

Safety and health in mining: Part 3

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Safety and health in mining is a position paper summarising key occupational safety and health risks in mining and their prevention. The paper is a joint effort by the members of the Scientific Committee on Mining Occupational Safety and Health (SC MinOSH) of the International Commission on Occupational Health (ICOH). The position paper will be published in three parts, in *Occupational Health Southern Africa*. The abbreviations and references used will be listed for each of the three parts. References are numbered consecutively across the three parts. The paper will also be published in its entirety on the ICOH website, as an output of SC MinOSH.

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PART 3

4. SPECIAL ISSUES IN INFORMAL MINING

The definition of artisanal and small-scale mining used here denotes 'mining by any method not involving substantial expenditure by an individual or group of persons, not exceeding nine in number, or by a co-operative society made up of ten or more persons'.¹⁶¹ This definition encompasses what is termed 'artisanal' operations that use only rudimentary implements, as well as mining that involves more sophisticated activities but operates at a relatively low level of production and requires limited capital investment. Processing of raw materials is often done in homes or near settlements. Sometimes, water sources that are used to treat the mineral resources, are also used as sources of domestic water supply.¹⁷

The United Nations Department of Economic and Social Affairs (UNDESA) describes small-scale mining as largely poverty-driven.¹⁶² Linked with poverty are many direct and indirect factors that contribute to challenges to human health in artisanal and small-scale mining communities.⁷⁷ Most mining community residents live in rural settings that lack basic resources, such as healthcare services and clean potable water. In artisanal and small-scale mining areas, there is often little separation between residential and mining activities and thus, community residents tend to be exposed to hazards that arise from mining activities. The interplay of occupational and general environmental factors with the socio-economic aspects necessitates that health impacts are viewed from a broad public health perspective.¹⁶³ 'Public health' as used here encompasses the broad notion of health as being 'not merely the absence of disease, but a state of complete physical, social and psychological wellbeing'.¹⁶⁴

4.1 Impacts on community health

The focus of this section is on communities residing in the locality of artisanal and small-scale mines.

Health effects of chemicals

Studies on artisanal and small-scale mining communities worldwide have provided some evidence of acute and chronic mercury-associated adverse health outcomes mediated through exposure to mercury. This exposure is caused by inhalation of inorganic or elemental mercury during smelting of amalgam, or ingestion of methylmercury in fish from contaminated water bodies, with effects on the renal, nervous, and immune systems.^{77,165,166} Risk assessments of heavy metal concentrations, especially arsenic, in surface and groundwater samples, and in cassava from four mining communities in the Western Region of Ghana, found cancer risks to be higher than the US Environmental Protection Agency's (EPA) acceptable range.^{167,168} However, no data exists on cancer rates in artisanal and small-scale mining sites, and further research is required to determine if such exposures might affect health outcomes in these communities.¹⁰⁶

The respiratory health of miners involved in artisanal and small-scale mining has not been studied extensively.¹⁰⁶ However, it is known that, in addition to biomass cooking smoke which is a major concern for respiratory health in rural communities, exposure to respirable crystalline silica, which exceeds 30% in some gold ore dusts, might occur.¹⁶⁹⁻¹⁷¹

It is worthwhile to consider that, in low-income countries, mixtures of hazardous substances within the vicinity of small-scale enterprises, smelters, mines, agricultural areas, toxic waste disposal sites, etc., often present complex health hazards to the local populations. Hence, there is a need to study the toxicological effects of mixtures of metals, pesticides, and organic compounds in these different exposure scenarios, of which artisanal mining is an example.¹⁷²

Noise

While noise is typically treated as an occupational hazard and is a public health concern, limited information is available on noise exposures associated with artisanal and small-scale mining processes, in miners or residents.^{106,173} Many tasks carried out within the artisanal and small-scale gold mining (ASGM) work process (extraction, crushing and milling) are associated with elevated occupational and community noise levels, often to levels that exceed guideline limits for the prevention of noise-induced hearing loss (NIHL), as reported by the WHO.¹⁷⁴

An Ecuadorian study in gold miners working in small-scale mines showed noise levels above 85 dB(A), largely dependent on the work area, and a prevalence of 32% of work-related sensorineural hearing loss, with a fourfold increased risk of developing NIHL in those working for longer than ten years.⁴² A pilot study in Ghana measured occupational noise exposures among residents of an ASGM community and documented average exposures during mining activities in the region of 85 dB(A); during grinding or crushing operations, the noise levels exceeded 92 dB(A).¹⁰⁸ In a study of noise exposures among individuals residing in a Nicaraguan ASGM community, miners and non-miners reported exposure to loud noise for more than 40 hours per week.¹⁷⁵ These and other studies indicate that health effects related to noise are not confined to mine workers, since it is common for mining activities to be interspersed within residential and commercial areas.¹⁷⁶

Injuries

Very little information is available regarding occupational injuries in artisanal and small-scale mining operations. Further, there is no systematic national- or

local-scale injury surveillance. A study in the small-scale mining district of Geita in Tanzania showed that district mining accidents were responsible for about 11 fatalities annually, with the main causes of accidents nationwide being tunnel collapses.¹⁷⁷ A study of an ASGM community in the Democratic Republic of the Congo revealed that 392 accidents had occurred during the 12 months preceding the study, affecting 72% of the miners, with most affected by accidents involving tool handling.¹⁷⁸ Data from Zimbabwe showed that ground falls and machinery/vehicle accidents were each responsible for 25% of reported mine fatalities in 1997. The study also estimated that two unreported deaths per month could occur during illegal mining of closed mines and unsafe alluvial mining.¹⁷⁹ Due to the ASGM process being relatively comparable across regions, similar patterns in injuries and accidents can be expected in other areas. The International Labour Organization (ILO) estimates that artisanal and small-scale mining operations worldwide are burdened by six to seven times more non-fatal accidents than large-scale operations.¹⁷ Injuries are known to have tremendous economic and social impacts on affected workers, as well as society as a whole.¹⁸⁰ Many factors are involved in evaluating the costs of injuries and fatalities, including healthcare costs, lost productivity for the injured worker, disability costs, and quality of life costs. Accidents and fatalities adversely affect both the injured parties and their families.¹⁰⁶

Nutrition

In addition to concerns about nutritional intake and food insecurity, there are concerns about food safety in artisanal and small-scale mining communities. Fish and other edible items from mining areas have been found to contain mercury and other heavy metals that likely entered the environment because of mining practices.¹⁸¹

HIV/AIDS and sexual health

Due to socio-cultural and socio-economic factors,¹⁸² members of small-scale mining communities, particularly ASGM communities, might be especially vulnerable to Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome (HIV/AIDS) and other sexually-transmitted infections (STIs).¹⁸³ Under-employment and related factors may encourage sex work, particularly among women.^{163,184}

Water, sanitation and vector-borne diseases

Malaria transmission has been associated with increases in the amounts of standing water (ideal mosquito breeding sites) in the vicinities of living quarters in mining communities in Ghana and Brazil.^{185,186} ASGM has also been cited as a risk factor for malaria and some other infectious diseases due to 'a possible reduction in acquisition of immunity that may be associated with conditions in gold mining, including mercury exposure', as stated by authors in Pará, Brazil.¹⁸⁷ Distances to remote gold mining sites¹⁸⁸ and the land use changes that often accompany ASGM, such as streambed disturbance, have been proposed as a mechanism for the spread of Buruli ulcer, a bacterial infectious disease affecting soft tissue.¹⁸⁹ In Ghana, the proximity of endemic Buruli ulcer communities to mining activity lends itself to speculation for ASGM as a risk factor for this disease.¹⁸⁸

Psychosocial health

Population growth associated with small-scale mining can strain resources, and many communities remain impoverished without adequate infrastructure and health services. Poverty and unsanitary living conditions raise concerns for psychosocial stress, inadequate nutrition, infectious diseases, and untreated chronic conditions. Tensions and conflict within communities can add to stress, while violence increases the risk of injuries and fatalities. The lack of accessible

healthcare in many communities compounds these risks. Without financial resources to cope with injuries or disease, poverty increases the risk of livelihood 'shocks' that temporarily impact negatively on wellbeing. These shocks can perpetuate a cycle of poverty,¹⁹⁰⁻¹⁹³ resulting in inadequate resources to sustain health. While evidence for physical health risks of ASGM is increasingly common in the literature, there are few studies on stress in artisanal and small-scale mining communities.¹⁰⁶

4.2 Women and children mine workers

Africa is reputed to have the highest proportion of female miners in artisanal and small-scale mining; women constitute 40 to 50% of small-scale miners in Zimbabwe and 40% in Tanzania, while in India they constitute 30%.¹⁹⁴ Although it is estimated that more than one third of artisanal miners in Zimbabwe are women, a 2015 scoping study showed that only 11% of artisanal miners in the two target areas reviewed were women.¹⁰⁵ Generally, in Asia, less than 10% of miners are women, while in Latin America, they constitute 10 to 20% of the mining labour force.^{194,195} The roles of women in small-scale mining have been largely overlooked by policy makers.^{105,163}

4.2.1 Work activities undertaken by women

In some areas of Africa and elsewhere, women tend to be engaged in mineral processing, such as digging and crushing on the one hand, and transporting or wagon-loading on the other hand.¹⁹⁶ Hayes (2008) reported on a study in Africa where women are involved in almost all stages of small-scale mining, from digging, crushing and pounding rocks, transporting, washing and sorting materials, and processing (i.e. amalgamation of gold), to trading activities.¹⁹⁷ Women have also been cited for involvement in drilling and exploratory excavations, traditionally regarded as men's work.¹⁹⁸ Gueye (2001) reported that women involved in small-scale mining in Burkina Faso performed 90% of mine ore processing activities.¹⁹⁹ According to Chakravorty (2001), women are employed in mining activities because of their alleged feminine characteristics, such as being assiduous, systematic and dependable;²⁰⁰ women also play multiple roles within their mining responsibilities, including being leaders of their groups and acting as conflict mediators.²⁰¹ In spite of the significant roles women play in small-scale mining activities, at all levels, they are rarely recognised as 'miners'.²⁰²

Most often, financial compensation for women lags behind that of their male counterparts. In some instances, e.g. the Philippines, women work without pay as they assist the male members of the family with this work.²⁰³ According to the ILO,¹⁷ women in artisanal and small-scale mining are usually compensated less than male mine workers. In the Birim North District in Ghana, women were paid various monthly rates in 2007, ranging from US\$50 to US\$100.¹⁶³ Bhagyalakshmi (2007) cites the monthly income of women in India as US\$120,¹⁹⁶ and Hayes (2009) reports approximately the same income for women in the Democratic Republic of the Congo.²⁰⁴ In Ecuador, female miners are called 'jancheras' and are mainly responsible for checking that no gold remains in the discarded materials.⁴²

4.2.2. Women's health and safety

Many artisanal and small-scale mining operations are conducted illegally. Hence, government regulations on safety and health standards are not enforced, or the mine does not follow the regulations.²⁰⁵ Lack of awareness of the risks inherent in mining, limited access to better equipment, and lack of proper education and training on safe work practices, are cited as factors leading to poor health and safety practices for all workers in small-scale mining.^{23, 205} However, women in mining are confronted with these issues in addition to those related to the double burden of work-home responsibilities.²⁰⁵ Women in

Bolivia have been noted to work long shifts, and are exposed to contaminated water without any protection.²⁰⁶ Other hazardous exposures for women in these environments include silica dust and dusts from manganese and other minerals, which may cause respiratory diseases, and also toxic chemicals like cyanide or mercury, used in extracting gold. The health of these women is compromised; millions of workers, including women and children, die or are injured annually due to mining work.²⁰⁵ Life expectancy of women engaged in small-scale mining in Bolivia is rarely above 40 years.²⁰⁶

Exposure to dust is a common hazard among women in mining, particularly those women involved in the crushing of ore.¹⁹⁸ The dust, when inhaled, can cause lung diseases and other respiratory ailments. Exposure to dust can also cause skin irritation and eye damage. Protective measures tend to be inadequate; for instance, Bhagyalakshmi (2007) reports that women workers in southwest India use towels to cover their faces, as protection from the red dusts generated from manganese-containing ore.¹⁹⁶

Miners also suffer from musculoskeletal disorders such as back pain. This may arise from the impacts of manual lifting of materials, to which women are more vulnerable because of their generally smaller and more fragile frames, when compared to their male counterparts.^{200,203} In Uganda, women working as salt miners have been reported to suffer from genital corrosions and miscarriages due to prolonged standing in concentrated saltwater.¹⁹⁷

Although few studies have characterised injuries in small-scale gold mining communities, the ILO estimates that small-scale mining in low-income countries, which employs large numbers of women and children, generates a workplace fatality rate up to 90 times higher than mines in high-income countries.¹⁹⁴ Physical trauma and miscarriages due to stress and injuries have been cited as risks to women in mining.¹⁹⁶ Studies in the small-scale gold mining region of Tarkwa in Ghana found the most injury-prone mining activities to be related to excavation and crushing. While the overall injury rate was five per 100 person years, the rate for women of 12 per 100 person years was significantly higher.²⁰⁷

Other health risks to women and girls that have been attributed to mining activities include sexual violence and abuse, and vulnerability to HIV/AIDS and other STIs.^{183,208} Women and girls may be particularly susceptible, given the inadequate access to sex education, healthcare, and family planning services in many ASGM communities, and the religious and social stigmas surrounding sex and contraceptive use. Because mining communities are predominantly composed of males with disposable incomes, economic factors such as under-employment may encourage women to engage in sex work in exchange for money or for jobs at mining sites, exacerbating the negative impacts of the mining environment on their safety and wellbeing.^{163,184,185}

4.2.3 Children's health and safety

The ILO states that a large number of children work in artisanal and small-scale mining.¹⁹⁴ In Papua New Guinea, for example, children provide up to 30% of the labour in small-scale mining.⁹ Children are found on the worksites, mainly in the company of their guardians, or driven by poverty, as they often have to fend for themselves. Children and women involved in artisanal and small-scale mining are exposed to similar risks, due mainly to their inherent vulnerabilities. Human Rights Watch, reporting on the problem of child labour in five Tanzanian cities/districts, states that community or family members are exposed to mercury during processing of ore for gold at home, or from eating mercury-contaminated fish from nearby rivers.²⁰⁸ Most adult and child miners are unaware of the grave health risks associated with exposure to mercury. Girls residing on mining sites, or in close proximity to artisanal and small-scale mining operations, face sexual harassment, including pressure to engage in sex work. As a result, some girls become victims of commercial



Children washing and sorting copper ore in water and mud, at an open-air mine in Kamatanda in Katanga, southeastern Democratic Republic of the Congo

Photograph: Gwenn Dubourthoumieu

sexual exploitation and risk contracting HIV and other STIs. Children who work in mining very often miss out on crucial educational opportunities and experiences.²⁰⁸

4.3 Improving working conditions in informal mining

Problems related to work in small-scale mining are primarily the result of its informality: no registers are kept; no taxes are paid; and contacts with, and support from, authorities are rare or non-existent. In low-income countries, the informal economy is populated by marginalised and vulnerable workers. There is a lack of infrastructure and facilities for safety and health. Associated factors that impact on health include job insecurity, lack of health insurance and other social benefits, no affiliation to worker unions or other worker organisations, lack of personal protection, migrant work, increasing numbers of women workers, and child labour.

From a long-term perspective, national development of the economy and society is necessary in order for informal work such as artisanal and small-scale mining to be legalised and formalised, particularly since the informal sector is a major contributor to the economy of many low-income countries. Education in primary and secondary schools has to be expanded and developed. National health systems have to be established or strengthened.

From a short-term perspective, the challenge for government at all levels, policy makers, health and safety professionals, worker organisations, community organisations and other non-governmental agencies, is to develop strategies that are inclusive, appropriate and feasible, with the ultimate objective of protecting informal workers and their dependants.^{105,183,209} Priority should be given to improvement of the conditions of vulnerable groups, mainly women and children. Labour inspection should be modernised and more resources should be provided for supervising and supporting work in informal mining. Frequent and substantial training in health and safety should be organised, and consideration given to apprenticeships to help workers understand the hazards and the means of reducing risks, through advice from more experienced workers. Safer mining methods must be introduced, e.g. by promotion of mercury-free gold mining and prohibition of dangerous mining activities such as underwater mining.²¹⁰ Prevention of occupational safety and health risks in artisanal and small-scale mining is difficult to achieve, and continued research is needed, along with development, implementation, and sharing of good practices.

The fact that many of the workers in artisanal and small-scale mining

are women and children creates special challenges for this sector. Governments, the United Nations (UN) agencies, donors, artisanal miners, gold traders, and companies are called upon to prioritise and fully support the elimination of child labour in an integrated way.²¹¹ Boys and girls should be enabled, encouraged and supported to go to school, and if possible, their families subsidised, to avoid the need for an income from the children. As for women, legal frameworks and development projects should include provision of more environmentally viable and sustainable employment.^{105,183} Attention should be paid to women facing disproportionate exposures due to their roles as mothers and home-makers, coupled with those arising from their involvement in mining.¹⁷ Women in artisanal and small-scale mining are known to experience negative impacts on their reproductive health, affecting fertility and/or pregnancy. Future generations are endangered when pregnant women work as miners or are involved in mining-related activities. This makes preventive measures important, especially in the case of women of child-bearing age. Preventive measures include avoiding heavy lifting in late pregnancy, and avoiding close contact with mercury, lead and other metals with health-detrimental effects. Research has shown that brain damage in the foetus hampers early childhood development, in cases where mothers were severely exposed to heavy metals such as mercury and lead during pregnancy.²¹²

Several international organisations provide comprehensive guidance on how to study, inform and raise awareness, and improve working conditions in artisanal and small-scale mining. The ILO organises conferences and other types of meetings to disseminate information about the working conditions, and to discuss and implement actions for change. Guidelines exist for the formulation of national employment policies and for the development of inspection manuals for worker safety and health.¹⁵ There are many examples of how to reduce and eliminate child labour in small-scale mining activities, and how cooperation can be established between the ILO's International Programme on the Elimination of Child Labour (IPEC) and local authorities.¹⁷ Activities to address informal mining issues are coordinated and facilitated by the ILO, often in collaboration with other organisations, including the United Nations Environment Programme (UNEP), the Southern African Development Community (SADC), the International Institute for Environment and Development (IIED), and the WHO.

The World Bank offers technical assistance to increase productivity in artisanal and small-scale mining, while also addressing social protection and fair labour standards, for example, within the Bank's programme on 'Communities, Artisanal and Small-Scale Mining' (CASM).¹² The Bank includes mining within a broad effort in local economies to promote better integrated rural development strategies. Pilot efforts are underway to model clean supply chains and fair trade of minerals as a means to spread the principle of responsibility across the supply chain. Additional organisations active in ASGM, considered to be one of the world's top ten pollution problems, include the United Nations Industrial Development Organization (UNIDO), Human Rights Watch, Green Cross, World Business Council for Sustainable Development (WBCSD), and Blacksmith Institute.

Although many organisations are active in terms of working conditions in artisanal and small-scale mining, there is considerable scope for additional action. It is estimated that 20 to 30 million mine workers are involved in informal mining across 80 countries, most of which are low-income countries. The safety and health risks that these workers are exposed to are numerous and serious – for them, their families and the surrounding communities. Infrastructure and facilities for preventive safety and health work are scarce or non-existent.

5. MESSAGE FROM THE ICOH SCIENTIFIC COMMITTEE ON MINING OCCUPATIONAL SAFETY AND HEALTH (SC MINOSH)

The ICOH SC MinOSH is committed to continuing its contributions to addressing risks and implementing sustainable solutions, in both formal and informal mining. The SC MinOSH has established its own website (www.icoh-minosh.com) to include activities and materials relevant to mining. There is a plan to develop a repository of useful publicly available materials and resources, obtained from national and international organisations. As described on the website, the SC MinOSH collaborated with three ICOH Scientific Committees (SCs) (SC Industrial Hygiene, SC Occupational Health and Development, and SC Small-Scale Enterprises and Informal Sector), and with other organisations, to host a conference and workshop on mining in August 2017, with small-scale and large-scale mining tracks. The conference presentations will be made available by webinar, especially for experts and interested parties from low-income nations who are unable to attend the training. The SC MinOSH will continue to establish collaborations with other ICOH SCs, other researchers and stakeholders in large-scale mining, as well as artisanal and small-scale mining. SC MinOSH members will be encouraged to promote the website and to provide extension services for informal mining, and will be engaged in further efforts regarding working conditions and preventive actions in formal and informal mining.

ABBREVIATIONS USED IN PART 3

AIDS	Acquired Immunodeficiency Syndrome
ASGM	Artisanal and small-scale gold mining
CASM	Communities, artisanal and small-scale mining
EPA	Environmental Protection Agency, USA
HIV	Human Immunodeficiency Virus
ICOH	International Commission on Occupational Health
IIED	International Institute for Environment and Development
ILO	International Labour Organization / International Labour Office
IPEC	International Programme on the Elimination of Child Labour
NIHL	Noise-induced hearing loss
SADC	Southern African Development Community
SC MinOSH	Scientific Committee on Mining Occupational Safety and Health
SCs	Scientific Committees
STIs	Sexually-transmitted infections
UN	United Nations
UNDESA	United Nations Department of Economic and Social Affairs
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
US/USA	United States/United States of America
US\$	United States Dollars
WBCSD	World Business Council for Sustainable Development
WHO	World Health Organization

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