

Stopping the child brain drain

The emerging public health threat from increasing mercury exposure in Western Balkans



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Emissions of mercury, especially from coal-powered electricity generation, are causing brain damage in children in Europe and throughout the world^d. Plans to double coal power capacity in the Western Balkans are worrying because more coal production means more mercury emissions, and each additional tonne produced by coal plants may result in significant impact losses in children's IQⁱⁱ.

Putting an end to the construction of new coal power plants in the region, as well as phasing out coal power generation globally, is an important way forward if we want to protect our children. Safe alternatives delivering healthy energy need to become priority. The renowned medical journal, The Lancet recently recommended a phase out of coal for the climate and our healthⁱⁱⁱ.

MERCURY AS A PUBLIC HEALTH ISSUE

Environmental exposure to mercury from coal plants is emerging as a major public health issue. It has prompted comparisons with concerns about lead in petrol the 1980s.

Neither of these heavy metals have a role in the normal functioning of the human body – and both are harmful to children because they are highly toxic to the developing brain and nervous system.^{iv}

Fortunately, if adequate action is taken, our body burdens of mercury will fall. From experience in relation to lead, it is clear that environmental measures can reduce human exposure. Following policy interventions, such as removing lead from petrol, firm evidence exists that the prevalence of elevated blood levels fell.

But now is a crucial time. Decisions on future coal investment are being taken and emissions from coal represent 50-60% of all deposits of mercury (or depositions) in the European Union (EU). Currently, governments around the world are discussing whether or not to embark on investments in coal-powered electricity generation. Major investment plans are on the table in India, China, Turkey and several Balkan countries – going ahead with them threatens the health of future generations^v.

MERCURY AND COAL: A TOXIC LINK

After artisanal and small scale gold mining, coal combustion is the second largest anthropogenic source for mercury emissions in the world. Burning coal accounts for 475 tonnes of emissions compared with 10 tonnes produced by the combustion of other fossil fuels.

Countries in Asian countries are emitting the most mercury globally^{vi}. In the EU, coal-burning is the main source of mercury emissions accounting for around half of all EU mercury emissions (around 87.5 tonnes per year)^{vi}. It has been said that mercury deposited in the EU originates from China. However, the opposite is true: depositions are largely from its own sources. As much as 60% of mercury deposits in some areas of Europe may be from local plants^{vii}.

Mercury levels are harming the environment as well as human health. The European Environment Agency (EEA) says that mercury levels in Europe are too high. Critical loads of mercury across 90% of ecosystems are exceeded in over half of 33 European Economic Area countries^{viii}. But studies also show that if industrial emissions of mercury were reduced by 50% to 0%, it could bring levels of mercury in atmosphere down 15-30%^{ix}. Zeroing primary anthropogenic emissions after 2015 would subsequently lead to almost instantaneous decrease by 30% in atmospheric deposition.

COAL RUSH IN THE WESTERN BALKANS

In the EU, coal is still an important source for energy production but its use is on a clear downward trend^x. The picture is significantly different in the Balkan countries, just beyond the EU's doorstep. Here, coal power generation is still the main source of energy and over half of all electricity is generated from lignite, the most polluted type of coal. A UNEP study showed that lignite contains twice as much mercury as other types of coal^{xi}.

Already relying heavily on coal power generation, the

Balkan countries plan to increase capacity even more. Meanwhile, Europe is turning towards renewables and increased production of electricity from clean sources. Since 2000 in EU, renewables have risen from 1% of power generation to 14%. Unfortunately, the beneficial potential of opting for renewables that exists in Balkans is not yet recognised by Balkan governments. According to a regional think tank: "By aligning their energy policies with the EU energy roadmap, closing all coal power plants and replacing them with renewable energy sources, the countries of South East Europe (SEE) can have a cleaner and cheaper energy system."^{xii}

Serbia has the largest electricity system in the region with some 62% of electricity generated from lignite^{xiii}. Bosnia and Herzegovina produces around half of its electricity from coal. While Montenegro is a small energy system, it is greatly dependent on fossil fuels. Currently, these three countries, like all the other Balkan countries, have no plans to turn away from coal (lignite).

To date, Serbia, Montenegro and Bosnia and Herzegovina together have 6.4 GW coal-fired power generation. They plan to build new installations generating an additional approximately 8.6 GW. Bosnia plans to invest in coal plants that would almost triple current capacity: from 1.7 today, an additional 4.6 GW from new installations are planned. Montenegro plans to add 0.8GW to its current capacity of 0.42 GW. Serbia, which has the greatest current capacity (4.2GW), plans to add an additional 3.2 GW by 2015. One analysis suggests that this capacity expansion is designed to meet export demand^{xiv}. If this is correct, it represents a threat of the Balkans becoming a dumping ground for unhealthy energy projects from China^{xv, xvi}.

Serbia emits 1.6 tonnes of mercury from industrial facilities, of which the majority (1 tonne) comes from coal power plants^{xvii}. Montenegro emits much less mercury (0.08 tonnes), but almost all of the emissions comes from the Pljevlja coal plant. Data for Bosnia and Herzegovina is not available.

HOW ARE WE EXPOSED TO MERCURY & HOW DOES IT AFFECT OUR HEALTH?

It has long been known that inhalation of elemental mercury vapour can lead to symptoms such as tremors, insomnia, memory loss, neuromuscular changes, and headaches. But what became very clear as a result of the catastrophic poisoning in Minamata Bay, Japan in 1965 was that the harm from ingesting fish and shellfish contaminated by processed mercury - discharged into waste water from a chemical plant - could be devastating.

Adults suffered major sensory and hearing disturbances and tremor. Of the more than 2,000 officially-recognised cases of mercury poisoning, almost half those affected have since died. The fetus of mothers who ingested

contaminated marine life were particularly badly affected. The infants symptoms were serious, including extensive lesions of the brain.^{xviii}

Since then, the public health concern associated with mercury has grown to include exposure to fine deposits in the environment, which can also cause brain damage to children. These traces of processed mercury, called methylmercury (MeHg), result from coal and industrial soot in the air landing on water and soil. From there, it is taken up by organisms and then builds up in different food chains, especially in fish.

Communities in which whale meat or large, predatory fish, such as swordfish, make up a large part of the diet are at particular risk. Studies by Harvard University Professor Philippe Grandjean have clearly demonstrated the impact on children's mental abilities damaged by their mothers' consumption of whale meat and fish during pregnancy. Prof Grandjean has shown that children born in the Faroe Islands to mothers who ate whale meat were failing badly by seven years of age.

Elsewhere in Europe, the risk from low-dose exposure may be less alarming at the individual level. This is because a higher mercury level in the mother does not automatically lead to brain damage in the child and because small effects may not be noticeable at the individual level. However, the implications of low levels of mercury in all childbearing women are enormous for our society. Widespread mercury pollution means current and future children are at greater risk of suffering from lower intelligence, learning disabilities, sensory deficits, and delays in normal development^{xix}.

An EU study has shown that more than 1.8 million children are born every year with methylmercury (MeHg) exposures above the limit of 0.58 microgram (μg)/g³. About 200,000 of these babies were found to exceed the higher WHO limit of 2.5 $\mu\text{g}/\text{g}$. Preventing exposure was estimated to save a potential of more than 600,000 IQ points annually, corresponding to a total economic benefit of between €8 billion and €9 billion per year^{xx}.

Each tonne of mercury emitted into the air is estimated to cause on average of €910,000 in damages, mostly due to IQ losses^{xxi}. These costs vary from country to country and depend on various factors such as population density and location of emissions.

EXPOSURE ROUTES IN THE BALKANS

With the number of coal power plants increasing rapidly today worldwide, deposits of methylmercury (MeHg) are increasing too. An estimated 84% of global fish stocks are now contaminated with mercury. The current levels of mercury in fish may not affect the adult population. However, even small amounts can pass through the placenta with possible harm to the developing brain of the unborn child.

HEAL'S SMALL-SCALE COMMUNITY SURVEY OF MERCURY IN HUMAN HAIR

About one in seven women in the European region may have a level of mercury above a widely-accepted recommended safety dose, according to findings of a survey by the Health and Environment Alliance (HEAL) in 2007.

Samples of human hair from women of reproductive age were tested because **exposure to mercury in the mother's womb can cause brain damage in her child**. Hair samples were used to assess exposure because the levels which people ingest are often estimated from the levels found in hair. 'Hair levels' are therefore considered to correspond with so-called 'intake' doses.

Although the sample size was small (involving approximately 250 women in 21 countries), the results reaffirmed figures published in the EU's extended impact assessment two years earlier (see above).

HEAL's survey results showed that more than 95% of the women tested taking part in the survey had detectable levels of mercury in their bodies. Fifteen per cent of the hair samples were above the most protective "Reference Dose" of 1 µg/g set by the United States National Research Council, a level which should not be exceeded in women of child-bearing age. However, all women had levels of mercury that were below the Benchmark dose limit of 10 µg/g set in 1990 by the World Health Organization. This is the level at which neurological effects are reported.

HEAL used the findings to raise awareness of the risks associated with low-level mercury exposure, especially for women, as part of its "Stay Healthy, Stop Mercury" campaign.

Although figures are not available for mercury levels in adults or children born in Bosnia & Herzegovina, Serbia and Montenegro, HEAL's small-scale community study (see box above) showed a significant problem among adult women in neighbouring Croatia.

The levels of mercury in hair samples of Croatian women were the third highest among samples from 21 countries around the world.

The findings of the HEAL study in Croatia are not statistically significant. However, the findings from the hair samples did suggest that the women were contaminated. This represents a concern for public health experts in Croatia and puts a question mark over risks in neighbouring countries.

The risk of mercury pollution in this region and elsewhere may be growing due to plans for coal investment. If expansion of coal-fired power plants in the region (biggest source of mercury pollution) takes place, more mercury will be deposited and human exposure is therefore likely to rise.

WHAT PROGRESS IN CONTROLLING MERCURY CONTAMINATION?

As a result of the overwhelming evidence on the harm to health from mercury, efforts to control the release of mercury and reduce people's exposure have been ongoing since for many decades. In 2005, the EU launched its mercury strategy with a comprehensive plan to tackle mercury pollution in Europe and globally^{xxii}. The strategy contains twenty measures to reduce emissions, cut supply and demand, and protect against exposure. Since 2011, there has been an EU export ban on mercury, which is currently under review.

RESULTS FROM COMMUNITY SAMPLING IN BALKANS

In 2015, prompted by concerns for the health of people living in the vicinity of coal mines and power plants, three NGOs in Balkan countries sampled human hair, soil, sediment, fish and chicken eggs for heavy metals. Samples were taken from Tuzla in Bosnia & Hercegovina, Pljevlja in Montenegro, and from a site in Serbia. Also, in a referent, clean, location samples were taken to serve as "heavy metal clean" locations. The heavy metals analysed were mercury and methylmercury, lead, arsenic, cadmium and chromium. Organisations involved in this what small sampling were the Center for Ecology and Energy, GreenHome and CEKOR.

Results showed that in Serbia mercury concentrations found in hair are worryingly high. A total of 17% of the samples were above the limit of 0.58 µg/g. Montenegro had elevated concentration values for cadmium (25% of samples) and lead (33% of samples), and Bosnian samples showed elevated levels of lead (17% of samples).

Progress has also been achieved at international level: in 2013, the Minamata Convention was agreed following years of intensive deliberations among governments from all over the world^{xxiii}. This UN Convention covers all aspects of the mercury life cycle, from primary mining to waste disposal, including trade provisions, rules for artisanal and small scale gold mining, and mercury emissions into the air.

The Minamata Convention introduces different, legally binding requirements for new and existing emission sources, which includes coal-fired power plants. Although actual obligations depend on the political will

of each state signing the Minamata Convention, the overall requirements foresee the use of best available technologies to control mercury emissions.

Despite these positive developments, the release of mercury into the air continues to be a challenge in the EU. Using all possible technical means, these emissions could be reduced by 50% by the year 2025, which would significantly decrease the health costs.

However, no limit has yet been set for mercury emissions into the air in the EU. This is the prerequisite for reductions. However, a horizontal mercury ceiling is being discussed under the revision of the EU's National Emissions Ceilings Directive. In July 2015, members of the European Parliament's Committee on Environment, Public Health and Food Safety supported such a limit.

TECHNOLOGIES TO CONTROL GLOBAL MERCURY

Air pollution controls contribute significantly to the reduction of mercury emissions - but they are not sufficient to stabilise the future mercury emission levels^{xxiv}.

The potential for large reductions exists if the most efficient technologies dedicated to Hg-removal are adopted on a large scale. A strategy to maximise feasible reductions would bring future mercury emissions to 40% below today's levels in 2050. An additional 15% reduction would be achieved if small-scale gold mining could be fully banned worldwide.

A wide range of control measures and technologies with different efficiency levels exist that can be used to control mercury emissions in coal power plants. The installation of certain filters could control mercury up to 95%. Examples of efficient technologies to reduce mercury emissions from a plant include a fabric filter to remove particulate matter from a gas stream, flue gas desulfurization to remove SO₂, selective catalytic reduction to reduce NO_x, and sorbent injection to remove hydrogen chloride (HCl) and other acid gases^{xxv}.



WHAT IS A SAFE LEVEL?

To tackle this public health problem, governments and international bodies have been setting recommended safety levels that aim to protect people. However, it is still unclear at what precise level there will be no toxic effects on the fetal brain. Over time, the scientific assessments of safe levels have been constantly revised downwards towards lower levels.

Some scientists believe that there may be no level of mercury that is safe for the human body. The current estimates of levels of exposure, therefore, both within and outside of Europe, are a cause for great concern.

WOULD POLICY CHANGE MAKE A DIFFERENCE?

Success in reducing lead levels in children's blood suggests that a moratorium on coal powered electricity stations would also significantly reduce mercury levels in women and children.

The key interventions to prevent lead poisoning was the removal of lead from petrol. The resulting increases in children's intelligence, and thus in lifetime economic productivity, have produced very large economic benefits^{xxvi}.

For example, the phasing-out of leaded petrol in the United States between 1976 and 1995 was associated with a more than 90% reduction in the mean blood lead concentration. Although still a problem in some communities, the average lead level of a child in the US declined to 1.9 µg/dl between 1999 and 2002. At the same time, lead was eliminated from the lining used in food cans and from new residential paint products. An estimated gain of 5-6 points in mean population IQ score was associated with the decline in mean blood lead concentrations, and this gain in IQ has been calculated to yield an annual economic benefit of between US\$100 billion (88 billion Euros) and US\$300 billion (264 billion Euros).

Similar reports of success in reducing the harm from lead in children were achieved in Europe and elsewhere as they began to phase out lead in petrol. In Germany,

experts say regulation instituted since the 1970s has reduced health risks significantly^{xxvii}.

For mercury, reductions in exposure could be achieved through the consumption of certain types of fish. A large percentage of the world's population consume fish regularly, and so far, regulation has not reduced this health threat to future generations.

WHAT NEEDS TO HAPPEN NOW?

The health community and concerned citizens can work together to achieve a reduction of mercury exposure, which will particularly protect future generations. National authorities and states also need to take their share of responsibility for a healthier future.

MEDICAL PROFESSIONALS AND PUBLIC HEALTH EXPERTS CAN:

- **Educate the public on health risks due to mercury.** Raise awareness on the health risks from mercury emissions that are emitted by coal in local consultation processes and help to ensure the enforcement of better pollution control for existing coal combustion in order to protect public health. Pollution control technologies are available and can reduce significantly the amount of mercury being emitted to the environment if deployed.
- **Engage in policy developments.** The time is right for advocacy on the health damage from mercury. Based on the established scientific evidence about the health risks from coal combustion, doctors and health organisations can add a long-neglected perspective to the debate about Europe's future energy supply. They can become involved in the discussions on higher environmental standards (e.g., air, energy, waste, water).

NATIONAL AUTHORITIES AND POLICY-MAKERS IN WESTERN BALKAN COUNTRIES SHOULD:

- Review the existing legislation on mercury (including trade, use, storage, waste disposal, transport, land/air/water protection, emissions from industrial sites, spatial planning); and ensure full implementation of these laws.
- Monitor emissions and work towards limiting them
 - By 2020, set binding mercury limit values for power sector.

- Ensure regular mercury emission monitoring and human biomonitoring and make sure the data is publicly available.
- Work towards a phase out of coal power generation
- Immediate: Introduce a moratorium on the construction of new coal power plants to prevent locking in tons of mercury emissions for years.
- Mid-term: Develop and implement policies on pollution control that ensure the maximum feasible reduction in mercury and other pollutants being emitted into the environment. Reductions can be implemented through the use of the best available emission control technologies (BAT) and best environmental practices. Technologies to control emissions of mercury and other pollutants are available and need to be installed on old plants to reduce environment and health degradation. Long-term: Develop a national phase-out plan for coal in power generation. A switch to the use of clean energy sources, which do not burn coal, would reduce mercury emissions and bring benefits to health and environment.

THE ENERGY COMMUNITY SHOULD:

The Energy Community is an international organisation dealing with energy policy. It brings together the EU, on one hand, and countries from the South East Europe (SEE) and Black Sea region on the other. The key aim of the organisation is to extend the EU internal energy market to SEE and beyond on the basis of a legally binding framework.

- Broaden the scope of rules related to environmental protection by adopting and implementing existing EU law on cleaner air. This includes all rules for industrial emissions, ambient air quality and emissions caps as well as strategic impact assessment.

FURTHER READING

Air and Mercury, Cutting mercury emissions, improving people's health (Fact sheet by HEAL, EEB and others) www.env-health.org/IMG/pdf/13._airmercury_final.pdf

Halting the child brain drain www.env-health.org Download the full report (PDF, 1,2 MB)

IPEN, Guide to the mercury treaty <http://www.ipen.org/sites/default/files/documents/ipen-booklet-hg-treaty-en.pdf>

WHICH EU LAWS RELATED TO THE COAL INDUSTRY HELP TO REDUCE MERCURY EXPOSURE?

- Chapter II of Directive 2010/75/EU on industrial emissions (also for existing plants) according to which, industrial installations must use the “best available techniques” to achieve a high level of environmental protection. The Directive ensures a level playing field in energy generation in the EU and Energy Community and prevents the danger of emissions leakage.
- Directive 2008/50/EC on ambient air quality and cleaner air for Europe, which defines objectives for ambient air quality and is designed to avoid, prevent or reduce harmful effects on human health and the environment as a whole.
- Directive 2001/81/EC on national emission ceilings for certain atmospheric pollutants, known as NEC Directive, which aims to reduce background emissions and to cut down transboundary pollution. It limits the emissions of pollutants in order to improve the protection of the environment and human health against risks of adverse effects from acidification, soil eutrophication and ground-level ozone and to move towards the long-term objectives of not exceeding critical levels and loads and of effective protection of all people against the recognised health risks from air pollution. It is important to note that this Directive is an instrument to cut down transboundary pollution.
- Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment according to which a Strategic Impact Assessment is obligatory for plans/programmes, inter alia those prepared for the energy sector, and which sets the framework for future development consent of projects listed in the Environmental Impact Assessment Directive.

**Note: This box relates only to EU regulation affecting mercury emissions from the coal industry. It does not address other industrial sources nor does it cover regulation aimed at reducing human exposure to emissions in air, water, food, cosmetics, healthcare products and so on.*

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The Health and Environment Alliance (HEAL) is a leading European not-for-profit organisation addressing how the environment affects health in the European Union (EU). With the support of more than 70 member organisations, HEAL brings independent expertise and evidence from the health community to different decision-making processes. Our broad alliance represents health professionals, not-for-profit health insurers, doctors, nurses, cancer and asthma groups, citizens, women’s groups, youth, environmental NGOs, scientists and public health research institutes. Members include international and Europe-wide organisations as well as national and local groups.

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Promoting environmental policy that contributes to good health