Mining, Environmental Contamination, and Public Health in Ghana: The Health Costs of Extractive Economies

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ABSTRACT

Mining has been a key part of Ghana's economic growth, bringing in a lot of money for the government, exports, and jobs. But the fast growth of both industrial and artisanal gold mining has caused a lot of pollution in the environment, which is becoming a bigger public health problem. This article analyses the correlation between mining-induced environmental degradation in Ghana and its consequent health risks at the population level, facilitated by various exposure pathways, such as contaminated water sources, the utilisation of mercury and cyanide, soil degradation, air pollution, and modified disease ecologies. Utilising peer-reviewed literature, policy reports, and contemporary empirical evidence, the study reconceptualises mining as a significant social and environmental determinant of health, rather than merely an economic or environmental concern. There is a lot of focus on mercury exposure, water insecurity, health risks at work, and the unfair burden that vulnerable groups like artisanal miners, women, children, and rural communities have to bear. Building on recent environmental assessments of mining impacts in Ghana, this article presents a public health perspective that emphasises how extractive economies transfer health costs to local populations while prioritising immediate economic benefits. The results highlight the pressing necessity to incorporate public health considerations into mining governance, environmental regulation, and development planning in Ghana. If we do not do this, the health costs of extractive economies will keep hurting long-term population health and sustainable development.

Keywords: Mining, public health, environmental contamination, mercury exposure, water insecurity, Ghana.

INTRODUCTION

Mining has been a big part of Ghana's economy and politics for a long time. It has affected how the country develops, how many people work, and how much money the government makes. Ghana is Africa's second largest gold producer, and mineral extraction is a big part of its economy and a way to make money from other countries (Minerals Commission, 2024). But underneath the apparent economic benefits of mining is a growing public health crisis caused by pollution and long-term exposure to dangerous chemicals. Rivers contaminated with heavy metals, landscapes marred by deserted pits, and communities subjected to perilous working conditions exemplify how mining has emerged as a significant factor influencing health outcomes in Ghana.

Conversations about mining in Ghana and public health have often been broken up into three groups: environmental damage, worker safety, and lack of regulation. This fragmentation hides the truth that environmental damage from mining affects people's health in many ways, both directly and indirectly. Contaminated water sources heighten the risk of waterborne diseases; exposure to mercury and cyanide jeopardises neurological, reproductive, and developmental health; land degradation threatens food security and nutrition; and modified landscapes promote the transmission of vector-borne diseases such as malaria (Hilson, 2017; Yaro et al., 2021). These results have a bigger impact on mining communities that already have trouble getting healthcare and social services. Recent environmental research has shown how bad mining is for the environment in Ghana, including deforestation, water pollution, and ecosystem disruption (Andoh, 2026). Nevertheless, the translation of these environmental effects into tangible public health ramifications has not been adequately scrutinised within a cohesive analytical framework. Consequently, the health expenditures associated with extractive economies are predominantly overlooked in policy discussions that emphasise revenue generation and economic metrics over human welfare.

This article contends that mining in Ghana should be re-contextualised as a public health concern, rather than solely an environmental or economic matter. From a public health standpoint, mining serves as a structural catalyst for disease, injury, and health disparities by influencing environmental conditions, occupational hazards, and access to vital resources like clean water and arable land. The term "health costs" in this study encompasses not only the direct morbidity and mortality linked to toxic exposure but also the indirect and cumulative health burdens resulting from livelihood disruption, food insecurity, and environmental stress. The growth of artisanal and small-scale gold mining, also known as galamsey, has made these health risks even worse. Artisanal mining works mostly outside of formal regulatory frameworks. It uses mercury amalgamation and simple extraction methods that put miners and people who live nearby at risk of toxic substances (Aryee et al., 2003). Industrial mining operations, although more regulated, have also caused environmental pollution through the release of tailings, cyanide spills, and large-scale land changes. These different types of mining create overlapping exposure pathways that make health risks worse in the areas where they happen. This study examines Ghana from 2000 to 2026, a timeframe characterised by swift mining expansion, heightened foreign investment, and growing environmental and public health issues. The article analyses the impact of mining related environmental contamination on health outcomes through four interconnected dimensions: (1) water contamination and chemical exposure, (2) occupational and respiratory health risks, (3) food security and nutritional effects, and (4) disease ecology and vector proliferation. The analysis utilises secondary data, peer reviewed studies, and policy reports, while also incorporating recent environmental assessments of mining impacts in Ghana (Andoh, 2026). By placing mining within the context of wider discussions on environmental justice and social determinants of health, this article adds to interdisciplinary public health research that connects development practices to health outcomes in populations. The main point is that extractive economies consistently shift health risks onto marginalized communities, causing long-term public health problems that are worse than the short-term economic benefits. To protect people's health and promote sustainable development, it is important to see mining as a public health issue so that effective regulatory, environmental, and health system interventions can be designed.

This research utilizes a qualitative public health synthesis methodology to investigate the health effects of mining-related environmental contamination in Ghana. Instead of providing new primary epidemiological data, the article synthesizes peer-reviewed scientific studies, institutional reports, and recent environmental assessments to examine how mining serves as a structural determinant of public health. This method is suitable due to the diffuse, cumulative, and enduring characteristics of health risks associated with mining, which cannot be sufficiently represented by single-site or short-term studies. Three criteria were used to choose the data sources. First, peer-reviewed studies that looked at how mining activities in Ghana affected the environment, toxic exposure, occupational health, or disease outcomes were given the most weight. Second, policy and institutional reports from reputable organizations, such as the World Health Organization, the World Bank, and the Minerals Commission of Ghana, were incorporated to situate environmental and health risks within national regulatory and developmental contexts. Third, recent environmental syntheses and assessments were utilized to assess the persistence of contamination and governance challenges, especially in areas where large-scale remediation has not been implemented. Even though a number of basic exposure studies were done between 2003 and 2015, their results are still important because both industrial and artisanal mining are still growing and there is no systematic environmental remediation in the areas that were affected. Recent national reports and environmental assessments demonstrate that exposure pathways identified in prior studies such as mercury contamination, water pollution, and land degradation continue to exist in the current period (Minerals Commission, 2024; Andoh, 2026). Thus, this study underscores the significance of continuous exposure and structural susceptibility over discrete measurements. Health risk interpretation relies on globally acknowledged exposure thresholds and public health standards, rather than novel statistical testing. The concentration ranges documented in the literature are assessed against World Health Organization guidelines for mercury and heavy metals, alongside recognized correlations between environmental exposure and health outcomes. This study synthesizes secondary data, so p-values are not recalculated. Instead, the focus is on exposure pathways, population vulnerability, and cumulative health effects.

This methodological approach facilitates a population-level evaluation of mining-related public health risks, redirecting the analytical emphasis from singular exposure incidents to overarching trends of environmental contamination, health disparity, and governance inadequacy. The study offers a holistic framework for

comprehending the health implications of extractive economies in Ghana by amalgamating environmental science with public health and policy analysis.

Conceptual Framework: Mining as a Public Health Determinant

Public health scholarship is increasingly acknowledging that population health outcomes are influenced not solely by biomedical factors, but also by extensive social, economic, and environmental conditions. In this context, mining can be seen as a structural factor that affects health. It changes the physical environment, spreads risks and resources unevenly, and creates health disparities between different groups of people. The growth of gold mining in Ghana has changed ecosystems, jobs, and social relationships in ways that directly and indirectly affect how people get sick, how vulnerable they are, and how easy it is for them to get health protective resources. To understand how mining affects public health, you need to know about environmental exposure pathways. Mining activities put harmful chemicals like mercury, cyanide, arsenic, and lead into the air, water, and soil. People can get these pollutants in a number of ways, such as through drinking water, eating food, breathing them in, and direct contact with them at work. Exposure is seldom isolated or transient; instead, it is cumulative and persistent, especially in communities situated near mining operations (Hilson, 2017). Repeated low-level exposure over time can lead to long-term health problems like neurological damage, respiratory illness, and a weakened immune system.

Mining also has indirect health effects that are often not taken into account in environmental assessments. Land degradation and deforestation lower agricultural productivity, which hurts food security and health. When people lose arable land, they have to find new ways to make a living or move, which breaks up social networks and raises psychosocial stress (WHO, 2019). In Ghana, displacement caused by mining has changed the economies of households and made it harder for people to do traditional subsistence activities, which has made them more likely to get sick or malnourished (Aryee et al., 2003; Andoh, 2026). These indirect effects demonstrate how environmental changes associated with mining can lead to more widespread public health issues.

From a public health standpoint, mining-related harm is most effectively comprehended through the framework of the social determinants of health. Income, job conditions, housing quality, access to clean water, and proximity to environmental hazards are some of the things that have a bigger impact on health outcomes than individual behaviours. Artisanal and small-scale miners in Ghana frequently work in dangerous conditions that lack formal structure, safety gear, and government oversight. These conditions put miners at greater risk of getting hurt on the job and make it harder for them to get medical care, social services, and compensation for injuries or illnesses (Hilson, 2017).

The distribution of health risks associated with mining is markedly unequal, mirroring broader trends of environmental injustice. Mining communities often rural, economically disadvantaged, and politically underrepresented experience a disproportionate amount of environmental pollution and health problems, while the economic benefits of mining mostly go to corporations, cities, and the state. This unequal distribution is similar to what public health researchers call the externalisation of health costs. This is when the negative health effects of economic activity are pushed onto groups that are already weak (WHO 2022; Andoh, 2026). In this regard, mining not only inflicts environmental damage but also engenders systemic health disparities ingrained in Ghana's development framework.

The relationship between mining and disease ecology is another important part of the conceptual framework. Changes to the environment caused by mining, like open pits, stagnant water bodies, and changed drainage systems, make it easier for disease vectors to spread. In Ghana, abandoned mining pits have been recognised as breeding grounds for mosquitoes, exacerbating malaria transmission in mining areas (Yaro et al., 2021). These changes to the environment show how mining changes the disease environment in a given area, turning environmental damage into a health risk.

Mining also puts a lot of stress on health systems, especially in rural areas where there are not many health care facilities. More people are getting hurt at work, being exposed to chemicals, getting sick from waterborne diseases, and getting sick from vector-borne diseases. This means that more people need health care, but the health system is not getting any bigger. Because of this, mining communities often have to deal with two

problems: more health risks and not enough access to care. This mismatch makes cycles of illness and poverty worse, which makes health disparities even worse.

It is important to note that mining has health effects that go beyond the areas where mining is happening. Polluted rivers carry pollutants downstream, affecting communities that are far away from where they are being extracted. Food grown in contaminated soils makes its way into regional markets, which means that people who live outside of mining communities are also at risk. These spatial spillovers make governance more difficult and show that we need a public health approach that works for everyone, not just fixing the environment in one place (WHO, 2017).

Mining and Environmental Contamination Pathways in Ghana

Environmental contamination is the main way that mining in Ghana leads to bad health effects for the public. Gold mining, whether industrial or artisanal, brings a lot of different kinds of stressors into the environment around it. These stressors interact across water systems, soils, air, and landscapes, creating multiple and overlapping exposure pathways that affect human health at the population level. To reframe mining as a public health issue instead of just an environmental or regulatory one, we need to understand these pathways.

Water Contamination and Chemical Pollution

Water pollution is the most common and well-documented way that mining can hurt people's health in Ghana. Artisanal and small-scale gold mining depends a lot on mercury amalgamation, which is when mercury sticks to gold particles and then burns off, putting mercury into nearby water bodies and sediments (WRCG, 2022). Industrial mining operations, although more regulated, have also caused water pollution by spilling cyanide, leaking tailings, and not properly disposing of waste (Hilson, 2017).

Mining-related pollution has had a big effect on a number of major river systems, such as the Pra, Offin, Ankobra, and Birim. Millions of people rely on these rivers for drinking water, irrigation, fishing, and other household needs. Environmental studies in mining-affected basins have found mercury levels in river sediments that are much higher than the World Health Organization's recommended level of 0.2 mg/kg for environmental safety (Donkor et al., 2006). The levels ranged from about 0.5 to 4.0 mg/kg. Arsenic and lead levels in surface water samples have also gone above WHO limits for drinking water in several places downstream of mining activities (Basu et al., 2015). Andoh (2026) shows that these bodies of water have been getting worse since the early 2000s, which is when both industrial mining concessions and informal galamsey operations have grown.

Contaminated water increases the risk of being exposed to harmful chemicals by drinking it, cooking with it, bathing in it, and using it for farming. In many rural mining communities, people cannot get treated piped water, so they have to use contaminated surface water or shallow wells that can leak from polluted rivers. According to the World Health Organisation (WHO), drinking water with low levels of heavy metals for a long time has been linked to neurological problems, kidney problems, heart disease, and a higher risk of cancer. Contaminated water also makes sanitation and hygiene less effective, making people more likely to get waterborne diseases like cholera, typhoid fever, and diarrhoea (GSS, 2023). In mining areas where there is not enough water treatment infrastructure or where pollution is too much for the infrastructure to handle, the public health burden goes beyond just exposure to toxic substances. It also includes the spread of infectious diseases. These combined risks show how pollution makes people in already marginalised communities even more vulnerable to health problems.

Mercury Pathways and Bioaccumulation

Mercury is one of the most dangerous chemicals that can be found in gold mining in Ghana. When elemental mercury gets into water, microbes change it into methylmercury, which is a very poisonous organic compound that builds up in fish and other aquatic organisms. This process creates a long-term exposure pathway that goes beyond mining sites and stays in place even after mining has stopped (Donkor et al., 2006). Fishing still serves as a big source of protein and money for many Ghanaian families, especially those who live in rural and peri-urban areas. Eating fish that has been contaminated is a major way that people, especially pregnant women and

children, are exposed to mercury. Chronic exposure to methylmercury has been associated with neurodevelopmental delays, diminished cognitive function, and behavioural disorders in children, along with cardiovascular and neurological effects in adults (WHO, 2017; Counter &, Buchanan, 2004).). According to Andoh (2026), mercury pollution in Ghana's river basins is a long-term public health threat that can't be solved by just short-term campaigns against illegal mining. Artisanal miners are directly exposed to mercury vapours when they burn amalgam, and they often do this without any protective gear or knowledge of the health risks. This exposure at work makes people even more vulnerable, making it more likely that they will get sick quickly or have long-term neurological damage. The informal nature of artisanal mining makes it harder to monitor and intervene in health issues, which means that health problems related to mercury are often underreported and not handled well.

Soil Contamination and Food System Impacts

Contamination of soils due to mining is a very important but often overlooked way that extractive activities affect public health. Excavation, tailings disposal, and chemical runoff add heavy metals to farm soils, which makes them less fertile and makes crops less safe to eat. Farmers in gold-mining areas like Obuasi, Tarkwa, Prestea, and Dunkwa-on-Offin have said that their crops are failing more often and their yields are getting worse because the soil is getting worse and chemicals are getting into it (Aryee et al., 2003; Andoh, 2026).

Heavy metals that crops take in can get into the human food chain, which means that people are exposed to toxic substances every day. Research has identified heightened concentrations of arsenic, mercury, and lead in staple crops cultivated in proximity to mining operations, prompting apprehensions regarding prolonged dietary exposure (Basu et al., 2015). These exposures lead to long-term health problems, such as problems with the digestive system, a weakened immune system, and a higher risk of cancer.

Land degradation from surface mining and abandoned pits, in addition to chemical pollution, makes farmland less available, which hurts food security and household nutrition. When people lose their jobs in farming, they have to find other ways to make money or buy food, which makes them more likely to become malnourished, especially children and the elderly. From a public health perspective, these nutritional effects signify indirect yet substantial repercussions of mining-induced environmental alterations.

Air Pollution and Particulate Exposure

Blasting, digging, moving ore, and processing all create a lot of air pollution in mining. Dust with silica and heavy metals in it gets into the air, where miners and people living nearby can breathe it in. Artisanal miners frequently operate in restricted environments devoid of respiratory protection, thereby elevating the risk of chronic respiratory ailments, such as silicosis, bronchitis, and asthma (Obiri et al., 2016). Industrial mining operations, although regulated by environmental standards, also generate localised air pollution through emissions from machinery, generators, and smelting processes. People who live near mines say that they have more respiratory problems, especially kids and older adults. These exposures make health problems that are already linked to poverty, bad housing, and limited access to healthcare even worse.

Mining-related air pollution is another way that environmental damage leads to health risks for the whole population. These risks are seldom isolated; individuals exposed to polluted air frequently encounter contaminated water and food concurrently, resulting in cumulative health effects that surpass the impact of any singular exposure pathway.

Landscape Modification and Disease Ecology

Mining changes the physical landscape in ways that have a direct effect on disease ecology and transmission dynamics. Open pits, abandoned excavations, tailings ponds, and changed drainage systems from both artisanal and industrial mining often lead to stagnant bodies of water that are perfect places for mosquitoes and other disease vectors to breed. In Ghana, empirical evidence indicates that such landscape alterations are associated with heightened malaria transmission in mining-impacted areas, especially within communities situated near abandoned pits and inadequately rehabilitated sites (Yaro et al., 2021).

From a public health standpoint, these environmental modifications convert mining sites into epidemiological hotspots by disrupting the ecological equilibrium that governs vector populations. When water stands, it makes mosquito breeding grounds denser and longer-lasting. Deforestation linked to mining changes local microclimates, which can make temperatures and humidity levels more favourable for malaria vectors. These changes in the environment make the cycles of malaria transmission stronger, especially in rural mining communities where people may not have easy access to preventive measures like insecticide-treated nets and indoor residual spraying. The public health effects go beyond just malaria. Mining can also make people more likely to get other vector-borne and water-related diseases by messing up natural drainage systems and sanitation infrastructure. In mining towns where the population is growing quickly and without planning, overcrowding and poor waste management make disease risks even worse. These circumstances exert additional strain on local health systems, which frequently lack adequate resources and preparedness to handle heightened disease burdens.

It is important to note that the health effects of ecological change caused by mining are not evenly spread out. Children, pregnant women, and migrant workers are especially at risk for getting sick or dying from malaria. Getting sick over and over again makes people miss school, lowers their productivity at work, and lowers their household income, which keeps the cycle of poverty and poor health going. Mining contributes to noncommunicable disease risks through toxic exposure and to communicable disease transmission through ongoing ecological disruption. This dual burden demonstrates the role of environmental modification as a vital intermediary between extractive activities and public health outcomes.

Cumulative and Spatial Spillover Effects

One thing that makes mining-related environmental pollution different is that it builds up over time and spreads out over a wide area. Heavy metals like mercury, arsenic, and lead are some of the pollutants that mining activities release. These pollutants do not stay in the places where they are mined. Instead, they spread through interconnected environmental systems like river networks, soils, and food chains, which means that people who live far away from mining sites are still exposed. Polluted rivers like the Pra, Offin, Ankobra, and Birim in Ghana carry pollutants downstream, affecting communities that may not be directly involved in mining. These populations downstream are still at risk because they drink water, use it for irrigation, fish, and do other things at home. This shows how health risks from mining spread across regions. In the same way, agricultural products grown in contaminated soils are sold in local and regional markets, which creates indirect dietary exposure pathways that affect people living in cities and suburbs as well.

These spillover effects complicate both risk evaluation and intervention strategies. Regulatory approaches that focus only on active mining zones and do not take into account downstream exposure and cumulative health risks are not effective. Chronic, low-level exposure to environmental contaminants may not yield immediate symptoms; however, it cumulatively results in long-term health consequences, including neurological disorders, renal impairment, cardiovascular disease, and developmental issues in children. It is hard to directly link these health outcomes to mining activities, which makes national health statistics underestimate the disease burdens related to mining.

Andoh (2026) stresses that the ongoing pollution of the environment in Ghana is due to problems with the country's governance structure, not just problems with individual regulations. Weak enforcement, divided institutional responsibility, and the informal nature of artisanal mining let environmental risks build up over time. This persistence results in prolonged exposure and an increased risk of chronic diseases among significant portions of the population, essentially transferring health costs to communities that are least equipped to manage them. The cumulative effects of mining-related exposure also pose health risks across generations. Contaminated environments have an impact on both current and future generations due to ongoing soil and water pollution, hindered ecosystem recovery, and prolonged food insecurity. These dynamics highlight the necessity for population-level public health interventions that encompass not only environmental remediation but also long-term health surveillance, exposure monitoring, and preventive care.

Public Health Outcomes in Ghana's Mining Communities

Mining-related environmental contamination in Ghana results in numerous detrimental public health consequences impacting individuals, households, and entire communities. These outcomes result from prolonged exposure to toxic substances, deteriorating living conditions, occupational hazards, and modified disease ecologies (Bose-O'Reilly, et al. 2010). Mining does not just cause health problems on its own; it also adds to a complicated and growing disease burden that hits people living in and around mining areas the hardest. This part talks about the main public health effects of mining in Ghana, focussing on neurological health, waterborne diseases, respiratory illnesses, vector-borne diseases, and the effects on the health system as a whole.

Mercury Exposure and Neurological Health Effects

Mercury exposure is one of the most serious and well-known health risks that come from gold mining in Ghana. Artisanal and small-scale mining heavily depends on mercury amalgamation, which causes mercury to be released into rivers, soils, and the air. From a public health standpoint, mercury exposure transpires via various pathways, including the inhalation of mercury vapour during amalgam combustion, the consumption of contaminated water, and the ingestion of fish tainted with methylmercury (Donkor et al., 2006; WHO, 2017).

Long-term exposure to mercury can cause a number of neurological problems, such as tremors, memory loss, poor motor coordination, and cognitive dysfunction. These effects are especially bad for kids and pregnant women because mercury easily crosses the placental barrier and stops the brain from developing properly in the foetus. Research in mining-impacted areas of Ghana has recorded heightened mercury concentrations in human hair and blood specimens, signifying prolonged exposure among both miners and non-mining residents (Basu et al., 2015). Now, exposure to mercury diminishes cognitive function and productivity, resulting in enduring social and economic repercussions. Kids who are exposed to mercury may not do as well in school, and adults may not be able to work as well and need more medical care. These results show how mining related pollution affects not only the health of individuals but also the health of the whole community and its chances for growth.

Water Insecurity and Waterborne Diseases

The pollution of surface and groundwater in mining areas has made water security much worse, which has direct effects on public health. Many rural communities get their drinking, cooking, bathing, and farming water from rivers that have been polluted by mining activities (Andoh, 2026). Because of this, drinking contaminated water makes it more likely to get waterborne diseases like diarrhoea, cholera, typhoid fever, and parasitic infections.

Mining-related water pollution also makes it harder for people to stay clean and healthy because they cannot get enough safe water. Not having enough water makes it harder to wash your hands and keep food clean, which makes you more likely to get sick. During seasonal flooding, these risks get worse because it can move pollutants and pathogens around communities more easily. From a public health systems point of view, outbreaks of waterborne diseases put even more stress on rural healthcare facilities, which are often short on staff and resources (WRCG, 2022). Recurrent illness diminishes household productivity, escalates healthcare costs, and sustains cycles of poverty and poor health. The health burden of water contamination is often underreported because people may not realise that their symptoms are caused by being around contaminated water or may think they are caused by something else.

Respiratory Illness and Occupational Health Risks

Mining produces a lot of pollutants that are released into the air, such as dust, silica, and chemical fumes. These pollutants are very bad for your health and can cause problems at work. Artisanal miners often work in small spaces without any personal protective gear, which puts them at risk of breathing in high levels of harmful vapours and particles. Industrial mining operations also cause air pollution in certain areas by blasting, moving ore, and letting machinery emissions escape. Long-term exposure to air pollution from mining has been linked to breathing problems like chronic bronchitis, asthma, and symptoms that are similar to silicosis. These conditions make life worse and make you more likely to get respiratory infections. Children and the elderly residing in proximity to mining operations are especially vulnerable due to their developing or compromised respiratory systems. Another big public health problem is injuries that happen at work. Artisanal mining has

unstable pits, bad ventilation, and not enough safety checks, which leads to a lot of accidents, injuries, and deaths. Because artisanal mining is not regulated, injuries often go unreported and unpaid, putting the burden of care on families and local health systems. From a public health standpoint, the occupational hazards linked to mining underscore the convergence of labour conditions, environmental exposure, and health disparities.

Vector-Borne Diseases and Altered Disease Ecology

As mentioned earlier, mining changes the landscape in ways that make it easier for vector-borne diseases to spread, especially malaria. Open pits, still water bodies, and changed drainage systems make good places for mosquitoes to breed, which raises the density of vectors and the intensity of transmission. In Ghana's mining areas, communities close to abandoned mines and poorly reclaimed landscapes have been found to have higher rates of malaria (Yaro et al., 2021). Malaria causes a lot of health problems and costs a lot of money for families that have it. This means that people miss work, school, and spend more on health care. Repeated malaria attacks can make anaemia worse, especially in kids and pregnant women, who are already at risk of nutritional problems (Afrane, et al. 2012). Thus, mining exacerbates communicable disease burdens by altering the environment, thereby highlighting the interrelation between ecological change and human health.

Nutritional Impacts and Food Security

Mining-related environmental degradation has a significant indirect effect on public health by compromising food security and nutrition. Heavy metals like mercury, arsenic, and lead can get into the soil and make it less fertile. This makes food crops grown in areas affected by mining less safe. Also, surface mining and the growth of abandoned pits permanently take away farmland, forcing farming families to move and breaking up local food production systems. These environmental changes hurt subsistence farming, which is still a very important source of food and money for many rural communities in Ghana (FAO, 2020). When local food systems break down, families have to rely more on store-bought food, which makes them more vulnerable to changes in market prices and limits the variety of foods they can eat. In mining communities where farming jobs have been lost, families often switch to cheaper, energy-dense but nutrient-poor foods, which raises the risk of not getting enough micronutrients. These dietary changes are especially bad for kids, pregnant women, and breastfeeding mothers because they need more nutrients and their health is more affected by not getting enough of them.

Moreover, malnutrition synergistically interacts with other health risks associated with mining. People who are not getting enough food are more likely to get infectious diseases like malaria and waterborne illnesses, and they have worse disease outcomes. In children, chronic undernutrition correlates with stunting, hindered cognitive development, and diminished educational achievement, resulting in enduring effects on human capital formation. In mining communities with significant income instability, households may prioritise immediate income generation over food quality, exacerbating nutritional vulnerability (Armah, et al. (2013). These nutritional effects are mostly hidden in studies of mining-related harm because they happen slowly and are caused by economic and environmental factors instead of short-term exposure events. Still, they are an important part of mining-related public health outcomes because they connect environmental damage to long term health and development problems for the population. It is important to see food security as a public health issue in mining areas so that we can plan integrated interventions that deal with both environmental contamination and nutritional resilience.

Health System Burden and Access to Care

Mining-related environmental contamination has long-term health effects that put a lot of stress on Ghana's health system, especially in rural and peri-urban mining areas. The rise in waterborne diseases, malaria, respiratory illnesses, work-related injuries, and long-term illnesses linked to toxic exposure has led to a greater need for healthcare services. However, there has not been a corresponding increase in health infrastructure, staffing, or funding. Because of this, local health facilities often have too many patients, which makes it harder for them to give timely and effective care (MOH, 2021).

People who live in mining communities often have trouble getting to health care because of things like long travel times to health facilities, bad transportation, and not enough trained health workers. In places where artisanal mining is common, informal settlements may not have any clinics nearby. This means that people have

to wait for treatment or rely on informal care. These access barriers lead to delayed diagnosis, disease progression, and increased morbidity, especially among vulnerable groups like children, pregnant women, and older adults (MOH, 2021).

It is noteworthy that the gap between health risks and system capacity shows how extractive economies push health costs onto other people. Mining brings in a lot of money for the country as a whole through exports, taxes, and royalties. However, the health problems that come with it are mostly felt in the areas where the mines are located, and there is often not enough money put back into health services to match the costs. This imbalance makes health inequalities worse and goes against the idea of health equity in development planning. Andoh (2026) contends that these dynamics are not coincidental but are entrenched within overarching frameworks of resource governance that prioritise economic extraction over human welfare. If there are no specific policies in place to direct mining revenues to local health systems, the health problems caused by mining will continue to put a strain on healthcare and keep people sick and poor. To deal with these problems, mining policy needs to take health impacts into account, environmental health monitoring needs to be improved, and communities affected by mining need to get targeted investments in healthcare infrastructure and preventive services.

Vulnerable Populations and Health Inequalities in Mining-Affected Communities

In Ghana, the health risks and environmental damage caused by mining are not evenly spread out across the population. Instead, they follow predictable patterns of social and economic inequality that hurt groups with little political power, money, and access to healthcare more than others. These differences show that extractive economies push environmental and health costs onto already marginalised groups. To frame mining as a public health and social justice issue, it is important to know who has the most health problems.

Artisanal and small-scale miners are one of the groups in Ghana's mining industry that is most at risk. These miners work in dangerous conditions because they do not have to follow the rules set by the government. The pits they work in are unstable, the air is not good, and they are in contact with toxic substances like mercury and cyanide for long periods of time. Without safety standards and personal protective equipment, the risk of injuries, respiratory illness, and long-term exposure to toxic substances goes up. Artisanal miners have to deal with both exposure and exclusion. They are directly exposed to environmental and occupational hazards, but they often don't have health insurance, workers' compensation, or other forms of social protection. Mining injuries and illnesses often lead to loss of income and long-term disability, which puts the responsibility of care on families and communities. These conditions demonstrate how informal labour arrangements exacerbate health vulnerability and perpetuate cycles of poverty and illness**.**

Women living in communities affected by mining face unique and heightened health risks, even if they are not directly involved in mining operations. Environmental pollution harms women by making them do things like collect water, cook food, and care for others, which puts them in contact with dirty water and food. Women also often do other mining-related jobs, like processing ore and trading informally, which may put them in direct contact with mercury and dust.

Health risks that are different for men and women are especially strong during pregnancy and breastfeeding. Exposure to mercury and other heavy metals presents significant hazards to maternal health and foetal development, resulting in low birth weight, developmental delays, and heightened infant morbidity. In mining communities, women often have trouble getting reproductive and maternal healthcare because of distance, cost, and health facilities that are too busy. This makes health outcomes worse. From a public health equity perspective, these gendered vulnerabilities underscore the necessity of integrating women's health considerations into mining governance and environmental health initiatives. Not doing so keeps gender-based health differences going and makes it harder to reach bigger goals for improving maternal and child health. Children are among the most vulnerable groups in mining-affected communities because their bodies are weak and they are still growing and developing. Heavy metals, especially mercury, are more harmful to children because they affect brain development and cognitive function. Children in mining communities are at a higher risk of getting infectious diseases like malaria and diarrhoea because they are undernourished and live in bad conditions. Frequent illness makes it hard for students to go to school and learn, which keeps the cycle of disadvantage going from one generation to the next. In certain mining regions, children are directly engaged in mining-related labour, which exposes them to physical dangers and jeopardises their long-term health and educational opportunities.

These intergenerational effects are especially alarming as they prolong the repercussions of mining beyond the current populace, influencing health and developmental outcomes for subsequent generations. To improve the health of children in mining areas, we need to use preventive measures that limit their exposure to harmful substances and make it easier for them to get education, food, and medical care (Krieger, 2011). People who live near mines in rural and indigenous areas often have the worst health problems and get the least economic benefit from mining. These communities depend a lot on local ecosystems for food, water, and jobs, which makes them especially vulnerable to environmental damage. Loss of farmland, pollution of rivers, and forced relocation of people all hurt traditional ways of making a living and social structures, which makes people more stressed and less able to bounce back (Briggs, 2003).

These communities cannot have much of a say in mining decisions or get compensation for environmental damage because they do not have much political representation and weak land tenure protections. Consequently, health risks accumulate over time, with minimal opportunities for mitigation or compensation. This pattern shows environmental injustice from a public health point of view. This is when marginalised groups bear an unfair amount of the environmental and health problems caused by economic activities that they benefit the least from. Mining areas often draw in migrant workers looking for work, which leads to the rapid growth of informal settlements that are overcrowded, have poor housing, and do not have enough access to sanitation and healthcare. These conditions pose further public health risks, such as augmented transmission of infectious diseases and intensified exposure to environmental hazards. Migrant populations may encounter obstacles to healthcare access owing to insufficient documentation, social exclusion, or inadequate awareness of available services. These barriers make health problems worse and make people less likely to report them. The concentration of vulnerable populations in environmentally degraded areas shows how migration, informality, and public health risk are all connected in mining areas.

Governance Failures and Public Health Policy Implications

The public health ramifications of mining-related environmental contamination in Ghana stem not merely from technical constraints or individual conduct, but are fundamentally entrenched in governance frameworks that dictate the regulation, oversight, and incorporation of mining activities into comprehensive development strategies. Weak enforcement of regulations, a lack of coordination between institutions, and a lack of focus on health issues in mining governance have all contributed to environmental hazards that continue to pose risks to public health (World Bank, 2024). Ghana has put in place laws and institutions to control mining and protect the environment. There are laws about mining minerals, protecting the environment, and keeping workers safe, but they are not always followed, especially in the artisanal and small-scale mining sector. Regulatory agencies are not very effective because they do not have enough money, political pressure, or institutional capacity. This lets harmful environmental practices continue with little accountability.

Weak enforcement makes it easier for people to be around toxic substances like mercury, cyanide, and heavy metals for longer periods of time. Regulatory failures are especially clear when it comes to keeping an eye on the quality of water, getting rid of trash, and reclaiming land. It is possible to find environmental violations, but they are not always punished enough, which makes people less likely to follow the rules and keeps unsafe practices going. These governance deficiencies directly facilitate the ongoing environmental contamination observed in mining areas (Andoh, 2026). Another big problem with governance is that responsibilities are spread out over many different institutions. Different ministries and agencies are in charge of mining oversight, environmental protection, and public health. Each has its own goals and priorities. This separation of institutions makes it harder to work together and makes it harder to include health issues in mining decision making.

Environmental assessments for mining projects often only look at how they affect the environment and not how they might affect the health of people living nearby. Health impact assessments, when performed, are often restricted in scope or executed subsequent to the initiation of mining operations. Because of this, public health risks are dealt with after they happen instead of before they happen, which makes long-term health problems more likely.

Because it is informal and decentralised, artisanal and small-scale mining is a unique governance problem. Attempts to stop galamsey through enforcement campaigns have not been very successful. This is partly because they do not deal with the social and economic factors that lead to informal mining, such as poverty,

unemployment, and problems with land access. From a public health perspective, criminalisation without supportive interventions heightens vulnerability by driving mining deeper underground, thereby diminishing opportunities for health education, exposure monitoring, and harm reduction. The lack of formal governance structures for artisanal mining constrains the acquisition of health data pertaining to occupational injuries, toxic exposure, and disease prevalence. This lack of data makes it harder to plan for public health based on facts and makes it harder to see the full extent of health problems caused by mining.

A primary theme identified in the governance analysis is the externalisation of health costs linked to extractive economies. Mining brings in a lot of money for the state and helps the national economy, but the health problems caused by pollution and dangerous jobs are not evenly distributed among local communities. These communities frequently lack the political influence necessary to advocate for the reinvestment of mining revenues into health infrastructure, environmental remediation, or preventive services. Andoh (2026) contends that this trend signifies a structural imbalance in resource governance, prioritising economic extraction over social and environmental sustainability. From a public health policy standpoint, the inability to internalise health costs hampers equitable development and transfers the enduring burden of disease to populations least equipped to manage it.

To see mining as a public health issue, the government needs to change its priorities. Mandatory health impact assessments, better environmental health surveillance, and cooperation between mining, environmental, and health authorities are all ways to make sure that public health is taken into account in mining policy (Minerals Commission Ghana, 2023). This kind of integration would make it easier to find exposure risks early on and help with preventive measures before health problems become permanent. It is also important to put money into local health systems. To deal with higher disease burdens, communities affected by mining need targeted improvements to their healthcare infrastructure, workforce capacity, and diagnostic services. Setting aside some of the money made from mining to improve the health systems in affected areas could help fix existing inequalities and make people's health better.

Lastly, getting people involved in their communities is very important for good governance. Getting local people involved in keeping an eye on the environment and reporting health problems can make public health interventions more accountable and responsive. Governance models that include community involvement are more likely to deal with the real-life health risks that come with mining and lead to long-term benefits.

Public Health Interventions and Policy Recommendations

To deal with the public health problems caused by mining-related pollution in Ghana, the government needs to move away from reactive regulation and towards health-cantered, preventive governance. Effective interventions must acknowledge mining as a structural determinant of health and implement integrated strategies that mitigate exposure, enhance health systems, and safeguard vulnerable populations. This part talks about important public health actions and policy suggestions that could help lower the health costs of economies that rely on extraction. One of the biggest problems with Ghana's mining policies is that they do not use comprehensive health impact assessments (HIAs) enough. Environmental impact assessments are often required, but they tend to focus on ecological indicators instead of health outcomes for the population. HIAs should be required as part of the process for getting permission to mine and renewing mining permits. They should look at the possible health risks of water contamination, toxic exposure, occupational hazards, and disease ecology before mining starts.

HIAs would help policymakers find groups of people who are at high risk, figure out how their exposure will build up over time, and come up with ways to protect people based on their specific health needs. From a public health standpoint, the prompt identification of risk is crucial for averting long-term disease burdens and diminishing healthcare expenses linked to chronic exposure.

Reducing exposure to mercury is still a top priority for public health in Ghana's gold mining industry. Training programs and technical support for artisanal miners should promote technologies that don't use mercury or use less mercury, like gravity concentration methods. Public health agencies can work with mining authorities to set up community-based education programs that teach people about the health risks of mercury and how to handle it safely.

Preventing exposure must also include people who live near mines. Regularly checking levels of mercury in food, water, and soil is important for finding places where people are most likely to be exposed and for making public health recommendations. Targeted screening programs for at-risk groups, especially children and pregnant women, can help find health problems caused by mercury early and make it easier to get help quickly.

A basic public health measure in areas affected by mining is to make it easier for people to get clean water. To lower the risk of getting sick from contaminated sources, we need to invest in water treatment infrastructure, alternative water supply systems, and regular monitoring of water quality. Environmental health surveillance systems need to be improved so that they can keep track of changes in the quality of water, soil contamination, and the number of diseases over time. Combining environmental data with health surveillance systems would make it easier to find links between exposure and disease and help make decisions based on facts. This kind of integration is especially important in places where contamination continues even after enforcement efforts, which shows how important it is to keep an eye on public health.

Interventions for occupational health must take into account the specific risks that artisanal and small-scale miners face. Making it easier for people to get personal protective equipment, safety training, and basic health care can lower the number of injuries and toxic exposures. Licensing and cooperative models for artisanal mining may help with regulatory oversight and make it easier to provide occupational health interventions.

Importantly, public health strategies should steer clear of punitive measures that push informal mining deeper underground. Harm-reduction frameworks that put worker safety and health protection first are more likely to lead to long-lasting improvements in the health of the population. To deal with the externalisation of health costs linked to mining, policy tools should make sure that some of the money made from mining goes to strengthening the health systems in the communities that are affected. Investing in healthcare infrastructure, staffing, and essential medicines can help lower the number of diseases and make it easier for people to get care. Reinvesting in this way is in line with the ideas of health equity and social responsibility. It makes sure that communities that have to pay for the health costs of mining get real benefits, like better healthcare services.

DISCUSSION

This study shows that pollution from mining in Ghana is a big public health problem that is not getting enough attention. By delineating the pathways through which mining impacts water quality, food systems, occupational safety, disease ecology, and health system capacity, the analysis underscores how extractive economies produce intricate and cumulative health burdens that extend significantly beyond immediate mining areas. One of the most important things this article does is change the way we think about mining as a

structural determinant of health. The findings indicate that mining systematically alters environmental and social conditions, resulting in predictable patterns of disease and inequality, rather than considering health outcomes as mere by-products of economic activity. These patterns have a bigger impact on artisanal miners, women, children, rural communities, and migrant populations groups that already have trouble getting healthcare and political representation. The ongoing health risks associated with mining demonstrate wider governance issues, such as ineffective regulatory enforcement, disjointed institutional duties, and insufficient incorporation of public health factors into development strategies. Andoh (2026) contends that these challenges are inherent in extractive development models that emphasise immediate economic benefits at the expense of enduring human welfare. Mining will continue to harm public health even as it brings in money for the country if people do not make an effort to internalise health costs. The results also show how important it is to take a public health approach that works for everyone. While site-specific remediation and enforcement actions are necessary, they are not enough to deal with cumulative and spatially diffuse exposure pathways. An integrated governance framework must include environmental protection, strengthening the health system, workplace safety, and community involvement in order for public health responses to work.

CONCLUSION

Mining remains a vital component of Ghana’s economy, yet it is environmental and public health costs are substantial and enduring. This article has shown that mining-related environmental contamination operates through multiple exposure pathways to produce a wide range of adverse health outcomes, including neurological

impairment, infectious disease, respiratory illness, nutritional vulnerability, and health system strain. These impacts are not evenly distributed, but instead reflect structural inequalities that place the greatest burden on marginalized populations. Reframing mining as a public health issue is essential for achieving sustainable and equitable development. Integrating health impact assessments into mining governance, reducing toxic exposure, strengthening environmental health surveillance, and reinvesting mining revenues in local health systems represent critical steps toward mitigating the health costs of extractive economies. Without such reforms, the health burdens associated with mining will continue to erode population well-being and undermine long-term development gains. By prioritizing public health within mining policy, Ghana has the opportunity to transform extractive activities from a source of preventable disease into a development pathway that safeguards both economic progress and human health.

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