MERCURY IN MINAMATA CONVENTION COP1 DELEGATES

November 2017

BIODIVERSITY RESEARCH INSTITUTE
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***Lee Bell*[2]** *(Lead author)*

Contributing authors: ***David Evers*[1]*, Sarah Johnson*[1]*, Kevin Regan*[1]*, Joe DiGangi*[2]*, Jennifer Federico*[2]*, Bjorn Beeler*[2]*, Laura Vyda*[2]*, Tiffany Tool*[2]*, Emily Boone*[2]*, Jitka Strakova*[3]*, Jan Samanek*[3]**

[1] Biodiversity Research Institute (BRI), Maine, USA
[2] IPEN, Göteborg, Sweden
[3] Arnika Association, Prague, Czech Republic

IPEN
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IPEN is a network of non-governmental organizations working in more than 100 countries to reduce and eliminate the harm to human health and the environment from toxic chemicals.

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Biodiversity Research Institute
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Biodiversity Research Institute is a nonprofit ecological research group whose mission is to assess emerging threats to wildlife and ecosystems through collaborative research, and to use scientific findings to advance environmental awareness and inform decision makers. BRI a the leading international institute supporting the global mercury monitoring efforts for the Minamata Convention on Mercury.

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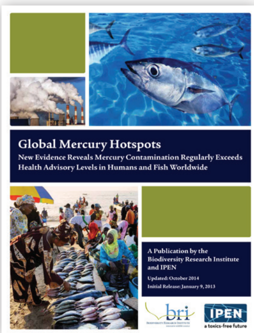
BACKGROUND OF INTERNATIONAL MERCURY MONITORING STUDIES

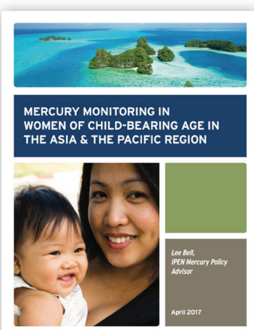
IPEN and the Biodiversity Research Institute (BRI) have collaborated since 2011, providing highly credentialed mercury monitoring data and bringing this scientific data to the policy arena, with a focus on the Minamata Convention on Mercury.

Three critical mercury studies from IPEN and BRI:



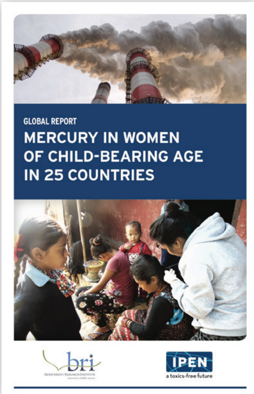
GLOBAL MERCURY HOTSPOTS

This IPEN and BRI collaborative report was the first of its kind to identify global biological mercury hotspots. Evidence revealed that mercury contamination regularly exceeds health advisory levels in humans and fish worldwide. These hotspots are of particular concern to human populations and the ecosystems on which they depend (**http://www.ipen.org/documents/global-mercury-hotspots**).



MERCURY MONITORING IN WOMEN OF CHILD-BEARING AGE IN THE ASIA AND THE PACIFIC REGION

This UN Environment, IPEN and BRI collaborative study revealed that women of child-bearing age living in four Pacific Island countries have elevated levels of mercury in their bodies. Mercury Monitoring in Women of Child-Bearing Age in the Asia and the Pacific Region examined hair samples from women aged 18 - 44 from the Cook Islands, Marshall Islands, Tuvalu and Kiribati, and two landlocked Asian countries, Tajikistan and Nepal (**http://ipen.org/Mercury-Monitoring-in-Women**).



MERCURY IN WOMEN OF CHILD-BEARING AGE IN 25 COUNTRIES

This IPEN and BRI collaborative study is the first of its kind to sample as many countries and regions and highlight women of childbearing age.

Researchers from IPEN coordinated hair sampling from 1044 women of reproductive age in 37 locations across 25 countries on 6 continents. Analysis, conducted by BRI, found that 42% of women sampled had average mercury levels over the US EPA health advisory level of 1 ppm, above which brain damage, IQ loss, and kidney and cardiovascular damage may occur.

The study additionally found that 55% of the global sample of women measured had more than 0.58 ppm of mercury in their hair, a level associated with the onset of fetal neurological damage.

See Annex 1 for the Executive Summary of the report and translated versions online:

http://ipen.org/site/mercury-women-child-bearing-age-25-countries

CONTENTS

SUMMARY OF RESULTS

In September 2017, IPEN invited delegates attending the first Conference of the Parties (COP 1) of the Minamata Convention on Mercury to volunteer to have hair samples taken and analyzed for total mercury concentration (THg). The methodology and sampling protocols for this survey were developed by IPEN and the Biodiversity Research Institute (BRI) in consultation with UN Environment. The methodology was employed in two recent studies. The first — *Mercury Monitoring of Women of Child-Bearing Age in the Asia and the Pacific Region* (IPEN/BRI/ UN Environment 2017) — focused on the Asia-Pacific region, and a subsequent global sampling study — *Mercury in Women of Child-Bearing Age in 25 Countries* (IPEN/BRI 2017) — included countries in additional regions.

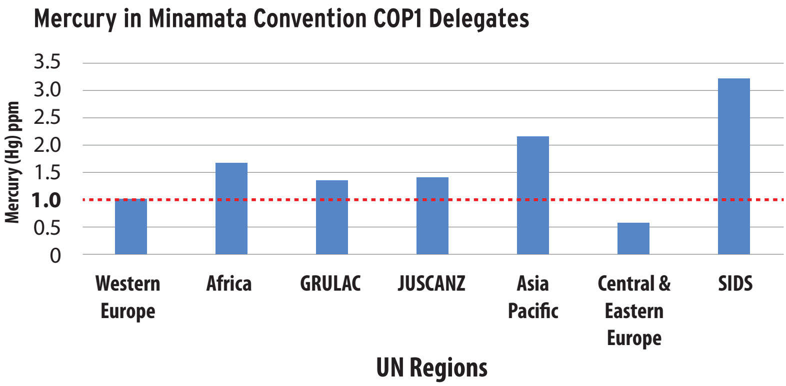
The results of the global sampling study are included in Annex 1 of this report to assist with contextualizing the results of delegate hair sampling and to highlight some of the trends where there were similarities between the global study and the survey of delegates. In particular, it should be noted that participants in both studies from Small Island developing States (SIDs), where a fish-rich diet is common, had significantly elevated mercury levels. This appears to be due to industrial mercury emissions from coal-fired power plants, cement kilns and waste incinerators, which are depositing in the ocean and contaminating fish stocks. The results of this study, and the studies noted above, reinforce the need for strong action to eliminate mercury pollution and its global impact on humans and the environment.

The hair monitoring results for delegates reflect some of the patterns of mercury pollution noted in earlier studies and therefore raise concerns. The shared methodology between the studies allows for some comparability of results. As for previous studies, the delegate hair samples were analyzed at the laboratory of the Biodiversity Research Institute (BRI), a globally renowned research group specializing in mercury bio-monitoring. In total, 180 delegates (104 women and 76 men) from 75 countries agreed to have hair samples analyzed.

The results have been compared to the US National Research Council mercury reference dose of 1000 µg /kg million (1 ppm). The basis for the use of this reference level in this study is that it corresponds closely with the U.S. Environmental Protection Agency's (EPA's) reference dose (RfD)

KEY FINDINGS

- Mercury was detected in all delegates.
- Regional mercury concentration levels exceeded the US EPA health advisory level of 1ppm in Africa, Asia Pacific, GRULAC, JUSCANZ, SIDS and Western Europe.
- The group with the highest mean level of mercury in hair were the delegates from SIDS.



Mercury levels above 1 ppm can be linked to brain damage, IQ loss, and kidney and heart damage. Fetal neurological damage can begin at mercury levels greater than 0.58 ppm.

(US EPA reference dose for mercury in human hair is equivalent to 1ppm.)

US EPA (1997) Mercury study report to Congress, Volume IV, An assessment of exposure to mercury in the United States, EPA-452/R-97-006.

Abbreviations: CEE, Central and Eastern Europe; GRULAC, Group of Latin American and Caribbean Countries; SIDS, Small Island Developing States.

of 0.1 µg/kg bw/day and a blood mercury concentration of 4 - 5 µg/L.[1] This level (approximately 1 ppm Hg as measured in hair) is the threshold above which the health impacts of mercury are known to occur in men, women and children. Mercury is a potent neurotoxin, especially to the developing brain, and can affect the developing fetus months after the mother's exposure. The harmful effects that can be passed from the mother to the fetus when the mother's mercury levels exceed 1 ppm include neurological impairment, IQ loss, and damage to the kidneys and cardiovascular system. High levels of mercury exposure in humans can

1 US EPA (1997) Mercury study report to Congress, Volume IV, An assessment of exposure to mercury in the United States, EPA-452/R-97-006.

Figure 1. UN Environment Director General Erik Solheim provides a hair sample at the IPEN booth. Photo: IPEN

lead to brain damage, mental retardation, blindness, seizures and the inability to speak.

Mercury was detected in all delegates. The results reveal that more than half of all delegates that provided hair samples exceeded the threshold level of 1 ppm. Delegates from Western Europe and Latin America and the Caribbean (GRULAC) had similar rates of exposure, with 42% and 47% (respectively) exceeding the safe threshold. In the Africa region, 52% of delegates were over 1 ppm, and JUSCANZ (Australia, Canada, Iceland, Israel, Japan, Liechtenstein, New Zealand, Norway, Switzerland, and the United States) results were even higher, with 60% exceeding 1 ppm. The Asia-Pacific region had the most elevated results, with 65% of delegates exceeding the threshold of 1 ppm. A small group of delegates from the Central and Eastern Europe (CEE) region participated, and 22% were above the threshold level; however, the sample size was very small, and the results may have varied significantly with additional CEE participants.

The results demonstrate that no region of the world where delegates live is protected from mercury exposure. Delegates, as a group, have a high level of knowledge about mercury pollution sources. However, this knowledge is not sufficient protection against mercury contamination. With the exception of the CEE region, approximately half of all delegates from any region have elevated mercury levels in their hair, which reflects an elevated body burden of methylmercury. In all regions except the CEE region, the mean levels of mercury exceeded 1 ppm, with the mean for delegates from the Asia Pacific region exceeding 2 ppm.

Mercury exposure can occur from many sources; however, the primary form of exposure for most people is diet. High trophic level fish such as shark, marlin, tuna and swordfish are known to have high levels of mercury in the flesh,[2] but smaller fish of other species (and some marine mammals[3]) may have also accumulated enough mercury to be a dietary concern to humans if eaten frequently. Mercury contamination of the oceans (and therefore fish) occurs due to deposition of mercury to the ocean from the atmosphere where industrial mercury emissions are carried over long distances. Subsequent methylation of mercury by ocean bacteria converts inorganic mercury emissions into highly toxic and bioavailable methylmercury (MeHg).[4] Studies have demonstrated that even with current attempts to reduce mercury emissions, mercury levels in the oceans will continue to rise and may increase up to 50% by 2050.[5]

The sources of atmospheric mercury include industrial emissions from coal-fired energy generation, cement kilns, waste incinerators, chlor-alkali and vinyl chloride monomer plants and metallurgy processes. For many communities, small-scale gold mining using mercury is a primary exposure source, with both metallic mercury vapor inhalation and contami-

2 Kim et al (2006) *The Effect of Fish Consumption on Blood Mercury Levels of Pregnant Women*. Yonsei Med J. 2006 Oct 31; 47(5): 626–633.

3 Evers, et al 2016. *Mercury in the Global Environment: Marine Mammals. Biodiversity Research Institute*. Portland, Maine. BRI Science Communications, Series 2016-03. 8 pages.

4 Sunderland et al (2009) *Mercury sources, distribution, and bioavailability in the North Pacific Ocean: Insights from data and models. Global Biogeochem*. Cycles, 23, GB2010, doi:10.1029/2008GB003425.

5 Sunderland, E. M., D. P. Krabbenhoft, J. W. Moreau, S. A. Strode, and W. M. Landing (2009), *Mercury sources, distribution, and bioavailability in the North Pacific Ocean: Insights from data and models, Global Biogeochem*. Cycles, 23, GB2010, doi:10.1029/2008GB003425.

nation of local fish supplies contributing to exposure.[6] Small-scale gold mining is a significant source of mercury vapor release.[7]

Other individuals may be exposed through mercury-contaminated sites, dental amalgam, mercury-added cosmetics, waste dumps containing used mercury-added products, and so on. This survey of delegate mercury body burden serves to highlight that mercury pollution can affect people from all parts of the world and that exposure may be due to a combination of sources. For these reasons, it is critically important that delegates work together at future Mercury Treaty COPs to ensure strong measures are taken to eliminate mercury pollution from priority sources such as coal-fired power stations, small-scale gold mining and contaminated sites.

An Executive Summary of the global IPEN/BRI study Mercury in Women of Childbearing Age in 25 Countries can be found in Annex 1. The Executive Summary of the study is included here as a reference so that readers can consider the findings of this study in the context of the global monitoring analysis.

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6 Bell. L., et al. (2017) *Mercury in Women of Child-bearing Age in 25 Countries*. A joint study by the Biodiversity Research Institute and the IPEN. September 2017. Berkeley California.

7 Serikawa et al (2011). *Emission and dispersion of gaseous mercury from artisanal and small-scale gold mining plants in the Poboya Area of Palu City, Central Sulawesi, Indonesia*. Toyama Prefectural University.

INTRODUCTION

Mercury has now been acknowledged by global policy makers as a pervasive and harmful pollutant that compromises human health and intellectual capacity while damaging ecosystems and contaminating wildlife. Mercury is a bioaccumulative, transboundary, persistent and toxic metal that is produced unintentionally through industrial activities such as burning coal, incinerating waste and manufacturing cement, and through the operation of chlor-alkali plants.[8] Mercury has also been deliberately used for the extraction of silver and gold on a global scale due to its ability to amalgamate with these precious metals and facilitate its extraction from ore. Many products have historically contained mercury and some of these products are still in use in the health care sector and in a large variety of applications such as lighting, switches and batteries, which are eventually disposed of as waste. As a result of the widespread intentional and unintentional emissions and releases of mercury, nearly all humans are exposed to some level of mercury. A critical exposure pathway for people is through the consumption of fish.

Figure 2. Fish accumulate mercury from industrial emissions that drop into the oceans.

8 Pirrone et al. (2010) *Global mercury emissions to the atmosphere from anthropogenic and natural sources*. Atmos. Chem. Phys., 10, 5951–5964, 2010

Mercury emissions from industrial and other sources enter the atmosphere and over time deposit back into the oceans where bacteria transform metallic or elemental mercury into the highly toxic methylmercury (MeHg) form that can be absorbed by fish and, in turn, by humans who eat those fish.

Not all fish are contaminated with mercury at levels of concern. However, some species of fish, particularly those that are predators and are on the higher trophic level of species, can contain harmful amounts of mercury as they consume smaller fish and assume their mercury body burden. When humans consume contaminated fish, they transfer the mercury body burden of the fish to themselves. The species of fish that are eaten, the size and maturity of those fish and the frequency of consumption are all factors that may affect the dietary exposure of an individual person. Consumption of fish should not necessarily be avoided over concerns of mercury exposure (and some communities have little choice as fish are the only protein source readily available). However, careful consideration should be given to the type and frequency of fish consumption, especially for women of child-bearing age considering pregnancy, as mercury levels above 1 ppm can potentially have serious impacts on the developing fetus.[9]

Men and women are equally susceptible to the health impacts of mercury, but mercury can also pass through the placental barrier to the fetus, rendering women and their offspring particularly vulnerable to the toxic effects of methylmercury. Mercury is a potent neurotoxin, especially to the developing brain, and can affect the developing fetus months after the mother's exposure. The harmful effects that can be passed from the mother to the fetus when the mother's mercury levels exceed 1 ppm include neurological impairment, IQ loss, and damage to the kidneys and cardiovascular system. At high levels of mercury exposure this can lead to brain damage, mental retardation, blindness, seizures and the inability to speak.

Health impairment caused by elevated mercury levels is a tragedy for the individual, but also has significant consequences for society. In addition to the health sector cost increases in treating elevated mercury levels, there are also strong socio-economic implications associated with elevated levels of mercury in the population. A recent study[10] concluded that elevated mercury levels in an individual had the potential to reduce IQ levels in

9 Grandjean et al (2012) *Calculation of Mercury's effect on Neurodevelopment*. Environ Health Perspect. 2012 December; 120(12).

10 Trasande et al. (2016) *Economic implications of mercury exposure in the context of the global mercury treaty: hair mercury levels and estimated lost economic productivity in selected developing countries*, Journal of Environmental Management 183:229 - 235, doi: 10.1016/j.jenvman.2016.08.058 http://www.ncbi.nlm.nih.gov/pubmed/27594689

Figure 3. IPEN staff take a hair sample using Nitrile gloves and alcohol wiped scissors to prevent sample contamination. Photo: IPEN

offspring and impact their economic productivity over decades. When extrapolated to population level, such impacts are costing millions of dollars in economic loss to that country. The study analyzed hair samples from 15 developing countries and countries in economic transition. The results showed that 61% of all participants had hair mercury concentrations greater than 1 ppm. Using a linear dose-response relationship and an assumed 0.18 IQ point decrement per part per million (ppm) increase in hair mercury concentrations, an estimate of lost productivity was developed. This data was used to estimate increases in intellectual disability and lost Disability-Adjusted Life Years (DALY). A total of $77.4 million in lost economic productivity for those countries studied was estimated assuming a 1 ppm reference level, and $130 million if no reference level was used.

The Minamata Convention is named in commemoration of the Minamata Bay disaster, which occurred when the Chisso Corporation's mercury-contaminated waste-water polluted fish in Minamata Bay, Japan. Thousands were injured or died, and the children born to women who were pregnant at the time sustained profound neurological injuries that are referred to as Fetal Minamata Disease. Shinobu Sakamoto is a survivor who has, since her first trip to Stockholm UN Environment Assembly in 1972, dedicated her life to advocating for No More Minamatas. Ms. Sakamoto is pictured here at the opening of the Minamata Convention First Conference of the Parties in Geneva, September 2017.
Photo: Kiara Worth, IISD/ENB

IPEN HAIR SAMPLING FROM INC 1 TO COP 1

The Minamata Convention on Mercury, a global treaty to protect human health and the environment from mercury pollution, was signed on the 10th October 2013 and entered into force on the 16th August 2017. The Treaty currently has 128 signatories and 84 ratifications, representing a global commitment to tackle mercury pollution, which is known for its long-range transport, persistence, ability to bioaccumulate, and toxicity. IPEN has had a strong involvement since the earliest negotiations on the Treaty and has maintained an ongoing presence in negotiations to strengthen aspects of the Treaty wherever possible.

IPEN attended the first meeting of the Treaty's International Negotiating Committee (INC 1) in Sweden during June 2010 and took the opportunity to invite delegates to participate in a hair sampling study[11] to assess the concentration of mercury in their hair and compare it to internationally accepted, health-related thresholds for mercury body burden. The results of that study highlighted to delegates the widespread impacts of mercury pollution. Mercury levels in participants from developing countries and countries with economies in transition (CEIT) were, on average, approximately twice as high as levels found in participants from developed countries. For delegate groups from developing and CEIT countries, the average level exceeded the US National Research Council mercury reference dose of 1000 µg/kg (1 part per million). The results of the study were published with aggregate data based on the region from which delegates originated so as to maintain the confidentiality of participants.

Seven years on from those early negotiations the Mercury Treaty has now entered into force, establishing legally binding provisions for Parties to take action to reduce sources of mercury pollution. The first Conference of the Parties (COP 1), held in Geneva, Switzerland in September 2017, marked the culmination of years of negotiations to establish binding measures to tackle mercury pollution on a global scale. IPEN took the opportunity at this important milestone to again invite delegates to volunteer hair samples for mercury concentration analysis. At the INC 1 meeting 56 delegates and others provided hair samples for analysis. At COP 1 in Geneva that number expanded considerably to 180 voluntary participants, including mainly governmental delegates but also NGOs and others.

The results, which are described in detail in the following sections of this study, clearly indicate that no region on earth is immune to the effects and spread of this potent toxic metal. Indeed, the impacts of mercury pollution present around the globe today are not restricted by national wealth or individual social status, class, gender or age, and can damage the health of any of us and our children. The results of this study should serve as a solemn reminder to all participants in the Mercury Treaty process that we must tackle the problem of mercury pollution urgently and cooperatively to immediately reduce the impact on human health and the environment.

Figure 4. IPEN and SSNC hair sampling report for INC 1 delegates

11 http://ipen.org/documents/ipen-ssnc-survey-mercury-hair

SURVEY DESIGN

The survey was based on opportunistic sampling of male and female government delegates and other participants over the age of 18 years who were present at COP1 of the Mercury Treaty in Geneva, Switzerland between 24 -29th September 2017. Delegates and others were invited to participate in providing samples via a general announcement at the meeting. Two opportunities were provided for sampling. A dedicated hair sampling session was conducted on the 28th September in the Centre International de Conférences, Geneva (where COP 1 was convened), and delegates were also invited to visit the IPEN exhibition booth in the same building to provide samples at any time during COP 1.

The methodology and protocols for the hair sampling were based on those used in previous hair mercury sampling studies conducted by IPEN in conjunction with BRI[12] and with BRI/UNEP[13] in 2016/2017, as well as a more recent joint study with BRI over the same period.[14] The methodology includes specific information on documenting samples, including the use of sample codes that maintain the anonymity of the participant but allow cross referencing to report the results to each individual. It also includes model consent forms, a dedicated questionnaire, shipping instructions to send the samples to the laboratory, analysis and measurement methods, data sheets for sample recording and contextual report back forms to explain the results to the participants. The sampling protocol describes how the hair sample should be taken and from what part of the scalp, the amount of hair required, sample storage, and measures to prevent cross-contamination of the sample.

At the close of the COP1 meeting, samples were correctly packaged, labelled and shipped by courier along with a data sheet listing each sample origin and a corresponding sample ID code. As soon as shipments arrived at BRI's Wildlife Mercury Research Laboratory, the hair samples were analyzed for total mercury following EPA method 7473 by gold-amalgamation atomic absorption spectroscopy following thermal desorption of

12 Evers, et al. 2014. *Global mercury hotspots: New evidence reveals mercury contamination regularly exceeds health advisory levels in humans and fish worldwide*. Biodiversity Research Institute. Portland, Maine. IPEN. Göteborg, Sweden. BRI-IPEN Science Communications Series 2014-34. 20 pages.

13 Bell. L. (2017) *Mercury Monitoring in Women of Child-Bearing Age in the Asia and the Pacific Region. A joint study by UN Environment*, Biodiversity Research Institute and IPEN. April 2017. Berkeley California.

14 Bell. L., et al. (2017) *Mercury in Women of Child-bearing Age in 25 Countries*. A joint study by the Biodiversity Research Institute and IPEN. September 2017. Berkeley California.

the sample using a Milestone DMA-80. A blank and two calibration standards (DORM-3 and DOLT-4) were used in each of the two detector cells.

Instrument response is evaluated immediately following calibration, and thereafter, following every 20 samples and at the end of each analytical run, by running two certified reference materials and a check blank. Instrument detection limit is approximately 0.050 ng. An acetone wash of the hair samples followed by a rinse with milli-Q water can be used to remove external contamination, such as hair products. Results of total mercury were then recorded for each sample in parts per million (ppm), and recorded in tables by location on a regional basis (extrapolated from data provided by the participant in his/her questionnaire).

The full methodology, including sampling protocols, can be viewed in Annex 2 to this report. An important feature of the methodology and protocol, which have been reviewed and approved by UN Environment, is that it can be adapted for use in any country as a cost-effective and efficient basis for conducting screening of mercury hair levels in local populations. In turn, this contributes to national level information of mercury impacts on citizens in a variety of locations that can contribute to establishing baseline levels of mercury body burden. This data can later be reviewed

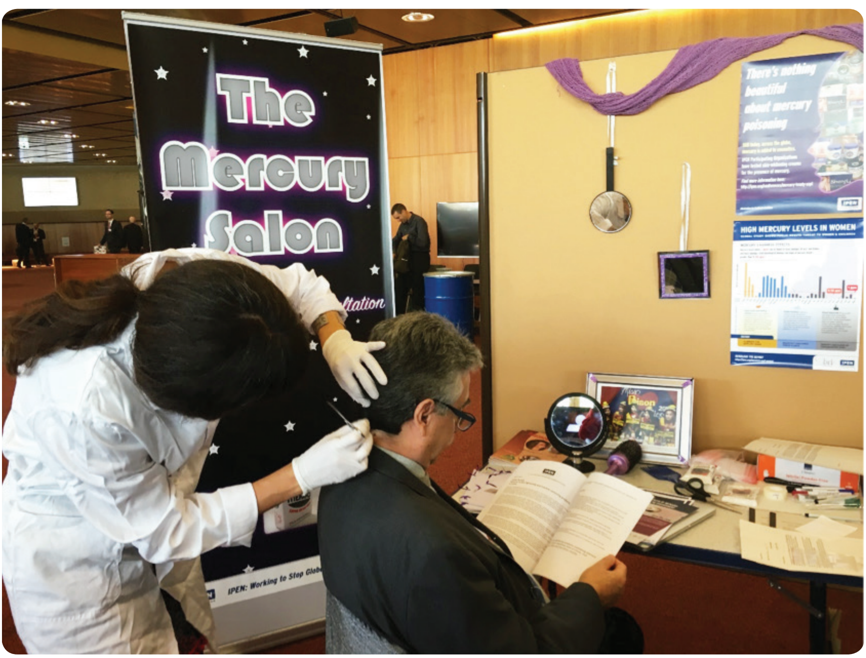


Figure 5. A participant reviews the sampling methodology during the hair sampling process. Photo: IPEN

to assess the effectiveness of national measures under the Treaty obligations to reduce mercury pollution. It may also allow efficient targeting of localized mercury pollution sources for effective reduction measures. In the studies IPEN has conducted using this methodology, it was possible to ascertain both localized mercury pollution sources and diffuse (global) pollution sources that were contributing to elevated mercury levels in many specific population groups that provided samples.

The survey of COP 1 delegates uses the same methodology with minor modifications and the same sampling protocol; however, no specific population level inferences on mercury body burden can be drawn in relation to the country of origin of the delegates, as the sampling cohort is very low (perhaps 1- 7 individuals per country). The results presented on a regional basis are indicative only.

The questionnaire completed by delegates as part of the sampling protocol does allow some inferences to be made in relation to individual mercury exposure. The questionnaire was designed to elicit responses in relation to the diet and other exposure factors of the individual hair sampling participant. For instance, a participant may be found to have highly elevated levels of mercury in hair and consume no fish, yet gave a positive answer to occupational mercury exposure, which may then be investigated as a contributing factor. Conversely, a participant may have highly elevated levels of mercury and respond that they frequently eat fish of higher trophic level species, which may be a probable exposure factor. Again, such contextual data can assist participants in assessing their mercury exposure and taking action to reduce it. When used in larger population groups from individual locations (villages, towns), the data can be very useful in detecting potential mercury exposure sources and developing preventative strategies.

RESULTS AND DISCUSSION

Following the COP 1 meeting in Geneva, the hair samples were carefully packaged and shipped to the Biodiversity Research Institute laboratory for analysis. The results are presented in three formats;

- As a single cohort or group
- As a comparison between regions (as indicated by each delegate)
- As a comparison between developed countries and developing countries, including countries in economic transition (CEIT).

An additional grouping was also considered and delegates who indicated their origin was in a Small Island Developing State (SIDS) were also clustered as a group for comparison to other regional groupings. The rationale for this was to examine whether SIDS as a grouping had a higher hair mercury mean than other regions. Island populations tend to have a higher reliance on fish as a staple protein due to their isolation and limited available space, or suitable land, to raise significant livestock or crops as an alternative protein source. Previous studies conducted by IPEN and BRI in Pacific SIDS to measure hair mercury levels found that nearly all Pacific nations where testing was conducted showed significantly elevated levels due to the fish-rich diet of island citizens. Although SIDS do not constitute a 'region,' this grouping was included for comparative purposes with regions not known for high levels of fish consumption (e.g. CEE).

RESULTS FOR ALL DELEGATES

The results for the group as a whole, or cohort, were significant in that 51% of the delegates who had hair analyzed for total mercury content exceeded the US National Research Council threshold value of 1 ppm. The cohort consisted of 104 men and 76 women from 75 countries, with a reasonable balance in representation from all UN regions except for a low number of delegates from the CEE. The range of values for hair mercury concentrations was from 0.010 ppm to 8.178 ppm. The standard deviation for the entire group was 1.406 ppm.

Importantly, the average level for the delegate group also exceeded the 1 ppm threshold level with a group mean of 1.451 ppm ± 1.402 ppm (fw). This indicates that a substantial number of delegates are exposed to a mercury source either directly (e.g. local mercury pollution, mercury-based cosmetics, dental amalgam or occupationally) or indirectly through diet, and perhaps a combination of both. As the data collected only sought the name of the country of origin, it is not possible to categorically identify local factors that may be responsible for an elevated mercury level in an individual delegate, although some dietary inferences can be made from questionnaire data.

There were 25 delegates that had significantly elevated levels of mercury (> 2 ppm) and we examined the data available from their questionnaires to ascertain if diet was a contributing factor, specifically consumption of fish.

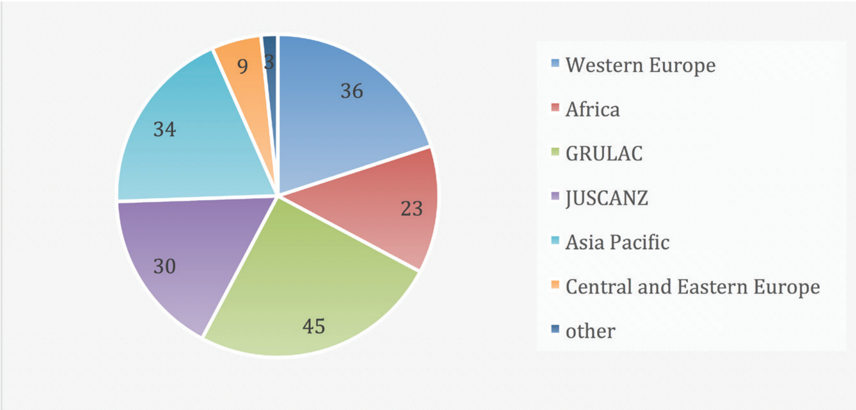
For these 25 individuals, the quality of the data from the questionnaires varied considerably, and for some delegates it was unclear if their diet contributed to their elevated mercury levels. The 25 delegates were divided into those with a) a confirmed fish-rich diet (4 fish meals per week), b) those who did not have a fish rich diet, and a third category c) where the data was unclear. We were able to ascertain that, of the 25 delegates who had results > 2 ppm, there were 44 % who clearly had a fish-rich diet. Those that did not meet this definition (16%) still ate fish twice per week, which could still be a contributing factor to mercury exposure depending on the species and the size of the fish consumed (as larger fish from higher trophic level species may have high concentrations of mercury). The third sub-group whose data was 'unclear' (40%) provided no direct indication of their frequency of fish consumption. However, it should be noted that 50% of the 'unclear' sub-group were from Small Island Developing States and one other country known to have relatively high levels of fish consumption. Without more detailed dietary data, it is not possible to infer that this sub-group delegates are exposed through diet; however, there are some indications, based on the country of origin, that this might be the case.

REGIONAL RESULTS

Figure 6 provides a break-down of the number of delegates who provided hair samples based on the region (as specified by the delegate in their questionnaire). IPEN has not provided an analysis of the results by country of origin, as this may compromise the anonymity of some delegates from countries with small delegations.

The results presented in Table 1 show that each region was represented by sufficient delegates to allow comparison between the groups. The CEE had a small group of delegates that provided samples, but the results of this group reflect results of some studies conducted previously in CEE countries where Hg levels were lower than other regions due to much lower fish consumption. However, this can only be considered as a gener-

Figure 6. Delegate participants by region



alization, as many localized mercury hotspots are present in the CEE. As in other regions, this can account for elevated levels among local populations. While the mean was lower for the CEE than other regions, a significant number of delegates (22%) still exceeded the threshold level.

TABLE 1: HAIR MERCURY CONCENTRATION SAMPLING RESULTS BY REGION

Region	n	Mean (average)	Standard deviation (ppm)	Percent of samples greater than 1 ppm Hg
EU (Western Europe)	36	1.038	0.677	42%
Africa	23	1.669	1.329	52%
GRULAC	45	1.346	1.361	47%
JUSCANZ	30	1.419	1.051	60%
Asia Pacific	34	2.180	2.108	65%
Central and Eastern Europe	9	0.584	0.533	22%
Other[15]	3	NA	NA	NA

Clearly the Asia-Pacific region had the most elevated mean among all regional groups analyzed; however, it is evident from the data that in nearly

15 The origin of these delegates could not be ascertained as they declined to indicate country of origin and the low number in this group did not provide useful data.

all regions a significant percentage of delegates (around half) are exposed to mercury at levels which result in exceedance of the threshold level (1 ppm). This means that many delegates, irrespective of their country of origin, are being exposed to mercury directly or indirectly at potentially unsafe levels. Some of the individual highest Hg results were also recorded in delegates from JUSCANZ and Western Europe. These results should provide an unequivocal reminder to delegates of the Minamata Convention that everyone is potentially affected by mercury pollution on a global scale and that efforts to address this crisis must be effective and immediate.

Figure 7 emphasizes the global nature of mercury pollution by providing a graphic representation of mean mercury levels found in the hair of delegates by region of origin. The red dashed line represents the NRC reference dose or threshold level (1 ppm), above which the health impacts of mercury are known to occur. The mean levels of mercury in the hair of delegates from Western Europe, JUSCANZ, Africa, GRULAC and Asia-Pacific all exceed the 1 ppm threshold level, while the CEE region is lower.

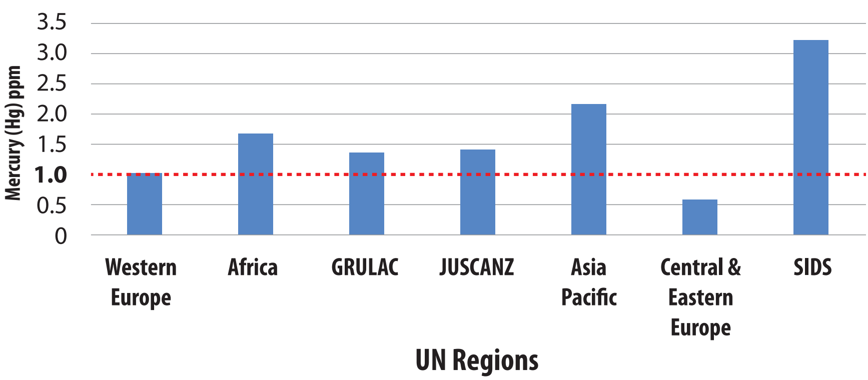
TABLE 2: SMALL ISLAND DEVELOPING STATES AND U.N. MEMBERSHIP STATUS

United Nations members		Non-UN Members/Associate Members of the Regional Commissions
Antigua and Barbuda	Marshall Islands	American Samoa
Bahamas	Mauritius	Anguilla
Bahrain	Nauru	Aruba
Barbados	Palau	Bermuda
Belize	Papua New Guinea	British Virgin Islands
Cabo Verde	Saint Kitts and Nevis	Cayman Islands
Comoros	Saint. Lucia	Commonwealth of Northern Marianas
Cuba	Saint Vincent and the Grenadines	Cook Islands
Dominica	Samoa	Curacao
Dominican Republic	São Tomé and Príncipe	French Polynesia
Federated States of Micronesia	Seychelles	Guadeloupe
Fiji	Singapore	Guam
Grenada	Solomon Islands	Martinique
Guinea-Bissau	Suriname	Montserrat
Guyana	Timor-Leste	New Caledonia
Haiti	Tonga	Niue
Jamaica	Trinidad and Tobago	Puerto Rico
Kiribati	Tuvalu	Turks and Caicos Islands
Maldives	Vanuatu	U.S. Virgin Islands

For comparative purposes, delegates from Small Island Developing States (SIDS) were grouped in a specific category to gauge whether the results of previous mercury hair concentration studies by IPEN in SIDS[16] were reflected in this delegate sub-group. These delegates were first included in their regional grouping (which is reflected in the Figure 7 histogram), and then also attributed to the SIDS category where appropriate. Table 2 provides a regional breakdown of SIDS.

The results suggest that SIDS have a higher exposure factor than other regions, with a significantly elevated mean of 3.23 ppm ± 2.205 ppm (fw); a level which IPEN (and others) have identified in previous studies as a function of high fish diets where the local fish are subject to mercury bioaccumulation. The origin of the mercury in ocean fish is largely due to anthropogenic emissions from coal-fired power stations, cement kilns, waste incineration, chlor-alkali plants and other known industrial emission sources.

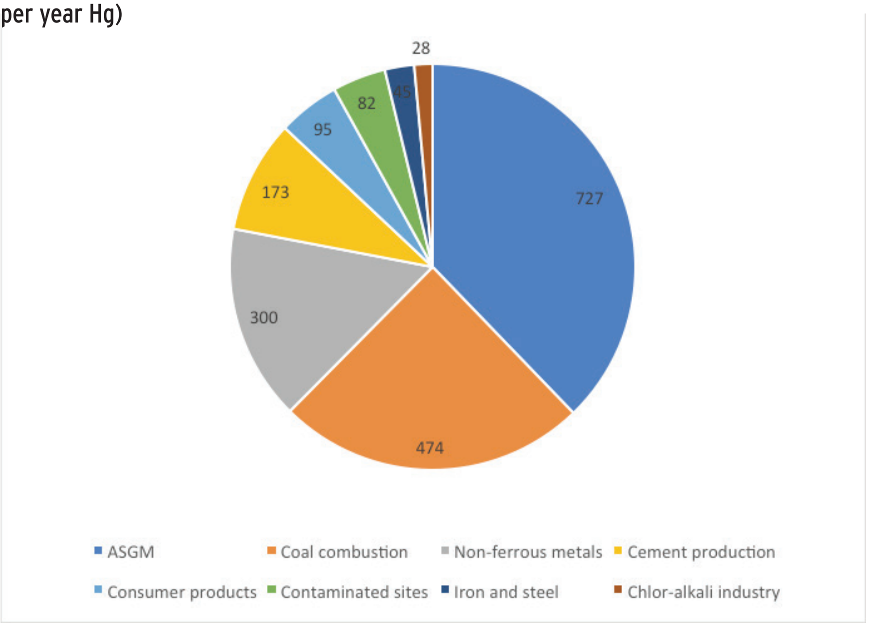
Figure 7. Mean hair concentrations by regions and SIDS



The relative contributions of major mercury pollution sources that are responsible for ocean deposition of mercury are shown in Figure 8 and are based on data from the UNEP Global Mercury Assessment of 2013. An updated version of the assessment is due for release in 2018.

16 Bell. L. (2017) Mercury Monitoring in Women of Child-Bearing Age in the Asia and the Pacific Region. A joint study by UN Environment, Biodiversity Research Institute and the International POPs Elimination Network. April 2017. Berkeley California.

Figure 8. Global anthropogenic emissions of mercury pollution to atmosphere (tons per year Hg)



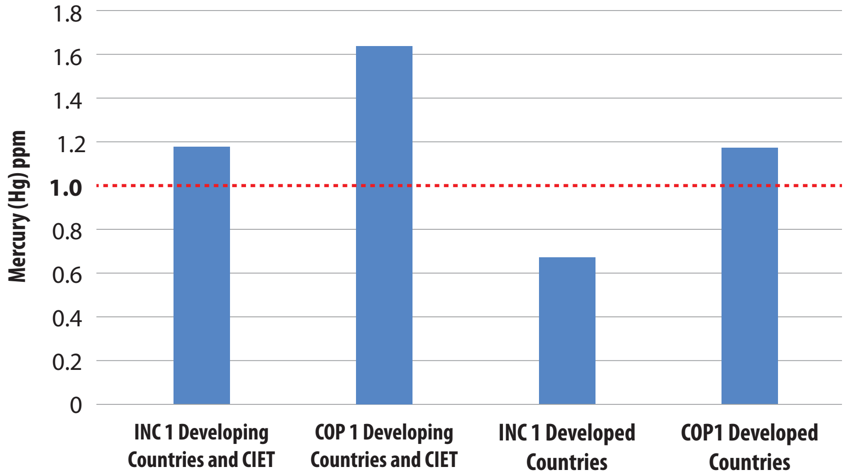
RESULTS OF COMPARISON BETWEEN DEVELOPED AND DEVELOPING COUNTRIES (INCLUDING CEIT)

The comparison between the categories of delegates from developed and developing countries at both INC 1 and COP 1 are presented graphically in Figure 9. Both COP 1 groups had a mean concentration of mercury that exceeded the US National Research Council threshold level of 1 ppm. **For developing/CEIT countries, the mean Hg level was 1.642 ppm ± 1.639 ppm (fw) and for developed countries the mean was 1.177 ppm ± 0.880 ppm (fw).**

For both INC 1 and COP 1 the results demonstrate that the average mercury levels in delegates from developing countries are higher. However, for COP1 the mean of both groups exceeded the 1 ppm threshold due to the global impact of mercury pollution. At INC 1 delegates from developed countries had mean mercury levels well below the 1 ppm threshold. The COP 1 results show a sharp increase in mercury levels from delegates of developed countries.

When the hair sampling results are compared to the sample data collected from delegates at INC 1 in 2010, the outcome is that both groups appear to have experienced significant increases in mean levels of mercury. This data is indicative only as different delegates were sampled between the

Figure 9. Comparison of mercury hair concentrations in delegates of developed and developing countries between INC 1 and COP 1.



two meetings (so we are not observing increases for specific individuals between 2010 -2017). The number of delegates sampled at INC 1 was significantly smaller and delegates at COP 1 may reside in different countries with differing localized mercury pollution profiles compared to those sampled at INC 1. Despite these differences between the groups sampled at both meetings, the increase in mercury levels is very significant and may point to trends of increased global mercury pollution.

TABLE 3: MERCURY LEVELS OF DELEGATES FROM DEVELOPING AND DEVELOPED COUNTRIES (COP1 COMPARED TO INC 1)

	Number of samples	Mean (Hg ppm)	Standard deviation (ppm)	Participants exceeding 1 ppm Hg in hair (%)
Developed countries (INC 1)	20	0.669	0.338	NA
Developing countries and CEIT (INC 1)	33	1.182	0.847	NA
Developed countries (COP 1)	70	1.177	0.880	48%
Developing countries and CEIT (COP 1)	108	1.642	1.639	53%

Figure 10. Delegates discuss the sampling methodology with IPEN staff. Photo: IPEN

CONCLUSION

Delegates from all parts of the world who provided hair samples had detectable levels of mercury in their hair and therefore their bodies. Approximately half of all delegates exceeded the US National Research Council threshold of 1 ppm Hg in hair, above which health impacts of mercury are known to occur. While delegates (as a group) from developing countries and countries in economic transition had higher mean mercury levels than developed countries, some of the individual highest levels recorded in this study were from delegates in Western Europe or JUSCANZ countries. These results clearly show that mercury pollution is a global threat and that geographic location, national wealth, social status, gender or age do not provide immunity from its impacts. Delegates from SIDS had mercury levels elevated above all other regional or economic groupings, with a mean mercury concentration (3.23 ppm ± 2.205 ppm fw) around 50% higher than the next most elevated group (Asia-Pacific region). This supports evidence from earlier IPEN/BRI studies that island populations face greater exposure to mercury through their fish-rich diets and points to the need to eliminate sources of mercury pollution emitted to air and then deposited to water bodies as soon as possible.

When compared to the results of hair sampling from INC 1 in 2010, the results are markedly higher for COP 1, suggesting a sharp indicative upwards trend in hair mercury concentrations (and perhaps global mercury pollution levels). Clearly, there is no geographical location that is immune to the impacts of mercury and its significant and serious effects on human health. For delegates, the urgency of action needed to dramatically reduce coal-fired power and other industrial emissions, eliminate mercury from ASGM and clean up contaminated sites may now be more immediate and personal.

The release of this report at the 3rd United Nations Environment Assembly in Nairobi - which carries the theme Towards a Pollution-Free Planet - should highlight to attendees that the real solution to beating pollution is to avoid creating it in the first place. For mercury, there are many pollution legacy issues that will take decades to resolve and this challenge must be faced, but we can avoid the ongoing creation of new mercury pollution that will become the legacy issues of the future. We can reduce the long-term impacts of mercury by taking immediate action to end the global trade in mercury, which continues to flourish unabated under the guise that impoverished communities need small-scale gold mining to secure their livelihood. Similarly, urgent action is required to reduce mercury pollution from coal extraction and burning for energy generation.

These worrisome hair sampling results reinforce the need for global decision-makers to act cooperatively to immediately reduce mercury pollution to protect current and future generations and protect global ecosystems.

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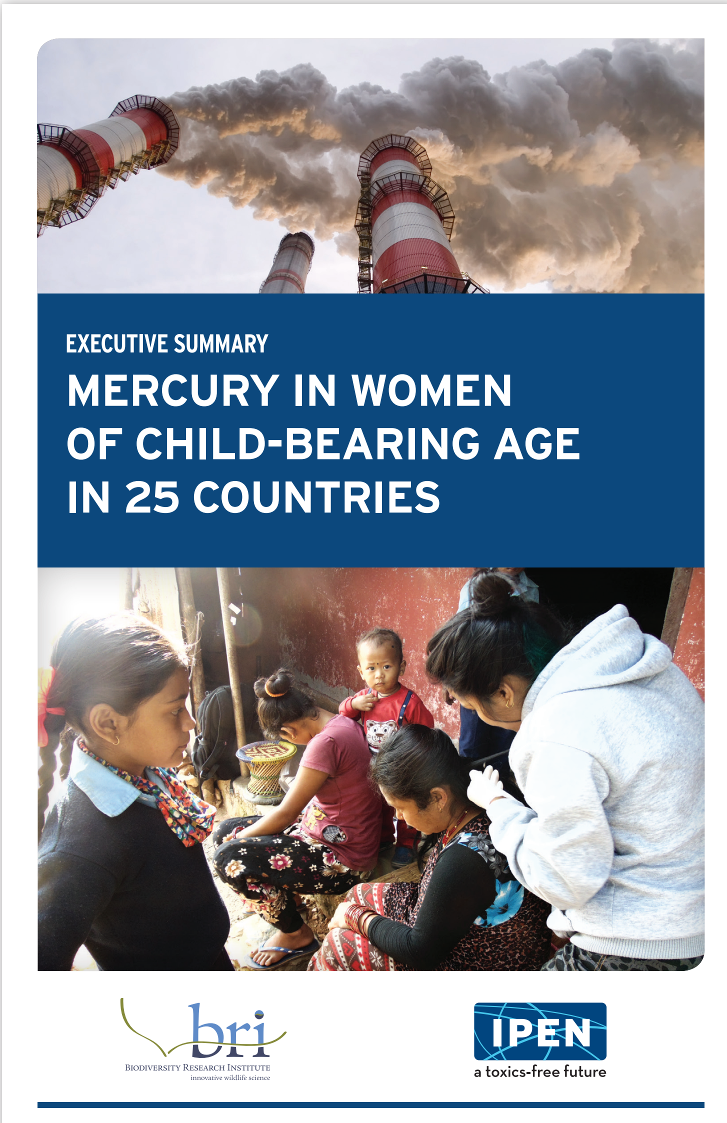
ANNEX 1. IPEN GLOBAL REPORT: MERCURY IN WOMEN OF CHILD-BEARING AGE IN 25 COUNTRIES



MERCURY IN WOMEN OF CHILD-BEARING AGE IN 25 COUNTRIES

Lead Author
Lee Bell
IPEN Mercury Policy Advisor

September 2017

IPEN is a network of non-governmental organizations working in more than 100 countries to reduce and eliminate the harm to human health and the environment from toxic chemicals.

www.ipen.org

Biodiversity Research Institute is a nonprofit ecological research group whose mission is to assess emerging threats to wildlife and ecosystems through collaborative research, and to use scientific findings to advance environmental awareness and inform decision makers. BRI a the leading international institute supporting the global mercury monitoring efforts for the Minamata Convention on Mercury.

www.briloon.org

Front cover photo: Mercury hair sampling in Nepal village. Ram Charitra Sah, CEPHED, Nepal

KEY FINDINGS

- 1044 women of child-bearing age from 25 countries participated in the study. 42% of them had mercury levels greater than 1 ppm – the level that approximately corresponds to the US EPA reference dose.* 55% of the women had mercury levels greater than 0.58 ppm mercury, a more recent, science-based threshold based on data indicating harmful effects at lower levels of exposure. Mercury is a health threat to women and the developing fetus.
- Women of the Pacific Islands have elevated mercury levels, likely due to a fish-rich diet. Distant air emissions of mercury from coal-fired power plants, cement kilns and other industries contaminate ocean fish that serve as a primary protein source for Pacific Islanders.
- Artisanal small-scale gold mining results in high mercury body burdens in women from Indonesia, Kenya, and Myanmar. Two likely mercury exposure sources are burning mercury amalgam and eating contaminated fish.
- Industrial mercury emissions contaminate local fish and elevate mercury levels in Thai women living nearby.
- Indigenous women in Alaska have mercury levels of concern due to their subsistence diet of sea mammals and fish. Consumption of seals may be a key source of mercury exposure.
- Women from locations in Albania, Chile, Nepal, Nigeria, Kazakhstan, and Ukraine have mercury levels of concern due to localised pollution of waterways and suspected fish contamination.
- Women using mercury to gold plate statues in Nepal have elevated mercury levels.

* This is the daily exposure that US EPA considers "likely to be without an appreciable risk of deleterious effects during a lifetime."

Reader Note: Page numbers in Annex 1 reflect the page numbers of the *Mercury in Women of Child-Bearing Age in 25 Countries Executive Summary*.

Normal pagination resumes on page 55.

OVERVIEW

Mercury is a potent neurotoxin, especially to the developing brain, and can affect the developing fetus months after the mother's exposure. The harmful effects that can be passed from the mother to the fetus when the mother's mercury levels exceed 1 ppm include neurological impairment, IQ loss, and damage to the kidneys and cardiovascular system. At high levels of mercury exposure this can lead to brain damage, developmental disabilities, blindness, seizures and the inability to speak. While researchers have studied mercury body burden in specific regions of the world, information in developing and transition countries is lacking. This comprehensive study focused on measuring the mercury body burden of 1044 women of child-bearing age in 25 developing and transitioning countries. The data indicates that there is a serious and substantial threat to women's and children's health from mercury exposure.

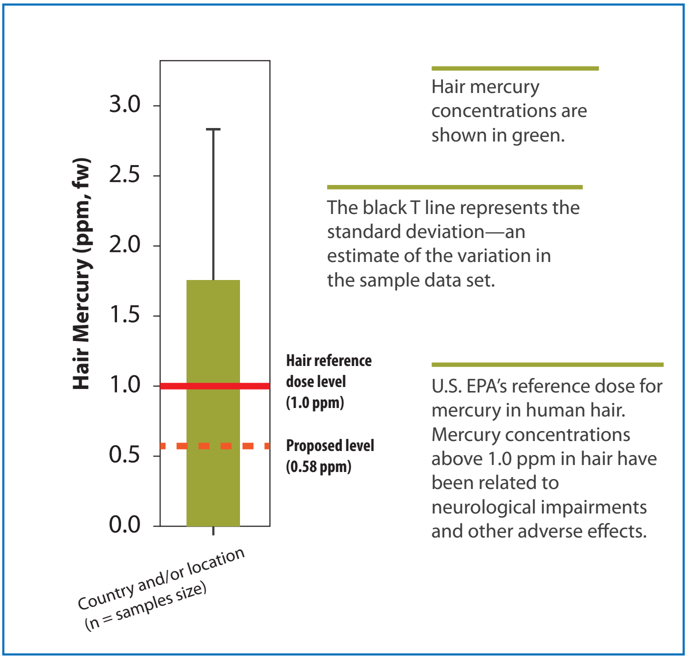
"THE DATA INDICATES THAT THERE IS A SERIOUS AND SUBSTANTIAL THREAT TO WOMEN'S AND CHILDREN'S HEALTH FROM MERCURY EXPOSURE."

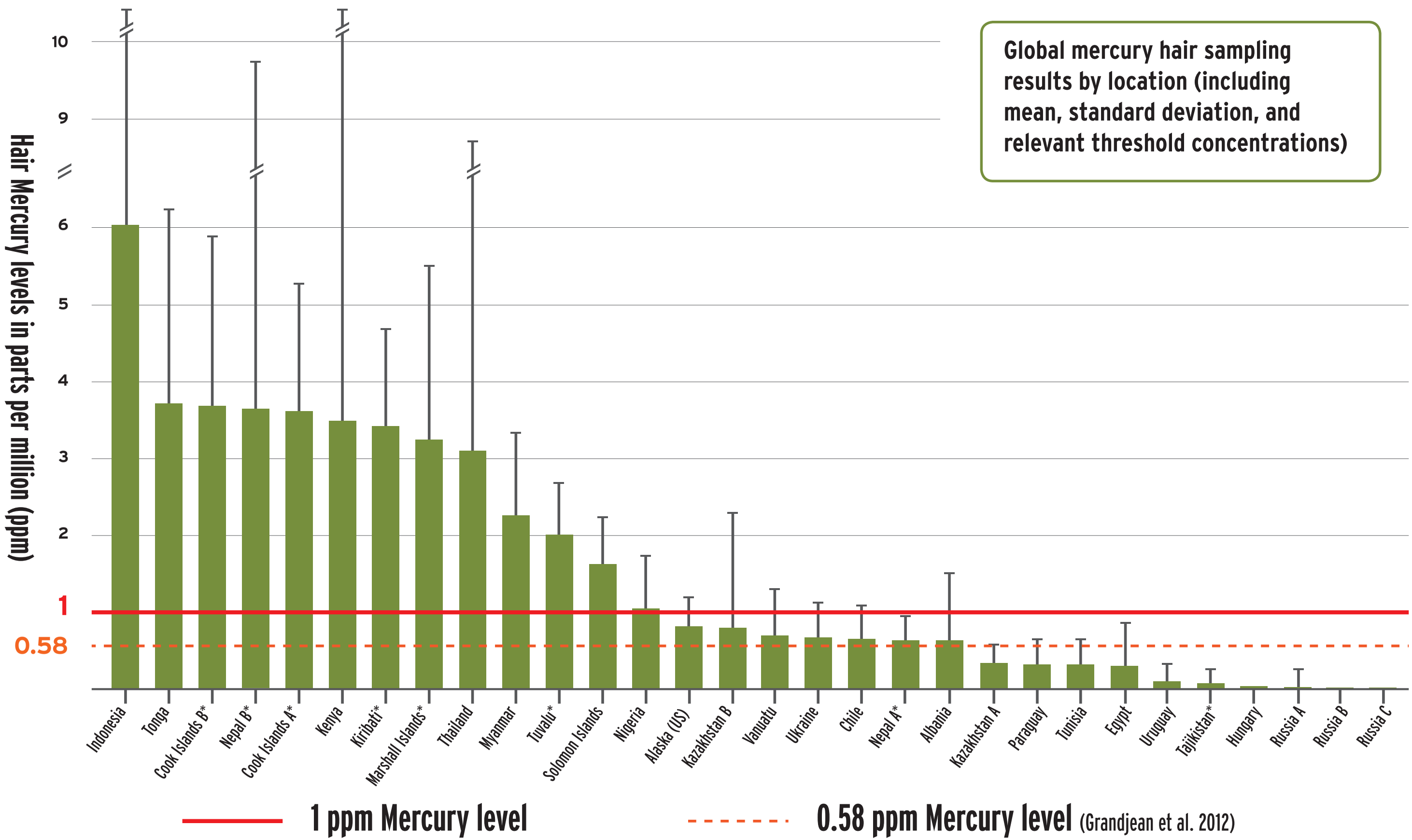
Indonesia, mother and child in mining community. Larry C. Price, Pulitzer Centre on Crisis Reporting

METHODOLOGY

Sampling was undertaken across the globe during 2015 and 2016 by public interest Participating Organisations (POs) of IPEN – a global network operating in more than 100 countries. IPEN POs reached out to communities in areas with known mercury contamination hotspots as well as areas that may be susceptible to mercury contamination of food supplies such as fish, which can transfer their methylmercury body burden to humans when consumed. The study resulted in samples being taken from 1044 women in 37 locations across 25 countries. The methodology for the study required IPEN POs to identify groups of 30-35 women of child-bearing age (denoted as 18 – 44 years old) in one or two locations in each country. The women provided signed consent to participate in the study. Participants were required to provide a small sample of hair and to complete a questionnaire to assist with contextual analysis. The samples of hair were shipped to the laboratories of BRI in the United States for analysis.

Interpreting the hair mercury concentration chart.





* Data source: Bell, L., (2017) Mercury Monitoring in Women of Child-Bearing Age in the Asia and the Pacific Region. A joint study by UN Environment, Biodiversity Research Institute and IPEN. April 2017.

Baby and children with birth defects in gold mining communities in Indonesia. (Left) Larry C. Price/Pulitzer Centre on Crisis Reporting; (Right) BaliFokus, Indonesia

Women in this age range were selected as they constitute part of the vulnerable sub-population groups at risk from mercury, a powerful neurotoxin that can affect both the health of the mother and impact on a range of developmental endpoints in the developing fetus with lifelong consequences.[1] Sample results were assessed against the internationally recognised reference level of 1 ppm total mercury (THg), above which health effects to the developing fetus of pregnant mothers may occur.

The basis for the use of this reference level in this study is that it corresponds closely with the U.S. EPA's reference dose (RfD) of 0.1 µg/kg bw/day and a blood mercury concentration of 4-5 µg/L.[2] For some time, the scientific literature has suggested that adverse effects on the sampled individual begin to occur at[3] or above the reference level of 1 ppm.[4] However, the latest scientific literature concludes that negative developmental effects may occur at even lower levels[5] and that a threshold level of 0.58

1 Bose-O'Reilly, S., et al (2010) Mercury exposure and children's health. Curr Probl Pediatr Adolesc Health Care, 2010 Sep; 40(8):186-215.

2 US EPA (1997) Mercury study report to Congress, Volume IV, An assessment of exposure to mercury in the United States, EPA-452/R-97-006

3 Trasande L, Landrigan PJ, Schecter C (2005) Public health and economic consequences of Methyl Mercury Toxicity to the Developing Brain, Environ Health Perspect 113:590-596

4 Grandjean P, Weise P, White RF, Debes F, Araki S, Yokoyama K, Murata K, Sorensen N, Dahl R, Jorgensen PJ (1997) Cognitive deficit in 7-year-old children with prenatal exposure to methylmercury. Neurotoxicol Teratol
19:417-428

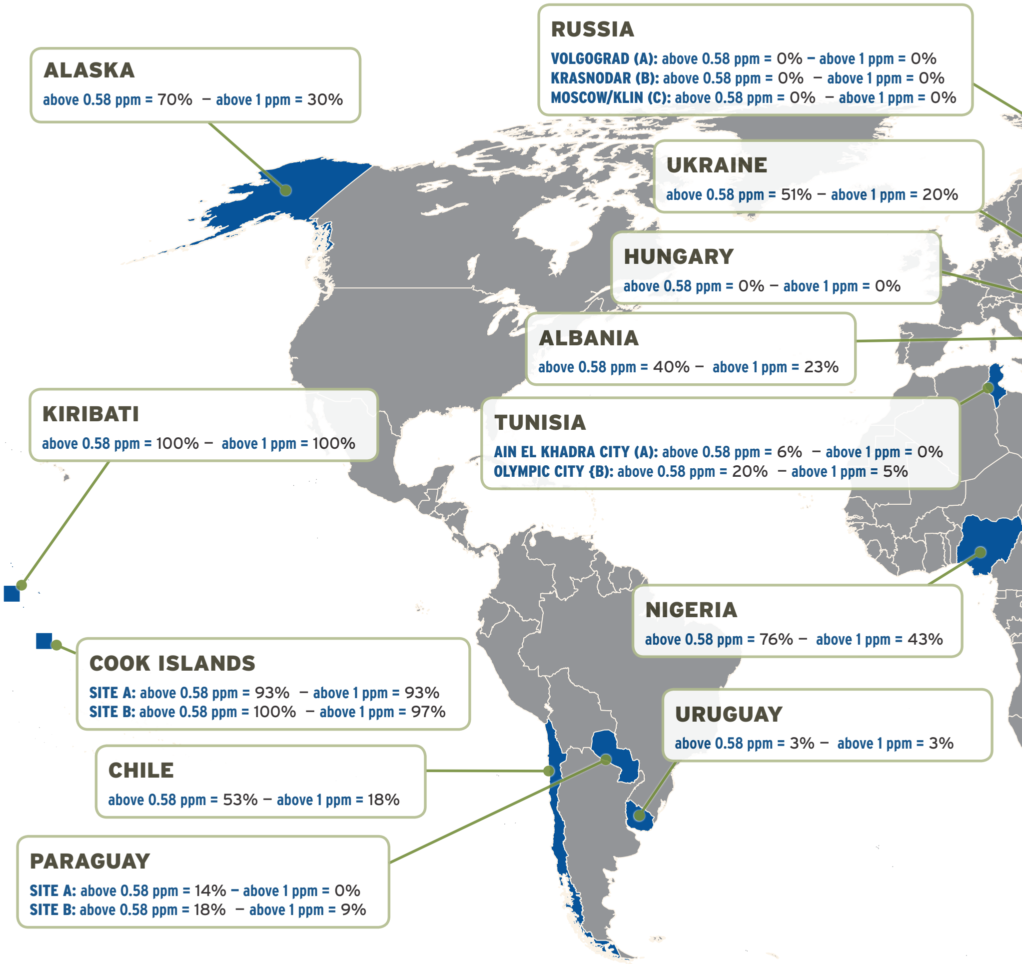
5 Murata K, Weihe P, Budtz-Jorgensen E, Jorgensen PJ, Grandjean P. (2004) Delayed brainstem auditory evoked potential latencies in 14-year-old children exposed to methylmercury. J Pediatr 144(2):177-183

ppm should be adopted as the level below which impacts on the developing fetus are negligible.[6] For the purposes of this study we used the accepted threshold of 1 ppm to assess elevated mercury levels in participants. However, where appropriate we have also included references to the latest science-based threshold concentration of 0.58 ppm for comparison.

Woman and daughter gold mining in Africa. Larry C. Price, Pulitzer Centre on Crisis Reporting

6 Grandjean P, Pichery C, Bellanger M, Budtz-Jørgensen E (2012) Calculation of Mercury's effect on Neurodevelopment. Environ Health Perspect. 2012 December; 120(12)

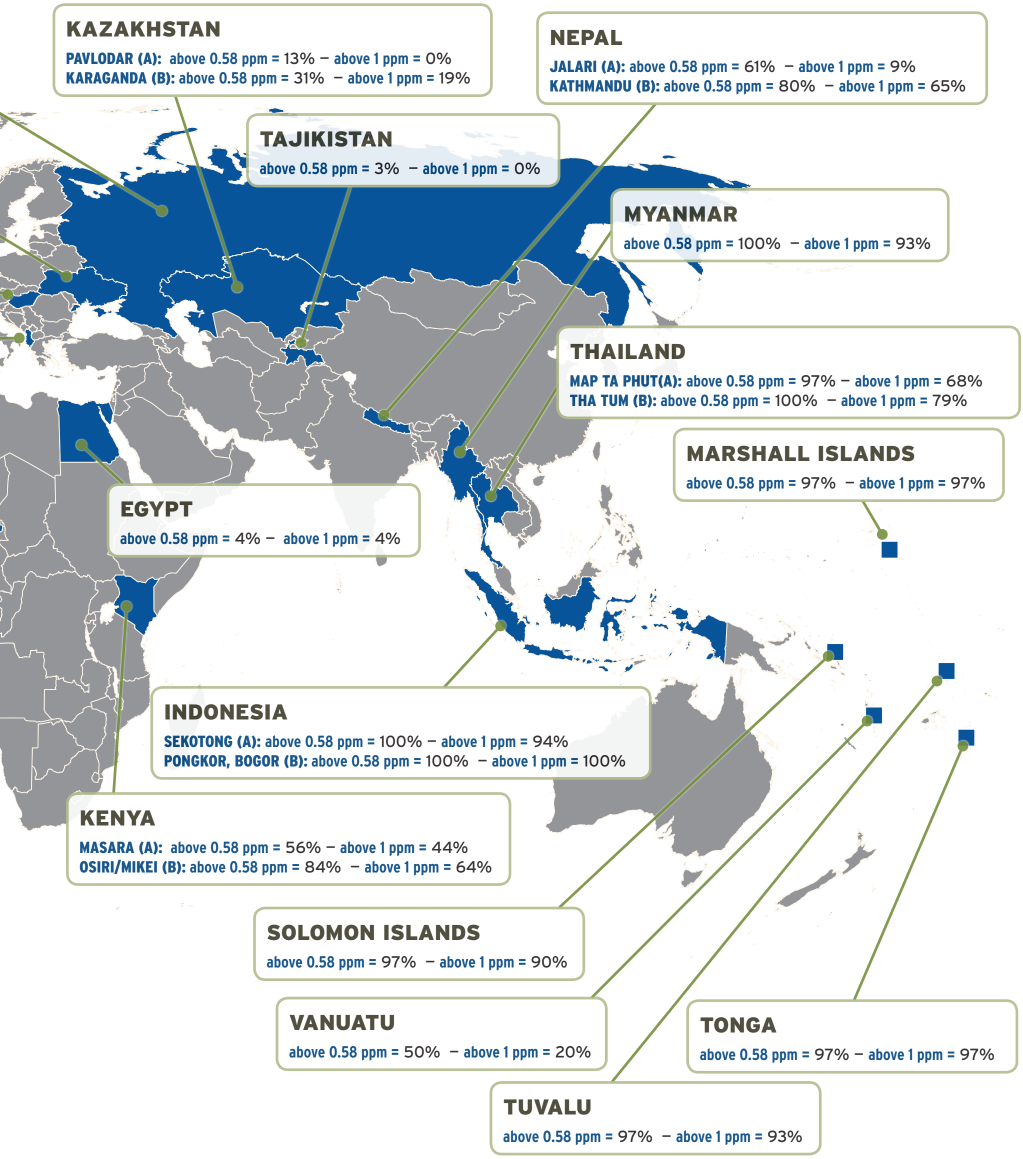
MERCURY IN WOMEN OF
RESULTS FROM COMMUNITIES



Mercury levels above 1 ppm can be linked to brain damage, IQ loss, and kidney and heart damage. Fetal neurological damage can begin at mercury levels greater than 0.58 ppm.

(US EPA reference dose for mercury in human hair is equivalent to 1ppm.)

CHILD-BEARING AGE ACROSS THE GLOBE



IPEN
a toxics-free future

Woman mining with child on her back.

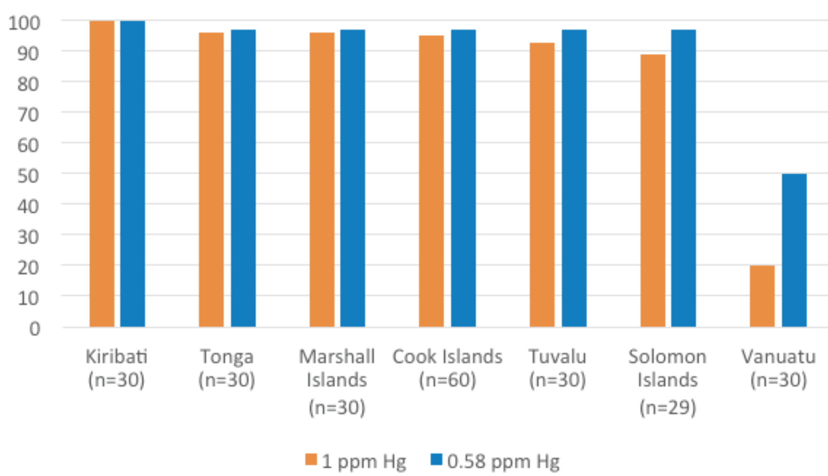
KEY FINDINGS

Mercury pollution poses a serious and substantial threat to the health of women and the developing fetus in many parts of the world. Of the 1044 women who participated in this study, 42% had a mercury body burden that exceeded the reference level of 1 ppm total mercury in hair. Locations where the mean (average) level for the group of women exceeded the 1 ppm reference level for mercury were the Cook Islands, Indonesia, Kenya, Kiribati, Marshall Islands, Myanmar, Nepal (location A), Nigeria, Solomon Islands, Thailand, Tonga, and Tuvalu. A second tier of women from Alaska, Albania, Chile, Kazakhstan (location B), Ukraine, and Vanuatu exceeded the 0.58 ppm mercury level as the mean for the group.[7]

The analysis suggests three specific factors resulted in elevated levels of mercury in mothers and potential mothers across different countries and continents: a fish-rich diet; the practice of artisanal and small-scale gold mining (ASGM); and proximity to industrial locations.

The data from the Pacific Islands illustrates the impact of a fish-rich diet. Women from Small Island Developing States (SIDS) in the Pacific were

Percentage of Pacific Islander hair samples exceeding the 1 ppm reference level and the 0.58ppm level.



7 Grandjean, P., et al (2010) Adverse Effects of Methylmercury: Environmental Health Research Implications. Environmental Health Perspectives, Vol 118. No.8. August 2010, 1137-1145

found to have very high levels of mercury body burden compared to most other locations except those engaged in ASGM. Of the 239 participants located in Pacific Island States, 209 (86%) exceeded the 1 ppm mercury threshold level. In Cook Islands, Kiribati, Marshall Islands, Tonga, and Tuvalu, 90% or more of each group exceeded 1 ppm mercury in hair. For Kiribati, 100% of women sampled exceeded the 1 ppm threshold level.

The high mercury levels in Pacific Island women are consistent with data from the study questionnaires and prior studies indicating that most of these women have a diet rich in seafood. Large predatory fish that feature in the diet of women in the Pacific SIDS are commonly cited in the literature[8] as having high methylmercury (MeHg) concentrations in their flesh. The absence of local industries with mercury emissions in the Pacific Islands and the remote distribution of the islands indicate mercury contamination of seafood as the primary factor in the elevated mercury body burden of these women. This points to a serious food chain contamination problem caused by global mercury deposition from industrial emissions to oceans. Subsequent bacterial methylation of mercury in oceans results in its magnification through the food chain, impacting on women reliant on fish as dietary protein such as Pacific Islanders.

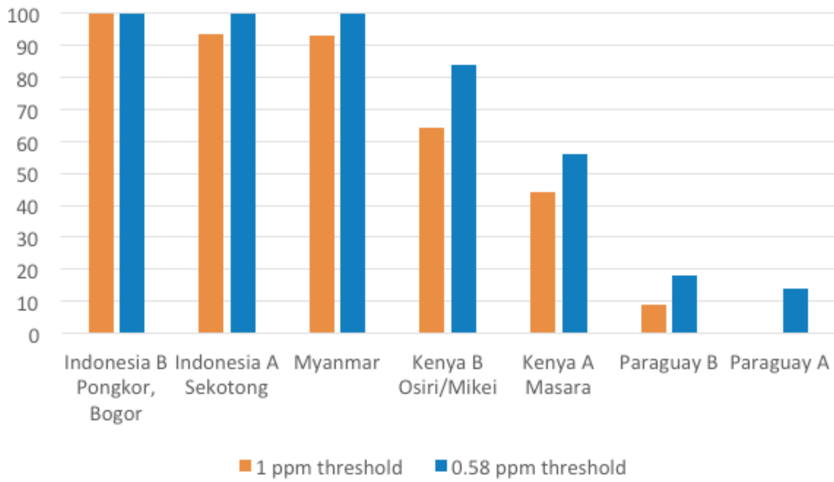
"OF THE 1044 WOMEN WHO PARTICIPATED IN THIS STUDY 42% HAD MERCURY BODY BURDENS WHICH EXCEEDED THE REFERENCE LEVEL OF 1 PPM TOTAL MERCURY IN HAIR."

The results from this study strongly suggest that the practice of artisanal and small-scale gold mining (ASGM) using mercury leads to elevated mercury levels for women engaged in this activity. In ASGM, elemental mercury is often used to amalgamate gold dust obtained by low technology mining (e.g. panning, sluicing and ball milling). The gold and mercury amalgam is 'roasted', often in domestic settings, to vaporise the mercury, leaving a small amount of gold. This leads to direct mercury exposure through handling and fume inhalation. Sampling results from women directly engaged in ASGM, or who had family members practicing

"IN COOK ISLANDS, KIRIBATI, MARSHALL ISLANDS, TONGA, AND TUVALU, 90% OR MORE OF EACH GROUP EXCEEDED 1 PPM MERCURY IN HAIR."

8 Silbernagle, et al, (2011) Recognizing and Preventing overexposure to Methylmercury from Fish and Seafood Consumption: Information for Physicians. J Toxicology 2011;2011 983072

Percentage of small-scale gold mining related hair samples exceeding the reference level of 1ppm and the 0.58 ppm level.



ASGM with mercury in Indonesia, Kenya, and Myanmar, show significantly elevated mercury levels in their hair. In Indonesia, 100% of women sampled exceeded the 1 ppm threshold level. In Kenya and Myanmar, the percentage of women exceeding the 1 ppm threshold level was 44% – 93% respectively. When compared to the 0.58 ppm threshold level, the percentage rose to 71% and 100% respectively.

Proximity to heavily industrialised areas or those areas with hotspots caused by historical industrial activities also led to high mercury body burden levels. This occurred in Thailand, where two locations featured

Gold plating worker mixes and burns off mercury-gold amalgam. (CEPHED, Nepal)

In many parts of the world babies and young children remain close to mothers throughout the day. Here women use mercury in an ASGM site in Kenya. (CEJAD, Kenya)

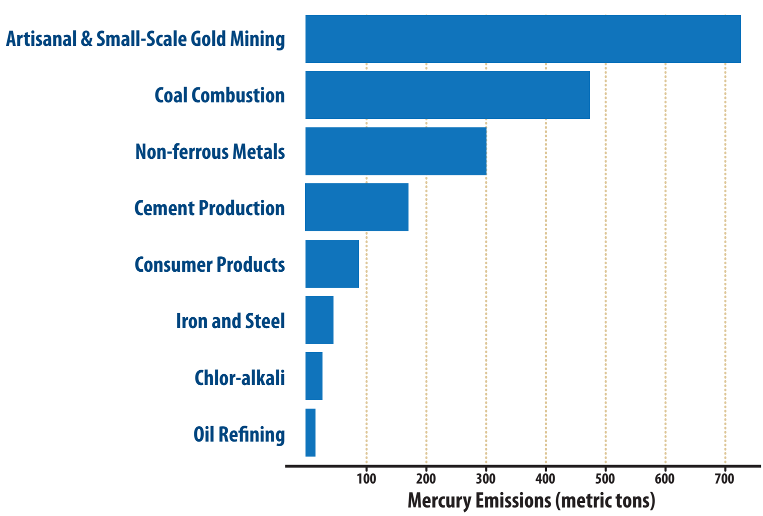
mixed heavy industry facilities with known mercury releases adjoining waterways from which local people consumed fish. The percentage of women exceeding the 1 ppm threshold level in the two Thai locations ranged from 68% - 79%. When compared to the 0.58 ppm reference level, the percentage rose to 97% and 100% respectively for the two locations. The elevated mercury levels reported by these women were comparable with those of women from most of the Pacific Islands where sampling took place.

CONCLUSION

The data indicates that there is a serious and substantial threat to the health of women and the developing fetus in many parts of the world as a result of mercury pollution. Reducing or eliminating atmospheric mercury pollution and deposition to oceans from coal fired power plants and other industrial sources should be a priority for the international community. In addition, urgent action must be taken to reduce and eliminate mercury exposure of women involved in ASGM activity. An outright ban on mercury use in ASGM and the trade in mercury associated with it would have the most immediate beneficial health impacts for women.

The Minamata Convention on Mercury represents a global consensus that mercury pollution poses a serious threat to human health. However, the time frame for action in the Convention and the multiple exemptions for mercury use will limit its effectiveness in the medium term. National governments should take matters into their own hands by banning the import and export of mercury and introducing tough measures to eliminate domestic sources of mercury pollution as soon as possible. Hotspot contamination from industrial sources such as those in Thailand must be much more strictly controlled and mercury emissions heavily restricted or, preferably, eliminated, to protect the women and children in those localities.

Global sources of mercury emissions to air. (UNEP, 2010)



An immediate step that should be taken to reduce impacts of mercury pollution in all the locations studied is to intensify and expand monitoring of women's body burden and food sources (especially fish and marine mammals). This should lead to locally relevant food advisories that should be rapidly developed to inform women of the safest types of fish and marine mammals to consume where alternative protein sources are unavailable. In the absence of urgent action, generations of women and their offspring will bear the brunt of mercury contamination, while others will profit from ongoing mercury pollution.

ABSTRACT

MERCURY IN WOMEN OF CHILD-BEARING AGE IN 25 COUNTRIES

Background and Objectives: Mercury is a potent neurotoxin and harms the kidneys and cardiovascular system. Recognition of mercury's health impacts and its designation as a global pollutant led to the Minamata Convention on Mercury, which became international law in August 2017. While researchers have studied mercury body burden in specific regions of the world, information in developing and transition countries is lacking – particularly in women. Mercury body burdens in women are important because mercury can harm both women and the developing fetus even months after the mother's exposure, causing brain damage, developmental disabilities, blindness, seizures and the inability to speak. This is the most far-reaching study of mercury in women to date, with 1044 women participants of child-bearing age in 37 locations across 25 countries on six continents.

Methodology: Hair samples and questionnaires were taken from 1044 of women of child-bearing age (18 – 44 years old) in 37 locations in 25 countries. The samples were analyzed in the laboratories of the Biodiversity Research Institute (BRI) in the US. Results were compared with the internationally recognized reference level of 1 ppm total mercury (THg), above which health effects on the developing fetus of pregnant mothers may occur. Samples were also compared with a level of 0.58 ppm mercury, a more recent, science-based threshold based on data indicating harmful effects at even lower levels of exposure.

Key Findings: High levels of mercury were found in women of child-bearing age. Of the 1044 women who participated in this study, 42% had mercury body burdens that exceeded the reference level of 1 ppm total mercury in hair. Women from the Cook Islands, Indonesia, Kenya, Kiribati, Marshall Islands, Myanmar, Nepal (location A), Nigeria, Solomon Islands, Thailand, Tonga, and Tuvalu exceeded the 1 ppm level as a group average. A second tier of women from Alaska, Albania, Chile, Kazakhstan (location B), Ukraine, and Vanuatu exceeded the 0.58 ppm mercury level as a group average. Altogether, women from 18 countries exceeded the 0.58 ppm

mercury level as a group average. In total, 55% of the 1044 women who provided samples exceeded the 0.58 ppm level.

Conclusion: Mercury pollution poses a serious and substantial threat to the health of women and the developing fetus in many parts of the world. This study showed high mercury levels in women of child-bearing age from six continents. The analysis suggests three specific factors resulted in elevated levels of mercury: a fish-rich diet; the practice of artisanal and small-scale gold mining (ASGM); and proximity to industrial locations. An immediate step that should be taken to reduce impacts of mercury pollution in all of the locations studied is to intensify and expand monitoring of women's body burden and food sources (especially fish and marine mammals). In addition, locally relevant food advisories should be rapidly developed to inform women of the safest types of fish and marine mammals to consume where alternative protein sources are unavailable. In the absence of urgent action, generations of women and their offspring will bear the brunt of mercury contamination, while others will profit from ongoing mercury pollution. The Minamata Convention on Mercury represents a global consensus that mercury pollution poses a serious threat to human health. However, the time-frame for action in the Convention and the multiple exemptions for mercury use will limit its effectiveness in the medium term. National governments should take matters into their own hands by banning the import and export of mercury and introducing tough measures to eliminate domestic sources of mercury pollution as soon as possible.

DOWNLOAD THE FULL REPORT

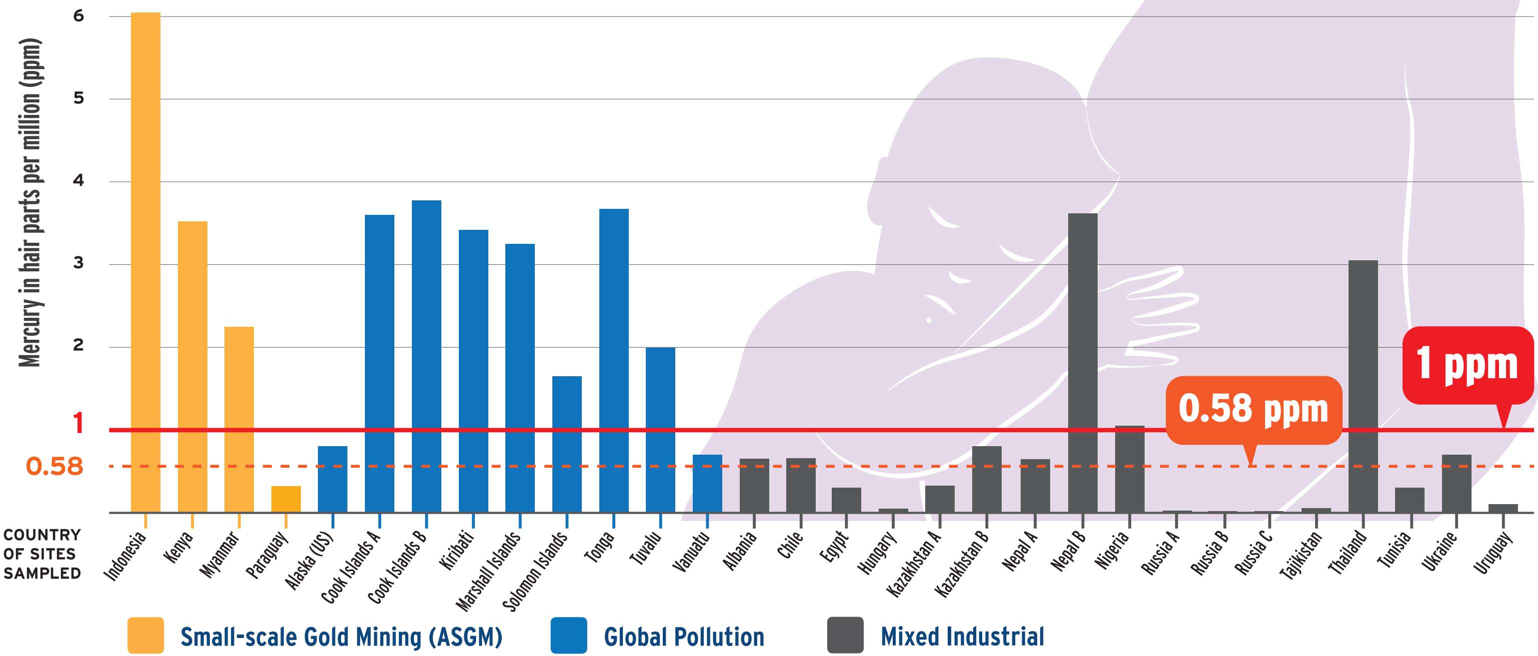
MERCURY IN WOMEN OF CHILD-BEARING AGE IN 25 COUNTRIES

http://ipen.org/mercury-and-women

RESULTS BY MERCURY POLLUTION SOURCE

Mercury levels above 1 ppm can be linked to brain damage, IQ loss, and kidney and heart damage. Fetal neurological damage can begin at mercury levels greater than 0.58 ppm.

(US EPA reference dose for mercury in human hair is equivalent to 1ppm.)



ACKNOWLEDGEMENTS

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- Island Sustainability Alliance Cook Islands Inc. (ISACI), Cook Islands;
- Centre for Public Health and Environmental Development (CEPHED), Nepal;
- Foundation to Support Civil Initiatives (FSCI) Dastgirie-Center, Tajikistan;
- Centre for Environmental Justice and Development (CEJAD), Kenya;
- Sustainable Research and Action for Environmental Development (SRAdev), Nigeria;
- Observatorio Latinoamericano de Conflictos Ambientales (OLCA), Chile;
- La Red de Acción en Plaguicidas y sus Alternativas para América Latina (RAPAL), Uruguay;
- Alter Vida, Paraguay;
- The Environmental Development, Education and Networking Center (EDEN), Albania;
- Ecomuseum, Karaganda, Kazakhstan;
- Public Association EKOM, Kazakhstan;
- Szubjektiv Értékek Alapítvány (Subjective Values Foundation), Hungary;
- Kenana NGO for Sustainable Development, Egypt;
- Association d'Education Environnementale pour la Future Génération (AEEFG), Tunisia;
- Dawei Development Association (DDA), Myanmar;
- Alaska Community Action on Toxics (ACAT), USA;
- BaliFokus, Indonesia;
- Ecological Alert and Recovery Thailand (EARTH), Thailand;
- NGO Rozbudova, Ukraine; and
- Volgograd-Ecopress Information Centre, Russia.

IPEN would also like to acknowledge the contributions from Biodiversity Research Institute (BRI), for assisting in developing the methodology and protocols, and thereafter organizing the international shipments of materials and samples and conducting sample analysis.

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For the full text of *Mercury in Women of Child-Bearing Age in 25 Countries*, please visit

http://ipen.org/mercury-and-women

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ANNEX 2: METHODOLOGY AND QUESTIONNAIRE

PROJECT: MERCURY MONITORING IN WOMEN OF CHILD-BEARING AGE IN THE ASIA AND THE PACIFIC REGION

Overview

IPEN's methodology for the "Minamata Convention COP1 Delegates Mercury Hair Monitoring" study takes into account scientifically sound and acknowledged human hair monitoring protocols and IPEN's previous monitoring studies of mercury in human hair (Evers et al. 2014). The methodology covers sampling method, collection of data, and mercury measurements, as well as assessment and evaluation of the results. IPEN and BRI have applied a similar methodology to the UNEP-IPEN-BRI Asia Pacific Study.[17]

IPEN is collaborating with the Biodiversity Research Institute (BRI) in the design and implementation of this study. BRI is a non-profit ecological research group with more than 25 years of experience assessing emerging threats to wildlife and ecosystems and is a leader in ecological research related to mercury toxicology.

This study will rely on IPEN's broad network of collaborating organizations across the globe, to inquire with Delegates at the Minamata Convention COP1 meeting if they wish to participate in the study. Hair samples will be shipped to BRI and analyzed in BRI's Wildlife Mercury Laboratory in Portland, Maine, USA. BRI will provide the results, including the raw data, as well as their interpretation, in a summary report to IPEN for distribution to all relevant participants and further use in the study.

The methods for sample collection, participant surveys, sample analysis, and data interpretation rely on previous work conducted by IPEN and BRI. All participant forms and survey materials have previously been approved by an Institutional Review Board (IRB) for Human Subjects through the University of Southern Maine (USM), Portland, Maine, USA, and incorporate techniques and approaches for engaging with participants used by national and international agencies. An updated IRB at

17 **http://ipen.org/Mercury-Monitoring-in-Women**

USM has been approved with laboratory methods following U.S. Environmental Protection Agency (EPA) standards. Information on mercury concentrations in individual hair samples will be returned to the relevant participants. Along with this, participants will be provided, in an accessible manner, detailed information to assist with interpretation of mercury concentrations in hair.

The methodology for this study draws upon the experience of past IPEN/BRI monitoring projects and has been refined further to ensure the generation of scientifically robust data that can contribute to the global mercury monitoring efforts of the UNEP Global Mercury Partnership, and meets the international scientific standards related to mercury monitoring (UNEP/WHO 2008).

This is considered a screening study with the aim to promote global mercury monitoring efforts of humans, fish, and the environment as implementation of the Minamata Convention on Mercury moves forward.

Hair Sampling Methodology (Protocols)

Annex A-D, enclosed, will be applied by the IPEN expert technician who is collecting hair samples, to ensure that the process of participant selection, surveying and sampling protocols will remain consistent and that the data generated will be scientifically sound.

Prior to sample collection, each participant will be required to complete a standardized questionnaire to record information relevant to the sampling program. The information recorded as part of the questionnaire will be attributed to an anonymous participant or used in an aggregated manner. A code number referred to as a 'sample label' will link the participants, their questionnaire and the sample taken to assist with contextual feedback to the participants on their recorded personal mercury levels following the analysis of samples and, if necessary, measures to reduce mercury exposure.

The sampling protocol will ensure that samples are taken in a safe and clean manner with particular attention to steps that will prevent any potential contamination of the sample from other personnel or sampling equipment. The target sample volume is one bundle of hair sample from each relevant participant.

Collection of Data (Protocols)

Participant Selection

All Minamata Convention COP1 delegates are invited to provide samples.

The right of confidentiality is granted to each individual participant unless she voluntarily waives it through written communication. For the purposes of this project data will be presented in an aggregated analysis that does not enable identification of individual participants. Once individual participant sample data is generated and communicated back to the participant, that individual has the right to release that information if she chooses to do so. This is consistent with an individual's right to know about their personal health information and disclose it if they wish to.

Mercury Measurements

Total mercury in hair will be analyzed at BRI's Wildlife Mercury Research Laboratory following EPA method 7473 by gold-amalgamation atomic absorption spectroscopy following thermal desorption of the sample using a Milestone DMA-80. A blank and two calibration standards (DORM-3 and DOLT-4) are used in each of the two detector cells. Instrument responses are evaluated immediately following calibration, and thereafter, following every 20 samples and at the end of each analytical run by running two certified reference materials and a check blank. Instrument detection limit is approximately 0.050 ng. An acetone wash of the hair samples followed by a rinse with milli-Q water can be used to remove external contamination, such as hair products. BRI has analyzed over one thousand fur/hair samples since 2008 and has published the results in scientific, peer-reviewed papers and BRI reports (e.g., to the Mexican government; Rinker et al. 2013).

Laboratory Selection

IPEN has identified BRI as the laboratory that will be used for the analysis and assessment of hair samples for mercury. BRI operates two laboratories, each outfitted with a Direct Mercury Analyzer (DMA). One laboratory maintains a BioSafety Level 2 status that permits tissue samples collected from areas outside the United States to be accepted without special treatment. BRI's Wildlife Mercury Laboratory analyzes thousands of samples annually, including egg, muscle, blood, feathers, fur, and human hair. As mentioned above, BRI follows laboratory methods approved by the U.S. EPA.

Note: IPEN has determined that BRI represents the most cost-effective option in terms of laboratory analysis for mercury samples for a study with limited resources.

Assessment

The interpretation of sample results will be based on the comparison of data generated from the field samples with the U.S. EPA's reference dose for mercury in human hair (U.S. EPA 2001). Mercury concentrations above 1.0 ppm in hair have been related to neurological impairments in adults (Yokoo et al. 2003; Karagas et al. 2012).

A secondary threshold level of 0.58 ppm may also be used for comparison as it relates to recent developments in mercury exposure science that is relevant to women of child-bearing age in terms of potential impacts on the fetus should they be considering having children. This threshold is the level above which studies have determined that neurological impairment of the fetus can begin (Grandjean et al 2012).

These data will help determine contaminant concentrations in participating delegates. Data obtained from the questionnaires will be used in the report that will be prepared as part of the study. Because there is not a parallel analyses of fish mercury concentrations in this survey, only categorical inferences will be made when comparing hair mercury concentrations and the foods that they eat. The results may include graphic representation of the information (graphs, charts, etc.) in the final public report.

The combination of all the data generated in this project will contribute to developing data and information in participating countries, elevating public knowledge about the threats of global mercury pollution, and contributing to knowledge of mercury levels internationally.

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Data presentation

Following measurement, analysis and interpretation of the data, IPEN, in collaboration with BRI, will develop a report. The release of the report will be accompanied by robust media engagement and presentation of the data at appropriate international forums including but not limited to the Third United Nations Environment Assembly (UNEA3) in Nairobi, Kenya.

ANNEX A. HAIR SAMPLING METHOD (PROTOCOLS)

EQUIPMENT NEEDED FOR SAMPLING HAIR

Materials needed are summarized in the table below.

HUMAN HAIR SAMPLING KIT

ITEM	PURPOSE
Stainless-steel scissors	Cutting hair
Self-adhesive label or tape that can be written on	Labelling and securing the hair sample
Small Ziploc bag	Storing the hair sample after collection
Hair Sample Log	To be completed after collection of samples to serve as an inventory for the BRI Lab
IPEN Hair Sampling Consent Form & Questionnaire	To be filled out for each individual sample collected
Nitrile examination gloves	To be worn during sample handling. Wear a fresh pair of gloves for each sample when possible.
Permanent marker & ballpoint pen	Labelling sample bags and data sheets
Alcohol wipes	For cleaning scissors before and after each sample is collected

HUMAN HAIR SAMPLE COLLECTION

Standard protocols for the collection of human hair samples are below. It is important that all steps are followed carefully to ensure the data collected is of the highest quality. For each sample, the consent form must be signed, and the questionnaire provided at Annex E must be completed by the sample subject before taking the samples.

- Ensure the Consent Form is signed (see Annex C).
- Complete the provided Questionnaire (see Annex D).

- The collector should wear a new pair of nitrile examination gloves when collecting and handling each sample.
- Use an alcohol wipe to clean the cutting surfaces of the stainless steel scissors.
- Grasp a bundle of hair approximately the diameter of a pencil eraser (approximately 30 strands of hair) in the occipital region of the head (i.e., near the nape of the neck). An adjacent area may be used if hair length is limited. See Figure 1 below.

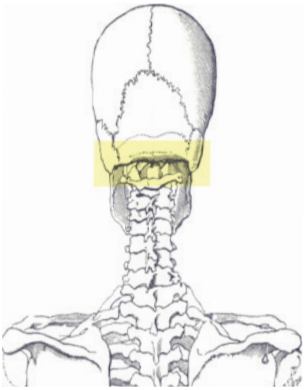

Figure 1. Occipital Region: Target sample area

- Cut the bundle of hair as close to the scalp as possible
- Secure the hair sample with a small self-adhesive label using an arrow to indicate the direction of the scalp.

Figure 2. Correct labelling and storage of sample

- Please leave 3-4 cm of hair exposed from the label. The hair closest to the scalp will be analyzed for mercury. If it is not possible to leave 3-4 cm of hair, leave as much hair as possible.
- If hair is shorter than 2 cm, please do not use a label. Just place the short hair in the Ziplock bag.

SAMPLE LABELING FORMAT

The "***Minamata Convention COP1 Delegates Mercury Hair Monitoring***" study will be analyzing scores of human hair samples from several countries. It will be very important that all sample labels are written legibly and clearly. In addition, it is imperative that all samples have a unique sample label ID.

When labeling each human hair sample, please use the following convention:

Record "MIN" code, followed by the word "HAIR", and the two-digit, sequential number of the sample (from 01 to 99). Below the label, please record the date the sample was collected, using the format of **dd-MM-yyyy**. As an example, the first sample collected on September 24, 2017, would be labeled as follows:

MIN-HAIR-01
24-SEP-2017

NOTE: the Sample Label will also serve as the participant identification.

SAMPLE DATA SHEET

Following sample collection, IPEN/Arnika will complete the Hair Sample Data Sheet (Annex C) and include it with the shipment of hair to BRI. This data sheet will provide BRI with an accurate inventory of samples included in the shipment. An electronic copy of our records will be retained in case it gets lost in transit.

INTERVIEWING SAMPLE DONORS

Each sample donor will have to fill out a questionnaire (Annex E). This will be done as an interview of the donor by IPEN/Arnika staff or by having the donor fill out the questionnaire.

PARTICIPANT INFORMATION

IMPORTANT: Prior to shipping human hair samples to BRI, IPEN/Arnika will record sample donors' names and their corresponding sample labels and securely retain this document. This way the results will be sent back to each individual participant upon completion of analysis. Mercury values will be listed with their corresponding sample label.

HAIR SAMPLE SHIPMENT

All samples will be shipped directly to the Biodiversity Research Institute's Wildlife Mercury Lab by IPEN/Arnika Association using DHL. The human hair samples and the Sample Data Sheet will be shipped to BRI as a package. IPEN/Arnika will retain an electronic copy of all documents by scanning hard copies and saving them or directly entering data in electronic form during the sampling activity. Hair samples will be stored at ambient temperature until shipment.

Figure 3. Example of a DHL envelope

ANNEX B. HAIR SAMPLE DATA SHEET

Below is an example of the data sheet to be used for the human hair sampling. This completed form will be included in the package containing the human hair samples to BRI.

Minamata Convention COP1 Delegates Mercury Hair Monitoring September 2017		
NGO/IPEN/Arnika name/contact:		
Date	**Sample label**	**Location of Residence**

ANNEX C. CONSENT FORM

Sample Label #____________________

IPEN Hair Sampling

Consent Form

Survey Overview

The primary goal of the IPEN-BRI "**Minamata Convention COP1 Delegates Mercury Hair Monitoring**" study will be to generate new data, and raise awareness about global mercury pollution. The mercury monitoring information generated will include sampling results from biomonitoring (via hair sampling) of delegates, in order to improve knowledge about their mercury exposure while also elevating public knowledge about the threats of global mercury pollution.

Hair samples will be collected by IPEN/Arnika and examined by an internationally certified laboratory to indicate the level of mercury detected in the individuals sampled. Results will be anonymous and included in outreach and education about mercury in the environment. **Names of participants in this analysis will never be used publicly unless agreed to by the participants.**

IPEN is a global network with more than 700 public interest NGO Participating Organizations in over 100 countries. Its 8 Regional Hubs operate in the African, Asian, Arab, Eastern European/Caucasus/Central Asian and Latin American regions and in all 6 UN languages (www.ipen.org).

Page 1 of 2

Voluntary Participation

Individuals are free to decline participation in this study or withdraw from participation at any point. In addition, participants in this study do not forfeit any legal rights by signing this informed consent form.

Consent

I have read this consent document and understand the nature of this assessment and procedures for hair sampling. I understand that my participation in this study is voluntary and agree to allow the analysis of my hair sample to be included in this study. I agree to complete this *Mercury Hair Sampling Survey* and, if asked, agree to a follow-up interview to discuss my results.

_______________________________ ________________

Participant's Name (Print) Date

____

Signature

Confidentiality

The results from this hair sampling will be compiled and included as data in a report on mercury exposure and contamination in COP 1 delegates. ***The right of confidentiality is granted to each individual participant unless she voluntarily waives it.***

I, ___________________________(print), voluntarily waive my right to keep the results of this test confidential.

Signed: ____________________________Date:___________

I understand that by waiving my confidentiality, I am allowing the results of my sample to be discussed in publications, press, or other educational means by IPEN **but that my name will never be used unless I agree to it.**

Page 2 of 2

ANNEX D. QUESTIONNAIRE FORM FOR SAMPLING OF MERCURY IN HAIR

The results from this test will be compiled and included as data in a report on mercury exposure and contamination in humans, for raising awareness of mercury body burden in the people. **The right of confidentiality is granted to each individual participant unless she voluntarily waives it.**

Consent: Each participant is providing hair samples and responses to the questionnaire at their free will. The participant must sign the consent form to indicate their consent and provide this and the completed questionnaire to the individual collecting the sample prior to sample collection.

Privacy & Anonymous Samples: Each participant will receive a sample label, to be utilized in collecting results and to conceal their names.

1. Date:	
2. Participant ID Code= Sample Label:	
3. Country:	
4. Gender:	Female ( ) Male ( )
5. Age:	
6. Do you want to be contacted by email or post mail to know your personal mercury burden? NOTE: Participants that wish to provide anonymous hair samples can collect results by emailing (hghair@ipen.org), providing their Participant ID Code and set password.	Yes ( ) No ( ) Email Address: Postal address in case an e-mail address is not available:

7. Do you eat fish? If not, skip to question 14.	Yes ( ) No ( )
8. If you eat fish, what are the one or two kinds that you eat most often?	
9. How often in one week do you eat _______ (first fish species name indicated in response to question 8 above)?	
10. How often in one week do you eat _______ (second fish species name indicated in response to question 8 above)?	
11. Approximately how many meals of fish are you eating every week?	
12. Have you eaten fish during the last 14 days? If so, approximately how many fish meals and what were the average amounts?	Yes ( ) No ( )
13. What species of fish have you eaten during the last 14 days?	
14. Do you avoid or limit your fish consumption because of concerns for mercury?	Yes ( ) No ( )
15. Do you think you will take measures to reduce your mercury exposure after participating in this survey?	Yes ( ) No ( ) I already take measures ( )
16. What is your occupation?	
17. Does you occupation involve exposure to mercury?	
Note: There is more than one type of mercury, organic and inorganic. Sampling hair for mercury illustrates organic mercury in the body. However, you may be exposed to inorganic mercury by sources like dental amalgam filling ("silver fillings"), skin cream or by occupation.	

18. Are you aware of the different ways you can be exposed to mercury?	Yes ( ) No ( ) If yes, please specify if you are exposed because of your occupation, and specify your work place (e.g. chlor-alkali plant, in dentistry, waste incinerator, on landfill, etc.)
19. Do you live or work nearby any facility that can be a source of mercury pollution?	Yes ( ) No ( ) If yes, please specify the facility: ____________
We would like to keep your results and the information you provided above in our CONFIDENTIAL research database.	
20. Is this okay?	Yes ( ) No ( )

ANNEX E. MERCURY INFORMATION AND FREQUENTLY ASKED QUESTIONS REGARDING HAIR SAMPLING

Please see fact sheet N°361 from the World Health Organisation (WHO) entitled, “Mercury and health” which notes these key facts:

- Mercury is a naturally occurring element that is found in air, water and soil.
- Exposure to mercury – even small amounts – may cause serious health problems, and is a threat to the development of the child *in utero* and early in life.
- Mercury may have toxic effects on the nervous, digestive and immune systems, and on lungs, kidneys, skin and eyes.
- Mercury is considered by WHO as one of the top ten chemicals or groups of chemicals of major public health concern.
- People are mainly exposed to methylmercury, an organic compound, when they eat fish and shellfish that contain the compound.

http://www.who.int/mediacentre/factsheets/fs361/en/

THE HAIR TESTING

Q° 1. Why was hair sampling chosen as the method for investigating mercury levels?

Hair sampling was chosen because it is not an invasive technique and can provide information about exposure to mercury over time, making it preferable to blood analysis.

Q° 2. Is hair sampling the only method to measure mercury levels?

No. Other methods to monitor mercury levels exist, such as analysis of blood, urine and saliva. Hair is particularly relevant in assessing exposure to methylmercury in the diet.

THE RESULTS OF THE TEST

Q° 3. What is recommended as a safe level of mercury in a hair sample?

In 2000, the US National Research Council established a "reference dose" of 1000 µg /kg (1 ppm) and noted that this level should not be exceeded in women of child-bearing age (USEPA 2001). Levels above 1 ppm in men and women have the potential to cause mercury related health impacts.

Q° 4. If my level is above this limit, does the result of the hair test tell me anything about my state of health?

No. Your result indicates the concentration of total mercury in your hair and your exposure to mercury during the past few months, depending on the length of your hair sent to the laboratory (as the average rate of growth of hair is approximately 1 cm per month). It does not mean that the mercury to which you have been exposed has necessarily caused a negative impact on your body or state of health. However, if your hair level is above the WHO limit, we would advise you to look for the source of exposure and reduce it if possible. For example, if you are regularly eating fish that are likely to be contaminated with high levels of mercury, you may want to switch to fish with lower mercury levels (see below).

SOURCES OF MERCURY EXPOSURE

Q° 5. What are the current sources of mercury exposure?

The most common route of exposure to mercury (methylmercury) is through the diet, especially fish. Some people may also be exposed to mercury vapor (elemental mercury) due to participation in certain gold mining activities. Exposure can also occur in other occupational settings or from mercury-containing wastes. However, air and water, depending on local mercury pollution load, can contribute significantly to the daily intake of total mercury.

Use of skin-lightening creams and soaps, and the presence of mercury in the home (e.g. broken thermometers) or in the working environment can result in substantial elevations of mercury exposure.

Q° 6. How can I reduce my exposure to mercury?

Among the various forms of mercury, methylmercury is the most toxic form. The general population is primarily exposed to methylmercury through the diet, with fish and fish products being the dominant source of methylmercury. Intakes of methylmercury from fish are dependent on fish consumption habits and the concentration of methylmercury in the fish consumed.

Large predatory fish, and mammals like seals and whales contain the highest average concentrations of methylmercury (see question 9).

RECOMMENDATIONS

Q° 7. Should I continue breastfeeding even if my result showed I had been exposed to mercury?

Yes. Although mercury can pass into breast milk, the amount of mercury in breast milk is not a problem under normal circumstances and health experts advise all breastfeeding women to continue to breastfeed for six months or more. The mother's diet appears to be the main source of mercury in breast milk. The primary danger from methylmercury in fish is to the developing nervous system of the unborn child, and mercury levels in breastfed babies usually decline significantly after 2-3 months.

Q° 8. Should I have my dental amalgams removed if I am pregnant or breastfeeding?

No. Women should avoid having dental amalgams removed while pregnant and breastfeeding. Replacement of amalgam fillings should also be postponed. Both of these interventions can generate an increase of mercury vapor, which can be transmitted from mother to developing fetus. If an intervention is necessary, the dentist should then take all precautions in order to minimize mercury vapor inhalation.

Q° 9. What is the kind and quantity of fish that I can eat safely?

The European Commission, based on a recommendation from the European Food Safety Authority (EFSA), advises:

> *"Women who might become pregnant, women who are pregnant or women who are breastfeeding should not eat more than one small portion (<100g) per week of large predatory fish, such as swordfish, shark, marlin and pike. If they eat this portion, they should not eat any other fish during this period. Also, they should not eat tuna more than twice per week. The advice also applies to young children."*

At national levels in the European Union, some Food Safety Authorities have issued recommendations that are more or less stringent than those of EFSA. They are adapted to the situation in each country.

Please consult your national food safety authority to know if there is any recommendation on fish consumption in your country. For the fish types mentioned above, we recommend that women who are pregnant or thinking of becoming pregnant, or breastfeeding follow the most stringent recommendation

Q° 10. If I am pregnant or breastfeeding, should I stop eating fish?

No. Pregnant women should continue to eat fishat least twice a week, varying the types of fish eaten and favoring less contaminated types of fish. Seafood is an important source of indispensable nutrients, and essential fatty acids are necessary for optimal neurological development of the fetus and young children.

Q° 11. Are mercury thermometers at home a risk?

Yes. These types of thermometers contain elementary mercury which, if the thermometer breaks, can vaporize at the temperature of the surrounding air, and be inhaled and pass into the blood stream. Elemental mercury can also pass into the blood stream following skin contact. Very high exposures to mercury vapor can cause acute poisoning (see question 12).

Note, if a thermometer breaks in a child's mouth it is not an acute danger as the elemental mercury is absorbed very poorly from the gastrointestinal tract (digestive system).

There are safe alternatives to mercury thermometers (e.g. digital thermometers), and in some countries, the sale of mercury thermometers has already been banned. We urge you to replace your mercury thermometer before it breaks, and to give the mercury thermometer to a pharmacy or the appropriate hazardous waste facility near your home.

Q° 12. What should I do and not do with the mercury spill from a broken thermometer?

Immediately after the spill, all people, especially children, should be kept away from the spill area. In order to minimize mercury vapors, heaters and air conditioners should be turned off, and the area should be ventilated by opening windows as long as possible.

First of all, do not touch mercury with bare hands - you should wear gloves. **Never collect mercury spills with a vacuum cleaner**. All mercury beads should be collected with a carton and put in a sealed plastic bag. Once all beads of mercury are collected, put the material used for clean up into the bag, close it and label it as mercury waste before taking it to the pharmacy or to the appropriate hazardous waste facility near your home. On a carpet or a rug, the mercury-contaminated section should be cut out. In a sink of water, mercury will sink to the bottom and mercury should be recovered with eyedropper and placed in a bag.

Never collect mercury spills with a vacuum cleaner. The heat of the vacuum will vaporize the mercury into the air and increase exposure. If you have done so, take the vacuum bag in collection facilities for hazardous waste. Do not touch the mercury.

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