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The impact of illegal mining on public health: A case study in kenyasi, the Ahafo region of Ghana

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Abstract. Mining is an economic pillar of many countries endowed with natural mineral resources, including gold, diamond, bauxites, and gemstone, among others. Unregulated or illegal mining poses several health risks to people living within or close to mining communities. People living within mining communities across the world have in the past experienced and continue to experience health threatening disease, which includes respiratory, kidney, musculoskeletal, and skin diseases. This research was conducted in Kenyasi the district capital of Asutifi north district of Ghana to examine the impact of illegal mining on public health A total of 200 respondents were contacted for essential information of which 100 lives close to mines and other 100 lives far away from mining communities; we identified the former by those who live 10 to 20 kilometers from mining communities whereas the latter were identified by those who live in a neighboring community where mining activities are not in existence. The main research instruments used were questionnaires, interviews, and focus group discussion. Data collected were analyzed using statistical package for social science (SPSS) software. Econometric models such as multiple linear regression model and Mann-U Whitney were used to analyze data collected. The findings revealed that inhabitants in the community face numerous challenges such as water, air, and land pollutions from illegal mining activities due to miners' excessive use of dangerous chemicals like mercury. The study also revealed that individuals close to mines at Kenyasi in the Asutifi north district capital suffered from health problems than their counterpart who live far from mines. The increment of illegal mining in the kenyasi district capital of Asutifi north of Ghana has caused numerous environmental hazards to many individuals and households. Although the negative impact of illegal mining affects the entire nation; It can be concluded in our study that both miners and non- miners who live close to mining area suffered more health problem which includes vulnerable group (women and children) than those who live far from mining areas.

Keywords. Mining, Public health, Education, Economy, Developing countries

Introduction

Mining continues to play a pivotal role in the socio-economic development of countries with abundant mineral deposits (1). Recent surges in demand for world natural resources have caused an increase in both local and international extraction of resources and land-use change (2). Gold is one of the predominant mineral resources that immensely support the economic progress of many developing countries. The last ten years have witnessed a significant increase in gold price (360%) at a constant rate of 18% per year; The price continues to set new records

due to the global increase in demand of gold (2). SAM (small-scale artisanal miners) workers have grown from 6 million as of 1993 to 40 million as of 2017 as a result of these changes. Asia has the highest number of ASM operators' with10.6 million operators as of 2014, 90% of whom are Chinese nationals; Africa is second on the list with 9.9 million operators; Artisanal and small-scale mining serve as sources of revenue for millions of people in about 80 countries worldwide (Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development 2017).

As a result of this, the non-industrial informal sector of gold mining (i.e., artisan miners who operate illegally and do not pay taxes to the government) has steadily gained momentum and had detrimental effects on the environment and health. The artisanal miners are usually locals who live in the communities and have little or no formal education or technical know-how on mining processes (3). The rapid growth in artisanal mining is associated with increase in life-threatening ailments among miners and people living within or close to mining communities.

Mining remains one of the most dangerous occupations in the world in terms of injuries, loss of human life, and illness such as cancers, silicosis, asbestosis and pneumoconiosis arising from the long-term exposure to hazardous mining practices (4). Recent evidence obtained from mining areas revealed an increase in vector-borne diseases such as malaria, schistosomiasis, onchocerciasis, and respiratory tract diseases, especially pulmonary tuberculosis, silicosis, skin diseases, and eye diseases among miners and inhabitants of mining communities (5). The world health organization reports on artisanal mining in Geneva (1989) have shown that the use of mercury in artisanal possess a severe health threat to both small-scale miners and people living in mining areas: Also, exposure to biohazards and excessive exploitation of labor at artisanal mining firms results in the development of health complications, musculoskeletal disorders like shoulder disorders, fatigue and lower back pain among miners(6)

Despite these health implications of unregulated mining, little has been done to regulate or minimize illegal mining activities, especially in developing countries. This research re-iterates the harmful effects of unstructured artisanal mining and provides suggestions for remedying the adverse health, economic, and environmental impacts of illegal mining.

Methods and material

This study used data collection techniques such as in-depth interviews, questionnaires by sampling 200 respondents living close and far from mining areas (we identify the former by those who live 10 to 20 kilometers from mining sites whereas latter were identify by those who live in a neighboring community where there is no mining activities) including both illegal miners and non- miners of the studied community through random sampling. Questionnaires were used to collect demographic information of respondents whiles in-depth interviews gathered subjective viewpoints of respondents. Unlike the quantitative approach, the interviews will be audio taped using a digital voice recorder. In relation to this, data in the analysis were presented, explained and discussed using frequencies, tables, graph and percentages; moreover, Mann Whitney U, Chi-square and Multiple linear regression test were employed to test the proposed hypotheses.

Results

Age Distribution of Respondents

The age of respondents‟ especially miners and those who live in mining communities are essential in order to know what kind of age groups are involved or affected by illegal mining activities in kenyasi. Table 1 revealed the age distribution of respondents in kenyasi, Asutifi

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district. As shown in tab 1, the least age of miners and people living close to mines range from 15 to 24 years whiles the highest age is 55 - 64 years. From tab 1 it indicates that 15% of the respondents are between the ages 15 - 24 years, 42% are between 25 - 34 years, 23% are 35 – 44 years, 15% are 45 - 54 years, and 5% are 55 - 64 years. Thus, respondents who are between the ages 55 - 64 years constitute the least from the table. As shown in table 1. Majority of those who are miners and live close to mining areas are between the ages 25 to 34 years, 35 to 44 years and 15 – 24 years which constitutes 42%, 23% and 15% respectively. We can therefore conclude that majority of the miners and those who live close to mining areas are youths below the ages of 45 years; this can be attributed to the hazardous and physical nature of mining.

Age (years)	Distance from mines		Total (%)
	Close to mines (%)	Far from mines (%)	
15 - 24	15	18	33
25 - 34	42	34	76
35 - 44	23	26	49
45 - 54	15	17	32
55 - 64	5	5	10
Total (%)	100	100	100

Table 1 Age distribution of respondents

Moreover, age of non-miners and those who live far from mining areas. From table 1, the least age of respondents is between 55 - 64 years which constitutes 5% whiles the highest age range are between 25 - 34 years which constitutes 34%. This suggests that majority of the respondents studied are youths. It is believed that these people are at their prime age of their lives and if mining is not properly managed it can jeopardize their lives both in socio-economical and health.

Distribution of Respondents by Gender

Gender is defined by the World Health Organisation (WHO) as "The characteristics of women, men, girls and boys that are socially constructed". From table 2, female respondents close to mines constitutes 27.0% whiles their male counterparts constitutes 73.0%. Deducing from the results it is clear that males are the majority respondents in mining. Thus, there is an imbalance between men and women.

The results also established the fact that illegal mining is a physical demanding job such as digging and transporting of mineral ore as well as working for several hours in a watery pit which explains why it's male dominated. The use of hard drugs such as marijuana and cocaine in order to work for long hours are very rampant in mining sites. However, during field observation the researcher had the opportunity to experience how females carry their duties in the mines, whereas females are being used to carry minor duties such as carrying and washing of mineral ores; they are also being used as sex workers. In the literature review, these findings are in agreement with (7) in her study on female study of artisanal small- scale mining. She found out that majority of females in mines are marginalized and used as sex workers.

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Gender	Close to mines		Far from mines	
	Frequency	Percentage%	Frequency	Percentage %
Female	27	27.0	37	37.0
Male	73	73.0	63	63.0
Total	100	100	100	100

Table 2 Genders of Respondents

As shown from table 2, female respondents far from mining areas constitutes 37.0% whiles their male counterparts constitutes 63.0%. However, it ought to be noted that the imbalance of gender does not in any way affect the study as the sample size was a representative of the target population.

Distribution of Respondents by Marital Status

Figure 1 shows respondents close to mines. According to the responses 71.0% are single whiles 28.0% are married; in addition, 1.0% are divorced. The results implied that since majority of the miners are single and most of them are men, they are into illegal mining to earn income in order for them to get married and provide basic needs for their future family.

With regards to respondents far from mines, 90.0% are single whiles 8.0% are married and 2.0% are divorced. These results show that majority of respondents close to mining areas are single and the likelihood of them engaging in illegal mining activities if there is no employment is very high as they will view it as alternative source of livelihood.

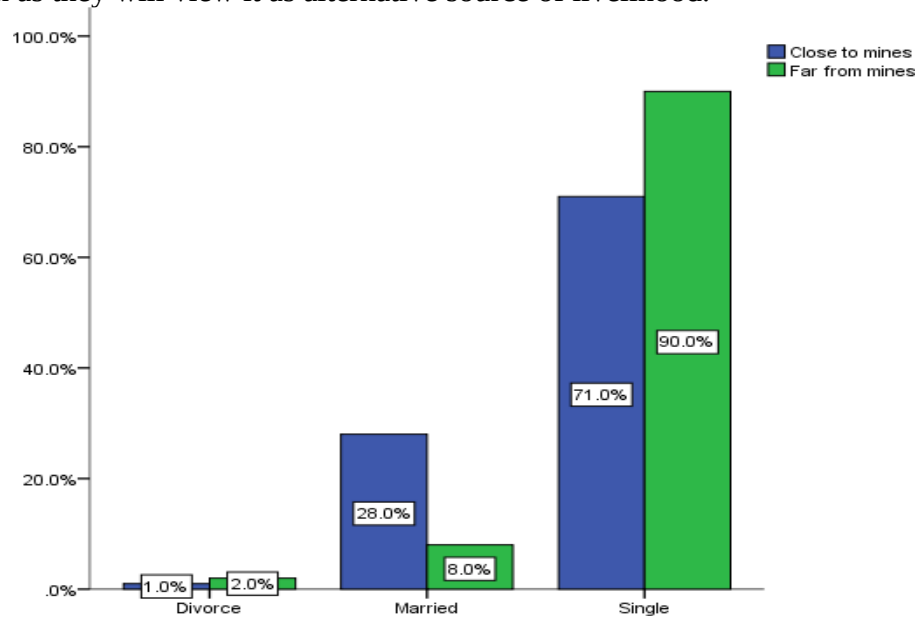

Figure 1. shows marital status of respondents close to mines

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Distribution of Respondents by Educational Status

As shown in table 3 is the educational status of respondents. From table 3, 19 people representing 19.0% that lives close to mines have no formal education, whiles 11% and 9.0% had primary education and junior high education respectively. It is worth noting that 22.0% and 39.0% had senior high and tertiary education respectively. The overall level of education of respondents close to mines including miners is very high as majority of respondents have attained tertiary education. It could be implied that unemployment rate is very high in those areas as the respondents view illegal mining as a means of survival. This is because most of the respondents have education prerequisite that qualify them for other jobs rather than illegal mining.

Distance from mines				
		Close to mines	**Far from mines**	**Total**
Level of education.	Junior high school	9	2	11
	No formal education	19	2	21
	Primary education	11	1	12
	Senior high school	22	23	45
	Tertiary education	39	72	111
	Total	100	100	200

Table 3. level of education of respondents

The study further interviewed those who live far from mining areas, where most of them are health workers, students and non-miners. The results show 2.0% and 1.0% had no formal education and primary education respectively; while 2.0% and 23.0% have junior and senior high school education. Those who have tertiary education represent 72%; the results implied that since there is very high education attainment among respondents who live far from mines, they are aware and enlightened of environmental dangers associated with illegal mining.

Distribution of Respondents by Income

Respondents were asked how much income they earn per month out of economic activities they undertake. Figure 2 shows how income is distributed for those close to mines and those far from mines. From figure 2, 10.0% of respondents that live far from mines earn monthly income less than 400ghs which is equivalent to 69usd. However, those who live close to mining areas including miners earned as high as over 2000ghs monthly i.e., 346usd which represent 43.0% as against 22.0% of those who live far from mining including non-miners. Respondents who live far from mining areas including non-miners earned relatively lower, as indicated in fig.2 10.0%,20.0%,9.0%,22.0% and 39.0% earned <400ghs,1000 -1499ghs,1500 -1999ghs,2000ghs+ and 500ghs respectively. The data shows that 43.0% of the respondents earned the highest salary indicated in the study.

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On the other hand, income of those who live close to mines including miners as indicated represent 2.0%, 24.0%, 8.0%, 43.0% and 23.0% earned <400ghs,1000 -1499ghs,1500 -1999ghs,>2000ghs and 500ghs respectively. Majority of miners earned above 2000ghs depending on amount of gold deposits mined. This explains why majority of the youths including those engaging in other jobs like farming, and trade are into illegal mining at kenyasi district capital.

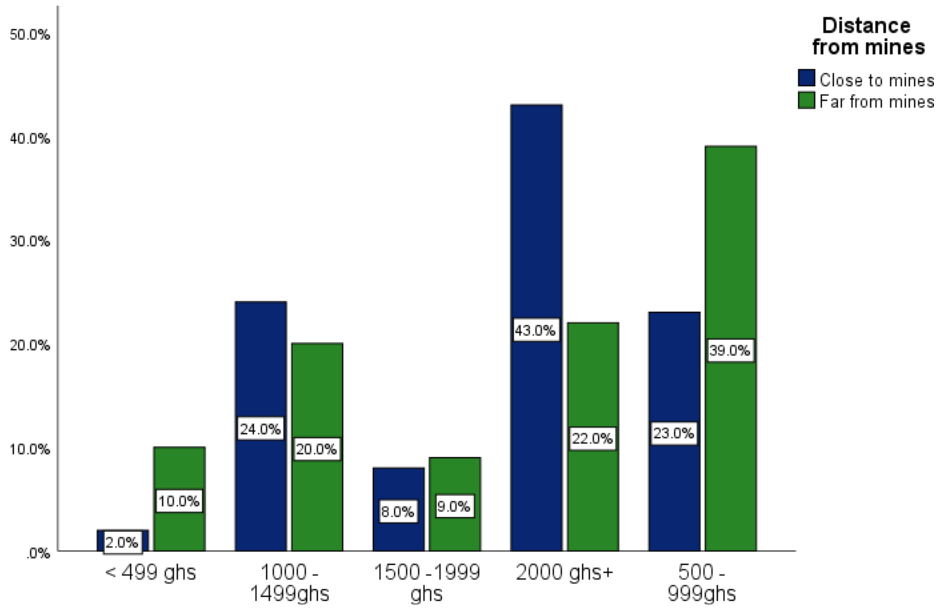

Figure 2 shows how income is distributed for those close to mines and those far from mines.

To further ascertain the impacts of illegal mining on public health in line with the objectives of this study, the researcher considered components such as environmental, frequently hospital visits, health issues as a result of illegal mining, assessing how each component affects the health of people.

Health consequences as a result of illegal mining

People living within mining communities across the world have in the past experienced and continue to experience health-threatening disease, which includes respiratory, kidney, musculoskeletal, and skin diseases; The world health organization's reports on artisanal mining in Geneva (1989) have shown that the use of mercury in artisanal possess a severe health threat to both small-scale miners and people living in mining areas. To further understand and ascertain the extent to which illegal mining has affected the health of people living around the studied area, respondents were asked what kind of diseases they had suffered as a result of illegal mining. Figure 3 shows the results of self- reported health of miners. Health reported diseases such as kidney, musculoskeletal, malaria, skin and respiratory illness are very rampant. According to a study conducted by (5) such diseases are very rampant among people who live in mining areas. As shown in figure 3, 61% of respondents who live far from mining areas have none of the disease asked them, while 8% of respondents who live close to the mines have reported such diseases. This implied that majority of respondents who live close to the mines had one way or the other suffered from such diseases; according to the results shown below, 28%, 3%, 25%, 12%, and 24%, have suffered headache and flu, kidney, malaria, respiratory and skin diseases respectively.

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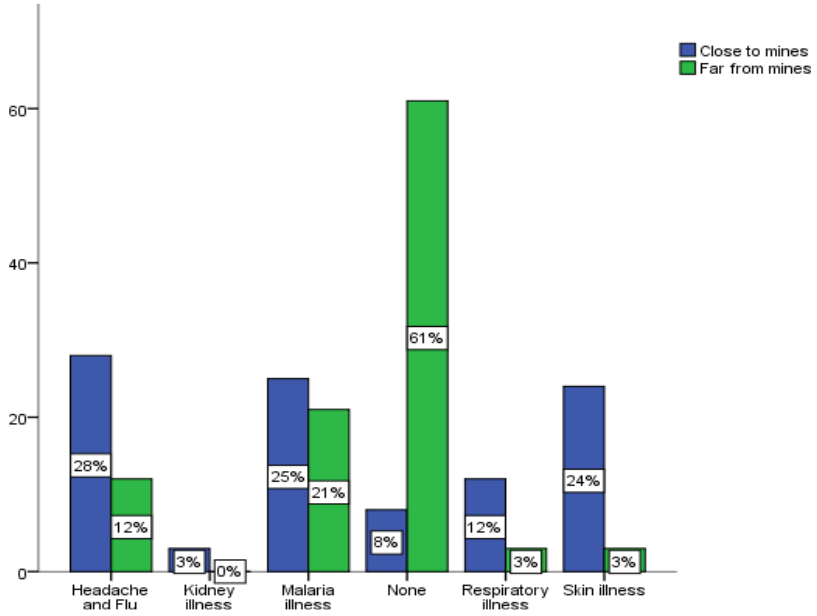

Figure 3 shows the results of self- reported health of miners. Health reported diseases such as kidney, musculoskeletal, malaria skin and respiratory illness

With regards to those who live far from the mines 0% of respondents had reported kidney illness; however, lower percentage of respondents had reported of such disease as 12%, 21%, 3%, and 3% had reported malaria, musculoskeletal, respiratory and skin diseases respectively. The results implied that those who live close to mines are in constant threat of getting ill as a result of illegal mining than their counterpart who lives far from mines.

Effects of illegal mining on environment

Hitherto, the emergence of illegal mining in kenyasi district populace relied on water sources such as streams, rivers, lakes etc. for their daily activities like cooking, washing, drinking etc. However, data from questionnaires and unbiased researcher's observation indicated that water sources can no longer be relied on as result of illegal mining activities in the district. From figure 4, majority of respondents (90%) said the colour and smell of various water sources such as lakes, rivers etc. has change considerably as opposed to 10% who said otherwise. A follow-up question was asked; whether drinking from such water bodies makes one ill. From figure 5, it can be seen that 71.5% of the respondents said that one is likely to become ill after drinking from the water bodies whiles 28.5% said no. These findings are in accordance with (8) Research Article Mining and Public Health Implications: Evidence from the Newmont Ghana Gold Limited Enclaves. In their study they found out that illegal mining activities accounted for a significant proportion of health problems confronting people living in and around mining areas. During field observation, researchers had first-hand experience on how illegal mining have devastated water bodies and lands in the mining area.

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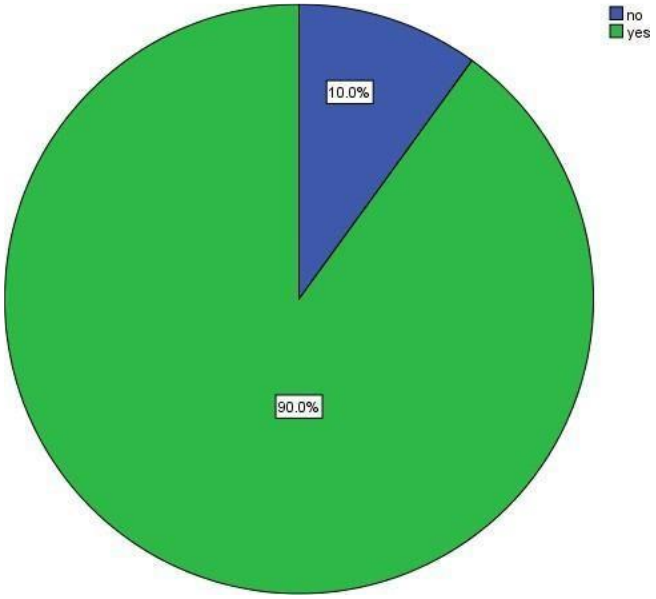

Figure 4, shows responses on how people in the community perceive the smell and colour of various water sources such as lakes, rivers etc. in the community

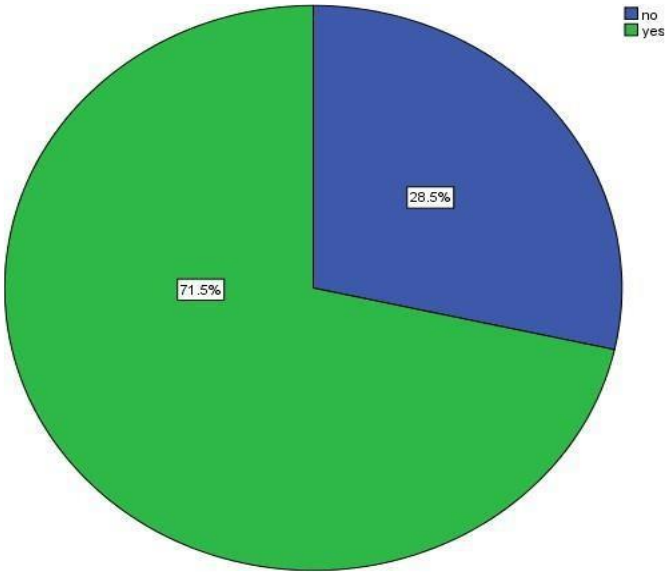

Figure 5, shows responses on the possibility of one falling ill after drinking from water bodies in the community

Acquisition of valid mining license

The last decade has seen an influx growth of illegal small-scale mining popularly known as Galamsey in Ghana. Previous successive government has made an effort to regulate small-scale mining in order to operate in a more economical and environmentally friendly manner. The main and first small-scale mining law was promulgated in the year 1989 and amended in 2006 as minerals and mining Act (Acts 703); this law provides for the assigning of all mineral rights, licensing procedures, and a positive competitive fiscal regime (9). This made

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provision for small- scale mining to Ghanaians who have acquired the license of through proper supervision and monitoring (10).

Response's	frequency	percentages%
Miners with license	2	3.4
Miners without license	53	89.8
Miners who don't know they have license	4	6.8
Total	59	100

Table 4 Acquisition of mining license

Small-scale miners were asked whether or not they have the right license to mine as the law requires. Table 4 shows results from respondents. Out of 59 responses 3.4% indicated that they operate with licenses while 89.8% said they do not have license; 6.8% of the respondents indicated they don't know whether they have the license. From the results, it is clear that 89.8% of miners interviewed operated illegally without license. The activities of illegal mining have over the years had a negative effect on both the environment and public health; mainly due to lack of supervision and monitoring, since they operate without license.

Explanations given by respondents especially those who operate without license was that acquiring license from the ministry to mine are bureaucratic and tiresome. According to them they rely on mining on a daily basis for survival and therefore a delay in the procedure means their only source of livelihood is under threat and will increase unemployment rates in the study area. Based on this reason, their only means of survival is to operate without license.

As explained in the livelihood framework, institution and legislation ought to work together in order to perform statutory role by granting mining license and also supervise and monitor mining. However, this is not the case in the studied area, as lack of cooperation among institutions had led to 89.8% of mining operators operating without license and these have caused a devastating effect on both public health and the natural environment. It was perceived during our interviewed that law enforcement agencies like police, immigration officers as well as traditional leaders‟ bargain with issues concerning illegal mining activities in the area.

Effects of illegal mining on Health

Health and safety risk associated with mining varies from the type of mining, location of mine, people involved in mining, and what product is mined (4). Globally, mining continues to remain one of the most dangerous occupations at all levels. These fatalities and injuries have both short- and long-term impacts such as respiratory diseases and cancers. In order to find correlation between health statuses of people who live close to mines and those who live far from mines. Body Mass Index (BMI) was used to measure each individual health status; with this we calculated the weight in kilograms and height in centimeters of each individual.

$BMI=M/H^2$
BMI = body mass index
Mass = kilograms Height = centimeter

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A BMI score less than 16 (>16) indicates an individual is very severely underweight, a range score between 16.0 to 16.9 (16.0 – 16.9) indicated severely underweight, underweight individual score ranges between 17.0 to 18.4 (17.0 – 18.4), normal BMI score ranges between 18.5 to 24.9 this score indicates that the individual is medically healthy, overweight individuals recorded a score range between 25.0 to 29.9 (25.0 – 29.9), whiles obese individual scored above 30.0 (<30).

Very severely underweight = >16 severely underweight = 16.0 – 16.9
Underweight = 17.0 – 18.4
Normal = 18.5 – 24.9
Overweight = 25.0 – 29.9
Obese = <30

Test Statistics

	Bodymassindex
Mann-Whitney U	2304.500
Wilcoxon W	7354.500
Z	-6.590
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: Distance from mines

Table 5 Health issues associated with illegal mining

In order to evaluate if there is a difference in body mass index and people who live close and far from mines, Mann-Whitney U test was analyzed. As shown in table 5, the test revealed significant difference of body mass index in close to mines (Median = 24, n = 100) and far from mines (Median = 24, n = 100), U = 2304.500, z = -6.590, p = .001, r = 0.47; according to (11) cited in (12) an effect size of 0.3 and 0.5 has a medium to large effect, hence an effect size of 0.47 means body mass index has a medium to large effect on proximity of mines. This indicates that those who live close to mines suffer from devastating health effects of illegal mining which includes respiratory, skin, kidney, malaria diseases etc., as compared with those who live far from mines. Thus, the Mann Whitney U test analysis confirmed that the distance to mines affect health related problems of populace

Analysis on the influence factors of public health

Our identification strategy is multiple regression model that correlate the health of people who live close to areas that there is mining with those far from them. In order to carry out this strategy we must identify those people who live close to mining areas as well as those who live far from mines. To identify the former, we create a 5 to 10km distance from the mines (close to mining). In order to identify people living far away from the mining areas we selected people from neighboring community where there are no mining activities. The dependent variable is public health which is measured by body mass index of individuals whereas the independent variables include distance to mines (Kg) in relation to illegal mining, occupation, gender, income per

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month, level of education and marital status. The rationale of these independent variables is because in terms of distance to mines; individuals closer to mines are more affected by the negative health effects of mines than those who stay far away (13). According to (14) occupation status is hypothesized to be related to health because it positions individuals within social structure which defines access to resources and constraints that can have implications for health and mortality. Additionally, the higher the level of education of an individual the more he/she appreciates the health problems associated with illegal mining; moreover, the single status of an individual attributes to the likelihood of him/her engaging in mining (15). According to this study, a lot of youth especially those unemployed engage in mining because of the high level of income earned and this has made them vulnerable to mining related health complications; also, through our observations we realised that, due to the physical nature and workload of mining there are more males engaged in it than their female counterparts.

The specific regression we estimate is

$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5 X_5 + \beta_6X_6 + \epsilon$

Yi = outcome of health-related problems

βo = Constant

β_1 = Regression coefficient

X1 = Distance to mines (kg) in relation to illegal mining

X2 = Occupation

X3 = Gender

X4 = Income per month

X5 = Level of education

X6 = Marital status

ϵ = error

Variables	Descriptions	Measurements
Health	Chronic diseases that are rampant at the study area	Body mass index (M/H^2)
Distance from mines	The proximity of respondents to illegal manning sites or area	5 to 10 kilometers from mining area
Occupation	Various occupation carried out by respondents	Measured by social class
Gender	Socially construct	Male or female
Income	Monthly salary of respondents	Amount in Ghana cedi's 1cedi's = 5.7 dollars
Level of education	The highest education attains	No formal education, junior high school, senior high school, tertiary education

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Marital status	Current state of respondents in terms of marriage	Single, married, divorce

Table 6 Variables description

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.490[a]	.240	.216	4.66694

a. Predictors: (Constant), Marital status, Income per month, Gender, Distance From mines, occupation, Level of education.

b. Dependent Variable: Bodymassindex

Table 7 Factors contributing to the health of people associated with illegal mining

Anova model		Sum of squares	df	Mean squares	f	Sig.
1	Regression	1326.657	6	221.110	10.152	.000[b]
	Residual	4203.595	193	21.780		
	Total	5530.252				

a. Dependent Variable: Bodymassindex
b. Predictors: (Constant), Marital status, Income per month, Gender, Distance from mines, occupation, Level of education.

The model as a whole was significant to predict Health (Body Mass Index): F (6,193) =10.152), p<0.001 as shown by the Anova Table. The R-square (R^2) of the overall model was 24% with an adjusted R^2 of 21% a small size effects are reported by the model of variations in health is accounted by the linear combination of the predictor variables (Distance to mines, Occupation, Income per month, Marital status, Gender, Level of education).

Coefficients

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Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	T	Sig.
1	(Constant)	27.840	2.832		9.832	.000
	Distance from mines	-4.546	.746	-.432	-6.094	.000
	Occupation	2.529	.828	.213	3.054	.003
	Gender	.709	.720	.063	.986	.326
	Income per month	.108	.178	.041	.608	.544
	Level of education.	-.341	.325	-.080	-1.047	.296
	Marital status	-.389	.824	-.033	-.472	.638

a. Dependent Variable: Bodymassindex

This study was conducted to determine which various factors such as distance from mines, income per month, occupation, gender, level of education and marital status correlates with public health (body mass index) in kenyasi the studied community. It was hypothesized that distance from mines will correlate or predict positively with public health (Body mass index). Looking at the individual contribution of the predictors, the results show that Distance from mines (b = -0.432, t = -6.094, p<0.001) and Occupation (b= 0.213, t = 3.054, p<0.003) positively predicted body mass index of public health in the studied area. This suggests that proximity of mines and occupation have influences on public health (Body mass index).

Conclusion

After a thorough analysis into the effects of illegal mining on public health a case study in kenyasi, it is concluded that illegal mining activities in the community are done informally without any proper license and these have caused detrimental effects on public health. Despite the numerous benefits of gold production in the community, it was believed that such commodity is significantly beneficial to miners who are more directly involved in the production of gold than non-miners in community. The illegal mining sector if properly managed and regulated, could provide employment and benefit the country's total Gross Domestic Product (GDP).

The increment of illegal mining in the kenyasi district capital of Asutifi north has caused numerous environmental hazards to many individuals and households. Although the negative impacts of illegal mining affect the entire nation; It can be concluded in our study that both miners and non- miners who live close to mining areas suffered more health problem than those who live far from mining areas. This was confirmed by the findings of (16) that small-scale mining in Ghana has caused negative effects to the lithosphere, hydrosphere and atmosphere of

the communities where the mines are located (17) cited in (16). This study found out that several community members have adopted numerous strategies to cope with the adverse effects of illegal mining activities. However, according to most respondents most of these coping strategies are not successful.

Moreover, because of the multiplier effect of illegal mining on public health; public education has to be intensified for both miners' and non-miners for them to understand the implications or danger associated with illegal mining. When citizens become aware of the dangers associated with illegal mining, they then become responsible and take care of the environment; when this happens, it will reduce illegal mining and improve water, air, and land degradation. Agriculture lands will be reclaimed, thereby increasing agricultural productivity and food security. These policies will then make agriculture attractive to the youth resulting in employment and reduction in rural-urban migration; when this happens, the youth will become more responsible and take care of their families and tend to reduce child labor and promote socio-economic development. Government has to also regularize the operations of illegal mining activities and also decentralize the process of acquiring mining license.

Suggestions for Future studies

This study assessed the impact of illegal mining on public health; a case study in kenyasi, Ahafo region of Ghana. Future studies could be conducted in a lager and broader area other than a single district capital to give a general overview on the threats of illegal mining in Ghana. Moreover, an analysis of parametric can be tested in future studies.

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Figure 1. shows respondents close to mines with regards to their marital status. These responses reflect on why people engage in illegal mining.
Figure 2. shows how income is distributed for those close to mines and those far from mines.
Figure 3 shows the results of self- reported health of miners. Health reported diseases such as kidney, musculoskeletal, malaria skin and respiratory illness
Figure 4, shows responses on how people in the community perceive the smell and colour of various water sources such as lakes, rivers etc. in the community
Figure 5, shows responses on the possibility of one falling ill after drinking from water bodies in the community
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