)	1.002 (0.002)	0.996 (0.001)
F 25–44	1.002 (0.001)	1.003 (0.001)	1.004 (0.001)	1 (0.001)	0.997 (0.001)
F 45–64	1.006 (0.002)	1.007 (0.002)	1.009 (0.003)	1.003 (0.002)	0.996 (0.002)
F ≥65	1.009 (0.004)	1.011 (0.004)	1.016 (0.004)	1.004 (0.004)	0.995 (0.002)

[a] Values presented are the modeled expected mean (SD) of medians for the whole population and for each demographic group among individuals at least 25 years of age. Increased MeHg content in local foods is assumed to have no impact on cancer risks.

[b] Representative basket of nutritious store-bought foods (SI Figure S2

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