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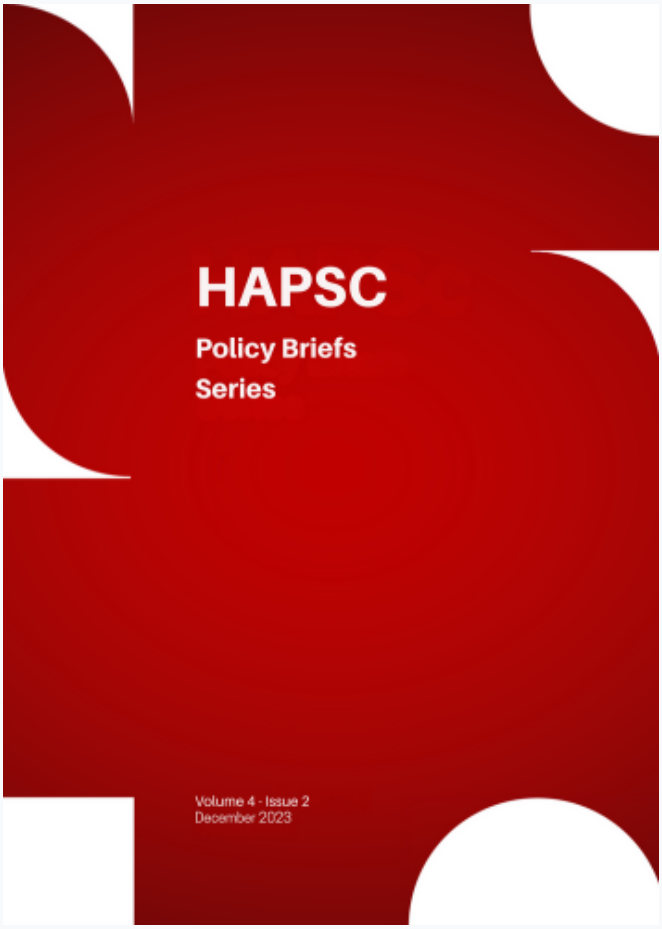


# Water Pollution and Children's Health

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# Water Pollution and Children's Health[1,2]

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**Abstract**

Water is the basic element for human survival and plays an important role to sustainable and socio-economic development, energy and food production, the preservation of healthy ecosystems. However, it is neglected, misused and undervalued as society does not protect it from various threats, climate change and pollution. The latter has affected freshwater sources, followed by an impact to children, as they are extremely sensitive to pollution. Most relevant water contaminants that affect are lead, pesticides, arsenic, perchlorate and nitrates. Addressing the problem and its components, the next step is to give answers to the issue outlining best practices and useful policy recommendations.

**Key Words**: water pollution, water scarcity, water contaminants, children's health, climate change.

## Introduction

One of the most basic human rights is access to safe water, sanitation and hygiene, which is, also, an important need for health and well-being. Factors, such as rapid population growth, urbanization and increasing demand for water from all sectors (agriculture, industry, energy) are influencing the exacerbation of the rising water demand (UN, 2023). According to UNESCO, one in three people don't have access to drinking water (WHO, 2019) and 1.8 million deaths are caused by water pollution annually. Environmental pollution is an underrecognized threat to children's health (Suk et al., 2016).

In spite of the size of the problem, international development and global health agendas do not address it with the same value (Landrigan et al., 2019). The purpose of this policy brief is to address the issue of water scarcity and pollution to children's health and to share and promote the best practices and recommendations from the experts.

## Water Scarcity and Water Pollution

Water scarcity is a constantly growing problem and it can be defined relatively as the amount of water that cannot be physically accessed easily as supply, therefore its demand for population changes,

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increases and/or as water supply is affected by decreasing quantity or quality (UN, n.d.).

On the other hand, water pollution is when water is contaminated by different sources, mostly polluted substances such as chemicals, trash, bacteria, and parasites, which make the water unusable for drinking, cooking, cleaning, swimming, and other activities. It is notable that pollution in any form eventually ends up in water. Pollutants from air might settle onto lakes and oceans and from land could make into an underground stream, following a river, and finally to the ocean. As a consequence, waste materials can eventually contaminate the water nearby (Last, 2007).

**Why is water scarcity an issue?**

On the one hand, the efficiency of water use has risen by 9% and between the years 2015 and 2022, access to safe drinking water increased from 69% to 73%. However, many countries still face problems with water stress -2.4 billion people lived in those in 2020 (UN, 2023)- and water scarcity -half of the world's population is already threatened at least one month a year (WMO, 2022). Therefore, the UN concerns that this number will quadruple unless effective actions are made to tackle these tremendous results of climate change (UN, 2023). Respectively, limiting global warming from 2°C to 1.5°C would approximately decrease by half the percentage of the world population expected to suffer from water scarcity (Douville et al. 2021).

Freshwater, essential for humans and ecosystems, is menaced by the sea-level rise, therefore the extended salinization of groundwater (Bates et al. 2008). Furthermore, food supply would suffer from water scarcity, as agriculture uses about 70% of global freshwater on average. To understand the impact of water in food supply in numbers, FAO estimates that 1kg of cereal requires 1 and 3 tons of water to grow, a kilogram of beef takes up to 15 tons and the production of daily food needs between 2.000 and 5.000 liters. In the last 30 years, there has been an enormous increase (more than 100%) of food production and by 2050 the need for food will rise up to 60% (FAO, 2017).

**Why is water pollution an issue?**

Clean water is not something to take for granted considering the fact that climate change is affecting the supply of water on Earth, which only 0.5% is usable and available freshwater (WMO, 2021). In the previous year, 2.2 billion people didn't have access to safely managed drinking water, 703 million people didn't have a basic water service, 3.5 billion people were living in environments that lacked safely managed sanitation and 1.5 billion of those were without basic sanitation services. Moreover, 2 billion couldn't wash their hands in a facility and 653 million didn't have a handwashing facility at all (UN, 2023).

Climate change has aroused extreme and severe weather events that impact the water supply and quality (Caretta, et al. 2022). Rising global temperatures affect the moisture of the atmosphere, resulting on the one hand in storms and heavy rains, followed by floods, which in that case remote rivers are not safe as water resources (FAO, 2017; World Bank, 2021). Since 2000 rain-generated floods have increased by 134%, with most of person and economic losses recorded in Asia (WMO, 2021). On the other hand, global warming provokes drought risk because of the intense dry spells and water evaporation (World Bank, 2021). The number and duration of droughts also increased by 29% compared with the two previous decades, with most drought-related deaths in Africa (WMO, 2021). Water quality is affected by frequent floods and droughts and it is projected to exacerbate many forms of water pollution – from sediments to pathogens and pesticides (Bates et al. 2008).

Sources of water contamination are runoff from farms, ranches, animal feeding operations (large industrial animal farms), manufacturing operations, excessive use of fertilizers, pesticides and chemicals that can impact the water quality of rivers, lakes, water and groundwater (Etzel & Balk, 2019), sewer overflows, storm water, rocks and soil that naturally have chemicals and minerals such as arsenic, radon, and uranium, cracks in water pipes or other problems in the distribution system (CDC, 2022).

**Who is vulnerable to water pollution?**

Among the most vulnerable population to get sick from germs and chemicals in water are infants and young children (CDC, 2022). Children consume more food and water in proportion to their body weight and thus, they are more likely to be exposed to contaminated water (Galvez & Balk, 2017). In addition, since their metabolic and organ systems are still developing, they are at risk of coming in contact with or ingesting chemicals when they are eating, putting objects in their mouth or crawling (Paulson & Council on Environmental Health, 2011). In 2016, pollution in air, water, soil and from chemicals caused 940,000 deaths in children worldwide, two-thirds of them in children under 5 years old. Main reasons were respiratory and gastrointestinal diseases caused by polluted air and water (Landrigan et al, 2019). Every year, 297.000 children under the age of 5 years die because of diarrhea linked to inadequate handwashing. Diseases such as cholera, dysentery, hepatitis A, and typhoid are associated with poor sanitation and contaminated water, too (WHO, 2019).

People familiar to children, healthcare professionals and parents, should be informed about the possible pollutants and their effects for the purpose of protecting the health of their children. As follows, it is important to explain the most relevant water contaminants that affect children's health,

which are lead, pesticides, arsenic, perchlorate and nitrates (Bantol et al., 2020), their health effects, with the intention of suggesting policy recommendations.

## Water Contaminants

### *Lead exposure*

First of all, lead exists in various sources, such as drinking water, playing with toys, jewelry, antiques or in fields with contaminated dust or soil, getting in contact with paint chips and dust from lead paint in buildings and homes built before 1978 and in some candy and candy wrappers (National Center for Environmental Health, 2022). Drinking water contaminated with lead is due to plumbing materials that contain lead corrode (in pipes, faucets, fictures). Lead absorption is associated with low levels of calcium, iron, and zinc in blood among infants aged 6 and 12 months and in adults during periods of calcium deficiency stored lead into blood is affecting both maternal and fetal blood lead levels (BLLs) (National Toxicology Program, 2012). If the level of lead in a child's blood is at or above the CDC action level of 3.5 micrograms per deciliter, it may be due to lead exposures from a combination of sources (EPA, 2023).

EPA estimates that up 20% or more of one's total exposure to lead can be drinking water and for infants who consume mostly mixed formula, the percentage reaches 40% to 60% of their exposure to lead from drinking water (EPA, 2023). Children in school and child care settings might be exposed to lead as, unfortunately, in most facilities, lead testing in drinking water is not required by law, thereby protecting them from lead in water varies across countries (GAO, 2020). Some of the serious dangers of lead exposure are damage to the brain and nervous system, slowed growth and development, learning and behavior problems, hearing and speech problems. Additionally, even low levels of lead in the blood of children can result in behavior and learning problems (Shadbegian et al. 2019), lower IQ and hyperactivity, slowed growth, hearing problems and anemia (EPA, 2023).

### *Pesticides*

Pesticides are reagents for protecting crops against harmful pests, insect-borne diseases in humans and increased the quality and quantity of food. However, their excessive use raised issues on affecting the environment, including water resources. Pesticides occur in soils and streambed sediment, groundwater and surface water due to agricultural activities, urban use and pesticide production factories (Syafrudin et al., 2021). 1 billion pounds of pesticides is applied annually to agricultural land, non-crop land, and urban areas throughout the United States (Water Science School, 2018). People may be exposed to pesticides from food (insecticides, herbicides, fungicides) and in some

water supplies where there are still running by conventional drinking water treatment technologies (Bantol et al., 2020).

Pesticide contamination in acute ratio might lead to symptoms, such as nausea, vomiting, eye irritation, coughing, shortness of breath (Galvez & Balk, 2017) and long-term exposure to low concentration has results in non-carcinogenic health risks (Syafrudin et al., 2021). Exposure to pesticides during pregnancy is associated with miscarriages, birth defects, such as gastroschisis (Shaw et al., 2014), urogenital and nervous systems' malformations, childhood cancer (risk of lymphomas, leukemia, bone tumor), neurobehavioral disorders (Matysiak et al., 2016), musculoskeletal development, poor cognitive function in school-aged children, lower scores on tests that require working memory, reasoning, comprehension and low IQ among agricultural families (Bouchard et al., 2011).

***Arsenic***

Arsenic is a widely metalloid found in soils, rocks, food, water and air that can be released through natural (volcanic eruptions, groundwater) and human (mining, commercial use) processes (CDC, 2018). Exposure to inorganic arsenic could cause cancer in skin, lungs, urinary bladder, kidney and, possibly, liver. Symptoms of acute poisoning are vomiting, abdominal pain and diarrhea, followed by numbness, tingling of the extremities, muscle cramping and death, in extreme cases. Moreover, effects after a long period of time could be skin pigmentation changes, skin lesions, hard patches on the palms and soles of the feet (hyperkeratosis), and adverse health effects may be developmental effects, diabetes, pulmonary disease and cardiovascular disease. Regarding children, arsenic is associated with adverse pregnancy outcomes, infant mortality (Quansah et al., 2015), increased mortality in young adults due to multiple cancers, lung disease, heart attacks and kidney failure (Farzan et al., 2013), problems with cognitive development, intelligence and memory (Tolins et al., 2014).

***Perchlorate and Nitrate***

Perchlorate and nitrate are common environmental pollutants in daily life. The former appears in military operations, explosives, fireworks, and notably high in drinking water and food (Nizinski et al., 2020). The latter is used as agricultural fertilizers, preservatives in processed meats and in contaminated water and leafy vegetables (Ward et al., 2018). Consequences of exposure to perchlorate and nitrate are perturbed thyroid homeostasis by lack of iodine uptake (Pleus & Corey, 2018), reproductive problems as urinary perchlorate and nitrate levels may relate to serum total testosterone levels in specific sex-age groups (Han et al., 2023). Evidence also showed that mothers

with thyroid problems due to perchlorate levels had high risk of having a child with lower IQ at 3 years old (Taylor et al., 2014).

**Policy Recommendations and Conclusions**

The quality and adequate quantity of water is one of the principal challenges our world face that threatens human health, limits food production, disturbs ecosystem functions and menaces economic growth. Water scarcity along with pollution of freshwater resources have a greater impact that might lead to an untreated situation. Pollution has a tremendous impact on children's health and the global burden of pediatric disease is still unknown. Also, chemical exposure and potential toxicity is underestimated. In order to understand the occurrence and association of pediatric NCDs and pollution, as well as the health effects, it is essential to invest in research to define new chemical pollutants, their characteristics and their associations to diseases (Landrigan et al. 2019).

Prevention is the key to pollution and it can be an opportunity to ameliorate children's health and prevent possible diseases (Landrigan et al. 2019). Collectively and individually, we have the duty to diminish this problem by taking the right actions, widely known from the professionals. Some solutions that can manage the danger from climate change are:

- Plan, implement and evaluate water management policies for healthy aquatic ecosystems aiming at lower greenhouse gas emissions and protection against climate hazards (Water and Climate Coalition).
- Nature based solutions to reduce greenhouse gas emissions and protect from extreme weather events, such as wetlands (mangroves, seagrasses, marshes, swamps) which are highly effective at absorbing and storaging of CO2, excess water from storms and precipitation (UNEP, n.d.)
- Invest in early warning systems for floods, droughts and other water-related hazards to reduce disaster risk (30% less damage after a 24-hour warning of a coming storm) (WMO, 2022).
- Invest and use of water supply and sanitation systems (ex. filter certified to reduce chemicals, lead, reverse osmosis or anion exchange for perchlorate and nitrates treatment) and facilities that can withstand climate change (Mountford et al., 2018; Maffini et al., 2016).
- Use of climate-smart agriculture means (drip irrigation) (UNEP, n.d.).
- Invest in implementing programs for the protection and restoration of water-related ecosystems and hygiene education (EPA, 2023c)

- Regarding children's protection from chemicals' exposure, healthcare professionals (pediatricians, specialized nurses, health visitors) could play an important role in the prevention of drinking contaminant water, with regular recommendations, consultations and providing educational resources to children's parents (EPA, 2023b).
- National, local and community leaders should strengthen communication systems to improve access to information regarding water pollution and quality with civil society (Scharp et al., 2019).
- Water-service providers (public and private) could develop and manage drinking-water safety plans to meet drinking-water standards and safeguard supplies against potential risks (Scharp et al., 2019).
- Construction services should cooperate with water-service providers and public health specialists with the aim of investigation, surveillance and management of water utility services in buildings constructed before 1978, especially schools, due to high risk of lead and pesticide pollution (National Center for Environmental Health, 2022).
- Educate and engage the community members to understand the risks of chemicals, exposure, their sources (crops, cooking water) (WHO, 2022).
- High-risk populations should be monitored. Although children with lead in their blood may seem healthy and have no visible signs or symptoms, CDC recommends blood testing at the age of 12 and 24 months (CDC, 2022). Usually, skin problems might be early signs of arsenic poisoning (WHO, 2022).
- Install arsenic removal systems – either centralized or domestic – and ensure the appropriate disposal of the removed arsenic. Technologies for arsenic removal include oxidation, coagulation-precipitation, absorption, ion exchange and membrane techniques.
- Reduce occupational exposure from industrial processes.
- Independent surveillance agencies could be responsible to assess the relationships and performance of sector institutions (ex. schools) in meeting health-based targets (Scharp et al., 2019).
- Decision makers should advocate on policy and regulatory reforms regarding water quality and protection. Also, civil society should force decision makers to advocate about those matters (Scharp et al., 2019).

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