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Assessment of impacts of air pollution on people living in Ezza North close to quarry operation sites in Ebonyi State, Nigeria

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Abstract

Quarrying activities have become lucrative work for low income people in low income countries most found in Africa. This study aimed assess the impacts of air pollution on people living in Ezza North close to quarry operation sites in Ebonyi State, Nigeria. A descriptive cross sectional study was used and pollution level was determined with the use of calibrated Handheld GPS, Amex multiple gas meter, Sound meter and interview of participants with a questionnaire on the health status. The collected data were entered into the Statistical Package for Social Sciences (SPSS) software (version 21). The one sample T-test was used to test the hypotheses at 95% confidence interval and 0.05 level of significance. The results showed that 31–40 years had 19(5.37%) males and 20(5.65%) females as highest quarrying workers. The concentration of carbon monoxide was highest at 193ppm, Sulphur dioxide at 568ppm, nitrogen dioxide at 1.9ppm, Suspended particulate Matter (SPM) at 1982ppm and sound level at 82.9dB. The concentrations of these pollutants were found to be significantly higher ($P<0.05$) than normal levels apart from sound level without significant impact at $P = 0.285$. The 93.3% of the participants reported blasting of rocks produced highest air pollution, 87.5% that reported crushing, conveying, sieving produce a lot of dust. Also, 80% of participants reported high level of noise came from machinery blasting rocks, processing and haulage trucks. In all, 35% reported they had fair health condition when asked about the health status since they started quarrying work. In conclusion, the concentrations of carbon monoxide, carbon dioxide, sulphur dioxide, particulate matter and nitrogen oxides were all higher than normal. It was observed air pollutants had association with respiratory system. Therefore, the air pollution at quarrying site can be mitigated through dust suppression techniques and treating quarry pit with water before discharging.

Keywords: Air pollution; Environmental Pollution**;** Risk Assessment; Noise pollution; Water Pollution

1. Introduction

One important problem of environmental quality, which affects human health and quality of life both directly and indirectly, is the level of air pollution. World Health Organization [1]; Godwin et el., [2] reported that any degradation and alteration of environment enhance ambient conditions and they are essential contributor to poor health, a low standard of living, and sustainable development. According to Abdulkarim [3], air pollution can be defined as the presence of any solid, gaseous, liquid substances, including noise, in the atmosphere in such way its usual/unnatural concentrations could be deleterious to the human health, other living things and climate. Also, Manisalidis et al. [4]

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stated that air pollution is the condition in which substances or the environment are harmed, or when humans and other living things are exposed to compounds known as pollutants in the atmosphere.

WHO [5] estimates, ischemic heart disease and stroke accounted for about 37% of premature deaths linked to outdoor air pollution. From the statistical report of WHO in 2019, 18% of chronic obstructive pulmonary disease 23% of acute lower respiratory infections linked to deaths of human beings respectively, and respiratory tract cancer accounted for 11% of deaths.

The burden of outdoor air pollution is disproportionately felt by people in low- and middle-income nations; 89% of the 4.2 million premature deaths worldwide take place in these regions. The WHO Regions of Western Pacific and South-East Asia have the highest burden. The substantial contribution of air pollution to cardiovascular disease and mortality is reflected in the most recent burden estimates [5].

From the findings of the study done by Brauer et al [6], the association between air pollution and proximity to a highway with pregnancy outcomes in a Vancouver cohort of pregnant woman using addresses to estimate exposure during pregnancy. The study proved that exposure to NO, NO_2, CO, PM_{10} and $PM_{2.5}$ had relationship with infants born at the period of gestational age (SGA). Brauer et al also stated that women living less than 50 meters away from an expressway or highway were 26% more likely to give birth to a SGA infant.

The mixture of gases that make up the atmosphere has been altered and the potential of the atmosphere to restore ambient air equilibrium is largely inhibited, by a variety of human operations that vary from small daily activities to enormous scale commercial/industrial activities that add overbearing air pollutants. Because there are numerous sources of air pollution, the detrimental effects on human health are as complicated, leading to a range of health consequences [7].

Infantes et al. [8], opined that when dust from quarrying operations is uncontrolled and allowed to enter the atmosphere, it can cause a variety of unpleasant environmental problems which may include wear and tear on machines, decreased visibility, an increase in the risk of accidents, and pulmonary damage from breathing in minerals like silica, asbestos, and coal dust.

The process of extracting quarry materials, which are typically rocks, from the ground or beneath it is known as quarrying [2]. Sandstone, limestone, perlite, marble, ironstone, slate, granite, rock salt, and phosphate rock are a few of the stones that are removed. Because the quarrying of stones is motivated by economic concerns, the acceptability of a stone for quarrying depends on its quality, its ability to be quickly and affordably transported to a big market, and its depth and inclination below the surface for easy harvesting.

Removal of overburden, rock material drilling, blasting, and crushing are typical quarrying processes. The final effects of these stages of the quarrying process depend on the locations and sizes of the products. The development of dust, noise production, smoke and fumes, vibration of the ground, and production of toxic gases are common concentrated adverse consequences of quarrying. Of all the pollutants from quarrying operational operations, particulate matters are contributed to the environment through quarrying to a significant extent [9, 10].

Ebonyi is one of the major states in Nigerian that have the highest clusters of quarrying activities. Following the effects of air pollution on general human being and environment. The major interest of people engaged in quarrying activities in Ebonyi State where Ezza North situated is socio-economic benefits. At the same, the operation of quarrying in the state serves as internal generating fund for the local government and state government, means of business profit to private stakeholder, and it provides employment opportunities to the populace [11].

According to Adeyanju and Manohar [12], different air pollutants are associated with health effects and they are stated as follows; nitrogen oxides (NO_X) linked with lung irritation, respiratory illness, premature death, carbon monoxide (CO) associated with headaches and reduces mental alertness, particulate matters and sulphur dioxide related with increase in existing heart disease, breathing difficulties and respiratory illness

The large operation of quarrying in Ebonyi state is not far from the myopic thinking the people have about it as a source of revenue without considering the health impacts of the operation. Therefore, this study aimed to assess the impacts of air pollution on people living in Ezza North close to quarry operation sites in Ebonyi State, Nigeria.

2. Materials and Methods

This research was a cross sectional study of Ezza North in Ebonyi State, Nigeria. The study deals with measurement of outdoor gaseous pollutants, interview of participants with a questionnaire on the health status of participants. The study was conducted in Ezza North Local Government Area, located at North part of Ebonyi State. Its headquarters is at Ebiaji town and it has an area of 305 km^2 and a population of 145,619 at the 2006 census. It is a predominant Igbo town inhabited by the Ezza and the Orring people of Idzem (Amuda) and Okpolo (Okpomoro) extraction. It is situated between Latitude of 6°18' 40" N and longitude of 8°1' 8"E of the Equator.

All workers and residents both males and females from the ages of 10 years and above who work at the quarry site or live within the quarry community in Ebonyi state, Nigeria was part of the study. People who did not give an informed consent to be part of the study.

The multistage sample technique was adopted starting with large cluster samples at the first stage which comprised the eleven (11) communities in Ezza North in Ebonyi State and six (6) communities were selected where the three quarry sites were located for this study.

In the second stage, the relevant resources that included human and instruments were deployed in the collection of the data during the research. The human resource actually deployed for the research was a team of health professionals made up of four (4) environmental health officers, one (1) environmental instrumentation specialist, and one (1) secretarial support person, while, Handheld GPS, Amex multiple gas meter, Sound meter were the instruments/tools used. The environmental health officers called the attention of quarry workers and residents of surrounding quarrying communities in groups and seek for their consent and health effects of the air pollution were discussed with them on approval. The environmental instrumentation specialist evaluated the handheld GPS, multiple gas meter and sound meter for proper functioning before data collection at different sites. The air quality status of the quarries and surrounding communities were assessed by evaluating the respective levels of carbon monoxide (CO), Sulphur IV oxide (SO_2), Particulate matter(PM), sound, Nitrogen IV Oxide(NO_2) and air environmental radiation levels. The respective readings were taken with relevant gadgets, at predetermined spatial distance between measurement points and at GPS locations points.

The collected data were entered into the Statistical Package for Social Sciences (SPSS) software (version 21). The one sample T-test was used to test the hypotheses at 95% confidence interval and 0.05 level of significance.

An ethical approval was obtained from the ethical committee of the Ebonyi State Ministry of Health, Abakaliki. Also, informed consent was gotten from all the owner and workers of the quarrying sites at Ezza North in Ebonyi State. Those who participated in the study was obtained via completion of a prototype consent on the secretarial desk.

3. Results

Table 1 presented the distribution of respondents by age and sex; 11 – 20 years had 1(0.28%) males and 2(0.56%) females; for 21 – 30 years, 7(1.98%) males and 11(3.11%) females; 31–40 years had 19(5.37%) males and 20(5.65%) females; 41-50 years had 14(3.95%) males and 22(6.21%) females; above 50 years recorded 11(3.11%) for males and 13(3.68%) for females.

Table 1 Age and gender distribution of People of Ezza North

Age group	Males		Females	
	N	%	N	%
11 – 20 years	1	0.28	2	0.56
21 – 30 years	7	1.98	11	3.11
31 – 40 years	19	5.37	20	5.65
41 – 50 years	14	3.95	22	6.21
Above 50 years	11	3.11	13	3.68
Total	52	14.69	68	19.21

The table 2 below showed that the CO level in ppm which stands for part per million of air was 184 at GPS location 6°18.467'N and 8°2.088'E. The value of 180ppm was recorded at 6°18.542'N and 8°2.134'E. The value of 182 ppm was seen at 6°18.502'N and 8°2.110'E. The value of 181ppm was recorded at 6°18.538'N and 8°2.334'E. The 195ppm was recorded at 6°18.365'N and 8°2.104'E and 193ppm recorded at 6°18.485'N and 8°2.156'E. The CO levels was significantly higher ($P<0.05$) than normal levels.

The sulphur dioxide **(**SO_2) level in ppm was 465 at GPS location 6°18.467'N and 8°2.088'E. The sulphur dioxide of 562 ppm was recorded at 6°18.542'N and 8°2.134'E. The sulphur dioxide of 442 ppm was gotten at 6°18.502'N and 8°2.110'E. The sulphur dioxide of 484 ppm was recorded at 6°18.538'N and 8°2.334'E. The sulphur dioxide of 568ppm was seen at 6°18.365'N and 8°2.104'E and the sulphur dioxide of 552ppm was recorded at 6°18.485'N and 8°2.156'E. The SO_2 levels was significantly higher ($P<0.05$) than normal levels.

The nitrogen dioxide (NO_2) level in ppm was 1.7 at GPS location of 6°18.467'N and 8°2.088'E; 1.5ppm at location of 6°18.542'N and 8°2.134'E; 1.2 ppm at location of 6°18.502'N and 8°2.110'E; 1.4ppm at location of 6°18.538'N and 8°2.334'E; 1.9ppm at location of 6°18.365'N and 8°2.104'E and 1.7ppm at 6°18.485'N and 8°2.156'E. The NO_2 levels was significantly higher ($P<0.05$) than normal levels.

Table 2 Distribution of Carbon monoxide (CO), Sulphur dioxide (SO_2) and nitrogen dioxide (NO_2) levels at active quarrying sites in Ezza North

GPS Location North	GPS Location East	CO (ppm)	SO_2 (ppm)	NO_2 (ppm)
6°18.467'	8°2.088'	184	465	1.7
6°18.542'	8°2.134'	180	562	1.5
6°18.502'	8°2.110'	182	442	1.2
6°18.538'	8°2.334'	181	484	1.4
6°18.365'	8°2.104'	195	568	1.9
6°18.485'	8°2.156'	193	552	1.7
P-value		P<0.05	P<0.05	P<0.05

Part per million (ppm)

The table 3 showed that the suspended particulate matter **(**SPM) level in ppm was 1962 at GPS location 6°18.467'N and 8°2.088'E. The suspended particulate matter of 1919ppm was found at 6°18.542'N and 8°2.134'E. The SPM of 1912ppm was located at 6°18.502'N and 8°2.110'E. The SPM of 1951ppm was located at 6°18.538'N and 8°2.334'E. The SPM of 1985ppm was located at 6°18.365'N and 8°2.104'E. The SPM of 1982ppm was found at 6°18.485'N and 8°2.156'E. The SPM levels was significantly higher ($P<0.05$) than normal levels.

Table 3 Distribution of Suspended particulate Matter (SPM), Radiation (mR/hr) and Sound SL (dB), levels at active quarrying sites in Ezza North

GPS Location North	GPS Location East	SPM (ppm)	Radiation (mR/hr)	Sound [SL (dB)]
6°18.467'	8°2.088'	1962	0.012	82.5
6°18.542'	8°2.134'	1919	0.013	82.9
6°18.502'	8°2.110'	1912	0.011	81.7
6°18.538'	8°2.334'	1951	0.012	82.2
6°18.365'	8°2.104'	1985	0.015	82.7
6°18.485'	8°2.156'	1982	0.017	82.5
P-value		P=0.001	P=0.00	P= 0.285

The radiation level in mR/hr at quarrying sites in Ezza North. The result showed that 0.012mR/hr was found at GPS location of 6°18.467'N and 8°2.088'E. ; The 0.013 mR/hr was gotten at 6°18.542'N and 8°2.134'E. The 0.011mR/hr was

found at 6°18.502'N and 8°2.110'E. The 0.012 mR/hr was saw at 6°18.538'N and 8°2.334'E. The 0.015 mR/hr was found at 6°18.365'N and 8°2.104'E. The 0.017 mR/hr was gotten at 6°18.485'N and 8°2.156'E. The radiation levels was significantly higher ($P<0.05$) than normal levels.

The sound level (SL) in decibel (dB) was 82.5 at GPS location 6°18.467'N and 8°2.088'E. The sound level of 82.9 dB at 6°18.542'N and 8°2.134'E; The sound level 81.7 dB at 6°18.502'N and 8°2.110'E. The sound level of 82.2 dB at 6°18.538'N and 8°2.334'E. The sound level of 82.7dB was obtained at 6°18.365'N and 8°2.104'E and 82.5dB at 6°18.485'N and 8°2.156'E. The sound levels was found not significant at $P = 0.285$.

Table 4 depicts the mean values of pollutants at active quarrying sites in Ezza North; Mean and standard deviation are most clearly presented in the table below; the average mean value of Carbon monoxide (CO), Sulphur dioxide (SO_2), Nitrogen dioxide (NO_2), Suspended particulate matter (SPM), Radiation (; RAD), Sound level (SL) was M = 5.793, SD = 15.51).

Table 4 Mean values of pollutants at active quarrying sites in Ezza North

Pollutants						**Mean**	**Standard Deviation**
CO (ppm)	**SO_2(µg/m³)**	**NO_2 (µg/m³)**	**SPM (µg/m³)**	**RAD (mR/hr)**	**SL (dB)**		
184	4.65	0.017	19.62	0.012	82.5	1.858	6.49
180	5.62	0.015	19.19	0.013	82.9	5.123	55.01
182	4.42	0.012	19.12	0.011	81.7	0.0157	0.25
181	4.84	0.014	19.51	0.012	82.2	19.518	30.92
195	5.68	0.019	19.85	0.015	82.7	0.0001	0.002
193	5.52	0.017	19.82	0.017	82.5	8.242	0.42
						5.793	**15.51**

CO: Carbon monoxide; SO_2: Sulfur dioxide; NO_2: Nitrogen dioxide; SPM: Suspended particulate matter; RAD: Radiation; SL: Sound level

Table 5 presented the response of the people on air pollution; 99(82.50%) of the subjects responded “strongly agree” to dust being the main source of dust in the village, 112(93.33%) to the concentration of dust being highest during blasting of rocks, 105(87.50%) to crushing, conveying and sieving producing a lot of dust; 107(87.85%) to transport vehicles on unsurfaced roads generating dust, 105(87.50%) to rain and cold weather reducing dust, 104(86.67%) to sunny weather promoting distance of air movement.

From the table, 109(90.83%) of the subjects responded “Yes” to dust being a nuisance to them, 108(90.00%) to dust affecting their health, 104(86.67%) to water harvested from roof containing dust, 105(87.50%) to frequent ill health may be from dust or noise vibrations and 26(21.67%) reported disease suffered from before quarrying as severe as during quarrying activities.

Table 5 Response of the People in Ezza North on Air Pollution and Health Issues

Information on Air Pollution	**SA (%)**	**A (%)**	**D (%)**	**SD (%)**
Main source of village dust is quarrying	99(82.50)	9(7.50)	6(37.50)	0(0.00)
Concentration is highest during blasting of rocks	112(93.33)	6(5.00)	0(0.00)	0(0.00)
Crushing, conveying, sieving produce a lot of dust	105(87.50)	10(8.33)	0(0.00)	0(0.00)
Transport vehicles on unsurfaced roads generate dust	107(89.17)	11(9.17)	0(0.00)	0(0.00)
Rain and cold weather reduce dust	105(87.50)	12(10.00)	0(0.00)	0(0.00)
Sunny weather promotes distant air movement	104(86.67)	13(10.830	0(0.00)	0(0.00)
Windy weather facilitates dust emission	89(74.17)	21(17.50)	0(0.00)	0(0.00)

Cold and cloudy weather reduce dust	90(75.00)	26(21.67)	0(0.00)	0(0.00)
Dry weather promotes dust emission	68(56.67)	49(40.83)	0(0.00)	0(0.00)
Health Issues				
Information on Health Issues	**Yes (%)**	**No (%)**		
Dust is a nuisance to you	109(90.8%)	7(5.8%)		
Dust affects your health	108(90%)	8(6.7%)		
Water harvested from roof contain dust	104(86.7%)	13(10.8%)		
Your frequent ill health may be from dust or noise vibrations	105(87.5%)	11(9.2%)		
Was disease suffered from before quarrying as severe as during quarrying activities	26(21.7%)	82(68.3%)		

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

4. Discussion

This study discussed the relatively findings and effects of air pollution on people living in Ezza North close to quarry operation sites in Ebonyi State, Nigeria. The findings with regard to age and gender of the respondents, the age and gender distribution in the studied area. The study showed, more females 68(19.21%) than males 52(14.69%) are involved in quarrying activities. Females of age brackets of prime economic & active reproductive age bracket of 31-40year 20(5.65%) and matured socio-economic age group of 41-22(6.21%) are the predominant age group engaged in the quarrying occupation in Ebonyi 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 of the female quarry workers. This has grave reproductive implications considering that $PM_{2.5}$ has been evidentially incriminated in negative pregnancy outcomes [11].

In Ezza North Local Government Area, women were predominantly more than female at quarrying sites, they moved stones to various locations while 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. 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. Exposure to these gases can have major health implications.

Measurements of gaseous levels were taken at quarrying sites within the communities. Carbon monoxide levels were found to be significantly higher ($P<0.05$) than normal levels at the active sites. The implication of this is that continuous inhalation and exposure of carbon monoxide gas to the quarry workers and community members could result to adverse health effects [13]. Hemoglobin in the blood has a higher affinity for carbon monoxide than oxygen and it combines with carbon monoxide to form carboxy-hemoglobin. Mild acute CO poisoning can cause light-headedness, confusion, headaches, vertigo, and flu-like effects [14, 15]. Larger exposures can lead to significant toxicity of the central nervous system and heart, and death. Following acute poisoning, long-term sequelae often occur. Carbon monoxide can also have severe effects on the fetus of a pregnant woman. Chronic exposure to low levels of carbon monoxide can lead to depression, confusion, and memory loss [16, 17].

Inhaling CO gas can lead to hypoxic injury, nervous system damage, and even death. Different people and populations may have different carbon monoxide tolerance levels. According to Prockop and Chichkova [18], human exposure to CO on average of 100 ppm or greater is dangerous to human health because it can easily reduce life span due to heart damage. Lipman [19] opined that any person has CO tolerance level and it usually altered by different factors such as personal level of activities, rate of ventilation, existence of cardiovascular disease, and many other health challenges.

Sulfur dioxide (SO_2) was another gas emitted at the quarry sites and it was found to be significantly higher ($P<0.05$) than normal levels. Since SO_2 is highly soluble in water, once it is inhaled, the SO_2 will be absorbed by themucous membranes of the upper airways with little reaching the lung. Individual exercise and good provision for ventilation can help the dose to reach the lung. According to Xuan et al. [20], exposure to Sulphur dioxide has been associated with

reduced lung function, bronchoconstriction (increased airway resistance), respiratory symptoms, cardiovascular and respiratory causes, eye irritation, adverse pregnancy outcomes, and mortality [21].

Thacher, et al [21] suggest that any short exposures or up to 100 ppm may be considered dangerous to life and health of the people. The workers of quarrying sites were exposed to other chemicals used at the site for other purposes, making it difficult to associate their health effects to sulfur dioxide (SO_2) exposure alone. In long-term exposure, Desalu [22] stated that small people of children age have shown possible associations between sulfur dioxide pollution and respiratory symptoms or reduced breathing ability.

The findings of the study showed that the level of suspended particulate matter at the quarrying communities was found to be higher than normal levels. Inhalation of these particles can produce mucous in the lungs to attract trap tiny particles and they equally moved out of the lung through coughing or swallowing. 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. A study conducted by Pope [23] indicated that $PM_{2.5}$ leads to high plaque deposits in arteries, causing vascular inflammation and atherosclerosis which can lead to heart attacks and other cardiovascular problems. Also, World Health Organization [24], reported that fine particulate air pollution ($PM_{2.5}$), causes about 3% of mortality from cardiopulmonary disease, about 5% of mortality from cancer of the trachea, bronchus, and lung, and about 1% of mortality from acute respiratory infections in children under 5 years. The WHO report was supported by Cohen et al [25]

Concerning the sound level produced from the use of heavy machinery while crushing the rocks at the quarrying sites. It was very high and capable of health effects such as hearing impairment, hypertension, ischemic heart disease, annoyance, and sleep disturbance which was supported by Awosusi and Akinduitire [26] in work done in Ekiti State, Nigeria where 29.7% of residents complained that noise pollution affected their hearing. Ede et al [27] reported that high level of noise is sufficient to impair the hearing of people who are exposed to the source in given population. Kryter [28] further stated that noise exposure can induce tinnitus, hypertension, vasoconstriction, and other cardiovascular adverse effects. Despite the health effects, increases in noise levels can create stress, increase workplace accident rates, and stimulate aggression and other anti-social behaviors [27, 28].

The pollutant of nitrogen dioxide (NO_2) can poisonous once it inhaled beyond the threshold limit value by human being. This study proved that concentration of NO_2 was found to be higher the normal level. Nitrogen dioxide gas poisoning causes severe damage to the pulmonary artery and respiratory tract [29]. Levy [30] opined that individual exposure to high level of nitrogen dioxide may lead to inflammation of the mucous membrane and the lower and upper respiratory tracts. The nitrogen dioxide poisoning can present the following symptoms; rhinitis wheezing or coughing, conjunctivitis, headache, throat irritation and dyspnea which may progress to nasal fissures, ulcerations, or perforation [30].

Study's Limitation

Lack of available records of the actual figure of people engaged as quarry workers since such anybody can go and work for money making purpose in Ezza North, Ebonyi State.

Limited participants' participations in the study leading to short fall on the number of the targeted population of the study.

Lack of fund to extend the study to other states beyond Ebonyi and workers were not trained for the quarrying work. Also, time availability was another challenge faced by the researchers.

5. Conclusion

Based on the outcome of the study, it was observed that all types of air pollutants had association with respiratory system. It was not far from time spent and the exposure of workers wind, dust, debris and varying temperature changes. The high concentrations of carbon monoxide, carbon dioxide, particular matters and nitrogen oxides were linked to symptoms such as nose and throat irritation, cough, chest discomfort due to narrowing of air airways, increased mucous production on the walls of upper airways. It is commonly noted that people with respiratory ailments are more sensitive to air pollution exposure.

Recommendations

The following recommendations were made;

- The air pollution at quarrying site can be mitigated through dust suppression techniques and treating quarry pit with water before discharging.
- It is important to give air pollution at the quarrying site prompt attention in order to prevent severe environmental hazards because nobody decides the type of air to breath.
- They should be an installation of air pollution control equipment at quarry sites in order to reduce gaseous (pollutant) emissions.
- The activities of quarrying workers should be monitored to determine the seasonal effects.

Compliance with ethical standards

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Disclosure of conflict of interest

There is completely no conflict of interest between the authors, workers and people around the operating sites but the interest of this study is for the advancement of knowledge. Authors have declared that no competing interests exist.

Statement of ethical approval

This study did not engage in collection of human fluid sample and ethical approval was got from College of Medicine and Health Sciences Human Research Ethics Committee, Abia State University, Uturu, Nigeria.

Statement of informed consent

Participants were informed with consent letter and purpose of the research was understood by them before taking part in the study.

Disclaimer

There is completely no conflict of interest between the authors, workers and people around the operating sites but the interest of this study is for the advancement of knowledge. Also, the research was not funded by the producing body or company rather than personal efforts of the authors.

Author Contributions

- **Nwazunku A. Alugbala:** Conceptualization, Funding acquisition, Resources, Supervision,
- **Ede A. Okorie[1]:** Writing–original draft, Data curation, Writing–review and editing, Supervision.
- **Kalu O. Obasi, Ihekwoaba E. Nwaoma and Mbaegbu O. Nnamdi:** Resources, Conceptualization.
- **Eze E.Goodness and Ingwu J. Akem:** Conceptualization, Writing–review and editing.

Data Availability

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

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