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Assessment of Blood Pressure and Forced Vital Capacity of Workers at Quarry Sites in Ivo, Ebonyi State, Nigeria

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ABSTRACT

Quarry workers are exposed to dust and gases that can cause respiratory and cardiovascular problems. This study was a clinical study carried out at Ivo, Ebonyi State, Nigeria to assess the blood pressure and forced vital capacity of workers at quarry sites. An electronic sphygmomanometer and a spirometer were used to measure the blood pressure and forced vital capacity respectively. Data was uploaded into the Statistical Package for Social Sciences (SPSS) version 21, and descriptive statistics was used for analysis of data. A total of 123 workers participated in this study. Results showed that 3 (2.44%) subjects had a systolic pressure between 81 – 100 mmHg; for systolic pressure of 101 – 120, 39 (31.71%); for 121 – 140, 63 (51.21%); 9 (7.32%) subjects had a systolic pressure of 141 -160 and 161 – 180. Six (4.88%) subjects had a diastolic pressure between 41 – 60 mmHg; for a diastolic pressure of 61 – 80, 84 (68.29%); for 81 – 100, 30 (24.39%); for 101-120, 3 (2.43%). The mean systolic blood pressure value was 107 ± 15.02 mmHg. The mean diastolic blood pressure value was 76.22±10.79. Twenty-one (17.07%) subjects had a Forced Vital Capacity between 1001 – 2000 ml; for a forced vital capacity of 2001 – 3000 ml, 69 (56.10%); for 3001 – 4000, 30 (24.39%); for 4001-5000, 3 (2.44%). The mean forced vital capacity of the workers was 1167 ± 726.93. Some of the workers were found to have a high blood pressure and forced vital capacity. Workers at quarry sites were advised to always wear their nose and face masks to prevent inhalation of air pollutants resulting from quarry activities.

Keywords: Quarry, Blood Pressure, Forced Vital Capacity, Systolic, Diastolic

INTRODUCTION

A quarry is a large deposit of rock such as granite which is mined for use in construction projects. Quarries are established when large deposits of commercially useful minerals or rock are found near the Earth's surface. [1] Quarrying is the surface exploitation and removal of stones or mineral deposits from the earth’s crust. It is the process of extracting stone for commercial use from natural rock deposits. Quarrying is a form of mining and is also known as open pit mining or strip mining. The industry has two major branches which are dimension stone and crushed stone. [2] The dimension-stone branch, involves extraction of large chunks of rocks of various sizes and shapes for use as building stone, monumental stone, paving stone, curbing, counters, roofs, flagstones and other projects which require large slabs of uniform stone. The crushed-stone branch, involves preparation of crushed and broken stone (gravel and particulate matter) for use as a basic construction, chemical, paint and metallurgical raw material. [2] Two of the oldest methods of quarrying are channel cutting, and drilling and broaching. A channeling machine cuts a channel in the rock using multiple chisel-edged cutting bars that cut with a chopping action. In drilling and broaching, a drilling tool first drills numerous holes in an aligned pattern. The broaching tool then chisels and chops the web between the drill holes, freeing the block. Both channel cutting, and drilling and broaching are slow and the cutting tool requires frequent sharpening. Channeling and wedging is a process of quarrying in which channeling machines are used in cutting long, narrow channels in the rock which is deep enough for the insertion of wedges. The rock is then split through the fracture. [3] The channeling and wedging process of quarrying is extensively used in quarrying marble, sandstone, limestone and other softer rocks but is not successful for granite and other hard rocks. Another method of cutting is by the combination of a power saw, an abrasive, and water as a lubricant and a coolant. The saw cuts a narrow channel; the primary or initial cut is then either expanded by a wedge or is blasted. This method is used in slate, granite, and limestone quarries. Line drilling and sawing are more modern techniques for quarrying. Line drilling (also called slot drilling) consists of drilling a series of overlapping holes using a drill that is mounted on a quarry bar or frame that aligns the holes and holds the drill in position. [4] Some of the environmental disturbances created by quarrying are caused directly by engineering activities during aggregate extraction and processing. Air pollution resulting from the activities of mining and mining support companies emanates from high airborne particulate matter, black smoke, noise and vibration resulting from blasting. [5] Large quarry waste tips or quarry fines stockpiles can be a source of airborne dust which can be exacerbated if they are elevated above the original ground level. Dust may also originate from air filtration units or stacks, haulage trucks, conveyors and transfer points. [6]

Quarrying generates a lot of particulate matter (dust) with diameter 1 - 75µm (micron). Particles with aerodynamic diameters less than 50 µm termed Total Suspended Particulate (TSP) matter can become suspended in the atmosphere, and those with aerodynamic diameters less than 10µm termed PM_{10}(inhalable particles) can be transported over long distances and enter the human respiratory system. [7] TSP is the concentration of all particles in the atmosphere. Particles with aerodynamic diameters less than 2.5 µm (respirable particles) are most effective at scattering light and have a great effect on visibility or visual intrusion, impairment and the earth's radiation balance. [8] $PM_4$and $PM_{2.5}$of inhaled penetrate deeply into the lungs and are capable of making their way to the air sacs deep within the lungs where they may be deposited and cause respiratory problems. [9] Air pollution also causes damage to man-made materials and structures, changes the weather and interferes with comfortable enjoyment of life, property or human activities. Air pollutants such as dust are unhealthy particles (solids, liquid gas mixtures) that are liable to harm both living and non-living things. [8] The main source of airborne particulate matter include the following activities: site clearing, road construction, top soil stripping and dumping, open pit drilling and blasting, stripping, loading and haulage. When air quality is monitored, the most common measure of the concentration of suspended particles is the PM index which is the amount of particulate matter that is present in a given volume of air. [5]

Blood pressure (BP) is the pressure of circulating blood on the walls of blood vessels. Most of this pressure is due to work done by the heart by pumping blood through the circulatory system. [1] Blood pressure is usually expressed in terms of the systolic pressure over diastolic pressure and is measured in millimeters of mercury (mmHg), above the surrounding atmospheric pressure. Normal resting blood pressure, in an adult is approximately 120 millimeters of mercury systolic, and 80 millimeters of mercury diastolic, abbreviated 120/80 mmHg. [5] Forced vital capacity (FVC) is the maximum amount of air a person can expel from the lungs after a maximum inhalation. [1] A person's vital capacity can be measured by a wet or regular spirometer. In combination with other physiological measurements, the vital capacity can help make a diagnosis of underlying lung disease. This study assessed the blood pressure and forced vital capacity values of workers at quarry sites in Ivo, a community located in Ebonyi State, Southeast Nigeria.

MATERIALS AND METHODS

This study was carried out at quarry sites at Ivo, Ebonyi state, Nigeria. It was a clinical study which involved measurement of blood pressure and forced vital capacity. The simple random sampling technique was used to select workers at the quarry sites to be part of the study. All the workers selected gave an informed consent to be part of the study. Measurement of blood pressure was taken with an electronic sphygmomanometer while the forced vital capacity was measured with a spirometer. Data was uploaded into the Statistical Package for Social Sciences (SPSS) version 21, and descriptive statistics was used for analysis of data.

RESULTS

A total of 123 workers participated in this study. Table 1 showed that 3 (2.44%) subjects had a systolic pressure between 81 – 100 mmHg; for systolic pressure of 101 – 120, 39 (31.71%); for 121 – 140, 63 (51.21%); 9 (7.32%) subjects had a systolic pressure of 141 -160 and 161 – 180. Table 2 showed that 6 (4.88%) subjects had a diastolic pressure between 41 – 60 mmHg; for a diastolic pressure of 61 – 80, 84 (68.29%); for 81 – 100, 30 (24.39%); for 101-120, 3 (2.43%). Descriptive statistics of the blood pressure values was shown in table 3.The minimum systolic blood pressure value was 107; maximum value was 171; mean value was 129.39; standard deviation was 15.02. The minimum diastolic blood pressure value was 55; maximum value was 112; mean value was 76.22; standard deviation was 10.79. Table 4 showed that 21 (17.07%) subjects had a Forced Vital Capacity between 1001 – 2000 ml; for a forced vital capacity of 2001 – 3000 ml, 69 (56.10%); for3001 – 4000, 30 (24.39%); for 4001-5000, 3 (2.44%). Table 5 showed the descriptive statistics of the forced vital capacity. The table showed that the minimum value was 1167; maximum value was 4418; mean value was 2502.44; standard deviation was 726.93.

Table 1: Systolic blood pressure of workers

Systolic Pressure (mmHg)	n	%
81 – 100	3	2.44
101 – 120	39	31.71
121 – 140	63	51.21
141 – 160	9	7.32
161 – 180	9	7.32
Total	123	100.00

Table 2: Diastolic blood pressure values of workers

Diastolic Pressure (mmHg)	n	%
41 – 60	6	4.88
61 – 80	84	68.29
81 – 100	30	24.39
101 – 120	3	2.43
Total	123	100.00

Table 3: Descriptive statistics of systolic blood pressure values

Blood Pressure	n	Min.	Max.	Mean	S.D
Systolic	123	107	171	129.39	15.02
Diastolic	123	55	112	76.22	10.79

n- Number; Min- Minimum value; Max- Maximum value; S.D - Standard Deviation

Table 4: Forced Vital Capacity of workers

FVC (ml)	n	%
1001 – 2000	21	17.07
2001 – 3000	69	56.10
3001 – 4000	30	24.39
4001 – 5000	3	2.44
Total	123	100.00

Table 5: Descriptive statistics of Forced Vital Capacity values of workers

n	Min.	Max.	Mean	S.D
123	1167	4418	2502.44	726.93

n- Number; Min- Minimum value; Max- Maximum value; S.D - Standard Deviation

DISCUSSION

Prolonged exposure to low concentration of the gases and dust from quarry activities may have lethal effects, as can short-term exposure to high concentrations. [4] Pollutants at quarry sites such as particulate matter, carbon monoxide and nitrogen dioxide are capable of causing severe health hazards such as coronary artery disease as well as stroke. It can aggravate the condition of people with high blood pressure and those at risk of the disease. Nitrogen dioxide gas poisoning causes severe damage to the pulmonary artery and respiratory tract. It is easily absorbed through the lungs and its inhalation result in heart failure and sometimes death in severe and fatal cases. [10] Individuals and races may differ in Nitrogen dioxide tolerance level and individual tolerance level for the gas may be altered by several factors, such as metabolic rate, barometric pressure and hematological disorders but significant exposure may result in fatal conditions that could lead to shorter life span due to heart failure. Exposure to high level of nitrogen dioxide may lead to inflammation of the mucous membrane and the lower and upper respiratory tracts. [11] The symptoms of acute nitrogen dioxide poisoning resembles that of pneumonia or viral infection and other inhalational injuries but common symptoms includes rhinitis wheezing or coughing, conjunctivitis, headache, throat irritation and dyspnea which may progress to nasal fissures, ulcerations, or perforation. The patient is usually ill-appearing, and presents with hypoxemia coupled with shallow rapid breathing. Systemic symptoms include fever and anorexia. Electrocardiography and Chest radiography can help in revealing diffuse, bilateral alveolar infiltrates. [12] The Chest radiography may be used in diagnosis and the baseline could be established with a pulmonary function testing. There is no specific laboratory diagnostic test for acute nitrogen dioxide poisoning but analysis of arterial blood gas level, methemoglobin level, complete blood count, glucose test, lactate threshold measurement and peripheral blood smear may be helpful in the diagnosis of nitrogen dioxide poisoning. [11]

Spirometry measures the forced vital capacity (FVC), which is the greatest volume of air that can be breathed out in a single large breath. In our study, values were low for some subjects and this could be an indicator for respiratory problems. [9] Subjects interviewed in this study complained of asthma, sneezing, and cough. Most of the workers and community members have never checked their forced vital capacity in a clinic before and therefore are not aware of the gradual reduction in normal level over the years of which they are exposed to dust and other gases in the atmosphere. As they breathe in this polluted air, particulate matter blocks the air spaces in their lungs and respiratory problems gradually develop. Ekpenyong, et al. [13] carried out a study to assess the respiratory health effect of city ambient air pollutants on transit and non-transit workers and reported respiratory function impairment due to their forced vital capacity levels. It is reasonable to perform spirometry every one or two years to follow how well a person's asthma is controlled. The blood pressure of many of the workers was also found to be higher than normal. Most of these people complained of respiratory and cardiovascular problems. Similar studies [14-17] have also reported pulmonary and cardiovascular problems among residents and workers at quarry communities.

In conclusion, while the blood pressure and forced vital capacity of many of the workers at quarry sites were found to be within normal range, a good number of them had higher than normal blood pressure and forced vital capacity levels. It was recommended that workers at quarry sites should always wear their nose and face masks to prevent inhalation of air pollutants resulting from quarry activities.

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