



Research article

Assessing the effect of working conditions on routine medical checkup among artisanal goldminers in Ghana

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ABSTRACT

The socio-economic impacts of unforeseen health challenges among mine workers cannot be overemphasized. Due to the nature of artisanal mining in Ghana, workers are responsible for their own health care. This, however, necessitates the need for insight into the dynamics of self-care among artisanal miners. A cross-sectional survey of 500 artisanal gold miners was conducted to explore the relationship between working conditions of artisanal miners and voluntarily going for routine medical checkup, even in the absence of the right support systems, using a nested binary logistic regression. All the working condition variables were robust in predicting routine medical checkup in all three models. In this case, goldminers who reported good health, safety and environmental conditions were more likely to go for routine medical checkup as compared to their co-workers who reported poor health, safety and environmental conditions. Contrariwise, miners who reported good economic conditions were less likely to go for routine medical checkup as compared to their counterparts who reported poor economic conditions. Also, routine medical checkup was less likely among artisanal miners who did not protect themselves at work and had experienced work related health challenges. For the compositional factors, miners who had senior high school education were more likely to go for routine medical checkup as compared to those with no formal education. Likewise, older miners were more probable to go for routine medical checkup as compared to their younger counterparts. At the contextual level, miners who worked on shift regime and miners who worked in non-production departments were more likely to go for routine medical checkup. The outcome of this study provides insight into the dynamics of self-care amongst artisanal miners and how best to possibly improve it in an attempt to maintain a healthy workforce and its cascading effects. To increase consciousness of self-health care in artisanal mining, there is the need for a national dialogue on how to improve the working conditions of artisanal miners in Ghana.

1. Introduction

Extraction of minerals has gone on in Ghana for over 1000 years (Hilson, 2002). The increasing demand for minerals worldwide has created an unprecedented increase in mining activities in the country. Currently, Ghana is the largest producer of gold in Africa and seventh largest in the world (Aram et al., 2021a). Artisanal mining is a multi-dimensional interaction between the environment, the economy, technology, social and health factors (Becker et al., 2020). This activity is characterized by the use of unskilled labor, producing at low levels and with limited capital (Aram et al., 2021b). Despite the limitation in size of artisanal mining and owing to the large numbers and high concentrations of their operations, their combined economic and social impact on the economy of a developing country is massive (Calys-Tagoe et al., 2015). In

Ghana, artisanal mining is a basic livelihood for survival in many rural communities.

Despite the benefits associated with artisanal mining, it is a notoriously dangerous occupation (Smith et al., 2016). This livelihood activity is faced with major challenges, particularly in the area of occupational health and safety (Calys-Tagoe et al., 2015; Pedersen et al., 2021; Armah et al., 2016a,b). In the vast majority of places where artisanal mining occur, it is characterized by the lack of long term planning and use of low levels of technology (Becker et al., 2020). People in the sector operate under dangerous, labor-intensive and insecure conditions, which is expected to increase the risk of occupational injuries and diseases, especially for those mining without any form of protection (Bansah et al., 2016; Aram, 2021). This stems out of the fact that health and safety issues in the artisanal mining sector have not been fully addressed by

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governments or regulatory institutions, in part because, the available artisanal mining-specific regulation (PNDC Law 218) requires artisanal miners to observe good mining practices, health and safety rules, without defining these practices and rules. Such openness afford artisanal miners to subject this provision to various interpretations. Also, artisanal mining activities often take place in rural areas and frequently operate, aligning with local customs (Smith et al., 2016). As a result, many artisanal mining companies have minimal or no compliance mechanisms and lack well-established reporting systems, and few if any facilities or resources exist to address health and safety problems in the sector (Bansah et al., 2016).

Due to the exposure to various contaminants and hazards, artisanal mining is associated with health problems (Laniyan and Adewumi, 2020). Health problems commonly associated with artisanal mining include upper respiratory tract diseases, especially pulmonary tuberculosis and silicosis, and skin diseases (Stewart, 2019). The resulting occupational ill-health have huge social and economic implications for individuals, their families and their communities (Hermanus, 2007). They also have economic impacts in the form of direct and indirect costs for society as a whole. According to Stewart (2019), mining health costs are not restricted to miners or industry but borne by everyone who partakes of mining benefits. Total costs of occupational accidents and disease have been estimated to be between 1% and 3% of GDP in various countries (Hermanus, 2007) and the International Labor Organization (ILO, 2012) estimates that 4% of global GDP is lost due to occupational accidents and diseases. Occupational ill-health could lead to disability, reliance on benefits (if they exist), early retirement, the loss of a breadwinner and poverty.

The socio-economic impacts of unforeseen medical problems cannot be overstated. Having good health prevents exclusion and poverty, suffering and economic costs to victims and their families and businesses. Artisanal goldminers, in this case are liable for their own health-care due to the nature of their occupation. Despite these evidences, most studies have focused on unsafe health, safety and environmental practices and its impacts (see Bansah et al., 2018; Lynas, 2018; Stewart, 2019; Wireko-Gyebi et al., 2020), risk perception (see Adeyemi and Olagunju, 2017; Antabe et al., 2017; Nunfam et al., 2019; Fadlallah et al., 2020) and economic impacts of artisanal mining (see Orleans-Boham et al., 2020; Zolnikov, 2020; Baffour-Kyei et al., 2021). No study, however, has investigated the complexities in self-care culture and how to improve it in the sector.

The artisanal mining sector in Ghana lacks well defined sub-sector specific regulations that ensure good working conditions and support miners in dealing with unforeseen health outcomes. Therefore, having a good self-care attitude, such as going for routine medical checkup is a necessity. Routine medical checkup is a helpful practice in promoting good health in the mining sector. This is a routine health-care process that includes detailed history, physical examination and screening of asymptomatic persons by physicians on regular basis (Ilesanmi, 2015). Routine medical checkup is considered effective in preventing illnesses. It promotes good health and reduces morbidity and mortality (Damiani et al., 2012). During routine medical checkup, any asymptomatic disease and potential health problems are noticed and managed in the form of preventive or curative service thereby reducing the mortality associated with it. This study, therefore, sought to explore the relationship between working conditions of artisanal miners and voluntarily going for routine medical checkup while controlling for relevant compositional and contextual factors, using a nested binary logistic regression. With a nested model, it is possible to determine the independent effect of the key predictors while controlling for the other independent variables.

2. Materials and methods

2.1. Study area

The study was conducted in the South Western part of Ghana (see Figure 1). This region is part of the Birimian and Tarkwain formations

(Ghana Statistical Service, 2014). The existence of high mineral deposits in this area is as a result of the Birimian and Tarkwain geological formations. The area provides outstanding opportunities to better grasp the relationship between working conditions and routine medical checkup by artisanal goldminers because it has the highest per capita concentrations of artisanal goldminers in Ghana.

2.2. Data collection and sampling procedure

In all, 20 artisanal small scale (ASM) and medium scale (AMM) mine sites were visited in the study area. A cross-sectional survey was used in this study between January 2018 to December 2019. The questionnaire was adapted and developed from other related studies, reviewed and approved by the Institutional Review Board of the University of Cape Coast, Ghana. The questionnaire was structured into three parts: working conditions, compositional characteristics and contextual aspects. It comprised of closed-ended questions. The close-ended questions provided a variety of multiple-choice answers from which the respondents were given opportunity to tick as applicable. Participants from the ASM and AMM subsectors were randomly recruited at their work sites for the survey. Participation was restricted to miners who had worked for more than a month and participants over 18 years old. A pilot study was conducted among 50 selected goldminers to pre-test the questionnaire. The pilot study was to improve the content of the questionnaire by contextualizing it to better fit the purpose of the study. Overall, 500 artisanal goldminers (300 ASM and 200 AMM) were recruited for the survey. The sample size was estimated based on a 95% confidence interval, 50% estimated population proportion and at a 5% error rate. Oral consent was sought from participants before the study as required by the minerals commission of Ghana (Ahadzi et al., 2020). Participants were not financially induced or coerced to take part in the study, it was explained to them that participation was voluntary.

2.3. Study variables

2.3.1. Dependent variable

The outcome variable in this study was routine medical checkup by artisanal goldminers. Goldminers were asked to indicate how often they go for routine medical checkup in a year. If the miner stated that they voluntarily go for medical checkup, it as was indicated as “Yes” and if they stated they never voluntarily go for medical checkup, it was indicated as “No”.

2.3.2. Key predictor variables

The key predictor variables selected for this study were working conditions. Working conditions in this instance were self-rated health conditions, safety conditions, environmental conditions and economic conditions of artisanal goldminers. Artisanal goldminers were asked to rate 10 items on each variable as very poor, poor, good, very good and excellent. Total scores on each item for each variable was used to determine if a condition was “poor” or “good”. Also included in the working conditions was a variable derived from the combination of “self-protection at work” and “experiencing work-related health challenges”. This combination produced four exclusive covariates “No Yes”, “No No”, “Yes No” and “Yes Yes”. For this study, “Health” referred to the functional status of gold miners. These include emotional wellbeing, physical fitness and rate of change in health status (Huber et al., 2011). “Safety” denotes the availability of appropriate personal protective equipment such as protective clothing, goggles, gloves, and institutionalization of practices such as safe disposal of hazardous materials, allowed levels of noise and protection against fall (Armah et al., 2016a). “Environment” is generally described to encompass both physical and social scopes. These include but not limited to resources required for the job, perceptions of their workspace quality and setting, the physical surroundings and space availability (Armah et al., 2016b). “Economic conditions” includes wages

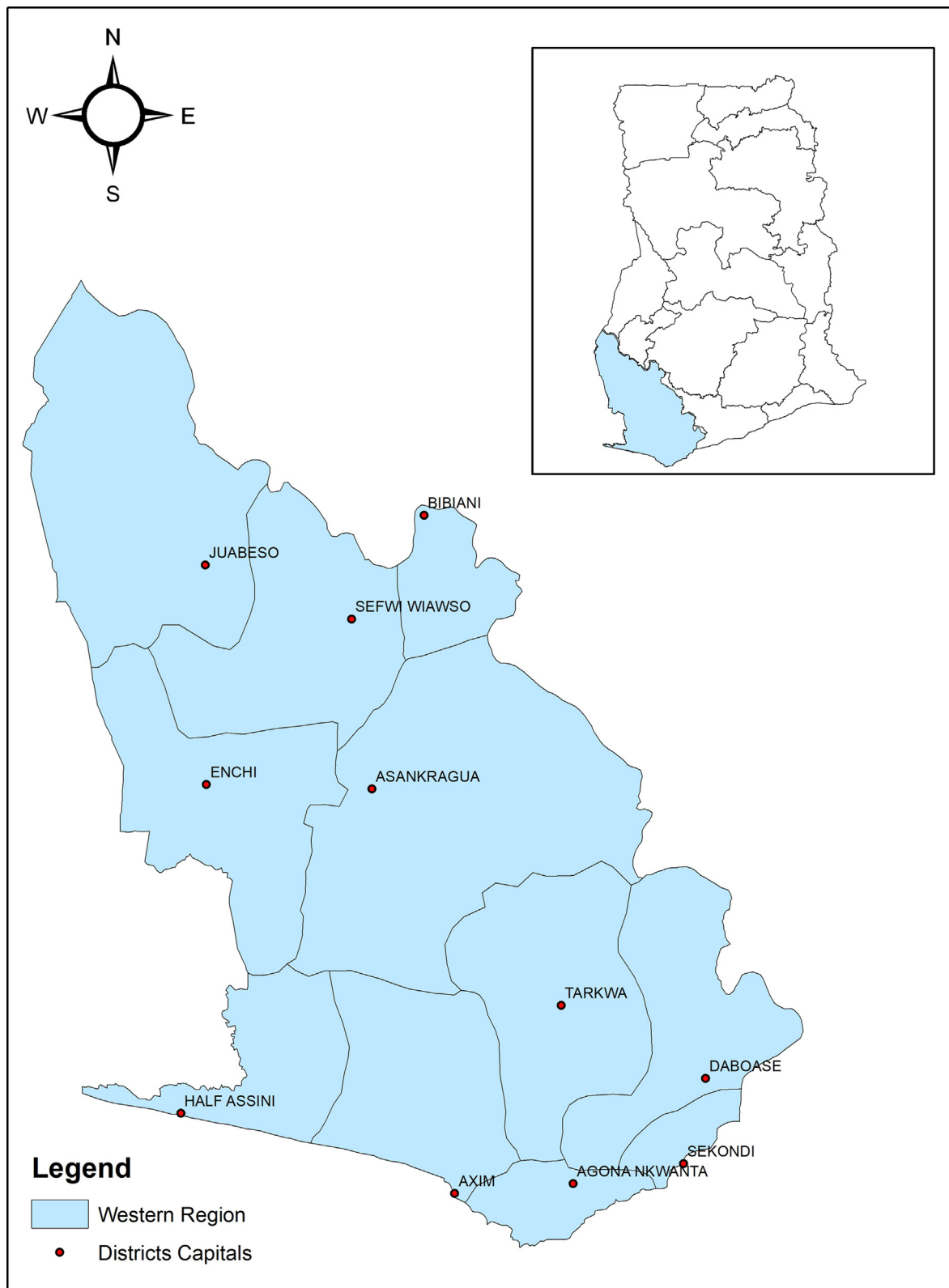


Figure 1. Map of the Western Region of Ghana.

or income, employment benefits, incentives and workload that cumulatively influence the productivity of goldminers.

2.3.3. Compositional and contextual factors

Compositional factors referred to socio-demographic characteristics of artisanal goldminers. These factors included age,

gender, marital status, education and years of experience. Contextual factors were work shift, department and subsector of the goldminer.

The selection of key predictors, compositional attributes and contextual factors for this study (model) were based on literature, practical significance, theoretical relevance and parsimony.

2.4. Statistical analyses

The data was analyzed using Stata 15 (StataCorp, College Station, Texas) SE software. The analyses started with descriptive analysis of the predictors and their distribution across routine medical checkup. Pearson's chi-square and Cramer's V statistics were conducted to ascertain the relationship between routine medical checkup and the working conditions, compositional and contextual factors. Bivariate and multivariate binary logistic regression was employed to examine the relationships and proportions between factors that influence routine medical checkup while controlling for theoretically relevant compositional and contextual factors. In this study, 61% of artisanal goldminers went for routine medical checkup indicating that the probability of the outcome was asymmetrical. For this reason, the complementary log-log link function was appropriate for modelling the dependent variable. All statistical analyses were performed at a statistical significance of 0.05 and at a confidence interval of 95%.

3. Results

3.1. Descriptive and bivariate analysis

Table 1 shows the distribution of the percentages of sample characteristics. Participants age was between 18 to 60 years and the number of years worked in the mines was between 1 to 52 years ($M = 7.092$, $SD = 6.48256$). Table 2 presents the distribution of predictors and routine medical checkup. Notably across subsectors, 84.5% of AMM miners indicated they routinely go for medical checkups while only 45.33% of ASM miners routinely go for medical checkups. For gender, 63.8% of male miners reported that they routinely go for medical checkup, while only 42.65% of women miners go for voluntary medical checkups. About 58.91% of goldminers who had no formal education or had primary education or junior high school education did not routinely go for medical checkup. Across departments in the subsectors, 80.61% of miners who worked in non-production related departments did not go for routine medical checkup. Also, 51.34% of miners in production related departments did not go for medical checkups.

Table 2 also presents Pearson's chi-square test of independence and Cramer's V statistic. Pearson's chi-square and Cramer's V statistics were used to determine whether the observed differences in routine medical checkup and working conditions as well as compositional and contextual factors were independent. Statistically significant relationship existed between health conditions ($\chi^2(1) = 59.9073$, $p < 0.001$), safety conditions ($\chi^2(1) = 116.6234$, $p < 0.001$), environmental conditions ($\chi^2(1) = 134.9452$, $p < 0.001$), economic conditions ($\chi^2(1) = 75.8013$, $p < 0.001$) and routine medical checkup. Also, statistically significant relationship existed between self-protection and experiencing work related health problems ($\chi^2(3) = 1458115$, $p < 0.001$) and routine medical checkup. This meant a rejection of the null hypothesis that working conditions did not affect artisanal goldminers' decision to go for routine medical checkup in Ghana. Cramer's V statistic in this instance indicated from moderately strong to strong associations. For the compositional variables, age ($\chi^2(3) = 21.4569$, $p < 0.001$), gender ($\chi^2(1) = 11.1433$, $p < 0.001$), education ($\chi^2(2) = 57.3533$, $p < 0.001$) and experience ($\chi^2(2) = 12.9425$, $p < 0.001$) had statistically significant relationship with routine medical checkup. There was however, no relationship between marital status ($\chi^2(1) = 1.6019$, $p = 0.206$) and routine medical checkup. This indicates that marital status did not systematically differ with routine medical checkup. Cramer's V statistic in this regard indicated weak association for age, gender, experience and moderately strong association for education. With the contextual factors, shift ($\chi^2(1) = 42.0967$, $p < 0.001$), department ($\chi^2(1) = 39.7921$, $p < 0.001$) and subsector ($\chi^2(1) = 77.3785$, $p < 0.001$) had statistically significant relationship with routine medical checkup. This indicated that routine medical checkup systematically differ across shift regimes, departments and subsector of artisanal goldminers in Ghana.

Table 1. Demographic characteristics of respondents.

Variables	Frequency (N)	Percentage (%)
Age		
18–24 years	166	33.2
25–34 years	239	47.8
35–54 years	67	13.4
Above 55 years	28	5.6
Gender		
Male	432	86.4
Female	68	13.6
Marital Status		
Single	332	66.4
Married	168	33.6
Education		
No formal Education	202	40.4
Senior High school	129	25.8
Tertiary	169	33.8
Experience		
1–5 years	287	57.4
6–10 years	116	23.2
Above 10 years	97	19.4
Shift		
No	392	78.4
Yes	108	21.6
Department		
Production	335	67
Non-production	165	33
Subsector		
ASM	300	60
AMM	200	40
Health conditions		
Poor	89	17.8
Good	411	82.2
Safety conditions		
Poor	249	49.8
Good	251	50.2
Environmental conditions		
Poor	209	41.8
Good	291	58.2
Economic conditions		
Poor	271	54.2
Good	229	45.8
Self-protection + health problems		
No Yes	46	9.2
No No	67	13.4
Yes No	273	54.6
Yes Yes	114	22.8

Cramer's V statistic indicated a weak to moderately strong association between shift, department, subsector and routine medical checkup.

The strength of the relationship between routine medical checkup and the predictors in increasing order of magnitude are as follows: gender < experience < age < department < shift < education < health conditions < economic conditions < subsector < safety conditions < environmental conditions < self-protection + health problems.

3.2. Bivariate logistic regression of routine medical checkup and predictor variables

For the working conditions in the bivariate analysis in Table 3, goldminers who reported good health conditions ($OR = 4.108$, $p < 0.001$), safety conditions ($OR = 3.982$, $p < 0.001$), environmental conditions (OR

Table 2. Percentage distribution of routine medical checkup by predictor variables.

Variables	Medical Checkup		Inferential statistics
	No (%)	Yes (%)	
Health conditions			$\chi^2 (1) = 59.9073, p < 0.001$
Poor	67 (75.28)	22 (24.72)	Cramer's V = 0.3461
Good	128 (31.14)	283 (68.86)	
Safety conditions			$\chi^2 (1) = 116.6234, p < 0.001$
Poor	156 (62.65)	93 (37.35)	Cramer's V = 0.4830
Good	39 (15.54)	212 (84.46)	
Environmental conditions			$\chi^2 (1) = 134.9452, p < 0.001$
Poor	144 (68.90)	65 (31.10)	Cramer's V = 0.5195
Good	51 (17.53)	240 (82.47)	
Economic Conditions			$\chi^2 (1) = 75.8013, p < 0.001$
Poor	153 (56.46)	118 (43.54)	Cramer's V = 0.3894
Good	42 (18.34)	187 (81.66)	
Self-protection + health problems			$\chi^2 (3) = 145.8115, p < 0.001$
No Yes	41 (89.13)	5 (10.87)	Cramer's V = 0.5400
No No	58 (86.57)	9 (13.43)	
Yes No	64 (23.44)	209 (75.56)	
Yes Yes	32 (28.08)	82 (71.93)	
Age			$\chi^2 (3) = 21.4569, p < 0.001$
18–24 years	84 (50.60)	82 (49.40)	Cramer's V = 0.2072
25–34 years	75 (31.38)	164 (68.62)	
35–54 years	20 (29.85)	47 (70.15)	
Above 55 years	16 (57.14)	12 (42.86)	
Gender			$\chi^2 (1) = 11.1433, p < 0.001$
Male	156 (36.11)	276 (63.89)	Cramer's V = -0.1493
Female	39 (57.35)	29 (42.65)	
Marital status			$\chi^2 (1) = 1.6019, p = 0.206$
Single	136 (40.96)	196 (59.04)	Cramer's V = 0.0566
Married	59 (35.12)	109 (64.88)	
Education			$\chi^2 (2) = 57.3533, p < 0.001$
No formal/Primary/Junior High	119 (58.91)	83 (41.09)	Cramer's V = 0.3387
Senior High	29 (22.48)	100 (77.52)	
Tertiary	47 (27.81)	122 (72.19)	
Experience			$\chi^2 (2) = 12.9425, p < 0.001$
1–5 years	127 (44.25)	160 (55.75)	Cramer's V = 0.1609
6–10 years	29 (25)	87 (75)	
Above 10 years	39 (40.21)	58 (59.79)	
Shift			$\chi^2 (1) = 42.0967, p < 0.001$
No	182 (46.43)	210 (53.57)	Cramer's V = 0.2902
Yes	13 (12.04)	95 (87.96)	
Department			$\chi^2 (1) = 39.7920, p < 0.001$
Production	163 (48.66)	172 (51.34)	Cramer's V = 0.2821
Non-production	32 (19.39)	133 (80.61)	
Subsector			$\chi^2 (1) = 77.3785, p < 0.001$
ASM	164 (54.67)	136 (45.33)	Cramer's V = 0.3934
AMM	31 (15.50)	169 (84.50)	

= 4.675, $p < 0.001$) and economic conditions (OR = 2.967, $p < 0.001$) were more likely to go for routine medical checkups as compared to their compatriots who reported poor health, safety, environmental and economic conditions at work. Also, goldminers who protected themselves and had no work related health conditions (OR = 12.606, $p < 0.001$) and miners who protected themselves and had experienced work related health problems (OR = 11.041, $p < 0.001$) were more likely to routinely go for medical checkups as compared to those who did not protect themselves and had experienced work related health problems.

For the compositional factors, female mine workers were 45% less likely to go for routine medical checkup. Mine workers who had senior high school education (OR = 2.821, $p < 0.001$) and mine workers who had tertiary education (OR = 2.419, $p < 0.001$) had a higher chance of

going for routine medical checkup as compared to those with no formal or primary or junior high school education. Mine workers who were between the ages 23–34 years (OR = 1.701, $p < 0.001$) and 35–54 years (OR = 1.775, $p < 0.001$) were more likely to go for routine medical checkup as compared to mine workers between the ages of 18–24 years. Similarly, miners with 6–10 years (OR = 1.700, $p < 0.001$) work experience in the mining sector were more probable to go for medical checkups as compared to their counterparts who had worked for only 1–5 years. Marital status was not a significant predictor of routine medical checkup by artisanal goldminers in Ghana.

For the contextual factors, workers on shift regime (OR = 2.759, $p < 0.001$) were more likely to go for medical checkups. Mine workers in the non-production departments (OR = 2.277, $p < 0.001$) and miners who

Table 3. Bivariate complementary log-log regression of routine medical checkup by artisanal goldminers.

Variables	OR	Robust SE	p value	Conf. Interval
Health conditions (ref: Poor)				
Good	4.108	0.917	<0.001	2.653 6.363
Safety conditions (ref: Poor)				
Good	3.982	0.523	<0.001	3.079 5.150
Environmental conditions (ref: Poor)				
Good	4.675	0.676	<0.001	3.521 6.208
Economic conditions (ref: Poor)				
Good	2.967	0.369	<0.001	2.324 3.787
Self-protection + Health problems (ref: No Yes)				
No No	1.254	0.700	0.686	0.419 3.747
Yes No	12.606	5.726	<0.001	5.175 30.706
Yes Yes	11.041	5.114	<0.001	4.454 27.372
Age (ref: 18–24 years)				
25–34 years	1.701	0.238	<0.001	1.294 2.237
35–54 years	1.775	0.340	0.003	1.219 2.584
Above 55 years	0.822	0.258	0.531	0.444 1.519
Gender (ref: Male)				
Female	0.546	0.108	0.002	0.370 0.805
Marital status (ref: Unmarried)				
Married	1.172	0.146	0.202	0.918 1.497
Education (ref: No formal/Primary/Junior High)				
Senior High	2.821	0.440	<0.001	2.077 3.830
Tertiary	2.419	0.357	<0.001	1.811 3.229
Experience (ref: 1–5 years)				
6–10 years	1.700	0.241	<0.001	1.288 2.245
Above 10 years	1.118	0.177	0.483	0.819 1.525
Shift (ref: No)				
Yes	2.759	0.392	<0.001	2.089 3.644
Department (ref: Production)				
Non-production	2.277	0.283	<0.001	1.784 2.905
Subsector (ref: ASM)				
AMM	3.087068	0.383747	<0.001	2.419553 3.93874

In bold are significant predictors at a 0.05 significance level

worked in AMM subsector (OR = 3.087, $p < 0.001$) were more probable to go for medical checkup as compared to those in production departments and in ASM subsector.

3.3. Multivariate complementary log-log nested logistic regression of routine medical checkup and predictor variables

Table 4 is a nested multivariate logistic regression model showing the relationship between working conditions, compositional factors, contextual attributes and routine medical checkup. In the working conditions model (model 1), health conditions (OR = 1.773, $p < 0.001$), safety conditions (OR = 2.656, $p < 0.001$), environmental conditions (OR = 2.492, $p < 0.001$) and economic conditions (OR = 0.369, $p < 0.001$) were all statistically significant in predicting routine medical checkup. This meant that artisanal goldminers who reported good health, safety and environmental conditions were more probable than those who reported poor health, safety and environmental conditions to routinely go for medical checkup. Contrariwise, artisanal miners who reported good economic conditions were less likely to go for routine medical checkup as compared to those who reported poor economic conditions. Additionally, goldminers who protected themselves and did not experience work related health problems (OR = 4.989, $p < 0.001$), and miners who protected themselves and experienced work related health challenges (OR = 4.662, $p < 0.001$) were more likely to go for routine medical checkup as compared to those who did not protect themselves and experienced work related health problems.

In model 2, where compositional factors were accounted for, it was evident that working conditions of artisanal miners were robust in predicting the chances of going for routine medical checkup. In this case artisanal miners who reported good health conditions (OR = 2.015, $p < 0.001$), safety conditions (OR = 2.703, $p < 0.001$) and environmental conditions (OR = 2.705, $p < 0.001$) were more likely to go for routine medical checkup. Inversely, miners who reported good economic conditions (OR = 0.332, $p < 0.001$) were less likely to voluntarily go for medical checkup. Also, goldminers who protected themselves and did not experience work related health problems (OR = 4.300, $p < 0.001$), and miners who protected themselves and experienced work related health challenges (OR = 3.587, $p < 0.001$) were more likely to go for routine medical checkup as compared to those who did not protect themselves and experienced work related health problems. There was a clear indication of moderation of the relationship between working conditions and medical checkup (changes in significant values) by the compositional factors. In the same compositional model, artisanal miners who were between 35–54 years (OR = 1.665, $p < 0.001$) were more likely to go for routine medical checkup as compared to their counterparts who were between the ages of 18–24 years. Likewise, miners who had senior high education (OR = 1.700, $p < 0.001$) were more probable to go for routine medical checkup as compared to those with no formal education or primary or junior high school education. Gender, marital status and experience were not statistically significant in predicting medical checkup.

In model 3, where contextual factors were controlled for, health conditions (OR = 2.626, $p < 0.001$) safety conditions (OR = 3.197, $p <$

Table 4. Multivariate complementary log-log nested logistic regression model predicting routine medical checkup by artisanal goldminers.

Variables	Model 1: Working Conditions				Model 2: Working Conditions + Compositional Factors				Model 3: Working Conditions + Compositional Factors + Contextual Factors						
	OR	Robust SE	p-value	Conf. Interval	OR	Robust SE	p-value	Conf. Interval	OR	Robust SE	p-value	Conf. Interval			
Health conditions (ref: Poor)															
Good	1.773	0.478	0.034	1.046	3.008	2.015	0.565	0.012	1.163	3.492	2.262	0.660	0.005	1.277	4.009
Safety conditions (ref: Poor)															
Good	2.656	0.865	0.003	1.403	5.028	2.703	0.955	0.005	1.353	5.403	3.197	1.118	0.001	1.611	6.345
Environmental conditions (ref: Poor)															
Good	2.492	0.521	<0.001	1.655	3.755	2.705	0.618	<0.001	1.729	4.232	3.071	0.731	<0.001	1.926	4.896
Economic conditions (ref: Poor)															
Good	0.369	0.120	0.002	0.195	0.697	0.332	0.130	0.005	0.155	0.714	0.363	0.125	0.003	0.185	0.715
Self-protection + Health problems (ref: No Yes)															
No No	0.728	0.394	0.558	0.253	2.101	0.584	0.337	0.350	0.188	1.807	0.631	0.359	0.418	0.207	1.922
Yes No	4.989	2.267	<0.001	2.047	12.158	4.300	2.095	0.003	1.654	11.176	4.590	2.234	0.002	1.768	11.916
Yes Yes	4.662	2.150	0.001	1.888	11.512	3.587	1.746	0.009	1.382	9.313	3.461	1.680	0.011	1.337	8.960
Age (ref: 18–24 years)															
25–34 years						0.974	0.167	0.879	0.697	1.362	0.968	0.171	0.852	0.685	1.367
35–54 years						1.665	0.411	0.039	1.026	2.701	1.795	0.468	0.025	1.077	2.992
Above 55 years						0.680	0.288	0.362	0.297	1.558	0.649	0.281	0.319	0.277	1.518
Gender (ref: Male)															
Female						0.817	0.184	0.369	0.526	1.270	0.893	0.212	0.633	0.561	1.422
Marital status (ref: Unmarried)															
Married						1.112	0.188	0.530	0.799	1.548	1.109	0.192	0.550	0.790	1.558
Education (ref: No formal/ Primary/Junior High)															
High school						1.700	0.336	0.007	1.154	2.506	1.665	0.335	0.011	1.122	2.470
Tertiary						1.135	0.224	0.522	0.771	1.671	1.276	0.266	0.243	0.848	1.919
Experience (ref: 1–5 years)															
6–10 years						1.014	0.169	0.935	0.731	1.406	1.029	0.176	0.868	0.735	1.440
Above 10 years						0.848	0.195	0.473	0.541	1.330	0.855	0.199	0.501	0.543	1.348
Shift (ref: No)															
Yes											1.470	0.269	0.036	1.026	2.105
Department (ref: Production)															
Non-production											1.548	0.112	0.003	0.367	0.819
Subsector (ref: ASM)															
AMM											0.839	0.245	0.547	0.473	1.486

In bold are significant predictors at a 0.05 significance level

0.001), environmental conditions (OR = 3.071, $p < 0.001$) and economic conditions (OR = 0.363, $p < 0.001$) were still robust in predicting routine medical checkup just as observed in model 1 and 2. Also, goldminers who protected themselves and did not experience work related health problems (OR = 4.590, $p < 0.001$), and miners who protected themselves and experienced work related health challenges (OR = 3.461, $p < 0.001$) were also still robust in predicting routine medical checkup just as observed in model 1 and 2. For the compositional factors, artisanal miners who were between 35–54 years (OR = 1.795, $p < 0.001$) were more likely to go for routine medical checkup as compared to their counterparts who were between the ages of 18–24 years. Likewise, miners who had senior high education (OR = 1.665, $p < 0.001$) were more probable to go for routine medical checkup as compared to those with no formal education or primary or junior high school education. For the contextual factors, shift (OR = 1.470, $p < 0.001$) and department (OR = 1.548, $p < 0.001$) were statistically significant in predicting routine medical checkup. In this instance, artisanal miners who worked on shift regime were more likely to go for routine medical checkup. Also, those in non-production departments were more likely to go for routine medical checkup. Subsector was not significant in predicting medical checkup.

4. Discussion

This study explored the relationship between working conditions of artisanal miners and voluntarily going for medical checkup, while controlling for compositional and contextual factors. Goldmining contributes substantially to Ghana's economy. Despite these positive impacts, artisanal mining is one of the most dangerous occupations in Ghana. The sector records one of the highest morbidities and mortality rates in the country. The prevention of occupational accidents and diseases in the artisanal mining sector is a serious concern. [Hakro and Jinshan \(2019\)](#) stated that workplace accidents can be controlled with effective occupational health and safety policies. From the policy angle, managing health and safety in the sector has been neglected. Lack of well-defined sector related regulations, lack of attention from stakeholders and the lack of capital investments are some of the challenges the sector faces. Mine workers in this case are responsible for their own health and safety at the workplace. This however necessitates developing or increasing the miners health care awareness and perception, and this can be achieved if the complexities of self-care in artisanal mining are disentangled and better understood.

The findings of this study clearly showed that working conditions of artisanal miners impacted their ability to undertake routine medical checkups. Working conditions were robust and persisted in predicting routine medical checkup in all three models. In this case, miners who reported good health, safety and environmental conditions at work were more likely to go for routine medical checkups as compared to those who reported poor health, safety and environmental conditions. [Aram et al. \(2021b\)](#) in their study reported that being exposed repeatedly to poor health, safety and environmental conditions influences the risk perception of miners. In this instance, they are more likely to perceive such risks as low. [Didla et al. \(2009\)](#) further states that, if workers perceive their workplace risks to be low, they are less likely to have a good health and safety culture. It is however not surprising that workers with poor health, safety and environmental conditions are more likely to have a poor self-care culture. This finding is in tandem with [Xia et al. \(2020\)](#), who stated that when a safety climate is positive at the workplace, worker's risk perception and, health and safety behavior improves. A positive health, safety and environmental culture at the mine can alleviate or even reverse negative effects on risk perception and the concomitant poor self-care culture. Conversely, when there is a negative health, safety and environment culture at the work place, miners are likely to demonstrate unsafe and poor self-care attitudes. This finding imply that to encourage routine medical checkup amongst artisanal miners, their consciousnesses of risk should be raised. This can be achieved by ensuring that the health,

safety and environmental conditions within which the miners operate at the workplace are good and standard.

Counterintuitively, artisanal miners who rated their economic conditions as good were less likely to go for routine medical checkup as compared to their counterparts who reported poor economic conditions. Normally, it is expected that people who have good economic conditions are likely to voluntarily go for medical checkup. This is because good economic condition is usually linked to higher education or knowledge in most cases and as such people who have good economic conditions at work are expected to know and do better. Additionally, workers with good economic conditions are more likely to be able to afford frequent medical checkups. In this instance, miners who had better economic conditions were rather not concerned about their health. It could be argued that miners with good economic conditions are complacent and confident that in the wake of an adverse or unforeseen health outcome, they are economically secured to take care of themselves, hence the reluctance to go for medical checkups.

This study also found that artisanal miners who protected themselves at work and did not experience work related health issues and also miners who protected themselves at work and experienced work related health challenges were more likely to go for routine medical checkup as compared to those who did not protect themselves at work and experienced work related health challenges. This is a clear indication that artisanal miners who are health and safety conscious (protect themselves at work) are more probable to go for routine medical checkup. This positive consciousness translated into their high self-care culture. A high self-care culture in this case could be attributed to the fact that such miners have a good sense of the risks involved in their occupation. A good estimation of risk is likely to lead to taking action such as self-protection and routine medical checkups.

Of the compositional factors, artisanal miners who were between 35–54 years were more likely to go for routine medical checkup as compared to their 18–24 years counterparts. This is similar to [Kao et al. \(2008\)](#), [Gyekye and Salminen \(2009a\)](#) and [Idrees et al. \(2017\)](#) who found that age has a statistically significant association with health and safety perception and culture. Older workers are more enthusiastic and, health and safety conscious than younger workers. Younger miners rely on their youthfulness and strength and therefore have little to no appreciation for self-care. Most younger workers in artisanal mining are found working in departments where raw strength is relied on. These departments include working in pits, chiseling, drilling etc. Older miners on the other hand work in non-physically demanding areas and also go for routine medical checkups. This implies older workers are more experienced and are likely to have worked in the artisanal mining sector longer than the younger miners, hence they are in a better position to develop a good self-care culture over time with their longer years in the sector.

Also, artisanal miners who had senior high school education were more likely to go for routine medical checkup as compared to their counterparts who had no formal or primary or junior high school education. This finding is in tandem with [Gyekye and Salminen \(2009b\)](#), who posits that mine workers with higher educational levels express more positive health and safety culture than their counterparts with lower educational levels. In this case, workers with no formal or primary or junior high school education had a poor self-care culture. Educational level is known to be a key factor in the health and safety culture of workers. Educational level has been found to be positively associated with health and safety culture and inversely associated with the rate of health problems, accidents and injuries ([Gyekye and Salminen, 2009b](#)). Less educated miners exhibit poor attitudes towards health and safety. Studies have also shown that workers with higher educational levels have skills that help them to manage their health and safety responsibilities better ([Idrees et al., 2017](#); [Aram et al., 2021b](#)). The most educated artisanal miners in this study had the relevant occupational knowledge for medical checkup by having a high sense of self-care.

Among the contextual factors, miners on shift regimes were more probable to go for routine medical checkup as compared to their non-shift regime counterparts. In this case, shift workers had a higher self-care attitude. This finding is supported by Horwitz and McCall (2005), who claim that shift regimes particularly night shift increases the risk of injury among workers. This could mean miners who work on shift regime have a high sense of awareness of risks involved in their occupation due to the odd hours they work in sometimes. Such miners have a good evaluation of the risk perception at the workplace, hence the high sense of self-care to go for medical checkups.

Also, miners who worked in the non-production departments had higher odds of going for routine medical checkup than their counterparts who worked in production related departments. This meant miners who worked in places such as gold buying and administration had a higher self-care attitude. Armah et al. (2016a) and Aram et al. (2021b) posited that in artisanal mining, experienced and educated miners avoid perceived dangerous departments. This means most of them work in the non-production related departments. Such category of miners are known to be health conscious than the inexperienced, young and uneducated goldminers who prefer working in the dangerous areas where strength and brute force is required (Ahadzi et al., 2021). Miners with such characteristics are reckless and mostly have a lower sense of self-care.

Overall, artisanal goldminers with poor working conditions demonstrated a low sense of self-care with higher odds of not going for routine medical checkups. Although the contextual and compositional attributes of these miners had significant associations with routine medical checkup, it had no influence on the effect of working conditions on the self-care attitude of artisanal miners in Ghana. One of the limitations of the study is the reliance on self-reported measures to evaluate the probability of going for routine medical checkup. The problem of self-reported indicators is widely known but it has been established that the extent of the supposed distortions may be exaggerated (Wagner and Crampton, 1993). It has also been well established in literature that self-reported measures have proven to be effective for health studies (Siu et al., 2003). The findings of this study showed a clear relationship between working conditions and routine medical checkup of artisanal goldminers in Ghana. The evaluation of factors that influence self-care of goldminers provides insight into the ever troubling attitudes and unhealthy practices in the artisanal mining sector. In the absence of well-defined legislation in the sector, indicators that promote self-care amongst these miners should be known. This study however provides useful information to managers, concession owners, NGO's and policy makers in addressing the working condition menace in artisanal mining. Additionally, to increase consciousness of self-care in artisanal mining, there is the need for a national dialogue on how to improve working conditions in artisanal goldmining in Ghana. The findings of this study could also provide an insight for the application and targeting of interventions in the sector.

5. Conclusion

To induce change in behavior, the key elements of the particular behavior is essential. The effects of working conditions, compositional and contextual factors on artisanal miners' ability to routinely go for medical checkup was assessed using a nested binary logistic regression model. Artisanal goldminers with poor working conditions demonstrated a low sense of self-care with higher odds of not going for routine medical checkups. Although the contextual and compositional attributes of these miners had significant associations with routine medical checkup, it had no influence of the effect of working conditions on the self-care attitude of artisanal miners in Ghana. The outcome of this study provides insight into the dynamics of self-care amongst artisanal miners and how best to possibly improve it in an attempt to maintain a healthy workforce and its cascading effects. To

increase consciousness of self-care in artisanal mining, there is the need for a national dialogue on how to improve the working conditions of artisanal miners in Ghana.

Declarations

Author contribution statement

Simon Appah Aram: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Data will be made available on request.

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The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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