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Determinants of Compliance with Occupational Safety Standards among Artisanal Miners in Chingola District, Zambia

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Abstract

Artisanal and small-scale mining (ASM) remains a critical livelihood source in Chingola District, Zambia, contributing significantly to local economies. However, compliance with occupational safety standards among artisanal miners remains persistently low, resulting in frequent preventable injuries and fatalities. This study investigates the socio-economic, institutional, behavioral, and cultural determinants influencing adherence to safety protocols. Grounded in the Health Belief Model (HBM) and Institutional Theory, a sequential explanatory mixed-methods approach was employed, combining surveys (n=150), interviews (n=20), and field observations. Findings reveal that economic hardship, insufficient training, weak regulatory enforcement, and entrenched cultural perceptions significantly hinder compliance. The study recommends integrated interventions, including localized safety education, community-led enforcement strategies, and economic incentives. These findings contribute to the broader global discourse on informal mining safety and offer actionable insights for national policy frameworks aimed at enhancing occupational health in resource-dependent communities.

Keywords: Artisanal mining, safety compliance, occupational health, regulatory enforcement, Zambia, Health Belief Model, Institutional Theory

1. Introduction

Artisanal and small-scale mining (ASM) plays an increasingly important role in global commodity production and rural development. Worldwide, over 40 million people are directly engaged in ASM, with millions more indirectly dependent on its economic benefits (Hilson, 2020). In Zambia, the copper-rich Chingola District has witnessed a surge in artisanal mining, particularly in response to formal sector job losses and rural poverty (Zambia Chamber of Mines, 2022). Despite its economic importance, ASM operations are often characterized by hazardous working conditions, limited oversight, and low compliance with occupational safety standards (International Labour Organization [ILO], 2021). Consequently, artisanal miners frequently suffer from accidents, respiratory diseases, and fatalities that could otherwise be prevented through improved safety adherence.

Occupational safety within the artisanal mining sector is not merely a technical challenge but a complex social issue intertwined with economic pressures, institutional weaknesses, behavioral patterns, and cultural norms. Against this backdrop, the present study aims to investigate the determinants of compliance with safety standards among artisanal miners in Chingola, utilizing theoretical perspectives and empirical evidence to inform policy interventions.

1.2 Problem Statement

Despite the legal frameworks and occupational health standards set by Zambian authorities, artisanal miners in Chingola continue to operate in highly unsafe environments. Fatal pit collapses, exposure to toxic dust, and lack of protective equipment are common (World Bank, 2023). Anecdotal evidence suggests that many miners prioritize immediate income generation over safety, often working without helmets, gloves, or proper ventilation. Weak institutional enforcement, coupled with socio-economic desperation, creates a cycle of neglect that undermines efforts to improve workplace safety. This study seeks to systematically identify the underlying factors contributing to this persistent non-compliance and propose actionable strategies for improvement.

2. Review of Literature

2.1 Economic Constraints

Economic constraints remain one of the most powerful determinants of occupational safety compliance among artisanal miners. In contexts such as Chingola, where artisanal mining is often the primary source of income for entire households, the pressure to meet daily subsistence needs often outweighs concerns for personal safety (Aryee, Ntibery, & Atorkui, 2022). The informal nature of artisanal mining further compounds this dynamic; without access to formal financing mechanisms, miners must self-fund protective gear and equipment, costs they often view as unnecessary given their immediate financial pressures. Studies have consistently shown that miners operating in economic hardship environments are less likely to invest in long-term safety measures, instead opting for operational shortcuts that expose them to occupational hazards (International Labour Organization [ILO], 2021). For example, in Ghana's Obuasi goldfields, research indicated that 63% of miners cited affordability as the primary reason for forgoing protective equipment (Hilson, 2020). Similarly, in Chingola, 78% of surveyed miners reported bypassing safety protocols to maximize short-term earnings, often working in unstable tunnels without helmets, masks, or support structures. These findings underscore the urgent need for integrating economic incentives into safety interventions to ensure that miners are not forced to choose between safety and survival.

2.2 Institutional Weaknesses

Institutional weaknesses within regulatory frameworks significantly contribute to non-compliance with occupational safety standards among artisanal miners. Regulatory bodies such as Zambia's Ministry of Mines and Minerals Development often face severe budgetary and staffing constraints, resulting in sporadic and largely ineffective site inspections (Kamundala, Kambuyi, & Mwamba, 2021). Without consistent regulatory pressure, unsafe mining practices become normalized. Moreover, corruption and lack of accountability in regulatory enforcement exacerbate the situation; miners and site owners often bribe inspectors or exploit legal loopholes to evade compliance requirements. The absence of coherent and stringent enforcement mechanisms mirrors the broader governance challenges that afflict the artisanal mining sector across Africa. For instance, in the Democratic Republic of Congo, only 12% of artisanal mining sites were found to have ever been inspected by government officials, leading to rampant violations of safety norms (Bashwira et al., 2014). In Chingola, interviews with miners revealed a pervasive belief that inspections are rare and penalties for non-compliance are either negligible or inconsistently applied. These findings suggest that improving institutional capacity through enhanced funding, staff training, anti-corruption measures, and community oversight is crucial to fostering a culture of safety compliance.

2.3 Behavioral and Cultural Factors

Behavioral and cultural factors play a critical role in shaping artisanal miners' attitudes toward occupational safety. According to the Health Belief Model (HBM), compliance with health and safety behaviors is largely influenced by individuals' perceived susceptibility to harm, perceived severity of outcomes, perceived benefits of preventive action, and perceived barriers to action (Jønsson & Bryceson, 2023). In the context of Chingola, miners often underestimate the probability and consequences of mining-related accidents, viewing injuries and fatalities as "acts of fate" rather than preventable incidents. Cultural fatalism belief that outcomes are predetermined and beyond human control significantly undermines proactive safety behaviors. In-depth interviews revealed that many miners believed that the use of protective gear would not necessarily prevent accidents if "their time" had come, echoing similar findings in Tanzania's artisanal gold fields (Jønsson & Bryceson, 2023). Furthermore, peer influence and local social norms discourage adherence to safety standards, as miners who prioritize safety are sometimes stigmatized as "cowards" or "weak." Behavioral change interventions must therefore address not only individual perceptions but also broader community- level cultural narratives about risk and survival.

2.4 Global Comparisons

The dynamics observed in Chingola align closely with global trends in artisanal mining contexts. In the Democratic Republic of Congo (DRC), for instance, Bashwira et al. (2014) found that miners faced similar economic and institutional barriers to safety compliance, with poverty compelling workers to engage in high-risk practices and weak state institutions failing to enforce basic occupational standards. In Ghana, Hilson (2020) documented that despite national efforts to formalize ASM operations, systemic non-compliance persisted due to a combination of income insecurity, distrust of regulatory authorities, and cultural perceptions of inevitability regarding mining accidents. Furthermore, international case studies have revealed that efforts solely focused on regulatory enforcement or punitive measures often fail without accompanying strategies that address miners' economic vulnerabilities and reshape cultural attitudes toward risk. For example, in Peru, an integrated approach combining microfinance services with mandatory safety training resulted in a 35% increase in the consistent use of personal protective equipment over two years (Siegel & Veiga, 2009). These global experiences underscore the need for multidimensional interventions that simultaneously target the economic,

institutional, and behavioral drivers of non-compliance. Lessons from other jurisdictions can inform the design of context-sensitive, sustainable strategies to enhance occupational safety among artisanal miners in Zambia.

3. Methodology

This study employed a sequential explanatory mixed-methods design. In the first phase, structured surveys were administered to 150 artisanal miners selected through purposive sampling across three mining zones in Chingola District. The survey focused on demographics, economic conditions, safety practices, perceptions of risk, and institutional interactions.
In the second phase, 20 in-depth interviews were conducted with miners, mining association leaders, and regulatory officers to contextualize survey findings. Field observations were also carried out to document actual mining practices and conditions. Data were analyzed using SPSS for quantitative data and thematic analysis for qualitative data.

4 Findings

The analysis revealed that artisanal miners' compliance with occupational safety standards in Chingola District is significantly influenced by a combination of economic, institutional, behavioral, and cultural factors.

4.1 Economic Hardship

Survey results indicated that 78% of respondents reported bypassing safety procedures due to the urgency of meeting daily income targets. Miners frequently entered unsupported mine shafts, worked without helmets, gloves, or boots, and continued operations even in visibly unstable environments.

Chi-square analysis showed a significant association between daily income pressure and non- compliance with safety practices ($\chi^2(1, N=150) = 23.45$, $p < 0.001$).

Further binary logistic regression analysis revealed that miners earning less than 2,000 ZMW (approx. 100 USD) per month were 4.7 times more likely (Odds Ratio = 4.71; 95% CI [2.1, 10.2]) to ignore safety protocols compared to those earning above this threshold.

4.2 Inadequate Training

Only 12% of miners reported receiving any form of occupational safety training. Of these, most described the training sessions as brief, ad-hoc, and non-standardized, often conducted by local NGOs rather than formal mining authorities.

Miners with formal safety training were significantly more likely to comply with basic safety practices (use of helmets, gloves, proper shaft reinforcement) ($\chi^2(1, N=150) = 19.12$, $p < 0.001$).

Qualitative interviews further highlighted the inadequacy of existing training, with miners noting that training was usually reactive conducted after accidents rather than as preventive measures.

4.3 Weak Regulatory Enforcement

Field interviews with regulatory officers revealed that inspections occurred approximately once every six months, far below the recommended quarterly visits stipulated by Zambian mining regulations. Limited staffing, logistical challenges, and resource shortages were cited as major constraints.

42% of miners interviewed admitted to knowing mechanisms for circumventing inspections, primarily through informal payments.

Survey data showed that perceived likelihood of inspection had a strong positive correlation with safety compliance ($r = 0.61$, $p < 0.01$), meaning miners who perceived inspection as probable were more likely to comply.

4.4 Cultural Perceptions

Cultural beliefs emerged as a critical barrier to compliance. Approximately 55% of respondents believed that accidents were acts of fate or divine will rather than outcomes of preventable hazards. This fatalistic view significantly weakened motivation for proactive safety behavior.

Thematic analysis of interviews revealed commonly cited sayings like:

- "If it's your day to die, no helmet will save you," and
- "The earth listens to God, not to man."

Miners who subscribed to fatalistic beliefs were significantly less likely to use safety gear ($\chi^2(1, N=150) = 17.36$, $p < 0.001$).

Table 1: Economic Pressure

Test	Purpose	Result	Interpretation
Chi-square (Economic Pressure & Non-compliance)	Association test	$\chi^2 = 23.45$, $p<0.001$	Significant association
Binary Logistic Regression (Income Level & Compliance)	Prediction	OR = 4.71, 95% CI [2.1, 10.2]	Low income predicts non-compliance

Table 2: Inadequate Training

Test	Purpose	Result	Interpretation
Chi-square (Training & Compliance)	Association test	$\chi^2 = 19.12$, $p<0.001$	Significant association
Correlation (Perceived Inspection & Compliance)	Strength and direction	$r = 0.61$, $p<0.01$	Moderate to strong positive correlation
Chi-square (Fatalism & Gear Usage)	Association test	$\chi^2 = 17.36$, $p<0.001$	Significant association

5 Discussion and Conclusion

5.1 Discussion

The findings of this study underscore the complex and multifaceted nature of safety compliance in the artisanal mining sector of Chingola District, Zambia. The study aligns with several key theoretical frameworks, particularly the Health Belief Model (HBM) and Institutional Theory, which suggest that both individual perceptions and broader structural influences shape safety behaviors.

Health Belief Model and Perceived Susceptibility

The Health Belief Model (HBM) postulates that individuals' health behaviors are influenced by their perceptions of susceptibility to harm, the severity of that harm, the benefits of taking action, and the barriers to adopting protective measures (Jønsson & Bryceson, 2023). In the case of artisanal miners in Chingola, the study reveals that miners' perceptions of economic vulnerability significantly diminish their perceived susceptibility to occupational risks. In other words, the urgency to meet daily income targets (perceived barrier) outweighs the perceived benefits of using safety equipment.

As the Health Belief Model predicts, when the perceived barriers to adopting safety measures (e.g., cost, time, and effort) are high, miners are less likely to engage in health-promoting behaviors. Economic hardship—primarily driven by low wages and lack of alternative income sources—forces miners to prioritize immediate survival over long-term health and safety. This behavior is consistent with the economic necessity hypothesis seen in other mining contexts globally (Hilson, 2020).

Institutional Weaknesses and Regulatory Gaps

Weak institutional frameworks play a significant role in the non-compliance with safety standards in artisanal mining, as evidenced by the infrequent regulatory inspections and under-resourced regulatory agencies in Chingola. Miners exploit these gaps by circumventing inspections through informal payments, a practice common in similar informal economies worldwide (Kamundala et al., 2021). Institutional Theory supports this, suggesting that weak or poorly implemented regulations fail to foster compliance. The lack of effective oversight creates an environment where miners feel they can ignore safety protocols without facing consequences. This issue is not unique to Zambia, as similar challenges are observed in Ghana and the Democratic Republic of Congo, where economic pressures and institutional weaknesses also undermine safety compliance (Aryee et al., 2022; Bashwira et al., 2014). These findings highlight that the root cause of non-compliance lies in the inadequacy of regulatory frameworks and the inconsistent enforcement of safety standards.

Cultural Beliefs and Fatalism

A striking finding in this study is the influence of cultural beliefs, particularly fatalism, on miners' safety behaviors. Over 55% of participants in Chingola believed that mining accidents were inevitable and determined by fate, rather than being the result of unsafe working conditions. This fatalistic mindset diminished the perceived importance of safety measures, aligning with similar findings in other mining communities where cultural outlooks reduce the motivation to adopt preventive actions (Clarke, 2021; Kamundala et al., 2021). The Health Belief Model offers insight into this behavior, suggesting that when miners perceive the benefits of safety measures as irrelevant or ineffective due to fatalistic beliefs, they are less likely to engage in safety practices (Jønsson & Bryceson, 2023). The perception that accidents are predestined severely undermines the impact of safety education initiatives and further entrenches non-compliance with safety standards.

Comparative Evidence from Ghana and the DRC

Comparative studies from the Democratic Republic of Congo (Bashwira et al., 2014) and Ghana (Aryee et al., 2022) reveal striking similarities to the Chingola case, particularly in how economic insecurity drives non-compliance with safety protocols. In Ghana's small-scale mining sector, miners prioritize production over safety due to income insecurity, resulting in higher injury and fatality rates (Aryee et al., 2022). Similarly, in the DRC, weak regulatory bodies contribute to miners neglecting safety practices because of inconsistent enforcement (Bashwira et al., 2014). These international findings highlight the combination of economic vulnerability and institutional failure as significant barriers to safety compliance in artisanal mining. What emerges from these studies is the need for multi-faceted interventions that address not only behavioral changes but also underlying economic and governance challenges. Interventions in Ghana and the DRC have been more successful when they tackled these broader issues rather than focusing solely on behavior change in isolation.

Implications for Policy and Practice

This study suggests that safety interventions for artisanal miners should combine economic support with safety education, such as providing micro-financing for protective gear, as successfully implemented in Ghana. Strengthening regulatory bodies through institutional reforms and introducing community-led enforcement mechanisms are crucial for effective oversight, especially in resource- limited areas. Additionally, safety education must address cultural beliefs, emphasizing the preventability of accidents rather than attributing them to fate, to shift miners' attitudes towards compliance.

5.2 Conclusion

This study contributes valuable insights into the determinants of safety compliance in artisanal mining in Chingola, Zambia. By applying the Health Belief Model and Institutional Theory, the study provides a deeper understanding of how economic vulnerability, institutional weaknesses, and cultural fatalism shape miners' attitudes toward safety. Furthermore, the findings align with international studies from Ghana and the DRC, reinforcing the importance of multi-faceted interventions that address economic, institutional, and cultural factors simultaneously. The study calls for more integrated and holistic approaches to safety regulation in the artisanal mining sector, ensuring that miners not only have access to training and protective equipment but also the economic support and institutional backing necessary to make safety a priority.

Declaration of Competing Interests

The authors declare that they have no conflicting interests.

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Data Availability statement

The data used to support the findings of this study are available upon request, from the corresponding author.

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