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Assessment of Occupational Health Hazards Associated with the Quarry Workers in Abakaliki, Ebonyi State

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Abstract: *The study aimed to assess the occupational health hazards among quarry workers in Ebonyi State, Nigeria. The study employed a cross sectional study that deals with observational and clinical examination that involved the measurement of outdoor gaseous pollutants, interview of participants with a well structured questionnaire and ocular examination of participants. The completed and collected questionnaire was analyzed using Statistical Package for Social Science (SPSS) version 21.0. The results were presented in frequency tables and percentages in line with the research objectives. A total of 212 subjects participated in the study, 92(43.40%) were males while 120 (56.60%) were females. The result showed that sneezing (79.40%) followed by cough (58.45%) were higher among crushed stone quarry-related disease compared to other diseases. It was reported that 34.26% of the subjects have developed ocular signs of cataract occurrence. Also, 31.3% of the subjects have developed ocular signs of blurry vision, 27.17% had itching and 15.5% had eye irritation as ocular symptoms. In terms of knowledge, 180(84.91%) of the subjects reported that noise is one of the source of pollution, 182(85.84) strongly agreed that dust is main source of pollution. For prevention aspect, 107(50.47%) reported that dust must be sprayed with water to reduce air pollution and 111(56.76%) said dusty haul roads must be watered regularly. In conclusion, the result showed a significant relationship between quarry activities and health problems because exposure to gases can have major health implications. Therefore, the quarry workers should be encourage to comply with personal protective equipment to protect their health*

Key words*: Dust, air pollution Health, Hazards, Occupation, Quarry*

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I. Introduction

Workers are easily exposed to various respiratory and pulmonary diseases due to dust inhalation. Sunyer (2011) reported that when dust deposited on the skin and in the eyes it may cause skin and eye irritation depending on the chemical composition and the concentration of the dust from the quarry site. In quarry industry, Hsin-Yi, (2012), stated that dust is the main source of air pollution and the extent of pollution by dust depends on the local microclimate conditions, the concentration of dust particles in the ambient air, the size of the dust particles and their chemistry. Dust has effect on both human health and the natural environment. In long-term exposure, dust can lead to chronic health effects for instance decreased lung capacity and lung cancer due to its toxic air pollutants (Sunyer, 2011). However, it blocks and damages the internal structure and abrasion of leaves and cuticles (Hsin-Yi, 2012). The number of quarrying industries in the state kept on increasing. Although it contributes to the internally generated revenue and the need to look at its effect on the neighboring communities and the environment in general is necessary. Work has been done on the levels of heavy metals in soil and vegetation of a quarry site by Bada & Fagbayibgo, (2009) and on the level of suspended particulates in the ambient air and around selected quarry sites by Oguntoke et al., (2009) but much work has not been done on the effect of quarry activities in relation to the emission of greenhouse gases and suspended particulates.

The health condition may worsen where the workers are ignorant of these risks and thus do not appreciate the importance of using protective clothing and gear when provided at work. The long exposure to crystalline silica dust, especially at the point sources, and the many years they have worked in the aggregate quarries expose the workers to respiratory and pulmonary diseases and are also at high risk of developing silicosis (Langer et al., 2014).

Studies have shown that silicosis predisposes workers to lung cancer and tuberculosis. In 2002 NIOSH concluded that there is sufficient evidence in humans for carcinogenicity of inhaled crystalline silica from occupational causes (NIOSH, 2012). In the study conducted by Pelucchi et al (2006), concluded that there is an association between silicosis and lung cancer.

Several studies have been carried out on occupational diseases and their etymology. However, literatures on the assessment of occupational health hazards associated with the quarry industry in Nigeria are

scanty due to the fact that quarry works are limit to some states. Therefore, this study was deemed necessary in order to determine assessment of occupational health hazards associated with the quarry workers in Abakaliki, Ebonyi State. Also, the study will help to increase awareness of occupational health hazard among quarry workers, quarry industries owners and the general public in Ebonyi State. It can be considered necessary in order to study the dust and address the health risks that the dust poses to the quarry workers.

II. Materials and Methods

This study employed a cross sectional study design to determine the occupational health problems (skin problem, eye irritation, chest pain, cough, wheezing, shortness of breath) associated with the quarry workers. It was both an observational study and a clinical study involving the measurement of outdoor gaseous pollutants, interview of participants with a questionnaire and the health and ocular examination of participants in the quarry communities of Ebonyi State, Nigeria.

The study employed systematic sampling to gather quarry site that are operational, at the first stage simple random sampling to obtain twenty (20) quarry sites out of 52 within the Abakaliki Local Government Areas in Ebonyi State (Ebonyi State of Environment).

The selected sites were done through randomization process in which 12 quarry workers was selected for interview with the questionnaire and clinical examination. And the selected sample through simple random sampling constituted the sample size of 212 that was determined used in the study

The collected data with the aid of questionnaire was entered into computer software called Statistical Package for Social Science (SPSS version 20.0). It was analyzed using a descriptive statistical analysis and qualitative data was presented on tables with frequency and percentages while inferential analysis was done using simple Statistical technique. Gender of quarry workers and occupational hazards were tested using ANOVA at 5% which was considered statistically significant.

III. Results

A total of 212 subjects participated in the study. 92(43.40%) were males while 120 (56.60%) were females. Data collected was presented below in tables. From table 1, 6(2.83%) subjects were aged between 11 – 20 years; for 21-30, 31 (14.62%); 31– 40, 70 (33.02%); 41–50, 62 (29.25%); above 50, 43 (20.28%). Also, for subjects 11 – 20 years, there were 2 (0.94%) males and 4 (1.88%) females; for 21 – 30, 12 (5.66%) males and 19 (8.97%) females; 31 – 40, 33 (15.57%) males and 37 (17.45%) females; 41 -50, 26 (12.26%) males and 36 (16.98%) females; above 50, 19 (8.97%) males and 24 (11.32%) females.

Table 2 showed that quarrying was the most occupation of the subjects with 75(35.38%); farming recorded 23 (10.85%); trading 12 (8.49%); drivers 12 (5.66%); truck loaders had16 (7.55%); civil servants 8 (3.77%); clerks 7 (3.30%); students and tailors had 5(2.36%) and retired workers had 7 (3.30).

The result in table 3 showed that 182 (85.84%) of the subjects responded “strongly agree” to dust being the main source of dust in the village; 201(94.81%) strongly agreed that the concentration of dust being highest during blasting of rocks; 187(88.21%) strongly agreed that crushing, conveying and sieving producing a lot of dust; 180(84.91%) strongly agreed to transport vehicles on unsurfaced roads generate dust; 182(85.85%) strongly agreed that rain and cold weather reducing dust; 178(83.96%) strongly agreed that sunny weather promoting distance of air movement; 165(77.83%) strongly agreed that windy weather facilitating dust; 160(75.47%) strongly agreed that cold and cloudy weather reducing dust; 123(58.02%) to dry weather promoting dust emission.

Table 4 showed that 181(85.38%) of the subjects responded “yes” to dust settling on roofing sheets; 170(80.19%) to plants being covered by dust; 186(87.74%) to having a health problem with dust.

In table 5; 180(84.91%) of the subjects responded “yes” to main source of noise being is from machinery blasting rocks, processing and haulage trucks; 164(77.36%) to noise level affecting hearing; 124(58.49%) to cracks in building due to blasting vibrations; 13(6.13%) to collapse of cracked building; 0.00% to death of community member in collapsed building.

The result in table 6 showed that 201(94.81%) of the subjects responded “yes” to heaps of quarry stockpiles blocking view; 193(91.04%) said that dust can prevent seeing things at distance; 197(92.92%) to heaps of quarry being an eyesore; 195(91.98%) to eye irritations from dust.

Table 7 showed that 58.45% of the subjects complained of cough; 79.40% reported sneezing, catarrh had 22.90%; sore throat recorded 19.12%; asthma recorded 6.44%; short breadth had 32.60% pneumonia had 18.21%; headache had 40.12%, eye problems recorded 540.28%; wheezing recorded 43.87% and skin irritation recorded 35.98%.

Table 8 and 9 showed that 71.70% of the subjects reported Malaria; Guinea worm, 0.14%; Typhoid, 27.70%; Gastroenteritis, 0.14%. None of the subjects reported Cholera. Table 9 showed that cataract was seen 34.26% of the subjects; conjunctivalnaevus said 13.43%; cornea opacity, 9.76%; hyperemia, 9.64%; pinguecula, 13.21%; pterygium, 22.49%; mucopurulent discharge, 6.92%.

In table 10; 31.30% reported blurry vision; 9.66% said discharges, 12.49% said headache, irritation, had 15.55%; itching had 27.17%; pain said 21.42%; tearing, 15.84%; redness 5.30%.

Table 11 presented mitigation measures where 50% of the subjects responded "strongly agree" to dust sprayed with water to reduce air levels; 64.41% for health screening organized every 6 months to a year; 55.08% to haulage trucks covered with sheets; 56.79% to dusty haul roads watered regularly; 60.17% to nose masks worn always; 72.60% to exposed stockpile surfaces watered regularly.

The analysis in table 12 showed that there is a statistical significant relationship between knowledge of quarry workers and Occupational health problems ($F=154.397$ at $p< 0.05$)

Table 1: Age and gender distribution of subjects

Age group	Males				Females	
	n	%	N	%	n	%
11 – 20	6	2.83	2	0.94	4	1.88
21 – 30	31	14.62	12	5.66	19	8.97
31 – 40	70	33.02	33	15.57	37	17.45
41 – 50	62	29.25	26	12.26	36	16.98
Above 50	43	20.28	19	8.97	24	11.32
Total	212	100	92	43.40	120	56.60

Table 2: Distribution of occupation of subjects by Gender

Occupation	Males		Females		Total	
	N	%	n	%	N	%
Farming	5	2.36	18	8.49	23	10.85
Trading	3	1.42	9	4.25	12	8.49
Quarrying	27	12.74	48	22.64	75	35.38
Driver	12	5.66	0	0.00	12	5.66
Caterpillar Operator	8	3.77	0	0.00	8	3.77
Clerk	`1	0.47	6	2.83	7	3.30
Cyclist	10	4.72	2	0.94	12	5.66
Food vendor	3	1.42	8	3.77	11	5.19
Truck loader	11	5.19	5	2.36	16	7.55
Hair dresser	2	0.94	9	4.25	11	5.19
Civil Servant	4	1.88	4	1.88	8	3.77
Student	2	0.94	3	1.42	5	2.36
Tailor	1	0.47	4	1.88	5	2.36
Retired	3	1.42	4	1.88	7	3.30
Total	92	43.40	120	56.60	212	100.00

Table 3: Response of all subjects in Abakikili on Air Pollution

Information on Air Pollution	SA (%)	A (%)	D (%)	SD (%)
Main source of village dust is quarrying	182(85.84)	20(9.43)	12(5.66)	0(0.00)
Concentration is highest during blasting of rocks	201(94.81)	17(8.02)	0(0.00)	0(0.00)
Crushing, conveying, sieving produce a lot of dust	187(88.21)	19(8.96)	0(0.00)	0(0.00)
Transport vehicles on unsurfaced roads generate dust	180(84.91)	27(12.73)	0(0.00)	0(0.00)
Rain and cold weather reduce dust	182(85.85)	30(14.15)	0(0.00)	0(0.00)
Sunny weather promotes distant air movement	178(83.96)	24(11.32)	0(0.00)	0(0.00)
Windy weather facilitates dust emission	165(77.83)	43(20.28)	0(0.00)	0(0.00)
Cold and cloudy weather reduce dust	160(75.47)	42(19.81)	0(0.00)	0(0.00)
Dry weather promotes dust emission	123(58.02)	90(42.45)	0(0.00)	0(0.00)

SA- Strongly Agree; A- Agree; D- Disagree; SD- Strongly Disagree

Table 4: Response of all subjects in Ebony state on dust emissions

Question on dust emissions	Yes		No	
	n	%	N	%
Does dust settle on your roofing sheets	181	85.38	26	12.26
Are plants in the area covered with dust	170	80.19	27	12.74
Do you have any health problem with dust	186	87.74	24	11.32

Table 5: Response of all subjects in Abakikili on noise pollution and vibration effects

Information on noise pollution/vibration effects	Yes		No	
	n	%	N	%
Main source of noise is from machinery blasting rocks, processing and haulage trucks	180	84.91	18	8.49
Noise level affected hearing	164	77.36	29	13.70
Cracks in building due to blasting vibrations	124	58.49	30	14.15
Main cause of building cracks is vibration blasts	105	49.53	24	11.32
Collapse of cracked building	13	6.13	121	57.08

Death of community member in collapsed building	0	0.00	188	88.68

Table 6: Response of all subjects in Abakikili to visual intrusion

Questions on visual intrusion	Yes		No	
	n	%	N	%
Do heaps of quarry stockpiles block your view	201	94.81	8	3.77
Does dust prevent you from seeing things at distance	193	91.04	15	7.08
Can these heaps of quarry be an eyesore	197	92.92	6	2.83
Eye irritations from dust	195	91.98	21	9.91

Table 7: Distribution of dust-related disease among all subjects in Abakikili

Dust-related disease	n	%
Cough	107	58.45
Sneezing	174	79.40
Catarrh	44	22.90
Sore throat	40	19.12
Asthma	13	6.44
Short breadth	66	32.60
Pneumonia	38	18.21
Heart problem	59	24.97
Headache	85	40.12
Eye problems	88	40.28
Phlegm	2	0.76
Wheezing	83	43.87
Skin irritation	78	35.98

Table 8: Distribution of water-related disease among all subjects in Abakikili during quarrying activity

Water-related disease	n	%
Malaria	152	71.70
Guinea worm	3	0.14
Cholera	0	0.00
Typhoid	46	27.70
Gastroenteritis	3	0.14

Table 9: Distribution of ocular signs among all subjects in Abakikili

Ocular signs	n	%
Anterior Synechiae	2	0.88
Aphakia	11	4.64
Cataract	81	34.26
ConjunctivalMelanosis	22	8.94
ConjunctivalNaevus	30	13.43
Cornea Opacity	21	9.76
Dilated pupil	13	5.60
Entropion	6	2.96
Hyperemia	22	9.64
Iris Coloboma	10	4.72
Miosis	18	7.84
Mucopurulent discharge	15	6.92
Pinguecula	29	13.21
Pterygium	58	22.49

Table 10: Distribution of ocular symptoms among all subjects in Abakikili

Ocular symptoms	N	%
Blurry vision	71	31.30
Discharges	24	9.66
Discomfort	22	8.64
Headache	30	12.49
Irritation	35	15.55
Itching	69	27.17
Pain	46	21.42
Photophobia	18	7.99
Pulling sensation	3	1.31
Redness	12	5.30
Sandy sensation	21	8.26
Squinting	3	1.93
Tearing	36	15.84

Table 11: Response of all subjects in Abakikili on mitigation measures

Information on mitigation measures	SA (%)	A (%)	D (%)	SD (%)
Dust must be sprayed with water to reduce air levels	107(50.47)	134(37.85)	0(0.00)	0(0.00)
Health screening should be organized every 6 months to a year	128(54.41)	74(20.90)	0(0.00)	0(0.00)
Haulage trucks must be covered with sheets	125(53.08)	129(36.44)	0(0.00)	0(0.00)
Dusty haul roads must be watered regularly	111(56.76)	109(30.79)	0(0.00)	0(0.00)
Nose masks must be worn always	133(60.37)	112(31.64)	0(0.00)	0(0.00)
Exposed stockpile surfaces must be watered regularly	157(74.06)	46(12.99)	0(0.00)	0(0.00)
A clinic must be sited at quarry site	111(56.76)	105(4.24)	0(0.00)	0(0.00)
Communities must be relocated or buildings rehabilitated	139(62.51)	97(27.40)	0(0.00)	0(0.00)

SA- Strongly Agree; A- Agree; D- Disagree; SD- Strongly Disagree

Table 4.27: Relationship between Knowledge of quarry workers and Occupational health problems

Descriptives

			Statistic	Bootstrap[a]			
				Bias	Std. Error	95% Confidence Interval	
						Lower	Upper
Yes	N		189	0	5	179	198
	Mean		4.8201	-.0111	.2156	4.3771	5.2228
	Std. Deviation		2.94261	-.02286	.09934	2.70223	3.10634
	Std. Error		.21404				
	95% Confidence Interval for Mean	Lower Bound	4.3979				
		Upper Bound	5.2423				
	Minimum		1.00				
	Maximum		10.00				
No	N		23	0	5	14	33
	Mean		12.4783	-.0160	.1202	12.2200	12.7094
	Std. Deviation		.59311	-.01295	.06888	.46984	.70339
	Std. Error		.12367				
	95% Confidence Interval for Mean	Lower Bound	12.2218				
		Upper Bound	12.7347				
	Minimum		11.00				
	Maximum		13.00				
Total	N		212	0	0	212	212
	Mean		5.6509	-.0007	.2720	5.0818	6.1662
	Std. Deviation		3.66757	-.01532	.13674	3.36005	3.91511
	Std. Error		.25189				
	95% Confidence Interval for Mean	Lower Bound	5.1544				
		Upper Bound	6.1475				
	Minimum		1.00				
	Maximum		13.00				

a. Unless otherwise noted, bootstrap results are based on 212 bootstrap samples

ANOVA

			Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	(Combined)		1202.547	1	1202.547	154.397	.000
	Linear Term	Unweighted	1202.547	1	1202.547	154.397	.000
		Weighted	1202.547	1	1202.547	154.397	.000
Within Groups			1635.623	210	7.789		
Total			2838.170	211			

IV. Discussion

The findings in this study on quarrying activities in Abakaliki Ebonyi State, Nigeria involve services of both male and female workers at different age groups. The quarrying activities in the study areas were predominantly occupied by women compared to men and it could be that they involved in moving the stones to various locations within the sites. The males engage in truck driving, caterpillar operating and truck loading. As a major contributor to the economy of these communities, most of the quarry workers were introduced into the vocation at an early age by their parents and guardians. For many of the families in the communities, it is the only job they know. Many enter fully into the profession after their secondary school education. Because of the economic hardship in the state, some do not complete their secondary school but drop-out to go and work at the quarry sites in order to make some money. These quarrying activities result in the emission of noise, gases and particulate matter into the atmosphere.

The level of suspended particulate matter within the quarrying communities as a result of quarrying activities was also significantly higher than normal levels. Langer, (2011) reported that when these particles are inhaled, the lungs produce mucous to trap the particles and tiny hairs wiggle to move the mucous and particles out of the lung. The mucous leaves the airway by coughing or swallowing. If the particle is small and it gets very far into the lungs, special cells in the lung trap the particles and then they can't get out and this can result in lung disease, emphysema, lung cancer. Because the $PM_{2.5}$ travels deeper into the lungs and because the $PM_{2.5}$ is

made up things that are more toxic (like heavy metals and cancer causing organic compounds), it can have worse health effects than the bigger PM_{10}. The effects of inhaling particulate matter include asthma, lung cancer, cardiovascular disease, respiratory diseases, premature delivery, birth defects, and premature death.

Noise exposure also has been known to induce tinnitus, hypertension, vasoconstriction, and other cardiovascular adverse effects. Beyond these effects, elevated noise levels can create stress, increase workplace accident rates, and stimulate aggression and other anti-social behaviors (World Bank, 2010). Exposure to high levels of noise have differing effects within a given population, and the involvement of reactive oxygen species suggests possible avenues to treat or prevent damage to hearing and related cellular structures. The elevated sound levels cause trauma to cochlear structure in the inner ear, which gives rise to irreversible hearing loss. A very loud sound in a particular frequency range can damage the cochlea's hair cells that respond to that range, thereby reducing the ear's ability to hear those frequencies in the future. However, loud noise in any frequency range has deleterious effects across the entire range of human hearing.

Misek and Patte (2014) stated that the knowledge of occupational and industrial quarry expose workers, employers, trade unions and the general public to the importance and relationship of work to health, that of work environment to health, that of attitude, practices and behaviour at work to health, that of mechanics, equipment and tools to health, that of job placement to health as well as that of management to health. Quarry workers spend hours at the quarry sites and are constantly exposed to wind, dust, debris and varying temperature changes. The continuous accumulation of dust and other atmospheric particles on the eye will cause symptoms of itching, sandy sensation and/or foreign body sensation. These symptoms can be prevented by wearing protective goggles while working.

In some studies by Isawumi et al., (2011); Erdogan et al., (2011), have identified pterygium and cataract as the two major ocular problems among quarry workers. Mantyjarvi (2010), reported hat cataract reduced the visual acuity and contrast sensitivity of industrial workers.

In another study by Azuamah et al., (2014), long-term exposure to ultraviolet rays of the sun was found to cause cataracts as well as pterygium. These ocular signs were seen upon external examination of the quarry workers. Though they do not cause any symptoms, but can causes evere reduction in vision if left unmanaged. Azuamah, et al. (2013) reported that cataract and pterygium were among the major causes of low vision in Southeast Nigeria. Other ocular features seen among the quarry workers such as conjunctivalnaevus and pinguecula can also be caused by exposure to ultraviolet rays.

V. Conclusion

The base line information got from the study was analyzed and it showed that there is a significant relationship between pollutants and health problems because exposure to gases can have major health implications.

The findings showed low knowledge of quarry workers, employers, trade unions and the general public to the health implications of quarry activities. The common observed occupational health problems include; headache, cough, sneezing, catarrh, sore throat, short breadth, asthma eye problems etc. Therefore, females were more exposed to gas pollutants in quarry activity sites compared to males.

VI. Recommendations

Based on the findings of the study, the following recommendations were necessary such as;

1. The quarry workers should be encourage to comply with personal protective equipment to protect their health
2. The quarry workers should be encourage on free screening of blood pressure and other gas concentration in the quarry sites among all ages.
3. It is necessary to educate quarry workers to change their attitude, practices and behaviour at work to suit good health
4. Quarry workers should spend fewer hours at the quarry sites and protect themselves on constantly exposed to wind, dust, debris and varying temperature changes.

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