

Review article

Exploring economic and health interventions to support adolescents' resilience and coping in mining communities: A scoping review

Hanna Chidwick^{a,*}, Nina Randolph-Koranteng^a, Betty Kwagala^b, Deborah Mensah^c, Lydia Osei^d, Stephen Ojiambo Wandera^b, Miriam Mutabazi^e, Lydia Kapiriri^f

^a Global Health, Faculty of Health Sciences, McMaster University, Hamilton, Canada

^b Department of Population Studies, Makerere University, Kampala, Uganda

^c Northern Empowerment Association/GRID, Tamale, Ghana

^d Department of Geography, University of Ghana, Accra, Ghana

^e Uganda Christian University, Mukono, Uganda

^f Department of Health, Aging & Society, McMaster University, Hamilton, Canada



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ABSTRACT

Economic and social disruptions, such as the global COVID-19 pandemic, heighten the vulnerability of adolescents. These disruptions exacerbate health and economic inequities which are further compounded in informal labour settings such as the mining sector. Therefore, strengthening adolescent resilience and coping are crucial for well-being and equitable health outcomes. However, there is a limited comprehensive literature that synthesizes adolescent resilience interventions, especially in mining communities. This study presents a scoping review, following Arksey & O'Malley's (2005) framework, to map existing literature on interventions for adolescent resilience in mining communities. Relevant studies were identified from academic journals and grey literature published between 2012 and 2022. Of the 1286 studies screened, 13 were retained for final analysis. Literature showed that common economic resilience interventions included policy-level advocacy and activism, and predominant health interventions focused on sexual and reproductive health including, HIV counselling, screening, and testing, targeting both individual and community-level change in mining communities. The findings emphasize the necessity for interventions to adopt multi-level, multi-sectoral, and multi-stakeholder approaches, while mainstreaming gender. Future research should prioritize intersectional, gender-transformative and community-based interventions to strengthen adolescent resilience in mining communities and advance health equity and rights amongst this last-mile population.

Plain language summary

Adolescents in mining communities face challenges during social and economic disruptions that worsen their health and economic situation. This study reviewed existing research on interventions to help these adolescents build resilience. Economic interventions focused on policy change, while health interventions addressed sexual and reproductive health and rights. Effective interventions were found to involve multiple levels of government, involve diverse sectors and stakeholders, and prioritize gender equality. Future research should explore community-based approaches to enhance resilience and promote equity in artisanal and small scale mining communities in particular.

Data availability

All relevant data are within the paper and its Supporting Information files.

1. Introduction

Adolescents, defined by the United Nations as young people aged 10 to 19 years old, are one of the most vulnerable groups in the world (Bearinger et al., 2007; Patton et al., 2016). Adolescents who identify as Indigenous, rurally located, belonging to a sexual, gender, religious or ethnic minority, out of school, living in extreme poverty or working in

* Corresponding author at: McMaster University, Faculty of Health Sciences | Global Health Office, 1280 Main St. West, Hamilton, ON, Canada.
E-mail address: chidwihw@mcmaster.ca (H. Chidwick).

the informal sector (such as artisanal and small scale mining (ASM)), are even more vulnerable and described as “last mile” (Davison et al., 2021; Nowshin et al., 2022; Pedrajas and Choritz, 2016). Last mile adolescents, experience an intersection of several vulnerabilities and these vulnerabilities are often more pronounced during global crises such as the COVID-19 pandemic (OECD, 2020). During the COVID-19 pandemic, many adolescents experienced exacerbated health, economic, and social challenges (OECD, 2020) in the already complex time of identity development, biological changes and shifting social relationships (Feldman and Elliott, 1990; Namy et al., 2017). The impacts of the pandemic including, reduced and/or loss of income, increased gender-based violence and teenage pregnancies, disruption in education, and less access to health services were magnified in the most vulnerable communities such as mining and specifically ASM communities across the globe (Delve, 2022; Hilson et al., 2021; Nuwematsiko et al., 2022; Nyakato et al., 2021; OECD, 2020; Parkes et al., 2020).

The ASM sector, which includes activities such as panning for gold and small-scale underground mining, is an important source of minerals and metals globally (Fritz et al., 2017; Mpagi et al., 2017). ASM is part of the informal sector and thus functions on precarious and unregulated work environments where there is a high risk of health and safety challenges (Fritz et al., 2017; Mpagi et al., 2017; Schwartz et al., 2021). ASM attracts women, men, girls and boys of all ages and backgrounds for a variety of reasons, spanning from reducing poverty, diversifying income sources, financing education and agriculture (De Haan et al., 2020; Hilson, 2009). The sector has grown rapidly in many sub-Saharan African countries as it provides work for vulnerable groups such as adolescents (Hilson, 2009). There are many intersectional and gendered aspects to the work that impact the health and well-being of adolescents involved (Bearinger et al., 2007; Buss et al., 2017; Fritz et al., 2017; Hinton et al., 2021; Ibrahim et al., 2020; Mpagi et al., 2017; Muheki and Geenen, 2018). These intersectional aspects are compounded by underlying economic and health challenges that adolescents experience related to poor governance, exploitation, unemployment and bans on ASM, and failure of governments and organizations to adhere to due diligence and social responsibility guidelines (Ackah-Baidoo, 2016; Bansah et al., 2022; Maconachie, 2017; Osei et al., 2021). However, these intersections may also contribute to the resilience of adolescents in times of challenge (Njeze et al., 2020; OECD, 2020; Pavarini et al., 2020).

Assessing the resilience of adolescents and their communities in relation to processes and skills applied to deal with social and economic disruption is essential not only for their wellbeing but also to handle future disruptions. Resilience in this study, is considered in terms of flexibility, inner-strengths, capacity (including organizational resources), minimizing casualties, adapting, growing and flourishing. In terms of adolescent development, resilience has been defined as “the ability of some individuals to adapt and maintain positive functioning in the face of significant adversity while others faced with similar difficulties experience negative outcomes” (Namy et al., 2017, p. 303). Literature has discussed adolescent resilience and coping in terms of the impacts of extreme weather events and climate change (Chen et al., 2022; Rother et al., 2020), the experiences of adolescents living with HIV (Laurenzi et al., 2021), and strategies amongst marginalized groups (i.e., sexual and gender minority groups) (Lucassen et al., 2022). In addition, literature has explored school-based interventions to strengthen adolescent resilience, coping, and mental health in various contexts (Berger et al., 2018; Dray et al., 2014; Khanlou and Wray, 2014; Kirby et al., 2021; Sarkar et al., 2017). As exemplified above, the experiences of resilience are intersectional since adolescents develop resilience and coping strategies based on aspects of their identity such as gender, age, socioeconomic status, and migrant status (Hirani et al., 2016).

Adolescent resilience has been discussed in terms of the COVID-19 pandemic given the significant impact it has had on adolescent mental and physical health, along with their relationships (Bischops et al.,

2022; Branje and Morris, 2021; Garagiola et al., 2022; O’Brien et al., 2021; Shi et al., 2022; Yusuf et al., 2022). While there is a growing body of literature on adolescents’ health and synthesis of the literature on the last mile populations (Nowshin et al., 2022); there is a paucity of syntheses of the available literature on economic and health interventions, best practices, and approaches to support adolescents in coping and building resilience to manage the impacts of social and economic disruptions outside of school contexts, especially in mining communities. Such a synthesis is relevant and timely and would inform policy and programming to address the needs of this very vulnerable population.

This paper responds to this gap in the literature by critically considering and consolidating the literature to understand existing interventions for adolescent economic and health resilience and identify effective approaches to inform future interventions and policy for adolescent resilience. The specific objectives are to:

1. Identify the economic and health interventions that have supported building resilience and strengthening coping skills amongst adolescents in mining communities in the literature.
2. Determine the overarching aspects that worked well in adolescent resilience interventions.
3. Discuss the transferability of adolescent resilience interventions to the other contexts in Sub-Saharan Africa and identify future directions for research, policy and programming.

2. Methods

This was a scoping review based on the five stages in Arksey & O’Malley’s (2005) framework for scoping reviews, widely accepted as best practice. These stages include, (1) identifying the research question; (2) identifying relevant studies; (3) study selection/screening; (4) charting the data; and (5) collating, summarizing and reporting the results (Arksey and O’Malley, 2005, p. 22). The five stages were also informed by a similar approach to scoping reviews from the Joanna Briggs Institute (Peters et al., 2015). Further, a quality assessment of the literature was completed in stage 4 using the Mixed Methods Appraisal Tool (MMAT) (Hong et al., 2018).

2.1. Identifying the research question

The research question was developed with the research team and is aligned within a larger study considering resilience amongst adolescents in ASM communities, specifically in Uganda and Ghana. This review was guided by the question – “what is known in the literature about the economic and health interventions aiming to strengthen coping skills and foster resilience amongst adolescents in mining communities?”

2.2. Identifying relevant studies

To gather literature relevant to the study question, we first conducted a preliminary search, in November 2022, using the terms “economic or health AND intervention AND resilience AND adolescents” through Google Scholar and OVID (MEDLINE, Embase, Global Health PsycINFO). One person from the research team (HC) scanned the results from this preliminary search to identify relevant keywords in titles and abstracts. Based on this preliminary search and scan, along with discussion amongst the research team, the search strategy was refined and search terms narrowed for this study.

A full search using the refined search strategy (Appendix A) was conducted through seven academic databases and four grey literature databases in February 2023. The search strategy was revised based on the preliminary search to include three main concepts and their related terms – adolescents, resilience and mining.¹ The full search strategy included the terms, *resilien* OR strength* OR “coping skill*” OR flexib* OR adapt* OR capacit* OR grow* OR well-being OR empower**; AND *adolescen* OR teen* OR young adult* OR young people OR youth**; AND mining. Academic databases included, Web of Science, Social Sciences Abstracts, African Index Medicus, and, MEDLINE, Embase, Global Health and PsycINFO through OVID. Initially, an additional grey literature search was conducted using Google Scholar, the PACT organization website, and the [Agency for Healthcare Research and Quality](#). Through consultation with the research team and the project International Advisory Committee, additional grey literature searches were conducted through the DELVE mining information database and World Bank Projects browser.

2.3. Study selection/screening

Identified references were uploaded to Covidence and duplicates were removed. Two team members (HC and NRK) independently screened all titles and abstracts against the eligibility criteria to determine articles to include in a full-text review (see [Table 1](#)). Discrepancies between reviewers were resolved through discussion. Studies that explored adolescent experiences in mining although did not present an intervention related to resilience were included in relevant (Background and Discussion) sections.

Two key aspects of the inclusion criteria are important to note – defining health and economic interventions, and the focus on mining. First, health interventions were defined as both formal and informal interventions, strategies, approaches, and/or policies that prevent disease and promote well-being. Particular focus was on interventions related to sexual and reproductive health. Economic interventions were defined as both formal and informal interventions, strategies, approaches, and/or policies that contribute to financial well-being, empowerment and livelihood. Second, we focused on “mining” instead of ASM in order to capture a wider breadth of information. Initial searches indicated that the literature on ASM was too narrow a focus and as such, the inclusion criteria was expanded to include interventions in mining communities generally.

Table 1
Inclusion and exclusion criteria.

Inclusion criteria	Published between 2012 and 2022 Discuss health and economic interventions to foster coping/resilience/strengths/growth Focus on adolescents (aged 10–19) Any type of study design, intervention, approach Written in English
Exclusion criteria	Focus of the intervention is in mining community Protocols, case series, letters to the editor, other reviews Studies in which the intervention is not health or economic specific and does not target resilience

¹ “Intervention” as a concept was removed from the search string after discussion with the research team and review of results from the preliminary search, as it was determined to pre-emptively narrow the focus of the study and limit the relevance of the results. The wider scope of both formal and informal interventions were interpreted by the reviewers in during the screening and selection of literature

2.4. Charting the data

The data extraction framework ([Table 2](#)) was developed with feedback from the research team and applied to included literature. Data were extracted by one team member (HC) through Covidence using the framework outlined in [Table 2](#). Data were extracted descriptively and then subsequently examined with a focus on what worked well and why, which aligned with the larger study. A quality assessment of literature was also completed by one team member (NRK) using the MMAT ([Hong et al., 2018](#)) (see Appendix B). The MMAT tool assesses studies based on the clarity of research questions, appropriateness of methodological approaches in addressing research questions and problems, clear connection between data collection, analysis, and interpretation of results, and adequate participant representation relative to the target population ([Hong et al., 2018](#)). Generally, most of the studies had clear research questions, used the appropriate methodological approaches to answer research questions and there was a clear coherence between data sources, collection, analysis, and interpretation. The methodological designs of three of the thirteen assessed studies did not meet the requirements for using the MMAT and were therefore not assessed using this tool. Nonetheless, they were projects with well-defined interventions, and target populations, and presented findings from the collected data.

3. Results

The initial search yielded 1489 results. Once 203 duplicates were removed, 1286 studies were screened (title and abstract). Of the reviewed studies, 54 were reviewed fully and 13 were included in the final review ([Fig. 1](#)).

3.1. Study locations

Of the included 13 studies, nine were conducted in sub-Saharan Africa (one in Mali ([Brottem and Ba, 2019](#)), two in the Democratic Republic of Congo ([Pact, 2020](#); [Shumsky et al., 2020](#)), one in Ghana ([Hilson and Osei, 2014](#)), two in Sierra Leone ([Maconachie, 2016, 2014](#)), two in Tanzania ([Abeid et al., 2022](#); [Kilale et al., 2015](#)), and one in Zambia ([Knoblauch et al., 2017](#))). Two studies presented an intervention that was conducted in Mexico ([Camacho et al., 2016](#); [Van Brussel et al., 2016](#)), one study was conducted in Papua New Guinea ([World Bank, 2014](#)) and one study was conducted in Russia ([Snegireva et al., 2020](#)). All of the studies presented interventions that were conducted in rural communities, aside from the study in Russia which was conducted in an urban industrial mining area (see Appendix 3 for full data extraction table).

Table 2
Data extraction framework.

Citation	Variable	Description
	Authors	Names of authors that published paper
	Year of publication	Year of publication
	Title	Title of paper
	Aims/objective	Aims/objectives that guided the study or paper
	Study design	Type of study design, sample size
	Population and location	Participants of the study (i.e., adolescents, age), country and context of study (i.e., urban/rural, mining community etc.)
	Intervention/approach/practice characteristics	Name of intervention/approach/practice Type of intervention Who implemented intervention Outcome measures Delivery method Duration of intervention Gender considerations Challenges faced
	Key findings	Impact of intervention/key learning

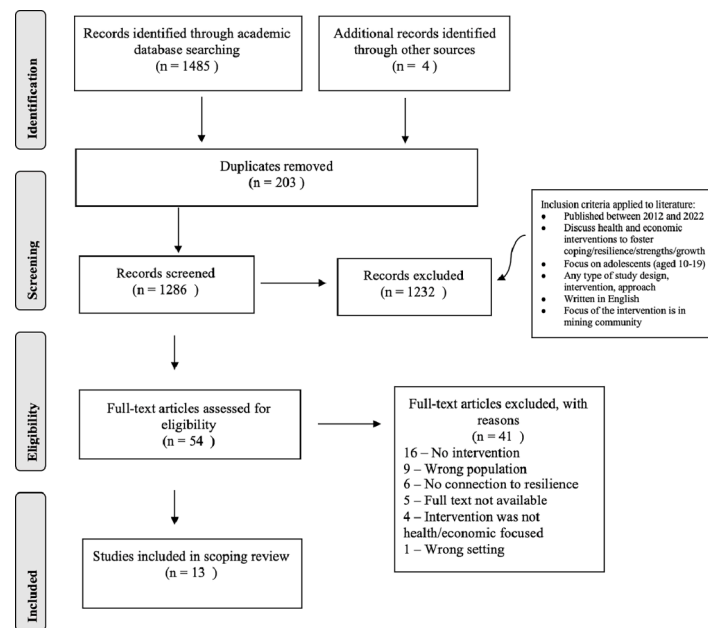


Fig. 1. Prisma flow diagram.

3.2. Study populations

All studies focused on the adolescent population. Although defined by the UN as individuals between the ages of 10 and 19 years (Patton et al., 2016), some studies expanded this age range in their focus. For example, four studies included individuals that were either younger than 10 years (Camacho et al., 2016; Van Brussel et al., 2016) or older than 19 (i.e., individuals up to 24 years) (Hilson and Osei, 2014; Knoblauch et al., 2017). Three studies included adolescents along with adult mine workers, community health workers, village leaders and relevant institutions (Kilale et al., 2015; Shumsky et al., 2020; World Bank, 2014).

3.3. Overview of interventions

Of the 13 studies included in the review, eight studies presented an intervention related to economic growth and/or livelihood resilience (Brottem and Ba, 2019; Hilson and Osei, 2014; Maconachie, 2014, 2016; Pact, 2020; Snegireva et al., 2020) (see Table 3). Five studies presented an intervention focused on health (Abeid et al., 2022; Camacho et al., 2016; Kilale et al., 2015; Knoblauch et al., 2017; Van Brussel et al., 2016). Most of the interventions ($n = 9$) were implemented in mining communities by local organizations, authorities or health teams (Abeid et al., 2022; Camacho et al., 2016; Kilale et al., 2015; Knoblauch et al., 2017; Maconachie, 2016; Pact, 2020; Shumsky et al., 2020; Van Brussel et al., 2016; World Bank, 2014). Two were implemented by the population of focus, for example adolescents and women, themselves (Brottem and Ba, 2019; Maconachie, 2014). The interventions described in the studies are summarized in Table 3 and in Appendix 3.

The subsequent sections summarize the findings according to the type of intervention (either health or economic). Under each intervention type detailed descriptions of the interventions, the aims of the interventions, implementation location, implementation body, outcome and impact measures, and level of impact are discussed.

3.4. Health interventions

The following section compliments Table 3 and Appendix 3 to further describe the health interventions presented in the literature and their impact.

3.4.1. Description and aim of interventions

Of the five studies describing health interventions, three (3) focused on mitigating communicable diseases that are prevalent in mining areas, for example, tuberculosis and HIV (Abeid et al., 2022; Kilale et al., 2015; Knoblauch et al., 2017) (see Table 3 and Appendix 3). These interventions provided peer education, health information, screening and testing, health counselling and some theatrical events to increase information on TB/HIV and services available (Abeid et al., 2022; Kilale et al., 2015; Knoblauch et al., 2017). The two interventions that solely focused on SRH promoted counselling and testing for HIV along with promoting safe sex and condom use (Kilale et al., 2015; Knoblauch et al., 2017). The intervention presented by Knoblauch et al. (2017) also included a peer education component, 'edutainment' and radio messaging, along with school health and gender equality education, the only intervention to specifically include a gender education component. Two studies presented an intervention focused on pollutants and mitigating health impacts of pollutants such as mercury (Camacho et al., 2016; Van Brussel et al., 2016). This intervention also included capacity building and an education component for youth to manage risks of mining pollution (Camacho et al., 2016; Van Brussel et al., 2016).

3.4.2. Level of intervention

Of the five studies, three described interventions that focused on community and individual level behaviour change (Abeid et al., 2022; Kilale et al., 2015; Knoblauch et al., 2017). These studies all had a significant HIV testing, counselling and information component. Two studies presented the CHILD framework (Camacho et al., 2016; Van Brussel et al., 2016), a stepped approach to identify and manage the health risks of mining pollution which was focused at both a community level through risk and health communication, building community centres and developing a Telehealth program; and at a policy level, working with the Mexican government.

3.4.3. Implementers of the intervention

Local actors were instrumental in the implementation of all interventions. For example, local authorities implemented the intervention in Mexico (Camacho et al., 2016; Van Brussel et al., 2016), a local organization and health centre delivered the HIV/TB intervention in Tanzania (Abeid et al., 2022), and similarly, local organizations alongside government administration delivered the HIV testing intervention

Table 3
Summary of interventions.

Study	Level	Description	Duration	Initiation actor(s)	Implementation body	Implementation strategy	Delivery location
Health Interventions							
Abeid et al., 2022	Community	Active TB case finding with expanded focus on HIV.	2 years	NGO	Local organization, health centers	Approach involved door-to-door screening, theatrical TB sensitization events in ASM settings, large TB awareness and screening events at mines and local bars/brothels, moonlight screening event to view educational videos on TB/HIV information with moderated question and answer. During door-to-door screening, peer educators provided 1:1 education about TB symptoms and risk factors. If TB symptoms are present, then a CHW would get involved and relevant referrals provided. HIV tests were also taking at screening time and if test was positive, a CHW would get involved for treatment and referral steps. At theatrical events, actors explained symptoms and risk factors.	Personal homes, mines, local bars, community gathering places
Van Brussel et al., 2016	Community and policy	Stepped approach to identify and manage risks of mining pollution.	Not specified	Not specified	Local authorities	The approach included: 1. Community-based risk identification – characterize and identify the risk. 2. Community habilitation to improve capacity to manage environmental, biological, social threats in a context of poverty and inequity. This included, capacity building programs to organize groups and establish community centers and also focused on improving professional training by developing a Telehealth program for clinical toxicology (e-TOX). 3. Implement of 3 relevant projects – risk communication programs with children, women, mine workers; environmental remediation actions to decrease exposure to pollutants; and environmental surveillance 4. Work with Mexican government to review and support intervention	Not directly specified (likely community gathering places, mines)
Camacho et al., 2016	Community and policy	Stepped approach to identify and manage risks of mining pollution.	Not specified	Not specified	Local authorities	This intervention is the same as the intervention presented in the Van Brussel et al. study, the “CHILD” framework. This article highlights Step 3 which involves three projects – risk communication with children, women and miners to increase education and awareness about the impacts of chemicals; environmental interventions to decrease pollutants; abandonment of mines for environmental remediation. Voluntary counselling and testing, promoting condom use and safer sex, distributing condoms, and providing risk	Not directly specified (likely community gathering places, mines)
Kilale et al., 2015	Community	Education campaigns to enable people to know their HIV status.	6 months	Not specified	Local organization, village administrations, government		Mining sites and surrounding communities

(continued on next page)

Table 3 (continued)

Study	Level	Description	Duration	Initiation actor(s)	Implementation body	Implementation strategy	Delivery location
Knoblauch et al., 2017	Community	HIV testing and counselling (HTC) through health promotion activities.	4 years	Mining company and district health team	District health management team and mining company	reduction counselling for young people. The approach also facilitated transport of mine workers to health facilities, if needed, where HIV services were available. Offered in communities through outreach activities and in workplace on a continuous basis at various service points. Peer education, health road shows in mass media, edutainment, community radio, behaviour messaging through media, posters, clothing, school health and gender equality education (with integrated gender equality education). HTC outreach through mobile units and condom distribution, relevant care, enrolment in treatment/national antiretroviral therapy	Mines (work-based health facilities), bus stops, canteens, surrounding communities
Economic Interventions							
Brottem and Ba, 2019	Community	Freehold land tenure rights and using land tenure processes to increase female success and empowerment in ASM context.	Not specified	Not specified	Women in ASM communities	Limited explanation of process, analytical description of involving women and local community processes to increase women's potential investment in land.	Communities
Hilson and Osei, 2014	Policy	Potential of an intervention focusing on formalizing ASM sector to benefit youth livelihoods.	Not applicable	Not applicable	Not yet implemented	Involved mounting policy pressure, refining laws, reorienting government goals to formalize ASM sector rather than continue to push it into informal sector, calling on government to better support youth with innovative employment options.	Multi-sectoral (local/national/ community governments)
Maconachie, 2014	Policy and mining company	Mobilizing youth groups to address labour issues and employment conditions – advocacy and activism.	Not applicable	Not applicable	Youth	Mobilize youth groups and support young people organizing to advocate for labour regulations that have long term economic and health benefits (safer workplace, consistent salary).	Mining communities, levels of government
Maconachie, 2016	Community and policy	Youth focused CSOs mobilization in response to exploitation and marginalization from corporate actors.	Not applicable	Not applicable	Youth-focused civil society organizations (CSOs)	This intervention included, mobilization of youth-dominated associational groups and CSOs, youth led protests (through phones, youth-orientated music etc.).	Mining communities, levels of government
Pact, 2020	Community	Vocational education training to youth in mining communities.	6–12 months	NGO	Communities, local CSOs, national, local and provincial government institutions, national/ local companies	This intervention involves completing a market study to identify profitable and sustainable alternative trade sectors to mining in the region of focus. Young people selected as apprentices participate in a 6-month intensive training program in a trade and are supervised by a local mentor (e.g., computer science, mechanics, barbering, metalwork). After completion, support for initial business start-up was provided (funding, equipment, trainings).	Mines and surrounding communities, local businesses
Shumsky et al., 2020	Community	A pilot project focussed on promoting decent mining work through increased productivity, and health and safety. This included	2 years	Mining company and NGO	Local authorities, local organization, independent researchers	Partnership with local ASM cooperative to implement a comprehensive package of technical assistance to enable cooperative to safely conduct	Mines

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Table 3 (continued)

Study	Level	Description	Duration	Initiation actor(s)	Implementation body	Implementation strategy	Delivery location
		partnered with a local mining cooperative to provide a package for practical assistant to semi-mechanize mining activities.				semi-mechanized mining and increase capacity. This included a health/safety component to build a safe workplace (i.e., training on workplace safety, free healthcare available on site, site risk register, provision of clean water, random alcohol testing to mitigate those working under influence of alcohol).	
Snegireva et al., 2020	Community	Youth entrepreneurial incubator that united active youth in Russia and China who are founders of innovative start-ups.	Not specified	Not specified	Universities	The approach provided an opportunity for young people to learn methods of building a business, capacity building, develop human capital, leadership skills.	University campuses
World Bank, 2014	Policy and mining company	Five component approach to strengthen regulatory frameworks and audit sector.	6 years	Not specified	Local authorities	The project consists of five components: 1 Strengthening the policy and regulatory frameworks for the mining sector (reviewing and recommending improvements to existing mining policy; establishing new policy) 2 Strengthening mining sector governance, regulation, and sustainable development outcomes (strengthen Mineral Resources Authority’s capacity through anti-corruption planning, and improving monitoring processes) 3 Improving revenue collection and audits of the sector (training internal revenue commission staff for project auditing) 4 Strengthening the foundations for a conflict-free mining sector in Bougainville (training government staff to review mining regulations and develop mine safety and health) 5 Project management	Government workplaces

in Tanzania ([Kilale et al., 2015](#)). For the HIV testing intervention in Zambia ([Knoblauch et al., 2017](#)), the relevant international and national mining companies were engaged alongside the district health management team.

3.4.4. Location of the intervention

Most of the health interventions ($n = 3$) were implemented and delivered in locations of target populations’ operation. For example in individual homes, mines, and local gathering places such as local bars and bus stops ([Abeid et al., 2022](#); [Kilale et al., 2015](#); [Knoblauch et al., 2017](#)). In other words, results indicate that interventions are implemented in places where people work and socialize. The implementation location for the intervention in Mexico was not directly specified. However the retrieved papers discussed creating community centers and programming for individuals in the surrounding communities of the mines ([Camacho et al., 2016](#); [Van Brussel et al., 2016](#)).

3.4.5. Outcome and impact measures

Health intervention outcome measures were two-pronged – measuring the level of information or awareness on the potential health

challenge or cause of the health challenge, and measuring the prevalence of the health issue (see Appendix 3). For example, the CHILD framework measured mercury levels and awareness of pollutants amongst the target group of participants ([Camacho et al., 2016](#); [Van Brussel et al., 2016](#)). Similarly, the interventions discussed by [Kilale et al. \(2015\)](#) and [Knoblauch et al. \(2017\)](#) measured prevalence of HIV, and behaviour changes based on increased information about HIV and testing.

3.5. Economic interventions

In conjunction with [Table 3](#) and Appendix 3, the following section describes the economic interventions presented in the literature and their impact.

3.5.1. Description and aim of interventions

Many of the studies that addressed economic interventions focused on enhancing economic well-being through advocacy and activism. Specifically, this included pressuring governments and mining companies to change their policies to create more sustainable work

environments or opportunities for greater economic stability (Brottem and Ba, 2019; Hilson and Osei, 2014; Maconachie, 2014, 2016; World Bank, 2014). For example, two studies highlighted the important role of youth-led organizations in leading advocacy and activism efforts such as protests (Maconachie, 2016, 2014). Three studies (Hilson and Osei, 2014; Maconachie, 2016, 2014) discussed the potential role of formalizing the ASM sector to create a structure of accountability for companies and governments, create labour regulations for adolescents, and ensure adolescents are compensated with development investment and better employment opportunities. Similarly, one study focused on strengthening regulatory frameworks of government and mining companies through capacity building for auditing and anti-corruption (World Bank, 2014). Two studies focused on youth entrepreneurship activities to build capacity and skills outside of mining (so youth would be able to get jobs elsewhere) (Pact, 2020; Snegireva et al., 2020). Finally, one study focused on partnering with a local cooperative to implement technical assistance for the mine to increase safety and productivity of equipment (Shumsky et al., 2020).

3.5.2. Level of intervention

Economic interventions targeted change for individuals and systems at both a community and policy level. Four interventions focused on community level change, for example, amongst adolescents through developing their skills towards more sustainable and safe livelihoods (Brottem and Ba, 2019; Pact, 2020; Shumsky et al., 2020; Snegireva et al., 2020). One study presented an intervention that would solely focus on policy level change, at different levels of government, to formalize the ASM sector for adolescents (Hilson and Osei, 2014). Three interventions targeted impact at a policy level along with the community level (Maconachie, 2016) or mining company level (Maconachie, 2014; World Bank, 2014).

3.5.3. Implementer of the intervention

The population of focus, adolescents, were discussed as the main actors in implementing three of the economic interventions. For example, the land tenure intervention for women in ASM communities was implemented by young women (Brottem and Ba, 2019), while youth/youth-focused organizations were described as implementers in advocacy and activism interventions in Sierra Leone (Maconachie, 2016, 2014). Four interventions described programs for miners, youth and government workers which were implemented by relevant institutional bodies – specifically, one was implemented by a university (Snegireva et al., 2020) and three were implemented by local authorities, NGOs, and government institutions (Pact, 2020; Shumsky et al., 2020; World Bank, 2014). One study did not directly describe the implementation actors involved (Hilson and Osei, 2014).

3.5.4. Location of the intervention

Three economic interventions were implemented in communities and mining workplaces only (Brottem and Ba, 2019; Pact, 2020; Shumsky et al., 2020). Two interventions were implemented in communities, mining workplaces and in government (Maconachie, 2016, 2014). Two interventions were only implemented at a government or policy level (Hilson and Osei, 2014; World Bank, 2014). One intervention was described as being implemented for adolescents on university campuses (Snegireva et al., 2020).

3.5.5. Outcomes and impact measures

Economic intervention outcome measures varied (see Appendix 3). Two interventions discussed the idea of formalizing the ASM sector for greater regulation, safety and compensation for youth (Hilson and Osei, 2014; Maconachie, 2014). Similarly, greater accountability amongst mining companies along with companies providing programming for youth to build safety and workplace skills was discussed as an outcome measure in one study (Maconachie, 2016; World Bank, 2014). One study indicated purchase of land by women for further economic stability as

the outcome measure (Brottem and Ba, 2019). Skill building towards increased alternative employment outside of the mining sector was discussed in one intervention (Pact, 2020). Similarly, one study noted productivity of miners and safer working conditions as the primary outcome (Shumsky et al., 2020). One intervention did not directly specify an outcome measure (Snegireva et al., 2020).

3.6. Comparing economic and health interventions

In summary, the health and economic interventions outlined in the literature were diverse in how they supported building resilience and strengthening coping skills in mining environments. Many economic related interventions targeted policy level change through advocacy and activism (Hilson and Osei, 2014; Maconachie, 2016, 2014), whereas majority of the health interventions focused on individual and community level change (Abeid et al., 2022; Camacho et al., 2016; Kilale et al., 2015; Knoblauch et al., 2017; Van Brussel et al., 2016). There was limited discussion of gender in the interventions presented – one study focused on the gendered impacts of mining and land ownership and tenure amongst women as a possible point of economic growth and resilience (Brottem and Ba, 2019) and another health focused study described gender equality education as part of their intervention (Knoblauch et al., 2017). Otherwise, the intersectional analysis or integration of intersectional considerations in implementing interventions was seldom discussed.

4. Discussion

Last mile adolescents in the mining sector experience the intersection of several vulnerabilities at an already complex time of development (Davison et al., 2021; Namy et al., 2017; Nowshin et al., 2022). These vulnerabilities such as limited access to health information and services and economic instability, are exacerbated in times of economic and social disruption (i.e., the COVID-19 pandemic) (OECD, 2020). As such, adolescent resilience, and coping are crucial for well-being and ultimately, for health equity. Findings indicate that studies on economic and health interventions that support adolescent resilience in mining communities are limited. However, common approaches, what worked well and why, transferability and future directions for adolescent resilience interventions are evident and contribute to addressing the gap in knowledge on the topic.

4.1. Common approaches

4.1.1. Health interventions

Although common approaches to health interventions were impactful there is opportunity to expand on what health interventions focus on (i.e., comprehensive sexual health and gender). Findings show that health interventions were commonly employed through door-to-door or at-work screening and testing, along with promoting condom use and safe sex through counselling, peer education and ‘edutainment’ (Abeid et al., 2022; Kilale et al., 2015; Knoblauch et al., 2017). Connecting with people to screen, test and provide counselling or ‘edutainment’ where people already gather has been discussed in other contexts throughout the COVID-19 pandemic as an effective approach to providing health information (Harvard Medical School Primary Care, 2021; NIH Community Engagement Alliance (CEAL), 2021). Although interventions connected with individuals for testing and screening in places they already gather, there was opportunity in health interventions to expand the focus and involve more comprehensive sexual and reproductive health and rights (SRHR) which includes sexual and gender-based violence and maternal health rather than just HIV and safer sex (United Nations Population Fund (UNFPA), 2019). This expanded focus on aspects such as comprehensive SRHR, gender-based violence and maternal health would also effectively work to address Sustainable Development Goal (SDG) 3, healthy lives and well-being,

which specifically refers to universal access to SRHR and maternal health services (United Nations General Assembly, 2015).

4.1.2. Economic interventions

Economic interventions were commonly implemented through a multi-faceted approach that targeted both government and mining company policies, and community/adolescent livelihoods demonstrating the importance of engaging multiple stakeholders and sectors. Findings show that stakeholders such as NGOs, local authorities, mining companies, government and communities are important to engage (Maconachie, 2014, 2016; Pact, 2020; Shumsky et al., 2020; World Bank, 2014). These multi-faceted approaches with diverse partners at multiple levels of government and community align with initiatives to promote better youth livelihoods. For example, the OECD Development Centre calls for better national and regional support to promote sustainable youth entrepreneurship (while recognizing its challenges) and greater policy coherence and commitment to youth employment through broad and inclusive youth focused programs (i.e., programs that focus on youth employment and their SRHR) (OECD, 2018).

4.2. What worked well and why

The findings emphasize the necessity for interventions to adopt multi-level, multi-sectoral, and multi-stakeholder approaches, while mainstreaming gender.

4.2.1. Multi-level approaches

A multi-level approach includes engaging multiple levels of national, regional, and community government, along with mining companies and communities. Findings indicate that for both health and economic interventions multiple levels of engagement are important to include (Camacho et al., 2016; Kilale et al., 2015; Knoblauch et al., 2017; Maconachie, 2016, 2014). Scholarly literature about both health interventions and mining in general also promote multi-level approaches engaging within levels of government and with communities to effectively reduce health disparities and strengthen the sustainability of interventions (Bester and Uys, 2023; Mikkelsen et al., 2016; Paskett et al., 2016). Multi-level engagement and decision making also creates an opportunity to leverage the differing roles of stakeholders towards effective policy-making and widespread implementation of interventions.

4.2.2. Multi-sectoral approaches

Multi-sectoral approaches prioritize collaboration amongst various sectors to leverage diverse knowledge and expertise towards strengthened interventions (Salunke and Lal, 2017; The Challenge Initiative, n.d.). Findings highlight that adolescent resilience interventions integrate multiple sectors such as public and private sectors and relevant stakeholders from sectors such as law, education, labour and health (Abeid et al., 2022; Camacho et al., 2016; Kilale et al., 2015; Knoblauch et al., 2017; Maconachie, 2016; Pact, 2020; Shumsky et al., 2020; Snegireva et al., 2020; Van Brussel et al., 2016; World Bank, 2014). Governments and international organizations such as the World Health Organization (WHO), have also endorsed multi-sectoral approaches as best practice to strengthen the impact of health interventions (Global Affairs Canada, 2017; Herriot and Valentine, 2018). Multi-sectoral approaches are especially important given the intersectional nature of challenges faced by last mile adolescents in mining communities (Bester and Uys, 2023; Buss et al., 2017; Fritz et al., 2017; Hinton et al., 2021; Ibrahim et al., 2020; Mpagi et al., 2017; Muheki and Geenen, 2018; Schwartz et al., 2021; Yakovleva et al., 2017).

4.2.3. Multi-stakeholder approaches

Multi-stakeholder approaches were also noted as important in the literature. For example, health and economic interventions were both implemented through partnerships with multiple stakeholders such as

youth-led organizations and Ministries of Health and Labour (Abeid et al., 2022; Kilale et al., 2015; Knoblauch et al., 2017; Maconachie, 2016, 2014; Pact, 2020; Shumsky et al., 2020). Scholars and practitioners note the importance of multi-stakeholder approaches for sustainable impact and legitimacy, especially towards the SDGs and the Africa Mining Vision which was developed in 2009 (African Union, 2009; Bansah et al., 2022; Bester and Uys, 2023; Eichhorn et al., 2020; United Nations Population Fund (UNFPA), 2019; Yakovleva et al., 2017).

Local actors also play a pivotal role in decision making and implementing community level interventions indicating that effective community participation is essential for ownership and sustainability of interventions. This is evident through the success and impact of community-based initiatives that prioritize community partnerships, community ownership, community leadership in priority setting and engaging end-users from the starting point of building interventions (Elder and Odoyo, 2018; Gokiart et al., 2017; Kapiriri et al., 2003; Kapiriri and Razavi, 2021; Ochocka and Janzen, 2014; Razavi et al., 2019; Villa-Torres and Svanemyr, 2015). Literature included in the review minimally discussed involvement of adolescents and community ownership. Organizations such as the WHO have advocated for participatory engagement of adolescents to build more community-owned interventions (World Health Organization, 2015). Some organizations working with out-of-school and last-mile adolescents use participatory methods such as sport and play to engage adolescents effectively (Frazier et al., 2015; Grassroots Soccer, 2023; Mercy Corps, n.d.). Future interventions in mining communities, and ASM communities specifically, should aim to engage adolescents through participatory methods at all stages of interventions (i.e., development, implementation, evaluation) to build community ownership.

4.2.4. Mainstreaming gender

Although seldom discussed in the literature included in this review, integrating gender-transformative approaches are broadly recommended for health and economic interventions. Gender equality has been a significant focus of global policy such as the SDGs (Choonara et al., 2018; United Nations General Assembly, 2015). In adolescent health/economic interventions, gender equality has also been emphasized as a key priority (Kabeer, 2018; OECD, 2008; UNFPA, 2023). Best practices for SRHR interventions, for example, integrate gender-transformative approaches which “seek to challenge gender inequality by transforming harmful gender norms, roles and relations, while working towards redistributing power, resources, and services more equally” (UNFPA, 2023). Practically, this could include engaging adolescent girls and young women in spaces that are safe and comfortable, and working to mitigate harmful gender norms and values that limit the access they have to SRHR information and services (UN Women, 2019; UNFPA, 2023). Adolescent boys and young men should also be engaged to change norms and beliefs towards gender equality (UN Women, 2019; UNFPA, 2023). Future health and economic resilience interventions for adolescents should prioritize integration of gender-transformative approaches across the multi-level, multi-sectoral, and multi-stakeholder aspects of the interventions.

4.3. Transferability of interventions

Many studies did not directly discuss transferability to different geographies and environments. However, results indicate that based on the aspects that worked well such as support from the Ministry of Health, Ministry of Labour, mining companies and/or NGOs, interventions are transferable. Transferability is based on multi-sectoral and multi-level collaboration along with strong partnerships and mutual interest amongst relevant organizations, companies, community individuals, and government bodies (Schloemer and Schröder-Bäck, 2018; Trompette et al., 2014). Majority of the studies in this review were based in Sub-Saharan Africa, so transferability based on geography

within Africa could be relatively high although context-specific adjustments based on population, culture, economic and political environments (i.e., ASM communities) would be important to prioritize (Cambon et al., 2014, 2012; Trompette et al., 2014; Wang et al., 2006).

4.4. Limitations

There are a few limitations of this study. First, there is limited literature about adolescent resilience in ASM communities that has been published through academic databases. As such, we endeavoured to search the literature through both academic and gray literature sources, expanded the inclusion of literature to studies that focused on mining communities in general (rather than ASM specifically), and engaged in team discussions while seeking advice from the project advisory committee about identifying pertinent literature. Second, defining study terms such as resilience and interventions was a challenge given the breadth of literature on the topic and multiple ways in which concepts such as resilience and intervention could be interpreted. To refine the focus of the study, the team extensively discussed such concepts and after considering literature on similar topics (Belita et al., 2022; LoVette et al., 2019; Mabrouk et al., 2022), developed a search strategy and approach to screening the literature that offered an opportunity to effectively consider a wider breadth of information and interpret, based on agreed upon definitions, ideas of resilience and intervention. Finally, limited literature included in the review discussed the complex global forces that impact challenges experienced by adolescents in mining such as capitalist exploitation, poor governance, climate change, and failure of safe mining guidelines. Future research is encouraged to examine these complex challenges amongst adolescents in mining communities.

4.5. Conclusions

This scoping review has explored existing economic and health interventions to strengthen adolescent resilience and coping during times of social and economic disruption in mining communities. The review has comprehensively identified aspects that worked well in adolescent resilience interventions to inform future interventions and policy. The results outline the importance of engaging a diverse range of stakeholders across various sectors while emphasizing strong partnerships with communities and individuals. Moreover, findings indicate the significance of a gender-transformative approach underscoring the need for interventions that address the intersecting identities of adolescents. Future research should prioritize intersectional, gender-transformative and community-based interventions to strengthen adolescent resilience in mining communities and advance health equity and rights amongst this last-mile population.

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Declarations of Competing Interest

None.

Data availability

All relevant data are within the paper and its Supporting Information files.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.exis.2023.101369](https://doi.org/10.1016/j.exis.2023.101369).

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