Predictors of work-related eye injuries among stone quarry workers in the Ashanti Region of Ghana: A cross-sectional study

KEYWORDS: Quarry worker, Prevalence, Risk factors, Eye injury, Occupational health

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ABSTRACT

Introduction: The occurrence of eye issues among quarry workers in southern Ghana is significant, with 58% reporting irritation and 9.4% experiencing quarry-related eye problems. This study assessed factors associated with work-related eye injuries among stone quarry workers in the Ashanti Region of Ghana. **Methods**: We conducted a cross-sectional study among stone quarry workers in the Ashanti Region of Ghana. A pretested semi-structured questionnaire was administered to collect data on workers' socio-demographic factors, occupational factors, lifestyle factors and history of work-related accidental eye injuries. Data was summarized into frequencies, means and odds ratio calculated at 95% CI using STATA. **Results**: Three hundred and seventy-five stone quarry workers took part in the study with 73 (19.5%) reporting at least one incidence of work-related eye injury. The mean age of the participants was 36.4 ± 11.3 years. Majority of participants 359 (95.7%) were males. Working for more than 8 hours (aOR=4.98, 95%CI: 1.25-19.76), being a smoker (aOR=4.59, 95%CI: 1.39–15.17) and alcohol consumption (aOR=2.15, 95%CI: 1.01-4.55) were associated with increased odds of eye injuries. Using Personal Protective Eye Devices (PPEDs) (aOR=0.07, 95%CI: 0.02-0.27) and education on PPEDs (aOR=0.05, 95%CI: 0.01-0.23) were associated with decreased odds of eye injuries among the workers. **Conclusion**: This study identifies extended working hours, smoking during course of work, and alcohol consumption as significant risk factors for work-related eye injuries among stone quarry workers. It also emphasizes the importance of implementing and promoting PPEDs use and providing education on their proper usage to mitigate the risk of such injuries.

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Introduction

Globally, injuries constitute about 8% of the occupational risk, with eye injuries representing approximately 1% and an estimated 3.5 million cases occurring annually in workplaces [1]. In Africa, data have shown varying prevalence of occupational eye injuries with some studies recording 31.4% rate among small-scale workers in Ethiopia [2] while other studies in Tanzania [3] and Nigeria [4] have shown 44.1% and 30.7% respectively. The situation is not different in Sub-Saharan Africa and especially Ghana, where a lack of regulatory enforcement of occupational health and safety standards at various quarrying sites predispose workers to eye and other health-related injuries [5].

Stone quarrying is a vital industry in Ghana, significantly contributing to economic growth and infrastructure. While recent data is unavailable, records from 2008 to 2012 show that stone quarrying in Ghana employed 9,569 workers, with the Ashanti Region leading at 2,639 workers. Stone quarry workers in Ghana, including men, women, and young adults, often face economic hardship, with many being uneducated, school dropouts, orphans, or individuals from broken homes, struggling without financial support to secure better jobs . According to a study conducted by Ahadzi et al., (2020) in southern Ghana, 58% of quarry workers had complaints of eye irritation. In a similar study, eye problems accounted for 10 (9.4%) of quarry-related health issues at Buoho in the Ashanti Region of Ghana [6-8].

The occurrence of eye injuries has been reported to be associated with various factors which can be grouped into socio-demographic, work-related and behavioural factors. These factors include age, sex, educational level, use of Personal Protective Eye Devices (PPEDs), work experience, specification of work, period of working hours, smoking status and alcoholism. In a study conducted in southern Ghana, male quarry workers were reported to have a higher risk of injury than female workers [9]. Moreover, Jovanovic et al. (2016) found that the likelihood of work-related eye injuries is highly correlated with educational level, and individuals with higher education than a college degree experience the lowest proportion of these injuries [10].

Work-related eye injuries among quarry workers if not prevented would result in long-term vision impairment and adversely impact the quality of life among affected populations and result in lower rates of employment. This would invariably have an impact on households' ability to sustain their economic well-being, as well as have a psychosocial impact on the victims [11].

Despite the high prevalence of eye injuries from previous studies among stone quarry workers and its associated consequences, there is currently limited knowledge on the prevalence and predictors of eye injuries among stone quarry workers in the Ashanti Region of Ghana [12]. Most studies conducted to assess work-related eye injuries in Ghana focused on professionals such as metal workers [13], woodworkers [14], welders [15] and miners [16]. This study therefore assessed the proportion of stone quarry workers in the Ashanti Region of Ghana who suffer from work-related eye injuries and the possible predictors of these injuries. The findings of this study will inform policymakers and management of various stone quarry sites in the country on the measures to adopt to reduce the occurrence of work-related eye injuries.

Methods

Study design

We conducted a quantitative cross-sectional study among 375 randomly sampled stone quarry workers from selected quarry sites in the Ashanti region of Ghana spanning December 2021 and October 2022. Data on workers' socio-demographic factors, occupational factors, lifestyle factors and history of eye injuries were collected by conducting face-to-face interviews using a semi-structured questionnaire.

Study setting

The study was conducted at A. J Fanj quarry, Consar stone quarry Limited, Northern Mines and quarries Limited (2 sites), and Cymain stone quarry sites. These sites were purposively selected because they are focal points of quarry activities in the region, heterogeneity of their populations, and have a significant population of quarry workers making them a reflection of the characteristics of quarry workers in the Ashanti region. These study sites are located in Atwima Nwabiagya North and South municipalities, Afigya Kwabre South and Kwabre East municipalities in the Ashanti Region. The

Ashanti Region, with a population of over 5.4 million inhabitants, has quarrying as a prominent occupation, engaging approximately 10% of its workforce in stone quarrying activities [17]. Considering this significant population of quarry workers, the region provides an ideal setting to understand the risk factors associated with work-related quarry activities in Ghana (Figure 1).

Study population and eligibility

The sampling frame for the study was determined by the number of quarry workers currently employed at each of the five quarry sites, totaling 1,080 workers (Table 1). This updated workforce list ensures that the sample selection accurately represents the current population, thereby enhancing the validity of the study.

The study was conducted among quarry workers from the five selected quarry sites in the Ashanti Region. Quarry workers within the age bracket of 18-64 years working at selected quarry sites and willing to participate in the study were eligible for the study. Quarry workers who have worked for less than one year in the industry were excluded. Also, workers who sustained eye injuries outside the workplace were excluded.

Sample size determination and sampling process

A study by Ezisi (2019) reported a prevalence of work-related eye injury of 64.1% among stone quarry workers in Nigeria [18]. Minimum sample size (n) was calculated using the Cochran formula [19],

$$n = \frac{z^2 \cdot pq}{d^2}$$

z = z score value of 1.96, at a confidence level of 95%, p = prevalence of stone workers with eye injuries reported 64.1% = 0.641, and used d=an error margin of 5%, we estimated a sample size of 354. Accounting for a 6% non-response rate (0.06× 354) = 21, the estimated minimum sample size was determined to be 375.

A probability proportionate to size sampling approach was used to calculate the number of quarry workers needed at each site. The five sites had a total number (a) of 1080 quarry workers. Using the population of workers at a specific quarry site (b) divided by total number of quarry workers (a) multiplied by the estimated sample size (n) we computed the site-specific sample size (s) ie. s=(b/a) x n (**Table 1).** A systematic random sampling approach was then used to sample workers at each study site. The sampling interval (*k*) was obtained by dividing the population (*b*) of quarry workers by their respective sample size (*s*) for each site. The first 5 numbers from the register were picked and one of them was randomly selected through balloting to serve as the baseline. The k^{th} number from the selected baseline on the register was then recruited as the second participant and so on until the site sample size was attained.

Data collection and pre-testing

Participants were interviewed using a semi-structured questionnaire. The questionnaire was pre-tested at a quarry site in the Asante-Akim South Municipality, which had similar characteristics to the main study sites but was far enough away from them to prevent participant overlap. The pre-test ensured the questions were clear and easy to understand, and revisions were made before field deployment. The questionnaire was designed on KoBoCollect Toolbox [20] and deployed on KoboCollect for data collection. Research support staff were trained and equipped on the usage of the KoBoCollect data collection tool and how to conduct face-to-face interviews with stone quarry workers. The questionnaire captured participants' socio-demographic variables including age, sex, educational level, marital status, among others.

Also, participant occupational factors such as years of work, period of working hours, use of an eye-protective device, specification of work, history of eye injury, monthly off days, smoking status, alcohol consumption as well as accidental work-related eye injury were assessed and responses noted. The study assessed work-related eye injuries based on quarry workers' self-reports of direct physical or chemical harm to their eyes during work activities.

Data management and statistical analysis

Data was exported into STATA version 16 I/C for analysis. Descriptive statistics were performed by estimating frequencies, proportions, and percentages for categorical variables. Continuous variables such as age, years of work, and average monthly income were summarized into mean with their respective standard deviations. A multivariate binary logistic regression model was used to identify factors

associated significantly with work-related eye injuries. All analyses were done at a 95% confidence interval and alpha (α) values less than 0.05 were considered statistically significant.

Ethical considerations

The Ghana Health Service Ethical Review Committee (GHS-ERC:020/05/22) granted approval for the study. Additionally, permission was sought from the Ashanti Regional Health Directorate and the management of the quarry sites. Written informed consent was sought from participants before administering the questionnaire. Confidentiality was also maintained throughout the entire study.

Results

Socio-demographic characteristics of study participants

The study involved 375 stone quarry workers with mean age of 36.4 ± 11.28 years. The majority of study participants were males 359(95.7%), married 215(57.3%), aged from 30-39 years 135(36.0%) and reported to have attained Junior High/Middle School education 195(52.0%) (**Table 2**).

Occupational Characteristics and Prevalence of eye injuries among study participants

The mean years of work was 4.71 ± 4.20 years with 140(37.3%) of study participants reporting using PPEDs during their last work activity. The majority of study participants were labourers 150(40.0%). The majority of participants indicated that they had not received education on PPEDs use 275(73.3%) whereas a significant proportion reported working the entire month without any off-day 260(69.3%). Out of the 375 quarry workers, accidental eye injuries during quarry activities were reported by 73(19.47%) (**Table 3**).

Factors associated with work-related eye injuries among study participants

In a multivariate logistic regression analysis, marital status (co-habitation), the use of personal protective eye devices (PPEDs), period of working hours, education on PPEDs, smoking during course of work and alcohol intake were significantly associated with the occurrence of work-related eye injuries among the workers. Quarry workers who used PPEDs had 93% reduced odds of eye injuries compared to their counterparts who did not use PPEDs (aOR = 0.07, 95% CI 0.02-0.27, p = 0.001). Participants who worked for 8-12 hours had 3.5 times increased odds of eye injuries compared to workers with less than 8-hour shifts (aOR = 3.49, 95% CI: 1.75–6.98, p = 0.001). The association was even stronger for those worked over 12 hours, who demonstrated nearly 6 times greater odds of eye injury (aOR = 5.93, 95% CI: 1.94–18.11, p = 0.002). The odds of experiencing an eye injury were reduced by 95% for those who received PPE education compared to those who did not (aOR = 0.05, 95% CI 0.01 – 0.23, p = 0.001). Quarry workers who reportedly smoke had 4.6 times increased odds of eye injuries compared to their counterparts who indicated otherwise (aOR = 4.59, 95% CI 1.39 – 15.17, p = 0.022). Likewise, those who consumed alcohol had significantly higher odds of an eye injury compared with those who did not consume alcohol (aOR = 5.48, 95% CI 2.55 – 11.79, p = 0.001) (**Table 4**).

Discussion

This study assessed the prevalence and associated factors of work-related eye injuries among stone quarry workers in Ghana. The findings revealed a 19.47% prevalence rate of work-related eye injuries among the study participants. This prevalence underscores the urgent need for the government and the labour commission of Ghana to implement and enforce strict safety protocols at various quarry areas in the country. This observed prevalence is consistent with the findings of similar studies conducted in New Zealand [21] and Scotland [22], which reported a prevalence range of work-related eye injuries from 15 – 20%. However, higher prevalences of 31.4%, 50.0%, 64.1% and 59.2% were found in Ethiopia [2], Thailand [23], Nigeria [18] and Ghana [24] respectively. The variations in prevalence rates could partly be influenced by the different methods of reporting and definition of eye injury (eye trauma, discomfort or impaired vision) employed in various studies.

In agreement with our finding which revealed that workers who reported using PPEDs had reduced risk of eye injuries compared to their colleagues who reported not using PPEDs. Adams et al. and Sufiyan & Ogunleye also demonstrated that the incidence of eye injuries among stone quarry employees is decreased by the provision of suitable protective

eyewear [17][18]. These findings therefore stand to highlight that the use of PPEDs is effective in reducing the risk of eye injuries among stone quarry workers.

The findings of this study also found work periods of 8 hours and more to be significant risk factors for work-related eye injury compared to those who work for fewer than 8 hours. This may be due to the fact that quarry workers who spend more hours at the sites are constantly exposed to wind, dust, debris, and varying temperature changes for a longer duration. This exposure can lead to the continuous accumulation of atmospheric particles on their eyes, causing symptoms like itching, a sandy sensation, and a foreign body sensation, which can result in work-related eye injuries [25-27]. This finding conforms with previous studies which found time spent at work to be significantly associated with the occurrence of work-related eye injuries among stone quarry workers [28], [29]. On the contrary, Zhang (2012) and Jovanovic et al., (2016) opined that the number of working hours per day had no significant effect on the occurrence of occupational injury [30], [31]. The differing results across studies could be attributed to variations in study design and data collection methods.

In addition, education on PPEDs use was another factor reported to be associated with work-related eye injuries among stone quarry workers in this study. This assertion was re-echoed by Tetteh et al., (2020) who indicated that workers with no training on the use of eye PPEs had two times increased odds of eye injuries [15]. These findings therefore emphasize the need for periodic training on the usage and importance of PPEDs to quarry workers. Employees who received institutional training on eye PPEs are less likely to get eye injuries as evidenced by Kumar & Dharanipriya in 2014 [32]. This increased awareness and knowledge of occupational safety may contribute to the decreased likelihood of eye injury among workers. Thus, there should be a deliberate effort aimed at informing workers about the content of the safety policy so that they can be abreast with the institutional policy governing the occupational and safety measures at these quarry sites.

The findings from this study also revealed that quarry workers who smoked during the course of work had a higher risk of work-related eye injuries. The rigorous nature of quarry work exposes workers to substance abuse in order to cope with the demands of the work and could thereby predispose them to work-related eye injuries. This finding is corroborated by Kyriakaki et al., (2021) and Khorshed et al., (2022) who reported smoking as an independent risk factor for the development of ocular symptoms among workers [33], [34]. In addition, smoking significantly increases the risk of eye injuries among quarry workers [35]. This underscores the need for targeted interventions to address smoking in this high-risk group. Implementing smoking cessation programs and providing education on the dangers of smoking, particularly in hazardous work environments like quarries, can help reduce the incidence of eye injuries.

In consonance with results from previous studies which indicated that alcohol-dependent drinkers have an increased risk of ocular trauma [33], [36-38], our study also demonstrated that alcohol consumption was associated with five-fold increased odds of work-related eye injury in comparison with non-users. Due to the rigorous and physical nature of the quarry work, workers probably tend to consume alcohol as a means of coping with the demands and hostile nature of the job. However, alcohol consumption impairs judgment and motor skills causing individuals to struggle in responding swiftly to hazards, increasing the likelihood of accidents and eye injuries [38]. These findings project the need for well-established legislation on alcohol use at stone quarry sites in Ghana to streamline the operations of these quarry areas and minimize the risk of eye injuries.

Study Limitations

To begin with, our study was a cross-sectional study and therefore could not establish causal relations across different factors. Additionally, the study may be limited by subject selection bias. We used random sampling methods and only voluntary subjects participated. Also, the study was unable to obtain medical diagnoses for eye injuries but relied solely on self-reported data from quarry workers, which may have introduced a misclassification bias.

Conclusion

This study reveals a prevalence rate of 19.47% for work-related eye injuries among stone quarry

workers in Ghana. This figure underscores the urgent need for the government and labor commission of Ghana to implement and enforce stringent safety protocols to protect workers. The study highlights several modifiable risk factors associated with work-related eye injuries among stone quarry workers, including inadequate use of protective eye equipment, extended working hours, insufficient training on the use of protective gear, and substance use such as smoking and alcohol consumption.

Minimizing prolonged exposure to occupational hazards by optimizing work schedules, discouraging substance use, and promoting awareness of risky behaviors are critical measures for safeguarding workers. Furthermore, the implementation of robust safety regulations, regular workplace inspections, and the provision of occupational health services are essential for addressing both workplace and lifestyle-related risk factors, ultimately improving worker health and safety.

What is already known about the topic

- The use of personal protective equipment (PPE) is effective in reducing the incidence of eye injuries.
- Globally, injuries account for approximately 8% of occupational risks, with eye injuries being a significant concern, particularly in Sub-Saharan Africa.
- A notable percentage of stone quarry workers in southern Ghana experience eye issues, with 58% reporting irritation and 9.4% of quarry-related health cases attributed to eye problems.

What this study adds

- This study reports a 19.47% prevalence of work-related eye injuries specifically among stone quarry workers in the Ashanti Region of Ghana.
- It identifies significant predictors of eye injuries, including extended working hours, smoking, alcohol consumption, and education on PPE use.
- The findings emphasize the urgent need for improved safety protocols and training to mitigate risks associated with eye injuries in this high-risk occupational group.

Competing Interest

The authors declare no competing interest

Availability of dataset or materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request

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Authors´ contributions

GAB, EA and AL conceived and designed the study. GAB and MHA collected the data. GAB, MAG and GNO did the statistical analysis and data visualization. GAB, MAG, MHA and GNO wrote the first draft. EA and AL were involved in giving technical guidance in the design of the study and in the revision of the manuscript. All authors read and endorsed the final version of the manuscript.

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Tables & Figures

Table 1: Proportionate to size stratified sampling of study sites		
Sampling site	**The population of Quarry workers (b)**	**Estimated Sample size at each site (s)**
A. J Fanj Quarry, Atwima Nwabiagya North	300	104
Consar Stone Quarry Ltd, Atwima Nwabiagya North	150	52
Northern Mines & Quarries Ltd, Atwima Nwabiagya South	180	63
Cymain Stone Quarry, Afigya Kwabre South	250	87
Northern Mines & Quarries, Kwabre East	200	69
Total	**1080 (a)**	**375 (n)**

Table 2: Socio-demographic Characteristics of Study Participants		
Variables	**Frequency N=375**	**Percentage (%)**
Age group		
< 20 years	5	1.33
20–29 years	110	29.33
30–39 years	135	36.00
40–49 years	60	16.00
50–59 years	52	13.87
60–64 years	13	3.47
Sex		
Male	359	95.73
Female	16	4.27
Education		
No formal	20	5.33
Primary	20	5.33
Junior High/Middle sch	195	52.00
Secondary/technical/vocational	95	25.33
Tertiary	45	12.00
Marital status		
Single	135	36.00
Married	215	57.33
Divorced	5	1.33
Co-habitating	20	5.33
Monthly Income level (GH₵)		
< 500	20	5.33
500–1000	115	30.67
1001–2000	210	56.00
> 2000	30	8.00
Smoking status		
Non-smoker	355	94.67
Current-smoker	20	5.33
Alcohol consumption		
Non-consumer	275	73.33
Current-consumer	100	26.67

Table 3: Occupational Characteristics and Prevalence of Eye Injuries among Study Participants		
Variables	**Frequency N=375**	**Percentage (%)**
Years of work (Mean ± SD: 4.71 ± 4.20 years)		
1–5	245	65.33
6–10	95	25.33
11–15	25	6.67
>15	10	2.67
Use of PPEDs		
No	235	62.67
Yes	140	37.33
Work Speciality		
Blaster	15	4.00
Breaker	30	8.00
Crusher	120	32.00
Driller	60	16.00
Labourer	150	40.00
Period of working hours (Mean ± SD: 10.01 ± 2.44)		
<8	150	40.00
8–12	200	53.33
>12	25	6.67
Education on PPEDs		
No	275	73.33
Yes	100	26.67
Monthly off days		
No	260	69.33
Yes	115	30.67
Eye injury at work		
No	302	80.53
Yes	73	19.47

Table 4: Multivariate analysis of factors associated with eye injuries among stone quarry workers				
Variables	**Crude OR (95% CI)**	**p-value**	**Adjusted OR (95% CI)**	**p-value**
Sex				
Male	Ref		Ref	
Female	1.72 (0.383–7.766)	0.477	0.72 (0.095–5.395)	0.745
Education				
No formal	Ref		Ref	
Primary	3.27 (0.802–13.349)	0.098	3.15 (0.507–19.517)	0.218
Junior High/Middle sch	1.03 (0.327–3.258)	0.957	0.45 (0.089–2.300)	0.340
Higher	1.06 (0.320–3.546)	0.916	0.34 (0.053–2.156)	0.251
Marital status				
Single	Ref		Ref	
Married	0.58 (0.339–1.016)	0.057	0.62 (0.349–1.107)	0.107
Co-habitating	3.35 (1.279–8.796)	0.014	3.52 (1.286–9.618)	0.014
Work Experience (years)				
1–5	Ref		Ref	
6–10	0.87 (0.473–1.605)	0.660	0.99 (0.525–1.891)	0.994
11–15	1.55 (0.615–3.932)	0.350	1.54 (0.589–4.072)	0.375
Use of PPEDs				
No	Ref		Ref	
Yes	0.07 (0.025–0.198)	0.001	0.07 (0.019–0.270)	0.001
Speciality of work				
Blaster	Ref		Ref	
Breaker	0.50 (0.123–2.022)	0.331	0.50 (0.119–2.099)	0.344
Crusher	0.44 (0.139–1.444)	0.179	0.44 (0.134–1.467)	0.183
Driller	1.07 (0.325–3.566)	0.903	1.03 (0.310–3.467)	0.953
Labourer	0.29 (0.089–0.9406)	0.039	0.29 (0.090–0.976)	0.046
Period of working hours				
<8	Ref		Ref	
8–12	3.15 (1.666–5.963)	0.001	3.49 (1.748–6.979)	0.001
>12	6.47 (2.452–17.101)	0.001	5.93 (1.941–18.114)	0.002
Education on PPEDs				
No	Ref		Ref	
Yes	0.02 (0.062–0.410)	0.001	0.05 (0.010–0.227)	0.001
Monthly off days				

No	Ref		Ref	
Yes	0.69 (0.385–1.240)	0.216	0.88 (0.462–1.675)	0.697
Smoking status				
Non-smoker	Ref		Ref	
Current-smoker	2.97 (1.168–7.569)	0.022	4.59 (1.391–15.166)	0.022
Alcohol consumption				
Non-consumer	Ref		Ref	
Current-consumer	3.12 (1.826–5.321)	0.001	5.48 (2.551–11.794)	0.001

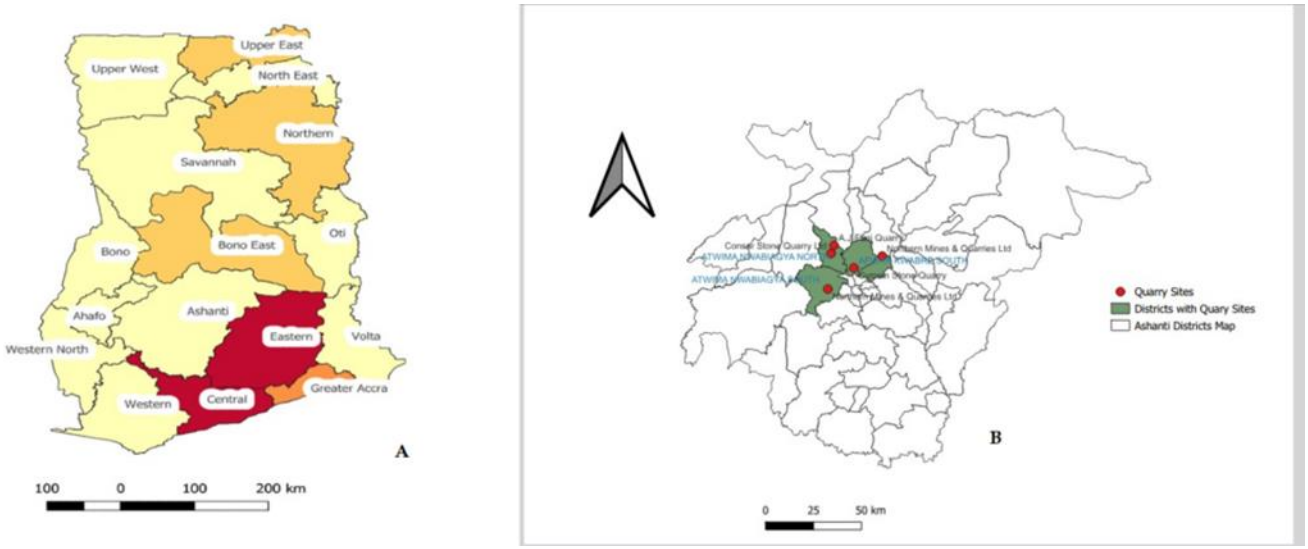

Figure 1: A Map of Ghana depicting Ashanti Region B. Map of Quarry sites in Ashanti Region