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Full Length Research

Assessment of Quarrying Activities and Dust-related Health Problems among Quarry Workers and Residents Communities in Ebonyi State, Nigeria

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The study aimed at assessing the quarrying activities in relation to dust-related health problems among quarry workers in Ebonyi State, Nigeria. The study employed a cross sectional study that deals with observation that involved the assessment of dust particles, interview of participants with a well-structured questionnaire. The completed and collected questionnaires were 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 objective. A total of 354 subjects participated in the study, 52(43.3%) were males while 68(57%) were females in Ezza North LGA. In Ivo LGA, 52(43.3%) were males while 71(58%) were females. In Ohaukwu LGA,49(44.1%) were males while 62(55.8%) were females. The most common occupation among the respondents was quarrying with 28(7.91%) in Ezza North LGA, 31(8.76%) in Ivo LGA and 25(7.06%) in Ohaukwu LGA. The result showed that sneezing was the highest with 76.67% in Ezza North LGA, 75.61% in Ivo LGA and 80.18% in Ohaukwu LGA; followed by coughing (57.50%) in Ezza North LGA, 58.54% in Ivo LGA and 59.46% in Ohaukwu LGA. All these dust-related health problems among people in the studied LGAs in Ebonyi state were higher among crushed stone quarry workers compared to those who have other occupations as farming and trading as so on. In conclusion, the result showed a significant relationship between quarry activities and dust-related health problems because exposure to dust particles can have major health implications. Therefore, the quarry workers should be encouraged to comply with personal protective equipment to protect their health and others.

Key words: Dust, Ebonyi, Hazards, Occupation, Quarry, Workers.

INTRODUCTION

Natural resources remain an important source of economic development in many developing countries like Nigeria. Some States in Nigeria like Ebonyi are endowed with abundant mineral resources and it has

contributed immensely to the socio-economic growth of the State and nation in general. Following the methods of obtaining the natural resources such as stone from a quarry process and quarrying can be stated as a process of removing rock, sand, gravel or other minerals from the ground in order to use them to produce materials for construction or other uses. Quarry is any kind of work on the surface of the earth where minerals are extracted. The methods and equipment used in quarry depend on the purpose for which the stone is extracted. According to Babatunde et al., (2013), different quarrying activities have different impacts on air quality and the process of creating or making holes in rock, limestone or overburden with the help of drilling machine (drilling process) may be regarded as a point source of pollutant emission. The process of shattering the drilled limestone or overburden in a bid to loosen the mass in smaller fragments remains a point source for suspended particulate is known as blasting. Then, the quarrying operations generally involve removal of over burden, drilling, blasting and crushing of rock materials. The major impacts of quarrying operations are dependent on the products sizes and locations and common quarrying operations focused on negative impacts of quarrying that are resulted to dust, noise generation, smoke and fumes, ground vibration, production of noxious gases. According to USEPA (2008), quarrying activities are significantly contributed to particulate matters to environment among all pollutants from quarrying operational activities.

In Ebonyi State, there are different types of quarry industry which ranges from manual (individual crushing) to small and medium scale quarry industries that use heavy machinery for stone crushing. Due to the nature of manual crushing method, it makes it difficult to estimate the number of such industries in the State because poverty level has made many people to engaged in manual stone crushing. On the other hand, most of quarry sites are located at residential homes; some are close to residential homes and public buildings all over the state majorly Abakaliki Capital Territory. Other places like Amaeze and Enyimumuagharu in Ezza North LGA, Ishiagu in Ivo LGA, Nkalagu and Ntezi in Ishielu LGA, Ezzamgbo in Ohaukwu LGA, EzzaInyimagu in Izzi LGA, Amoha in Afikpo North LGA and many others in Ebonyi State.

Following the economic situation of the people in Ebonyi State, the major interest driving the quarrying endeavour is socio-economic. It serves as source of internal generated revenue to the State Government, means of business profit to private stakeholder entrepreneurs, and provides a much needed employment opportunities to the populace. This type of myopic interest facilitates a widespread operation of quarrying activities with neither any policy to promote governmental supervisory or regulatory inputs nor any articulate provisions to control or mitigate the environmental and health impacts of quarrying by the owners. This situation critically predisposes the quarry workers and residents of the surrounding community to high vulnerability to air pollution and other health problems such as asthma, emphysema, bronchitis, chronic obstructive pulmonary disease, hearing loss, etc., emanating from exposure to air pollutants from quarrying activities. According to Akanbi, et al., (2009), in a study in western Nigeria reported that the morbidity rate of asthma was 10.4% in males and 17.9% in females. Also, Onyeonoro et al., (2016), reported that the risk of lung cancer in people exposed to dust was between 20% and 30% with symptoms like coughing, wheezing, headaches to seizures, hearing loss, stroke, coma and death. Therefore, this study was aimed to assess the quarrying activities in relation to dust-related health problems among quarry workers and residents communities in Ebonyi State, Nigeria.

MATERIALS AND METHODS

This study employed a cross sectional study design to determine the quarrying activities in relation to dust-related health problems among quarry workers and residents' communities in Ebonyi State, Nigeria. The study involved an observational study which involved the measurement of outdoor dust particles through the use of particle counter dust measuring device PCE-PCO 1. PCE-PCO 1 is a handheld laser optical particle counter, or dust particle measuring device, for measuring the concentration of particles in the air. The dust particle measuring device can measures 6 sizes of particles such as 0.3 µm, 0.5 µm, 1.0 µm, 2.5 µm, 5.0 µm, 10 µm. The sampling duration was 1-2 days and 3-5 days for outdoor and it was considered that dusts are solid particles, ranging in size from below 1 µm up to at least 10 µm and above, which may be or become airborne, depending on their origin, physical characteristics and ambient conditions. The exposure to harmful air pollutants and hazardous airborne dust and others were similar to work of Hsin-Yi, (2012) on effect of

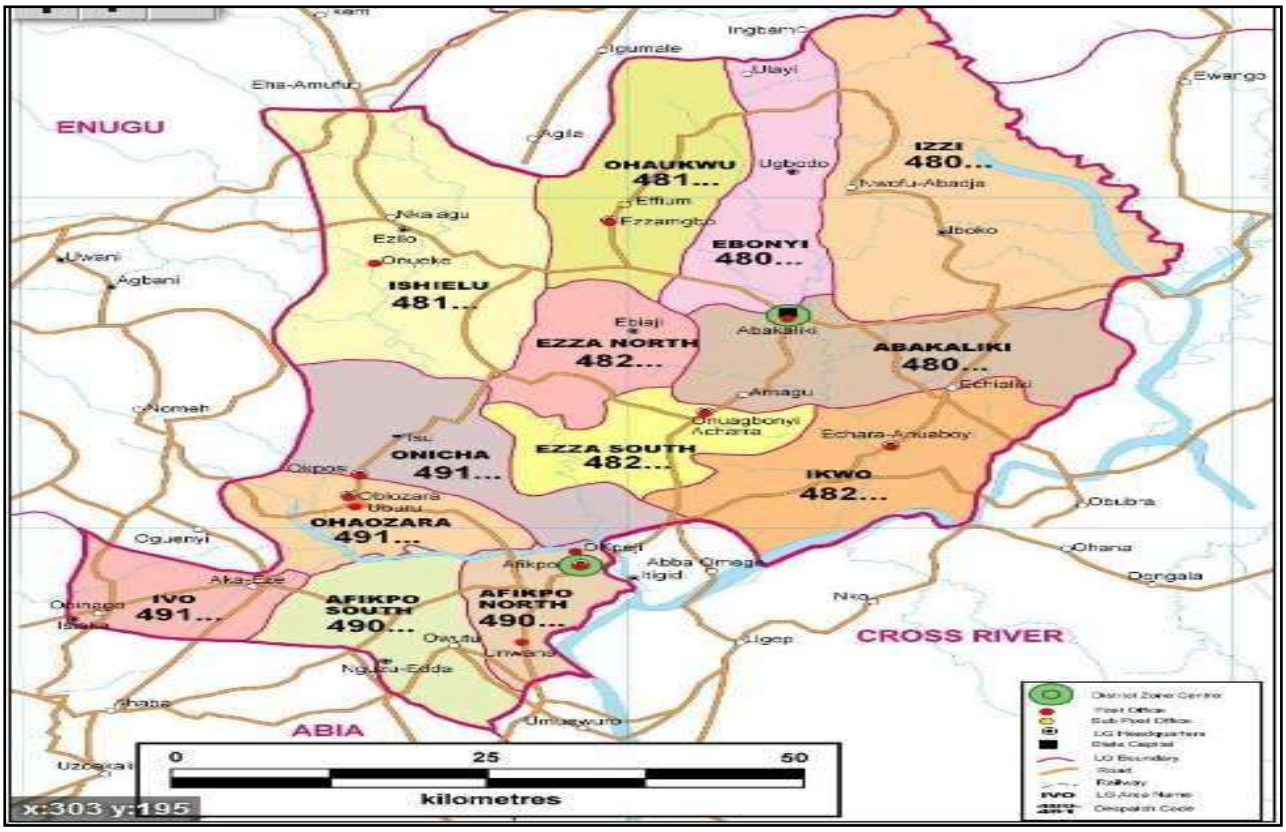

Figure 1. Map of Ebonyi State showing the three Selected LGAs
Source: www.ebonyionline.com

dust on human health and the natural environment and examples include exhaust, smoke, is a health hazard and can result in sneezing, a stuffy or runny nose, itchy or red eyes, headaches, fatigue, fever, cough, shortness of breath, dermatitis, asthma, bronchitis, pneumonia and cancer. Also, interview of participants was done with a questionnaire within the quarry communities of Ebonyi State, Nigeria.

The sample size was determined using formula of Kish and Leslie for cross-sectional descriptive studies for a population > 1,000.

$$n = \frac{z^2\, q\, (1-P)}{d^2}$$

n = Minimum sample size, Z = Standard normal deviation usually set at 1.96 which corresponds to the 95% confidence level.

p = Assumed population prevalence in %, Population of the study is estimated to be 50% to represent the target population in this study.

q = 1-p

d = Maximum acceptable random sampling error in %

In this case,

P= 50%= 0.5

q = 1- 0.5 =0.5

d = 5%= 0.05

Therefore,

$$\text{Sample size (n)} = \frac{(1.96)^2\,(0.50)\,(0.50)}{(0.05)^2}$$

n =384

Then, the sample size of the study was 354 because of no response and it employed a multistage sample technique starting with large cluster samples to gather quarry site that are operational, at the first stage, simple random sampling was adopted to obtain 5 quarry sites within each selected Local Government Areas in Ebonyi State (Ebonyi State Ministry of Environment) and it gave a total of 15 quarry sites (Amaeze and Enyimumuagharu in Ezza North LGA, Ishiagu in Ivo LGA, Nkalagu and Ntezi in Ishielu LGA, Ezzamgbo in Ohaukwu LGA, EzzaInyimagu in Izzi LGA, Amoha in Afikpo North LGA and many others in Ebonyi State) as seen in Figure 1.

Table 1. Distribution of Subjects by Age and Gender in the three Selected LGAs.

Age group	Ezza North LGA			Ivo LGA			Ohaukwu LGA		
	Age n(%)	Male n(%)	Female n(%)	Age n(%)	Male n(%)	Female n(%)	Age n(%)	Male n(%)	Female n(%)
11 – 20 years	3(2.5)	1(1.9)	2(2.9)	4(3.3)	2(3.8)	2(2.8)	6(5.4)	2(4.8)	4(6.5)
21 – 30 years	18(15)	7(13)	11(16)	16(13)	7(13)	9(12.7)	17(15.3)	7(14.3)	10(16.1)
31 – 40 years	39(33)	19(36)	20(29)	36(29)	14(26)	22(30.9)	35(31.5)	16(32)	19(30.6)
41 – 50 years	36(30)	14(27)	22(32)	38(30)	15(29)	23(32.4)	30(27)	14(28.5)	16(25.8)
Above 50 years	24(20)	11(21)	12(17)	29(24)	14(27)	15(21)	23(20.77)	10(20.4)	13(20.9)
Total	**120(100)**	**52(43.3)**	**68(57)**	**123(100)**	**52(42.3)**	**71(58)**	**111(100)**	**49(44.1)**	**62(55.8)**

In each selected site, 25 quarry workers were selected through randomization process for interview with the questionnaire. And the selected sample through simple random sampling constituted the sample size of 375 but 354 gave consent and it was used as the sample size of the study.

The collected data with the aid of questionnaire was entered into computer software called Statistical Package for Social Science (SPSS version 21.0). It was analyzed using a descriptive statistical analysis and qualitative data was presented on tables with frequency and percentages.

RESULTS

A total of 354 subjects from the 3 Local Government Areas participated in the study. Data collected is presented below in Tables (1,2,3 and 4). For the tables, “n” represents the number while “%” represents percentage value.

In Ezza North LGA, 3(2.5%) subjects were aged between 11- 20 years; 21- 30 years had 18 (15%); 31-40 years had 39 (33%); 41-50 years had 36(30%) and above 50years recorded 24 (20%).

From the same Ezza North LGA, the subjects between 11-20 years, there were 1(1.9%) males and 2 (2.9%) females; for 21-30 years had 7(13%) males and 11(16%) females; 31-40 years recorded 19(36%) males and 20 (29%) females; 41-50 years had 14(27%) males and 22(32%) females; above 50 years had 11 (21%) males and 12(17%) females. In Ivo LGA; 4(3.3%) subjects were aged between 11-20 years; for 21-30 years reported 16 (13%); 31-40 years said 36(29%); 41-50 years said 38(30%); above 50 years said 29(24%).

From the same LGA, subjects between 11–20 years, there were 2(2.8%) males and females; for 21–30 years, 7(13%) males and 9(12.7%) females; 31-40 years, 14(26%) males and 22(30.9%) females; 41-50 years, 15(29%) males and 23(32.4%) females; above 50 years, 14(27%) males and 15 (21%) females. In Ohaukwu LGA; 6(5.4%) subjects were aged between 11 - 20 years; for 21 - 30 years had 17(15.3%); 31 – 40 years had 35(31.5%); 41 – 50 years had 30 (27%); above 50 years had 23(20.7%). In the same LGA, subjects between 11–20 years, there were 2(4.8%) males and 4(6.5%) females; for 21 – 30 years, 7(14.3%) males and 10(16.1%) females; 31 – 40 years, 16(32%) males and 19(30.6%) females; 41-50 years, 14(28.5%) males and 16(25.%) females; above 50 years, 10(20.4%) males and 13 (20.9%) females (Table 1).

In Ezza North LGA; the Table 2 showed that quarrying was the most occupation of the subjects with 28(7.91%), 4(1.13%) were farmers, 3(0.85%) were traders, 3(0.85%) were recorded for drivers, Caterpillar Operator, truck loader, civil servant, clerks and tailor respectively; cyclist and food vendor had 1(0.28%), hair dresser and students had 2(0.85%), and retirees had 4(1.13%).

In Ivo LGA; the most common occupation of the subjects with 31(8.76%) was quarrying; 5(1.41%) were farmers, 2(0.56%) recorded for traders, food vendor, tailor and civil servant respectively, drivers, hair dresser, caterpillar operator and students had 3(0.85%) respectively, truck loader had 5(1.41%), clerks had 4(1.13%) and retired recorded 4(1.13%).

Table 2. Distribution of Occupation of Subjects at LGAs in Ebonyi State.

Occupation	Ezza North LGA	Ivo LGA	Ohaukwu LGA
Occupation	**n (%)**	**n (%)**	**n (%)**
Farming	4(1.13%)	5(1.41%)	3(0.85%)
Trading	3(0.85%)	2(0.56%)	1(0.28%)
Quarrying	28(7.91%)	31(8.76%)	25(7.06%)
Driver	3(0.85%)	3(0.85%)	3(0.85%)
Caterpillar Operator	3(0.85%)	3(0.85%)	1(0.28%)
Clerk	3(0.85%)	4(1.13%)	4(1.13%)
Cyclist	1(0.28%)	1(0.28%)	1(0.28%)
Food vendor	1(0.28%)	2(0.56%)	0(0.0%)
Truck loader	3(0.85%)	5(1.41%)	2(0.56%)
Hair dresser	2(0.56%)	3(0.85%)	2(0.56%)
Civil Servant	3(0.85%)	2(0.56%)	4(1.13%)
Student	2(0.85%)	3(.085%)	3(0.85%)
Tailor	3(0.85%)	2(0.56%)	2(0.56%)
Retired	4(1.13%)	4(1.13%)	4(1.13%)

In Ohaukwu LGA, quarrying was the most occupation of the subjects with 25(7.06%), farminghad 3(0.85%), 1(0.28%) were traders, 3(0.85%) were drivers, 2(0.56%) were truck loader, 4(1.13%) were civil servant,4(1.13%) were clerks, 3(0.85%) were students,2(0.56%) were tailors and4(1.13%) were retired ones.

Table 3 presented the Distribution of GPS Location and dust particular matter in the three Selected LGAs, for the SPM level in μg/m^3 was 196.2 at GPS location 6º18.467'N and 8º2.088'E; 191.9 at 6º18.542'N and 8º2.134'E; 191.2 at 6º18.502'N and 8º2.110'E; 1951 at 6º18.538'N and 8º2.334'E; 198.5 at 6º18.365'N and 8º2.104'E; 198.2 at 6º18.485'N and 8º2.156'E. The SPM levels showed a significantly difference at P<0.05.

For the SPM level in μg/m^3 was 192.6 at GPS location 5º57.280'N and 7º34.582'E; 152.4 at 5º57.223'N and 7º34.612'E; 186.2 at 5º57.290'N and 7º34.598''E; 202.1 at 5º57.245'N and 7º34.638'E; 206.2 at 5º57.288'N and 7º34.655'E; 199.8 at 5º57.292'N and 7º34.618'E. The SPM levels showed a significantly difference at P<0.05.

For the SPM level in μg/m^3 was 142.1 at GPS location 6º18.500'N and 8º1.805'E; 122.2 at 6º18.477'N and 8º1.823'E; 125.5 at 6º18.470'N and 8º1.780'E; 132.2 at 6º18.416'N and 8º1.844'E; 140.5 at 6º18.517'N and 8º1.892'E; 130.5 at 6º18.519'N and 8º1.995'E.The SPMlevels showed a significantly difference at P<0.05.

The Table 4 showed that 57.507% of the subjects in Ezza North complained of cough, 58.54% in Ivo, 59.46% in Ohaukwu; sneezing, 76.67% in Ezza North, 75.61% in Ivo, 80.18% in Ohaukwu; catarrh, 21.67% in Ezza North, 20.33% in Ivo, 20.72% in Ohaukwu; headache, 40.83% in Ezza North, 39.83% in Ivo, 42.34% in Ohaukwu; wheezing, 49.17% in Ezza North, 47.15% in Ivo, 50.45% in Ohaukwu; skin irritation, 38.33% in Ezza North, 39.02% in Ivo, 39.64% in Ohaukwu.

DISCUSSION

This study discusses the quarry workers in relation to dust-related health problems in Ebonyi State. From the findings, average number of workers (male and female) between the economic productive age range between 31-40years and 41-50years were the predominately age groups engaged in the quarrying work in Ebonyi State as causal non-professional workers without job security. This was not far from the idea that most of the workers did not acquire higher educational certificate to secure good jobs. Also, the results showed that workers within formative age of school and skill acquisition age of 11 years were less involved in quarrying work and equally regarded as unskilled labourers.

However, the age and gender scenarios among quarry workers in this study, showed more average number of females than males who were involved in quarrying activities across Ebonyi State. Females of age brackets of prime economic and active reproductive age bracket of 31-40years and matured

Table 3. Distribution of GPS Location and dust particular matter in the three Selected LGAs.

Ezza North LGA			Ivo LGA			Ohaukwu LGA		
GPS Location	SPM (µg/m³)	P-value	GPS Location	SPM (µg/m³)	P-value	GPS Location	SPM (µg/m³)	P-value
6°18.467'	19.62		5°57.280'	192.6		6°18.500'	142.1	
6°18.542'	19.19		5°57.223'	152.4		6°18.477'	122.2	
6°18.502'	21.67		5°57.290'	186.2		6°18.470'	125.5	
6°18.538'	19.12		5°57.245'	202.1		6°18.416'	132.2	
6°18.365'	19.51		5°57.288'	206.2		6°18.517'	140.5	
6°18.485'	19.85		5°57.292'	199.8		6°18.519'	130.5	
		0.00			**0.00**			**0.00**

Table 4. Comparison of Distribution of Dust-related Health Problems among Subjects in the LGAs in Ebonyi State.

Dust-related disease	Ezza North		Ivo		Ohaukwu	
	n	%	N	%	N	%
Cough	69	57.50	72	58.54	66	59.46
Sneezing	92	76.67	93	75.61	89	80.18
Catarrh	26	21.67	25	20.33	23	20.72
Sore throat	24	20.00	24	19.51	22	19.82
Asthma	8	6.67	9	7.32	6	5.41
Short breadth	43	35.83	45	36.59	38	34.23
Pneumonia	22	18.33	25	20.33	21	18.92
Heart problem	35	29.17	34	27.64	30	27.03
Headache	49	40.83	49	39.83	47	42.34
Eye problems	62	51.67	61	49.59	55	49.55
Phlegm	0	0.00	3	2.44	0	0.00
Wheezing	59	49.17	58	47.15	56	50.45
Skin irritation	46	38.33	48	39.02	44	39.64

socio-economic age group of 41-50 are the predominant age groups engaged in the quarrying occupation in the State. Interestingly, females in the age group of 21-30years ranks third as the most exposed age group within the female gender. Therefore, female workers of the age range between 21 and 50years are the jointly most exposed among the quarry workers and such exposure may have grave reproductive implications considering that suspended particle matter ($PM_{2.5}$).

In regard to occupation of the respondents, it showed that quarrying has the highest number of patronage; followed by farming and retired people and they reasonable spend much time in the quarry site or vicinity and such long stay can critically led them to health risks.

Quarry workers spend hours at the quarry sites and they are constantly being 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. Studies from Isawumi et al., (2011) and Erdogan et al., (2011), have identified pterygium and cataract as the two major ocular problems among quarry workers but this study identified sneezing, coughing and eye problems as the major health problems due to dusty particles. Mantyjarvl (2000) reported that 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 cause severe reduction in vision if left unmanaged. Azuamahet 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.

CONCLUSION

The findings from the study showed that there is a significant relationship between dust-related health problem and quarry workers because exposure to dust particles can have major health implications. The major observed occupational health problems of quarry work from dust point of view include; sneezing, coughing, eye problems, headache, sore throat, short breadth, asthma and so on. Therefore, females were more exposed to air pollutants in quarry activity sites compared to males.

Based on the findings of the study, the following recommendations were necessary such as; the quarry workers should be encouraged to spend fewer hours at the quarry sites and protect themselves on constantly exposed to wind, dust, and varying temperature changes. The quarry workers should be encouraged to comply with personal protective equipment to protect their health. It is necessary to educate quarry workers to change their attitude, practices and behaviour at work to suit good health.

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Conflict of interest

All authors of this article report no conflicts of interest throughout the work.

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