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Gendered health impacts of industrial gold mining in northwestern Tanzania: perceptions of local communities

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ABSTRACT

Mining projects affect the health of surrounding communities by inducing environmental, economic, social and cultural changes in different population groups. Health impact assessment (HIA) offers an opportunity to manage these impacts. This paper aims to explore gender differences of impacts on the wider determinants of health as described by communities impacted by industrial gold mining and consider the implications for impact assessment. We conducted 24 gender-separated, participatory focus group discussions at three study sites in northwestern Tanzania. Participants reported on a broad range of impacts on the wider determinants of health. Based on a thematic analysis, we identified gendered health impacts on men and women; in addition, children and adolescent boys and girls emerged as differently affected subpopulation groups. Located in the theory of the 'triple role of women', we suggest that different gender needs should be addressed more explicitly by HIA. Increased use of mitigation measures that recognise and address impacts on women's engendered roles, and their health, through addressing women's strategic gender needs, would strengthen HIA as a tool towards sustainable development.

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1. Introduction

Natural resource extraction projects (NREPs), such as industrial gold mines, may have transformative potential for sustainable development, encompassing the health-related targets of the Sustainable Development Goals (SDGs) (Yakovleva et al. 2017, Winkler et al. 2020a). This includes both positive and negative implications for local communities and their health. On the one hand, NREPs have the potential to strengthen health systems through partnership arrangements and improve people's health through specific disease prevention and health promotion measures (Knoblauch et al. 2014, 2020). Further, NREPs can contribute to health and well-being through improved socio-economic status or upgraded infrastructure and public services, such as education and access to clean water, sanitation and hygiene (Admiraal et al. 2017; Winkler et al. 2012). On the other hand, environmental degradation, exacerbating poverty and social disruption associated with NREPs often lead to adverse health outcomes in impacted communities (Winkler et al. 2012; Carney and Gushulak 2016; Aboka et al. 2018; Dietler et al. 2020a).

Due to their different social roles, men and women do not equally experience the benefits and trade-offs of NREPs. Previous research suggests that women are disproportionately affected by the negative impacts

(Eftimie et al. 2009b; Muchadenyika 2015; Sulle and Dancer 2019; see also Hill et al. 2021, Kimotho and Ogol 2021, this volume). Evidence also shows that particularly in terms of socio-economic impacts (e.g. employment), women are left behind if no specific measures to promote their inclusion are put in place (Adusah-Karikari 2015; Knoblauch et al. 2018). This paper builds on this body of research by focusing on the gendered health impacts of large NREPs, based on the example of industrial gold mining in Tanzania.

Gender can be defined as a social construct referring to the conventions, roles, behaviours, rights, and decision-making power of men and women in society (Krieger 2003). As such, gender is also considered as a structural determinant of health, together with social class and ethnicity (WHO 2010). Gender thus intersects with other factors, such as age, education, income, ethnicity, sexual orientation and place of residence, and the impact of gender on health and any mitigating interventions must be considered in the context of these other factors (Bates et al. 2009; Hankivsky 2014; O'Neill et al. 2014). As a powerful determinant for health and well-being, achieving gender equity is also an important step towards a more equitable world as stated in the imperative of the 2030 Agenda for Sustainable Development to 'Leave no one behind' (UNGA 2015; George et al. 2019).

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 Supplemental data for this article can be accessed [here](#).

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Mining companies, financial institutions, and international civil society organisations have developed tools, measures and strategies to reduce gender inequities and prevent potential adverse health impacts. For example, the international mining company Rio Tinto (2009), has published a resource guide emphasising the importance of gender and diversity in local communities; the World Bank and the International Finance Corporation (IFC) have provided guidance documents pertaining to gender aspects in risk mitigation and project development potential in affected communities (IFC 2009, 2018; Eftimie et al. 2009a; World Bank 2016, 2018); and the civil society organisation Oxfam has produced a gender impact assessment (GIA) guidance (Hill et al. 2017). Impact assessments are commonly carried out at different stages of NREP development, to systematically identify and mitigate potential negative impacts along with maximising potential positive impacts – and as such present an opportunity for operationalising such tools. Guidance for health impact assessment (HIA) has also been developed (e.g. ICMM, 2010; IPIECA, 2016). When it comes to the application of these guides and tools, however, there is a significant gap between theory and practice (see also Götzmann and Bainton 2021, this volume). This holds particularly true for sub-Saharan Africa where research has demonstrated that HIA practice comes with many challenges (Leuenberger et al. 2019; Dietler et al. 2020b; Winkler et al. 2020b).

While several papers have investigated economic or social gender impacts in industrial mining areas in Africa, gender-specific health impacts have not yet been researched (Jenkins 2014; Adusah-Karikari 2015; Muchadenyika 2015). Additionally, while many studies on gender issues in NREP settings have focused on women, far fewer have engaged deeply with men's gender roles as part of scrutinising the complexity of gender issues (Hankivsky 2012). Therefore, this paper explores local perspectives on how NREPs impact on gender roles as related to health. More specifically, our research seeks to understand how NREPs influence the wider determinants of health and how the respective health outcomes are distributed in communities, with a focus on the differences between men and women. The 'wider determinants of health' can be defined as a diverse range of environmental, economic and social factors which impact on people's health; where it is recognised that such factors are influenced by the distribution of power and resources that shape the conditions of everyday life (WHO 2010). Our research was guided by the following three research questions: How do affected communities perceive impacts of large NREPs on the wider determinants of health? How are these impacts distributed among key population subgroups? How are the differences between men and women explained?

The paper proceeds as follows. We first present the methodology and findings from our qualitative field study conducted in Tanzania and contextualise the

gendered health impacts with the theory of the 'triple role of women' (Moser 1989, 1995). We then discuss the implications of the results for promoting HIA as a unique opportunity to more explicitly address strategic gender needs in NREP settings.

2. Methods

This study was conducted as part of a larger research project, including the necessary ethics approvals, aiming to generate scientific evidence about health impacts in mining settings to strengthen HIA in sub-Saharan Africa (Farnham et al. 2020; Winkler et al. 2020a).

2.1 Study area

The study was conducted in northwestern Tanzania, where several industrial gold mines have been implemented in the last two decades, including the three gold mines investigated. Data was collected in communities surrounding the Geita, Bulyanhulu and Buzwagi gold mines (see Figure 1). In these rural areas, agriculture is the main occupational activity, while artisanal mining was observed around all three industrial mines (Ministry of Health Zanzibar and Office of Chief Government Statistician Zanzibar 2016). With the implementation of the large-scale gold mines, the livelihoods of local populations have changed, which can be closely linked to the associated loss of land and rapid urbanisation (Bainton et al. 2020; Dietler et al. 2020a).

2.2 Sampling and interviewees

At each study site, we collaborated with local coordinators from the respective health district. Based on a transect walk under the guidance of the local coordinator, we identified highly impacted communities in proximity of the mine and identified community members for focus group discussions (FGDs). In the selected villages and with the assistance of community leaders or health workers, gender-separated FGDs were held with purposively sampled community members.

Overall, 183 community members participated (94 men, 89 women), with an average of eight community members per FGD (see Table 1). On average, participants were 44.5 years old (median: 42 years), had lived for 20 years in their communities (median: 18 years) and had attended few years of formal education. Agriculture was the main occupation reported, but artisanal mining was also mentioned as a common income-generating activity at all study sites. Furthermore, about a third ($n = 27$) of all participating women were running their own business, and a minority ($n = 3$) of them considered being a housewife as their main occupation. At the time of the data collection, none of the participants reported being employed by the mining companies. Notably, unskilled labour work, such as a local security guard

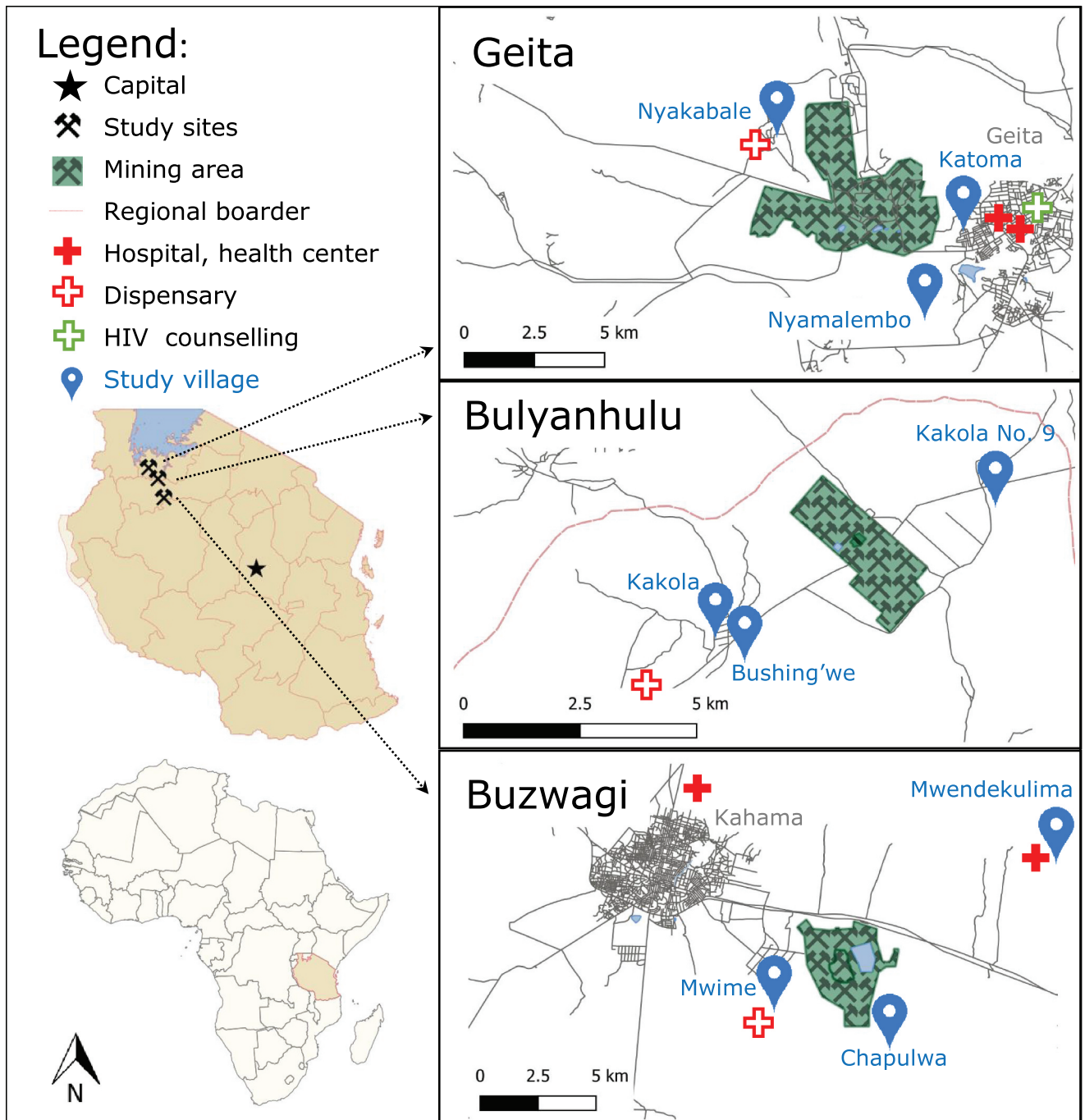


Figure 1. Map of study area and study sites with indicated study villages, where data has been collected in Tanzania, 2019.

(*'sungusungu'* in Swahili) at the mines, was not considered by participants to constitute 'proper employment'. About a third ($n = 58$) of all respondents (but relatively more women, $n = 35$, 60.3%) were actively engaged in community-based organisations, such as 'savings and borrowings' (*'vikoba'*) or the association of vegetable gardeners.

2.3 Data collection and preparation

Fieldwork was conducted from March to May 2019. As shown in Figure 2, a participatory tool to collect, categorise and rank impacts on the wider determinants of health was used to facilitate the FGDs. All discussions were

moderated and audio-recorded in Swahili by an experienced social sciences researcher (female, Tanzanian) and assisted by another researcher (female, Swiss). At all three study sites, four FGDs were conducted with men and four with women (24 FGDs in total), each of which lasted on average 91 minutes and was followed by a team debriefing. Swahili audio-files were transcribed verbatim into English.

2.4 Data analysis and theoretical framing

As indicated in Figure 2, the aim of the analysis was threefold: (1) to explore the communities' perceptions of impacts on the wider determinants of health; (2) to compare the differences in how women and men

Table 1. Socio-demographic characteristics of study participants from all 24 focus group discussions conducted at the three study sites in northwestern Tanzania.

	Women	Men	Total
Total number of participants	94	89	183
Age			
Average (in years)	41.5	47.6	44.5
Range (in years)	20-77	19-77	19-77
Marital status			
Married	75	85	160
Single	17	4	21
Widowed	2	0	2
Education			
None	8	3	11
Primary incomplete	1	6	7
Primary completed (Standard VII)	66	62	128
Secondary incomplete	1	1	2
Secondary completed (Form IV)	15	14	29
Higher education (Diploma, University)	3	3	6
Occupation			
Farmer	58	70	128
Entrepreneur	27	9	36
Others	9	10	19
Community based organizations			
Member	35	23	58
Leading role (chair or assistant chair)	13	8	21

perceived these impacts; and (3) to understand how men and women, adolescents and children are differently impacted as key subpopulation groups with regard to gender. The initial analysis, which included data from all three study sites, was mainly driven by the first author using Nvivo Pro (QSR International Pty Ltd, Victoria, Australia).

Rooted in thematic data analysis, the categories applied during the data collection process (see Figure

2) were used as initial coding structure and emerging themes (i.e. sanitation and community dynamics) were incorporated during the analysis (Braun and Clarke 2006; DeCuir-Gunby et al. 2010). Beyond the thematic structure of the different impacts (e.g. air pollution), the data was coded along other axes, such as related health outcomes (e.g. cough, flu) and population groups affected (DeCuir-Gunby et al. 2010). Based on the axial coding and case classifications, queries were run in Nvivo to analyse the data and to create the matrices (see Figures 3 and Figure 4).

To interpret our findings with a gender lens, we draw on the concept of the 'triple role of women' (Moser 1989, 1995). This concept is a key element of Moser's gender analysis and planning framework, in which mapping the gendered labour divisions is a core element for planning development interventions. Based on the recognition of the interplay between the different roles Moser identifies women's work to be threefold: (1) women take care of the child-rearing and household work (reproductive work); (2) women are responsible for creating a secondary income for the household (productive work); and (3) women are engaged in the community (community managing work). The male role, in contrast, is considered as primary income-generator (productive role). Although men play an active role in reproductive work, expectations are not as clearly defined compared to women, and men continue to be seen as key decision-makers in all domains, according to Moser and others (Balgah et al. 2019). While the triple role concept has been criticised, including on the basis that it can obscure the distinction between an activity and an outcome (e.g. Kabeer 2015), we find that the concept provides a useful entry point for analysing our findings of environmental, economic and social

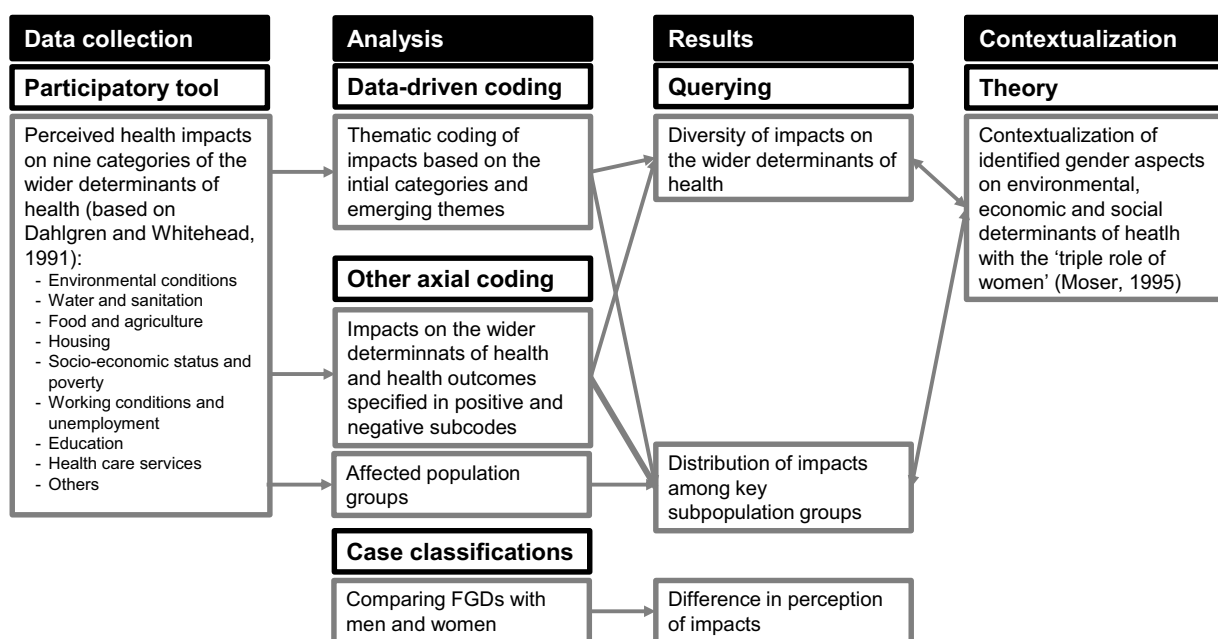


Figure 2. Flowchart indicating methodological aspects of different phases of the study from data collection, to analysis, results and contextualisation (FGD: focus group discussion).

impacts of NREPs through the reproductive, productive and community managing gender roles; as well as to locate our findings beyond gender roles, in practical and strategic gender needs. Practical needs evolve from concrete experiences, and thus from women's engendered role in the sexual division of labour. Strategic gender needs originate from an analytical perspective of the subordinated position of women (Moser 1989). Addressing strategic gender needs potentially translates to a transformative gender approach with the ultimate objective of shifting unequal gender relations (Kågesten and Chandra-Mouli 2020). If more cognisant of these different types of needs, HIA, we suggest, provides a unique opportunity to contribute to realising gender equality through identifying and addressing strategic gender needs more explicitly in NREPs settings.

2.5 Limitations

While aiming for rigour in research, the scope of our methodology is limited by the following three characteristics. Firstly, although highly impacted villages were systematically chosen based on a transect walk, it is probable that the mines' impacts reach far beyond the villages sampled. Several other studies have investigated impacts of industrial NREPs on their broader environment, including the closest towns and their inhabitants, suggesting that we chose an appropriate radius for our impacted villages (Jackson 2018; Dietler et al. 2020a). Secondly, this study purely reflects the perspectives of the community members. Further research would benefit from including voices from the health district officials or employees of the mining companies. To minimise the risk of an unbalanced sample of participants in terms of their attitudes towards the mining projects, we targeted knowledgeable community members from systematically selected villages, which were positively and negatively impacted. Thirdly, the analysis and contextualisation of this qualitative gender paper focusses mainly on differences between men and women. The categorisation of gender as social roles assigned to men and women is used in this paper as a transversal category, while it does not reflect the full diversity of a community in terms of other social, economic and cultural aspects (Bates et al. 2009; Hankivsky 2014; see also Levac et al. 2021, this volume). While touching on some intersectional elements (i.e. age), applying a more comprehensive intersectional analysis was beyond the scope of the current study.

3. Results

In all FGDs, a broad range of impacts on the wider determinants of health was observed. Based on the coding frequency, Figure 3 visualises how often the different topics were discussed, disaggregated by gender. Figure 4 shows how the impacts are distributed

among key subpopulation groups, as identified based on the communities' perception (i.e. men, women, adolescent boys and girls, and children). A more detailed overview of positive and negative impacts and related health outcomes is given in the Annex (see Supplementary Material). In the following sections, we focus on specific gender impacts and analyse how these key subpopulation groups are differently affected by impacts on environmental, economic and social determinants of health.

3.1 Environmental impacts, gender and health

Overall, discussions about environmental issues were profoundly negative, and consisted mainly of the environmental hazards and degradation caused by the mines. The main concern of respondents was the unsafe and insecure housing situation caused by cracks in the houses due to mining-related blasting, potential or actual resettlement, and increased traffic. Cracks in the house were mentioned in all FGDs and described by one participant as follows:

Blasting causes strong vibrations, which cause cracks on many houses in the community ... Triiiiiiiiiiiiiii (sound of vibration) it is like the sound of the train. (BUZWAGI, L4)

Consequently, community members were fearful that their house would fall down while they were sleeping. According to some participants, this fear particularly affects women and children, as they spend more time at home compared to men. However, cracks in the house also affect men, as they are usually responsible for repairing the house.

The next most frequently mentioned topics were related to soil and land. Participants noted a decrease in agriculture due to less productive or polluted soil and loss of land. The communities reported being affected by chemicals coming from the mines to the agricultural fields, expressing that this polluted their crops and caused skin rashes. In some extreme cases, participants associated this exposure with miscarriages. Further, due to the reduced agricultural production, providing food for the family was reported as a challenge for men, but also for women who had to find alternative means to feed the family. Deforestation emerged as another theme in the category of soil and land. This affected women in particular, as they had to walk further to collect firewood for cooking. In case no firewood was available, participants reported buying charcoal as an alternative, which was an additional burden on the men who were considered primarily responsible for providing for these additional funds. Although women's health and their different domestic tasks were heavily impacted, men mentioned topics related to soil and land more frequently, especially as

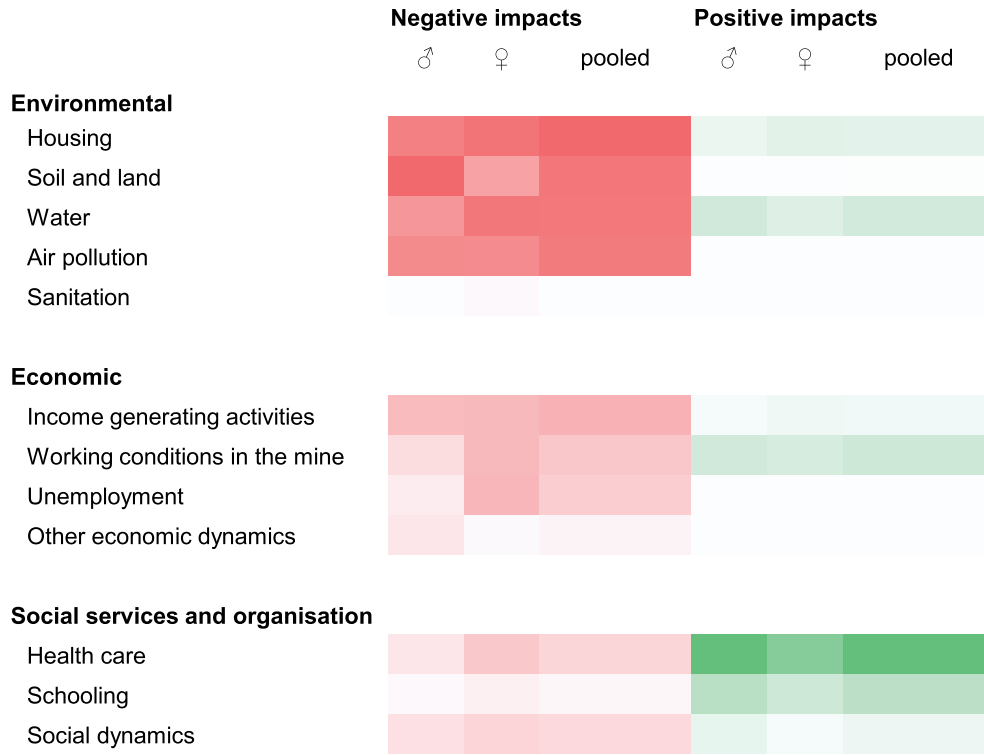


Figure 3. Negative (red) and positive (green) impacts on the wider determinants of health classified by data sources (i.e. FGDs with men, FGDs with women and pooled analysis); colour gradient indicates relative coding frequency.



Figure 4. Distribution of negative (red) and positive (green) impacts on the wider determinants of health among key subpopulation groups (children, boys, girls, men and women) based on axial coding; colour gradient indicates coding frequency.

related to loss of agricultural land and their role as landowners.

The third major environmental theme discussed was water. Participants reported pollution of different water bodies and decreased availability of water. They stated that the dust from the blasting in the mines had contaminated their (unprotected) wells, dams and rivers, as well as leaving them unable to drink the rainwater they traditionally

collect as drinking water. They also perceived that chemicals from the tailings dam had penetrated their water sources. Consequently, reaching a clean water source was difficult and fetching water, which was in general reported as one of women’s domestic tasks, was more time-intensive. Because of the ‘unsafe water’, as participants often referred to poor water quality, they stated that children were getting intestinal diseases more frequently.

Fourthly, air pollution was a recurrent theme with different causes. Participants mentioned the dust from the mining activities, the passing mining trucks on the unpaved roads and bad odour next to the mines. According to the participants, the whole community was exposed to air pollution, but children were particularly at risk. They mentioned frequent respiratory ailments and diseases, such as cough and flu and linked it to the children's immature immune system.

Taken together, the environmental degradation caused by the mines affected women in particular in their domestic tasks as mothers and housewives, as well as having particular impacts on children as they fall sick more often. Participants, however, also acknowledged positive effects of the mining industry, such as new roads and water access points constructed by the mining companies. The improved road network allowed community members to more quickly reach health facilities. New water access points were – when functional – perceived as a relief, particularly for women due to the culturally constructed gender expectation that fetching water is the role of women.

3.2 Economic impacts, gender and health

Overall, the topic of having, generating or seeking an income is a highly dynamic topic for communities around industrial gold mines and clearly a key concern for their health as a means to be able to afford food and health care. The link between their poor economic situation and health was explained as follows:

There is [a] decrease of the economic status of people living in this community ... To be healthy you must have enough income which will enable you to get requirements needed for yourself and your family. But if you don't have enough money then you will not manage to provide for your family or even to access health services when necessary. (BUZWAGI, L4)

Most prominently in this category, participants discussed the impact on their traditional income-generating activities, such as farming and artisanal gold mining. Despite compensation payments or reallocation, in several villages participants felt that their land for agriculture or areas for artisanal mining had been taken by the mine. This forced them to stop these activities, or for the latter one, continue it illegally:

We are practicing agriculture and pastoralism but we are mostly dependent on small mining in certain areas that's why when the mining company took this area we were affected a lot because we don't have another area to do our work. (BULYANHULU, L7)

As a consequence, new gender-specific strategies to generate income were developed and reported at all study sites. Boys and young men risk their life to illegally access the tailings in the mine to 'steal precious stones', as they described it. Once caught by guards

inside the mine ('ukorokoronī'), they are reportedly heavily beaten. Adult men who committed the same crime were even subject to fatal consequences, according to participants. Adolescent girls and adult women reportedly became involved in 'prostitution', including sexual transactions as well as commercial sex work, through either seeking income or being seduced by in-migrants. As a result, girls and young women have to deal with early pregnancies and often drop out of school. Human Immunodeficiency Virus (HIV) was reported as another lethal health outcome related to these community dynamics. These high-stakes gendered health impacts indicate the important role that boys and young men, as well as girls and young women, play in their family, especially in settings with unsecured household income.

The industrial mining operations provided new job opportunities – but mainly for men. Participants reported limited opportunities for local community members, as they were not qualified for specialised jobs. Therefore, men were mostly involved in unskilled labour work, such as construction works, local security guards ('sungsusungsu') and only a few opportunities such as being a gardener inside the mine were mentioned. However, negative outcomes for their health due to the harsh working conditions and losing their job after a short time outweighed these opportunities. Additionally, salaries of these job opportunities were reported to be low and with these jobs alone men could rarely fulfil their role as 'breadwinners' of their family.

In contrast to the new job opportunities for men, being unemployed was perceived by women to be a major issue, as they need money to raise the children:

They are not giving employment opportunities to women but women are the ones raising children. Some employed men are spending money on alcohol but women who are employed are spending their money to buy food and take good care of their families. (BULYANHULU, L6)

The opportunity for women to be employed by one of the mining companies are lower, based on their statements. Although they were willing to pursue unskilled work like cleaning or cooking, women reported that these tasks were subcontracted to external companies. Regarding other jobs offered to local residents, they were afraid of the hard working conditions, for example, night shifts as a local security guard. In the absence of other opportunities, adolescent girls and women seeking an income become involved in sexual transactions and commercial sex relationships. As a result, the communities noticed an increase in HIV infections, which particularly affected women, who were perceived to be more susceptible than men due to their alleged involvement in prostitution. Participants also reported impacts that were initially perceived as

positive, but were not sustainable. At one study site, the mining company staff educated women in 'modern' agriculture and bought their vegetables to prepare food for mining employees. This was acknowledged as a helpful contribution to women's income, but men and women were disappointed once this collaboration was suspended and only few community members continued to benefit.

Other economic factors were identified as a minor theme, such as embracing the compensation payment for land or being resettled, as well as the increase of living costs. Men, as landowners and heads of families, negotiated with the companies about their land and compensation payments. For men, suddenly having a lot of money and the freedom to spend it without the need of consulting other family members, had ambiguous results. As both men and women reported, it should allow men to provide for their children and the family (such as paying school fees), but in practice, this money was on some occasions spent on alcohol, tobacco or sexual transactions. In one case reported, there was no money left to buy new land, with negative implications for the entire household. Some men were overwhelmed by the amount of money received and wished to be educated about keeping or investing money:

People had farms to cultivate but when the investors came they negotiated and paid. But the problem is I have never had a lot of money since I was born so having a lot of money at once made people misuse money and continued to be poor to date. (BUZWAGI, L4)

The increased living costs are particularly challenging for women, who have to pay for certain key household goods, such as food. Satisfying the basic needs for their family without having a reliable source of income was perceived as a major challenge.

Taken together, both men and women struggle to fulfil the economic needs for their families. Some examples indicate windows of opportunities for men to benefit economically, but in the end, negative consequences for their health and well-being often prevailed.

3.3 Social services, social organisation, gender and health

The category of social services and social organisation, which embraces the topics of health care, schooling and social dynamics, was reported by participants as being highly dynamic in positive and negative aspects.

The topic of health care was mostly positively perceived, especially in relation to the newly constructed health care facilities and the provision of specific services such as ambulances, HIV testing and counselling, as well as disease-specific medical treatment. At most study sites, the upgraded or even newly constructed

dispensaries and health centres reportedly benefitted women, and pregnant women in particular. These positive experiences are illustrated as follows:

The presence of that dispensary has helped us, first as women we get health services, for example, in the past when you needed family planning services you must go [to] Geita town but now there are health service providers here at our dispensary, we get that service here. Even delivery services, we give birth here ... unlike in the past where we used a lot of money to go to Geita town. (GEITA, L2)

Although positive perceptions dominated in terms of health care, participants also reported that their needs are not fully satisfied. Overcrowded hospitals and long waiting times, as well as unavailable services or equipment, were still issues of concern.

In relation to education, which is 'key for their health' according to different respondents, positive and negative aspects were reported. On the positive side, construction of teacher houses, school buildings and renovation of toilets contributed to improving the quality of education by promoting ready availability of teachers at school, increasing student enrolment and improving student attendance. On the negative side, the presence of the mine has caused people to drop out of school early, according to participants. It was reported that girls dropped out because of unexpected pregnancies, and boys because of seeking employment elsewhere.

Positive and negative themes also emerged in relation to social dynamics. Respondents valued the formation of specific interest groups such as vegetable gardeners or beekeepers, and the financial support of the mining companies to these groups. In contrast, the introduction of the mines was associated with in-migration, crime and incoherent family structure. Participants linked these impacts to an increased spread of HIV, increased HIV-mortality, and ultimately to an increase in orphans. In response, an orphanage was constructed at one study site and participants reported financial support for orphans from the mining company. Further, community leaders who acted in some villages as liaison officers between the mine and the community became more powerful. For example, they were responsible for distributing job opportunities among community members. These changes in power led to stories about bribing that were narrated during the FGDs.

Taken together, the mining projects served as a strong pull factor for migration, causing different negative impacts on social services and the social organisation of the communities. But related interventions implemented by the mining company were common at all study sites, while new health facilities contributed in particular to improved community health.

4. Discussion

As demonstrated by the above findings, local communities experience multiple and dynamic impacts by industrial gold mines on the wider determinants of health, as well as resulting consequences for their health. Our findings also show that the distribution of these impacts differed between specific groups in the population according to age and sex. Particularly adult men and women are impacted differently. This can be explained by their different exposure resulting from their gender-differentiated roles as men and women in reproductive work, productive work (income generation), and community management, as conceptualised by Moser's (1989, 1995) concept of the triple role of women.

4.1 Extractive industries, gender roles and gender needs

Settings of NREPs are highly dynamic and changes in traditional livelihoods, such as the shift from subsistence towards a more cash-oriented economy, have implications for different gender roles (see also Hill et al. 2021, this volume). Figure 5 shows the alignment of gendered health impacts with environmental, economic and social determinants of health as influenced by gender roles (Moser 1995). The triple role of women and the related division of labour as suggested in Moser's theory, was the dominant gender-role model at our study sites. Overall, women's triple role as mothers and housewives, as secondary income generators and with their low-prestige community engagement, contrasted with men's role as primary income generator and decision-maker.

The manifold environmental degradation caused by the mines particularly challenged the agricultural and domestic subsistence work, which was found to be primarily the responsibility of women. In addition, women take care of the children, who were reported to fall sick more often since the commencement of mining activities. Consequently, women's workload as mothers and caregivers increases in such dynamic environments, while there is less time to invest in paid work (Adusah-Karikari 2015). In contrast to women, men are considered responsible for the financial and physical aspects of maintaining the household, such as paying school fees of the children and the repair of the cracks in the house. While their role in reproductive work of child rearing was found to be limited, men may only partly be able to meet these financial expectations, shifting the overall burden of the negative impacts towards women.

Regarding economic impacts, only few men and women benefit from the establishment of the mines. Women particularly struggle to ensure the economic well-being of the household as their time and

opportunities to create an income are more restricted after the development of the mine. It is worth mentioning that although Moser and other researchers consider women as secondary income generator, they all agree that women's work often provides the actual income for the family (Adusah-Karikari 2015; Balgah et al. 2019; Bryceson 2019). In comparison, men focus on doing remunerated work and this is consistent with them being primary income generators. If men can get a job in the mine, they still face difficulties to fulfil their role as 'breadwinners' given the low salaries for unskilled labour work. In addition, these opportunities are also closely linked to harsh working conditions and health risks. As landowners, they negotiate about resettlement and receive the compensation payment for land. Despite these potential windows of opportunities for men, only few are able to benefit in the long run. In the context of NREPs, where traditional income-generating activities are changing and new jobs are available mainly for highly skilled external workers, both women and men have to find new ways to create an income. According to the narratives from our study, new income-generating activities can be hazardous and even life-threatening for men and women. In accordance with the work from Whitehead and Kaber (2001), our data further indicate that women spend their income on the health and well-being of the family, hence fulfilling their reproductive role, while some men tend to spend their money for their own purposes.

Our study also identified gendered impacts on social services and organisation, but the link to the community managing role is less evident. For example, improved health care services, are highly beneficial for women because of their role in reproduction and as caregivers. In this sense, women's engagement in community-based organisations, which allows them to share their interests and support each other, is in line with their gendered role in the community. According to Moser, men, as community leaders, also have a role in the community. However, in contrast to women, this role is usually related to an increase in social status and political power. In settings of NREPs, this role can be further strengthened when community leaders become liaison officers between the company and the community, widening the gender gap within the community.

Overall, the triple role of women and the gendered impacts in the three categories increase women's workload and constrain them from actively participating in the labour force. While men are to a certain extent involved in the mining industry, job opportunities are nonetheless scarce and paid salaries are low. Although increasingly challenging, subsistence work remains an important part of the household's productive work, while women continue to depend financially upon men. While more research is needed on the dynamics of natural resource extraction and its impacts

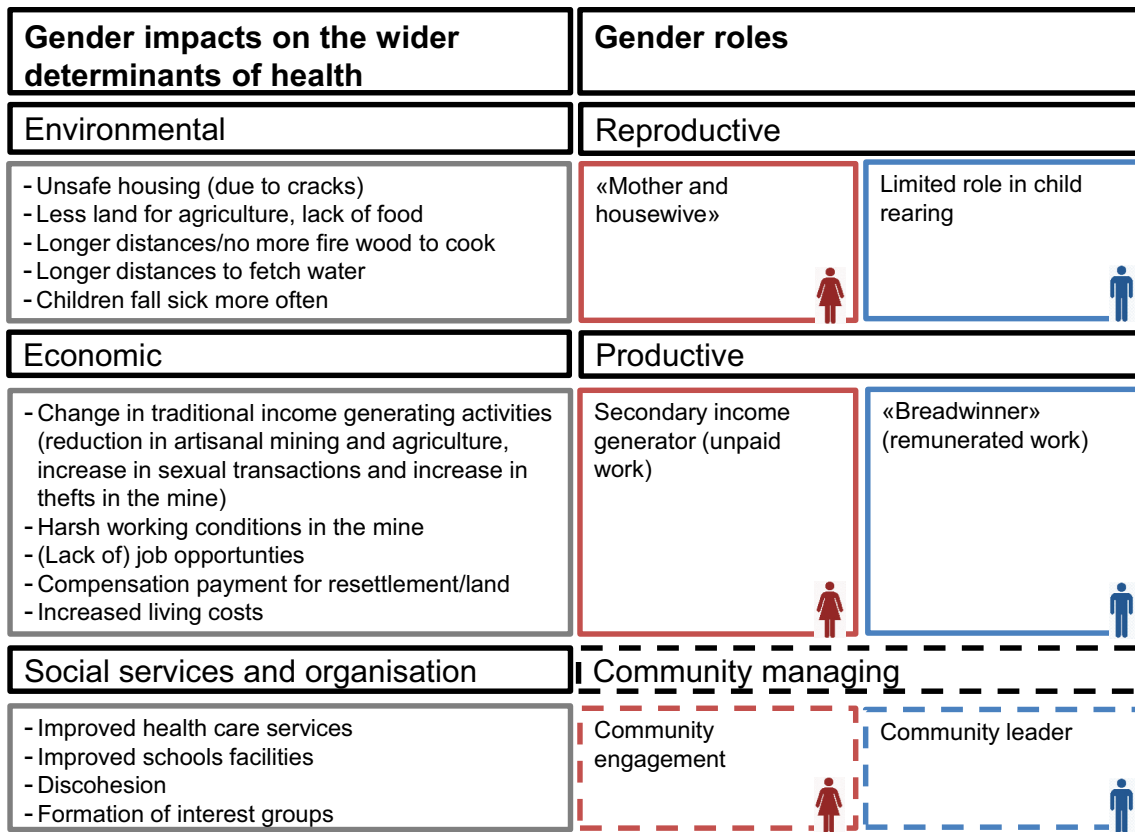


Figure 5. Alignment of gender impacts on the wider determinants of health induced by industrial gold mines and gender roles as of Moser's theory (dashed lines indicate weak evidence based on our data).

on traditional gender roles in society, our findings indicate how gender roles are interlinked with structural inequalities. Further, gender roles and gendered impacts indicate an unequal distribution of power and resources between men and women, reflecting the subordinated position of women in society (Moser 1995; Bryceson 2019). Consequently, men and women, as well as other population groups, have different strategic needs to address these power dynamics, which need to be made explicit in HIA.

In our context and in line with Moser's theory, interventions for basic services, such as new water access points and improved health care services, address the practical needs of women. Indeed, such interventions satisfy women's concerns and contribute to the improved health of the community. However, they help to maintain the view that women are subordinate to men, and may preserve engendered roles. As such, new health facilities might mitigate negative impacts but women remain financially dependent on their male partner to seek health care. In contrast, few interventions mentioned during the FGDs recognised women's productive role in income generation. For example, educating women in alternative farming practices or supporting them in vegetable gardening and marketing holds promise in transforming practical needs into strategic needs. While both men and women in mining communities face health effects,

our data indicates that women are particularly adversely affected in patriarchal societies. Therefore, a gender transformative approach is needed in HIA practice to reduce gender inequalities and challenge the sexual division of labour (Sharma and Rees 2007; Kågesten and Chandra-Mouli 2020).

4.2 Solutions to gender-based needs from HIA

This paper reflects on community perception of gender-related impacts of mining on health within the framework of a larger research project focused on HIA in sub-Saharan Africa (Farnham et al. 2020; Winkler et al. 2020a). Our findings suggest that negative impacts outweigh positive impacts, with men and women, as well as children, boys and girls, experiencing adverse consequences for their health. Hence, our study provides evidence and fuels the need for improved identification and management of gendered health impacts.

With regard to gender and health, GIA and HIA arguably have great potential to prospectively identify and address gender-based inequities around mine implementation. The Oxfam guide for GIA holds promise to address strategic gender needs by evaluating the possession of and control over assets, as well as decision-making power (Hill et al. 2017). Beyond the differences between men and women, the guide also

highlights the differences within these population groups and considers other factors determining effects on different subpopulation groups, such as age and place of residence. Unlike GIA, HIA is primarily focused on contributing to health and well-being of impacted communities. With equity as a core value, HIA holds promise to address inequities, yet the specific experiences of impacts of different subpopulation groups, need to be considered more systematically (Leuenberger et al. 2019; Winkler et al. 2021). Evidence shows that rigorously conducted HIA contributes to better health of impacted communities, and in some cases also particularly to women's health (Knoblauch et al. 2014, 2018, 2020). Further, equity-focused HIA, a specific and more advanced HIA methodology, holds promise to specifically address communities' needs in order to achieve more equitable outcomes (Harris-Roxas et al. 2004; Heller et al. 2014).

Although our findings are specific to our study, we can conclude that more thoroughly considering the gender roles and dynamics in NREP settings is key to understanding inequalities and developing strategies for mitigation (see also Hill et al. 2021, Kimotho and Ogol 2021, this volume). Given the above-mentioned potential of HIA, it could be further improved by more systematically considering the gendered division of labour and addressing strategic gender needs more explicitly. For example, comprehensive HIA should aim for minimising the negative impacts on subsistence (i.e. agricultural production for home production) and reproductive work, and strengthening the economic and social development of impacted communities, while considering mitigation strategies for negative gender-based impacts. As emphasised in the new gender guidelines published by IFC, special attention should be drawn to women's conflicting responsibilities and their subordinate position, as they play a central role in the health of the community as well as its development (Sen and Hausman 2007; IFC 2018). Hence, HIA offers a great opportunity to contribute to fostering sustainable development by promoting community health and simultaneously contributing to shifting gender norms and reducing gender inequities (UNGA 2015; Gupta et al. 2019). Finally, solutions to improve health should be gender sensitive by creating inclusive approaches for decision-making as well as gender transformative by challenging imbalanced power structures in society (WHO 2011). Yet, HIA is underutilised in sub-Saharan Africa and continued efforts are needed to strengthen HIA in contexts of natural resource development.

5. Conclusion

Large NREPs, such as industrial gold mines, have transformative potential for sustainable development. For local communities, risks might outweigh the opportunities, with women being disproportionately affected, which in turn calls for thorough and inclusive

management. Particularly in sub-Saharan Africa, current measures for the health and well-being of impacted communities are weak and approaches such as HIA or environmental, social and health impact assessments, need to be more rigorously promoted. In this qualitative, gender-focused study, we demonstrate the diversity of impacts on the wider determinants of health based on communities' perceptions in the context of industrial gold mining and we describe how these impacts are distributed among key subpopulation groups. We observed gender impacts across environmental, economic and social determinants of health. Linked to women's triple role, specific gender impacts were observed across all three categories, with the most substantial impacts in their productive and reproductive role. In contrast, specific gender impacts for men were mostly related to economic determinants of health, linked to their primary role as 'breadwinners'. Clearly, men and women, due to their different roles, have different needs. Indeed, HIA and other forms of impact assessment should explicitly address these gender needs, while considering how health and health care may be affected if women are more strongly included in the economy and therefore suggesting gender-transformative solutions to improve community health. As a tool for achieving equity and sustainability, HIA offers a particular opportunity to integrate strategic interventions that create equal opportunities for good health and well-being for all.

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References

Aboka YE, Cobbina SJ, Doke AD. 2018. Review of environmental and health impacts of mining in Ghana. *J Health Pollut.* 8(17):43–52. doi:10.5696/2156-9614-8.17.43.

- Admiraal R, Sequeira AR, McHenry MP, Doepel D. 2017. Maximizing the impact of mining investment in water infrastructure for local communities. *Extr Ind Soc.* 4 (2):240–250. doi:10.1016/j.exis.2017.01.014.
- Adusah-Karikari A. 2015. Black gold in Ghana: changing livelihoods for women in communities affected by oil production. *Extr Ind Soc.* 2(1):24–32. doi:10.1016/j.exis.2014.10.006.
- Bainton N, Owen JR, Kenema S, Burton J. 2020. Land, labour and capital: small and large-scale miners in Papua New Guinea. *Res Policy.* 68:101805. doi:10.1016/j.resourpol.2020.101805.
- Balgah RA, Amungwa FA, Egwu BMJ. 2019. A gender analysis of intra-household division of labor in Cameroon using Moser's triple roles framework. *Asian J Agric Extension Econ Sociol.* 29 (4):1–12. doi:10.9734/ajaees/2019/v29i430095.
- Bates LM, Hankivsky O, Springer KW. 2009. Gender and health inequities: a comment on the final report of the WHO commission on the social determinants of health. *Soc Sci Med.* 69 (7):1002–1004. doi:10.1016/j.socscimed.2009.07.021.
- Braun V, Clarke V. 2006. Using thematic analysis in psychology. *Qual Res Psychol.* 3(2):77–101. doi:10.1191/1478088706qp0630a.
- Bryceson DF. 2019. Gender and generational patterns of African deagrarianization: evolving labour and land allocation in smallholder peasant household farming, 1980–2015. *World Dev.* 113(2019):60–72. doi:10.1016/j.worlddev.2018.08.021.
- Carney JG, Gushulak BD. 2016. A review of research on health outcomes for workers, home and host communities of population mobility associated with extractive industries. *J Immigrant Minority Health.* 18(3):673–686. doi:10.1007/s10903-015-0328-4.
- DeCuir-Gunby JT, Marshall PL, McCulloch AW. 2010. Developing and using a codebook for the analysis of interview data: an example from a professional development research project. *Field Methods.* 23(2):136–155. doi:10.1177/1525822x10388468.
- Dietler D, Farnham A, De Hoogh K, Winkler MS. 2020a. Quantification of annual settlement growth in rural mining areas using machine learning. *Remote Sens.* 12 (2):235. doi:10.3390/rs12020235.
- Dietler D, Lewinski R, Azevedo S, Engebretsen R, Brugger F, Utzinger J, Winkler MS. 2020b. Inclusion of health in impact assessment: a review of current practice in sub-Saharan Africa. *Int J Environ Res Public Health.* 17 (11):4155. doi:10.3390/ijerph17114155.
- Eftimie A, Heller K, Strongman J. 2009a. Mainstreaming gender into extractive industries projects. Washington (DC): World Bank. [accessed 2020 April 10]. http://siteresources.worldbank.org/EXTOGMC/Resources/eifd9_gender_guidance.pdf
- Eftimie A, Heller K, Strongman J. 2009b. Gender dimensions of the extractive industries: mining for equity. Washington (DC): World Bank. [accessed 2020 April 10]. https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/publications/publications_report_genderdimensionsofextractiveindustries_wci_1319576704143
- Farnham A, Cossa H, Dietler D, Engebretsen R, Leuenberger A, Lyatuu I, Nimako B, Zabre HR, Brugger F, Winkler MS. 2020. Investigating health impacts of natural resource extraction projects in Burkina Faso, Ghana, Mozambique, and Tanzania: protocol for a mixed methods study. *JMIR Res Protoc.* 9(4):e17138. doi:10.2196/17138.
- George AS, Amin A, García-Moreno C, Sen G. 2019. Gender equality and health: laying the foundations for change. *Lancet.* 393(10189):2369–2371. doi:10.1016/s0140-6736(19)30987-0.
- Götzmann N, Bainton N. 2021. Embedding gender-responsive approaches in impact assessment and management. *Impact Assess Project Appraisal.* 39(3):171–182. doi:10.1080/14615517.2021.1904721.
- Gupta GR, Oomman N, Grown C, Conn K, Hawkes S, Shawar YR, Shiffman J, Buse K, Mehra R, Bah CA, et al. 2019. Gender equality and gender norms: framing the opportunities for health. *Lancet.* 393(10190):2550–2562. doi:10.1016/s0140-6736(19)30651-8.
- Hankivsky O. 2012. Women's health, men's health, and gender and health: implications of intersectionality. *Soc Sci Med.* 74 (11):1712–1720. doi:10.1016/j.socscimed.2011.11.029.
- Hankivsky O. 2014. Intersectionality 101. The Institute for Intersectionality Research & Policy. [accessed 2020 April 10]. https://www.researchgate.net/profile/Olena_Hankivsky/publication/279293665_Intersectionality_101/links/56c35bda08ae602342508c7f/Intersectionality-101.pdf
- Harris-Roxas B, Simpson S, Harris L. 2004. Equity-focused health impact assessment: a literature review. Sydney: Australasian Collaboration for Health Equity Impact Assessment (ACHEIA). [accessed 2020 April 10]. [http://hiaconnect.edu.au/old/files/Harris-Roxas_B_\(2004\)_Equity_Focused_HIA.pdf](http://hiaconnect.edu.au/old/files/Harris-Roxas_B_(2004)_Equity_Focused_HIA.pdf)
- Heller J, Givens ML, Yuen TK, Gould S, Jandu MB, Bourcier E, Choi T. 2014. Advancing efforts to achieve health equity: equity metrics for health impact assessment practice. *Int J Environ Res Public Health.* 11(11):11054–11064. doi:10.3390/ijerph111111054.
- Hill C, Madden C, Collins N. 2017. A guide to gender impact assessment for the extractive industries. Melbourne: Oxfam Australia. [accessed 2020 April 10]. https://www.oxfam.org.au/wp-content/uploads/2017/04/2017-PA-001-Gender-impact-assessments-in-mining-report_FA_WEB.pdf
- Hill C, Namara C, Orcaya J, Bogrand A, Sellwood SA. 2021. Hidden in plain sight: gender analysis of the environmental and social impact assessment of the East African Crude Oil Pipeline. *Impact Assess Project Appraisal.* 39(3):229–239. doi:10.1080/14615517.2021.1904696.
- [ICMM] International Council on Mining and Metals. 2010. Good practice guidance on health impact assessment. London: ICMM [accessed 2020 April 10]. <https://www.icmm.com/website/publications/pdfs/health-and-safety/792.pdf>
- [IFC] International Finance Corporation. 2009. Women in mining. Washington (DC): IFC. [accessed 2020 April 10]. https://www.ifc.org/wps/wcm/connect/a3e296da-ffd8-40b3-a4d3-254fdc1d5231/IFC-LONMIN_WomenInMining_Manual.pdf?MOD=AJPERES&CVID=jaDDmao
- [IFC] International Finance Corporation. 2018. Unlocking opportunities for women and business: a toolkit of actions and strategies for oil, gas, and mining companies. Washington (DC): IFC. [accessed 2020 April 10]. https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/gender+at+ifc/resources/unlocking-opportunities-for-women-and-business
- [IPIECA] International Petroleum Industry Environmental Conservation Association. 2016. Health impact assessment: a guide for the oil and gas industry. London: IOGP. [accessed 2020 April 10]. <https://www.ipeica.org/resources/good-practice/health-impact-assessment-a-guide-for-the-oil-and-gas-industry/>

- Jackson RT. 2018. Migration to two mines in Laos. *Sustainable Dev.* 26(5):471–480. doi:10.1002/sd.1892.
- Jenkins K. 2014. Women, mining and development: an emerging research agenda. *Extr Ind Soc.* 1(2):329–339. doi:10.1016/j.exis.2014.08.004.
- Kabeer N. 2015. Gender, poverty, and inequality: a brief history of feminist contributions in the field of international development. *Gen Dev.* 23(2):189–205. doi:10.1080/13552074.2015.1062300.
- Kågesten A, Chandra-Mouli V. 2020. Gender-transformative programmes: implications for research and action. *Lancet Global Health.* 8(2):e159–e160. doi:10.1016/s2214-109x(19)30528-5.
- Kimotho W, Ogot D. 2021. Exploring the drivers of gendered grievance mechanisms: examples from the agribusiness, extractive and wind power sectors in Kenya. *Impact Assess Project Appraisal.* 39(3):240–250. doi:10.1080/14615517.2021.1906020.
- Knoblauch AM, Divall MJ, Owuor M, Musunka G, Pascall A, Nduna K, Ng'uni H, Utzinger J, Winkler MS. 2018. Selected indicators and determinants of women's health in the vicinity of a copper mine development in northwestern Zambia. *BMC Women's Health.* 18(1):62. doi:10.1186/s12905-018-0547-7.
- Knoblauch AM, Farnham A, Zabre HR, Owuor M, Archer C, Nduna K, Chisanga M, Zulu L, Musunka G, Utzinger J, et al. 2020. Community health impacts of the trident copper mine project in northwestern Zambia: results from repeated cross-sectional surveys. *Int J Environ Res Public Health.* 17(10):3633. doi:10.3390/ijerph17103633.
- Knoblauch AM, Hodges M, Bah M, Kamara H, Kargbo A, Paye J, Turay H, Nyorkor E, Divall M, Zhang Y, et al. 2014. Changing patterns of health in communities impacted by a bioenergy project in northern Sierra Leone. *Int J Environ Res Public Health.* 11(12):12997–13016. doi:10.3390/ijerph111212997.
- Krieger N. 2003. Genders, sexes, and health: what are the connections—and why does it matter? *Int J Epidemiol.* 32(4):652–657. doi:10.1093/ije/dyg156.
- Leuenberger A, Farnham A, Azevedo S, Cossa H, Dietler D, Nimako B, Adongo PB, Merten S, Utzinger J, Winkler MS. 2019. Health impact assessment and health equity in sub-Saharan Africa: a scoping review. *Environ Impact Assess Rev.* 79:106288. doi:10.1016/j.eiar.2019.106288.
- Levac L, Stinson J, Manning SM, Stienstra D. 2021. Expanding evidence and expertise in impact assessment: informing Canadian public policy with the knowledges of invisible communities. *Impact Assess Project Appraisal.* 39(3):218–228. doi:10.1080/14615517.2021.1906152.
- Ministry of Health Zanzibar; Office of Chief Government Statistician Zanzibar. 2016. Tanzania demographic and health survey and malaria indicator survey 2015–2016. ICF International. [accessed 2020 April 10]. <http://dhsprogram.com/publications/publication-FR321-DHS-Final-Reports.cfm>
- Moser C. 1989. Gender planning in the Third World: meeting practical and strategic gender needs. *World Dev.* 17(11):1790–1825. doi:10.1016/0305-750X(89)90201-5.
- Moser C. 1995. Evaluating gender impacts. *New Directions Eval.* 67:105–117. doi:10.1002/ev.1009.
- Muchadenyika D. 2015. Women struggles and large-scale diamond mining in Marange, Zimbabwe. *Extr Ind Soc.* 4(4):714–721. doi:10.1016/j.exis.2015.08.003.
- O'Neill J, Tabish H, Welch V, Petticrew M, Pottie K, Clarke M, Evans T, Pardo Pardo J, Waters E, White H, et al. 2014. Applying an equity lens to interventions: using PROGRESS ensures consideration of socially stratifying factors to illuminate inequities in health. *J Clin Epidemiol.* 67(1):56–64. doi:10.1016/j.jclinepi.2013.08.005.
- Rio Tinto. 2009. Why gender matters: a resource guide for integrating gender considerations into communities work at Rio Tinto. Melbourne: Rio Tinto. [accessed 2020 April 10]. http://www.riotinto.com/documents/ReportsPublications/Rio_Tinto_gender_guide.pdf
- Sen A, Hausman DM. 2007. Capability and well-being. *Philos Econ.* 270–294. doi:10.1017/cbo9780511819025.019.
- Sharma S, Rees S. 2007. Consideration of the determinants of women's mental health in remote Australian mining towns. *Aust J Rural Health.* 15(1):1–7. doi:10.1111/j.1440-1584.2007.00842.x.
- Sulle E, Dancer H. 2019. Gender, politics and sugarcane commercialisation in Tanzania. *J Peasant Stud.* 47(5):1–20. doi:10.1080/03066150.2019.1632294
- [UNGA] United Nations General Assembly. 2015. Transforming our world: the 2030 agenda for sustainable development. A/RES/70/1.
- Whitehead A, Kabeer N. 2001. Living with uncertainty: gender, livelihoods and pro-poor growth in rural sub-Saharan Africa. *IDS Working Papers*, 134. [accessed 2020 April 10]. <https://opendocs.ids.ac.uk/opendocs/bitstream/handle/20.500.12413/3896/Wp134.pdf>
- Winkler MS, Adongo PB, Binka F, Brugger F, Diagbouga S, Macete E, Munguambe K, Okumu F. 2020a. Health impact assessment for promoting sustainable development: the HIA4SD project. *Impact Assess Project Appraisal.* 3(8):225–232. doi:10.1080/14615517.2019.1694783.
- Winkler MS, Furu P, Viliani F, Cave B, Divall M, Ramesh G, Harris-Roxas B, Knoblauch AM. 2020b. Current global health impact assessment practice. *Int J Environ Res Public Health.* 17(9):2988. doi:10.3390/ijerph17092988.
- Winkler MS, Krieger GR, Divall MJ, Singer BH, Utzinger J. 2012. Health impact assessment of industrial development projects: a spatio-temporal visualization. *Geospat Health.* 6(2):299–301. doi:10.4081/gh.2012.148.
- Winkler MS, Viliani F, Knoblauch AM, Cave B, Divall M, Ramesh G, Harris-Roxas B, Furu P. 2021. Health impact assessment international best practice principles. International Association for Impact Assessment. https://www.iaia.org/uploads/pdf/SP5%20HIA_21_5.pdf
- World Bank. 2016. Addressing risks and impacts on disadvantaged or vulnerable individuals or groups. Washington (DC): World Bank. [accessed 2020 April 10]. <https://policies.worldbank.org/sites/ppf3/PPFDocuments/e5562765a5534ea0b7877e1e775f29d5.pdf>
- World Bank. 2018. Good practice note on addressing sexual exploitation and abuse and sexual harassment in investment project financing involving major civil works. Washington (DC): World Bank. [accessed 2020 April 10]. <https://policies.worldbank.org/sites/ppf3/PPFDocuments/e5562765a5534ea0b7877e1e775f29d5.pdf>
- [WHO] World Health Organization. 2010. A conceptual framework for action on the social determinants of health: debates, policy & practice, case studies. Geneva: WHO. [accessed 2020 April 10]. http://apps.who.int/iris/bitstream/10665/44489/1/9789241500852_eng.pdf
- [WHO] World Health Organization. 2011. Gender mainstreaming for health managers: a practical approach. Geneva: WHO. [accessed 2020 April 10]. https://apps.who.int/iris/bitstream/handle/10665/44516/9789241501071_eng.pdf?sequence=1
- Yakovleva N, Kotilainen J, Toivakka M. 2017. Reflections on the opportunities for mining companies to contribute to the United Nations sustainable development goals in sub-Saharan Africa. *Extr Ind Soc.* 4(3):426–433. doi:10.1016/j.exis.2017.06.010.