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Original Research Article

Enzymatic Activities of Glucose 6 Phosphate Dehydrogenase and Some Liver Enzymes among Quarry Workers in Umuoghara, Ebonyi State- Nigeria

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ABSTRACT

Background: Respiratory hazard among quarry workers have been over-emphasized over the years, there is need to study the possible adverse effects of this quarry exposure on the cells, tissues, organs and even the entire system of the body.
Objectives: Enzymatic activities of glucose 6 phosphate dehydrogenase (G6PD), Aspartate transaminase (AST), Alanine transaminase (ALT) and Alkaline phosphatase (ALP) among quarry workers in Umuoghara, Ebonyi State-Nigeria.
Methods: About fifty (50) quarry workers (29 female and 21 male) of mean age 32.80 ± 9.36 were seen at Umuoghara quarry site for the study. Thirty five students (20 female and 15 male) of Medical Laboratory Science Department, Ebonyi State University-Abakaliki were recruited as controls. About 5 ml blood samples was collected from each subject unto heparin container for the analysis of glucose 6 phosphate dehydrogenase (G6PD), Aspartate transaminase (AST), Alanine transaminase (ALT) and Alkaline phosphatase (ALP) respectively by spectrophotometric method of Randox.. All statistics were done using IBM-SPSS statistical software (version 20.0).
Results: Test subjects showed mean ± sd of G6PD, AST,ALT and ALP as follows; 4.61 ± 2.36, 14.12 ± 4.12, 5.66 ± 2.14 and 241.44 ± 132.70 while the control subjects had 11.24 ± 1.34, 11.10 ± 4.01, 6.18 ± 2.49 and 138.68 ± 62.31. Test subjects showed significantly lower ($p < 0.001$) G6PD activity and significantly higher ($p < 0.001$) levels of ALP and AST when compared with their control. There was significant and positive correlation between duration of exposure to quarry dust and AST and ALP. Conclusion: Quarry workers showed significantly lower levels of G6PD activity, and significantly higher levels AST and ALP levels than the control group. AST and ALP increased with duration of exposure to quarry dust.

Key words: Quarry, Glucose 6 Phosphate Dehydrogenase, Liver enzyme, Umuoghara, Ebonyi State.

INTRODUCTION

A quarry is a place from which dimension stone, rock, construction aggregate, riprap, sand, gravel, or slate has been excavated from the ground. Long exposure of quarry workers to these dusts via inhalation, skin contact, ingestion and infection has adverse effect on their health.

Many hazard s are reported to occur in quarrying and mining ranging from air borne to physical hazards. The air borne hazard include particulate matters, chemical vapour ,naturally occurring gases, engine exhaust while physical hazards include noise, physical injury, segmental vibration, heat, changes in barometric pressure and ionizing radiation. Among some groups of miners who live and work together in isolated locations, there is also risk of transmitting some infectious diseases such as tuberculosis, hepatitis (B and E), and the human-immunodeficiency virus (HIV) [1-5] Quarry workers are exposed to respirable particles formed whenever silica-bearing rock is drilled, blasted, cut, crushed or otherwise pulverized into fine particles. These respirable particles also settle in the water and some other consumables at the quarry site. Ingestion of these chemicals can harm the cells, tissues, organ and system of the body. They are also exposed to lubricating oil and grease, fuel and toxic chemicals from the quarry machines and equipment; explosion or fire; Fumes from vehicle exhausts and welding operations, from volatile liquids such as cleaning fluids, thinners, paints; highly corrosive fluids such as battery acids and a lot more. [5]

Much exposure to silica causes silicosis, a typical pneumoconiosis that develops after years of exposure. [6] Other occupational hazards associated to quarrying exposure include; an increased risk of respiratory impairment, chronic bronchitis, emphysema [3,4] tuberculosis, lung cancer and of some autoimmune diseases, scleroderma, systemic lupus erythematosus and rheumatoid arthritis. [1,2] Pollution of water and air around quarry site has can be harmful to both human and animals who consume/inhale the polluted water and air. [5,7,8] Throughout the history of coal mining, fires and explosions have been the principal cause of death of thousands of miners. [5]

Occupational hazards have been recorded in most quarry sites in Nigeria. Occupational hazards recorded among quarry workers in Zaria, were respiratory (64.9%), cuts from the stones (68.9%), eye irritations (14.9%), and skin irritations (10.8%). [9] Quarry workers in Sabon-Gari Local Government Area, Kaduna had mainly hand injury, leg injury, eye injury and facial injury. [10] In Umuoghara Ebonyi state, Nwibo et al [4] concluded in his work that Chronic exposure to dust due to stone quarrying may increase the risk of re-spiratory problems and impaired lung function; cigarette smokers are at higher risk. Common health problems diagnosed among quarry workers in Abeokuta, Ogun State were nasal infection (29.3%), cough (26.0%), followed by catarrh (20.0%), and sinusitis (15.0%) while silicosis recorded the least number of cases. There were similarities in the health problems suffered by the residents living near quarry sites and quarry workers in the study area. [11] Among an unselected group of 126 quarry sites in Kano State Nigeria, radioactive evidence showed traces of silicosis in the quarry workers. [11]

Respiratory hazard among quarry workers have been over-emphasized over the years, there is paucity of information on the possible adverse effects this quarry exposure could cause to the cells, tissues, organs and the entire system of the body now and in the future. There is need to study the possible hazards of quarrying to the cells and organs of the body since these workers are exposed to polluted water and air by

quarry dust. In this work, we therefore assessed the liver function of quarry workers by assessing plasma levels of Aspartate transaminase, Alanine transaminase and Alkaline phosphatase as an indicator. We also assessed the activities of Glucose 6 phosphate dehydrogenase a red cell enzyme; and correlated the parameters with the duration of exposure to quarry dust.

METHODOLOGY

Subjects: About fifty (50) quarry workers (29 female and 21 male) of mean age 32.80 ± 9.36 were seen at Umuoghara quarry site for the study. The consent of the workers was sought by explaining the reasons for the study and educating them on the benefits of the research to them and the society at large. Withdrawal at any time was allowed. Thirty five students (20 female and 15 male) of Medical Laboratory Science, Ebonyi State University-Abakaliki were recruited as controls. The students have the knowledge of the study and they participated willingly. Ethical issues were referred accordingly.

Sample collection and analysis: About 5 ml blood sample was collected from each subject unto a heparin container for the analysis of glucose 6 phosphate dehydrogenase (G6PD), Aspartate transaminase (AST), Alanine transaminase (ALT) and Alkaline phospahatase(ALP) respectively. G6PD enzyme activity was determined using spectrophotometric method of Horecker and Komberg, (Randox Laboratories Ltd United Kingdom). Normal range of G6PD activity in erythrocyte as prescribed by Randox G6PD Kit (2010) is 6.97- 20.5 U/gHb (37^oC). Quantitative in-vitro determination of AST, ALT and ALP in plasma was done using Randox colorimetric method. Normal values of the liver enzymes are; AST $\leq$ 12U/l, ALT $\leq$ 12U/l while ALP is 98-279 U/l.

Data analysis: Descriptive data was expressed as mean ± standard deviation. Comparative analysis involving two variables was performed using independent sample t-test while those involving more than two variables were done using one-way ANOVA. Correlation analyses between variables were determined using Pearson's bivariate correlation test. Statistical significance was set at $P<0.05$. All statistics were done using IBM-SPSS statistical software (version 20.0).

RESULTS

Table 1. Demographic and baseline characteristics of control and test subjects

VARIABLES	CONTROL (N = 35)	QUARRY WORKERS (N = 50)	P-VALUE
Age (yrs)	27.30 ± 2.83	32.80 ± 9.36	0.014*
Height (meters)	1.67 ± 0.06	1.58 ± 0.31	0.190
Weight (kg)	60.50 ± 5.41	56.33 ± 12.62	0.171
Body Mass Index (kg/m2)	20.59 ± 4.48	21.09 ± 3.74	0.666
Systolic Blood Pressure (mmHg)	126.85 ± 11.54	120.60 ± 6.30	0.017*
Diastolic Blood Pressure (mmHg)	82.10 ± 3.87	75.76 ± 4.53	0.000*
Duration of exposure to Quarry Dust (yrs)	-	3.46 ± 3.40	-

Data is mean ± standard deviation. *Significant difference between control and test subjects.

Table 2: The mean ± SD levels of G6PD, ALT, AST and ALP in quarry workers and their unexposed control

VARIABLES	CONTROL (N = 35)	QUARRY WORKERS (N = 50)	P-VALUES
G6PD (µ/g)	11.24 ± 1.34	4.61 ± 2.36	0.000*
AST (IU/L)	11.10 ± 4.01	14.12 ± 4.12	0.000*
ALT (IU/L)	6.18 ± 2.49	5.66 ± 2.14	0.265
ALP (IU/L)	138.68 ± 62.31	241.44 ± 132.70	0.000*

Data is mean ± standard deviation. *Significant difference between control and test subjects.

Table 1 shows the mean age, weight, height, body mass index (BMI), systolic blood pressure (SBP), diastolic blood pressure (DBP), and duration of exposure to quarry dust in both control and test subjects. Independent sample t-test indicated significant differences in age, SBP and DBP of subjects respectively. Data indicated that the control subjects had significantly higher age, SBP and DBP compared to the test subjects. In contrast, no significant differences were observed in weight, height and BMI between the two groups. The mean duration of exposure to quarry dust in the test subjects was 3.46 ± 3.40 years.

Table 2 shows that the mean G6PD, AST, ALT and ALP levels in the test subjects (quarry workers) were 4.61 ± 2.36, 14.12 ± 4.12, 5.66 ± 2.14 and 241.44 ± 132.70 while the control subjects had 11.24 ± 1.34, 11.10 ± 4.01, 6.18 ± 2.49 and 138.68 ± 62.31 respectively. Independent sample t-test indicated that the quarry workers had significantly lower ($p < 0.001$) mean G6PD level compared to the control subjects while AST and ALP levels were significantly higher ($P<0.001$) in test subjects when compared to the control groups. No significant difference was observed in ALT.

Table 3. Relationships between duration of exposure to quarry dust and biochemical parameters of test subjects (n=50).

DURATION OF EXPOSURE Vs.	CORRELATION COEFFICIENT (R)	P-VALUE
ALT	0.253	0.076
AST	0.368	0.008*
ALP	0.329	0.020*
G6PD	0.187	0.322

*Significant correlation.

Pearson's linear regression test indicated significant and positive correlations between duration of exposure to quarry dust and AST and ALP. These results suggest that ASP and ALP increased or decreased with an increase or decrease in duration of exposure to quarry dust. In contrast, no significant relationships were found between duration of exposure and ALT and G6PD.

DISCUSSION

Our finding showed that quarry workers had significantly low concentration G6PD while the control had G6PD concentration within the normal range. A healthy red cell should have sufficient G6PD in other to protect the red cell from lysis caused by oxidative stress. Cells that lack G6PD otherwise known as G6PD deficiency are subject to lysis. The glucose VI phosphate dehydrogenase is an enzyme that protects the red cells from oxidative injury caused by oxidants and drugs. [13] Therefore, decreased concentration of G6PD activity found among the quarry workers is unhealthy and shows a possible indication that exposure to quarry dust reduces this enzyme which can result to heamolysis of the red cell when exposed to oxidants. No scientific literature has been shown to link quarry exposure to G6PD and this call for more research in this area.

Enzymes are protein with catalytic and specific functions on the cells, tissues and organs where they are found. These enzymes are released by the damaged or injured liver into the blood there by increasing their concentration in the bloodstream. Their increase in the blood is an indication of diseased organ. [14,15] Liver enzymes (AST, ALT, ALP) are necessary for screening liver abnormalities. These enzymes are used in liver function test and thus show rough indices of hepatic structure, cellular integrity and function. Liver damage releases ALT, AST and to a lesser extent ALP into the bloodstream. ALT is found primarily in the liver; AST is also found in skeletal muscles and erythrocytes. Therefore, elevations in ALT levels generally are more specific for hepatic injury. [14,15] Alkaline phosphatase is present in all tissues throughout the entire

body, but is particularly concentrated in liver, bile duct, kidney, bone, and the placenta. ALP is elevated in liver disease and hepatitis, hepatobiliary disease. [17]

In this study, it was observed that ALT and ALP levels in both quarry workers and control subjects were within the normal range while AST was slightly higher than the normal range in quarry worker but not in the control subjects. It is worthy to note that Nwibo et al [4] in their work observed that 3.7% of the quarry worker had hepatomegally. This shows the possibility of the quarry dust affecting the liver. It was reported that driver at zeberced quarry located off Arab road, kubwa, in 2011 suddenly developed severe stomach ache and was rushed to the hospital but he died before getting to the hospital. [17] No diagnosis was done on him since he could not make it to hospital. This showed that the driver could have died as a result of other systemic and/organ hazard associated with quarrying other than respiratory problem.

Correlation using Pearson's linear regression test indicated significant and positive correlations between duration of exposure to quarry dust and AST and ALP. These results suggest that ASP and ALP increased with an increase in duration of exposure to quarry dust. There is paucity of information on the relationship of liver function in quarry workers, more research is needed to fully explore the possible adverse effects of quarry exposure to liver and other tissues/organs of the body.

CONCLUSION

In Umuoghara quarry site, Ebonyi state, the majority of quarry workers comprise mothers with their under-aged children, and men who are poor, under-educated and know nothing about occupational safety measures required for the job thus they are faced with the challenges of many health hazard. Therefore there is need for constant education on safety measures and precautions. The government, cooperate organizations and individual should create awareness on the occupational health hazards of quarry mining. All workers who are likely to be exposed to hazardous substances should be trained in the following:

- Information on and safe use of substances relevant to the specific site.
- Safe storage of the substances.
- Reasons for need to avoid exposure and safe work procedures.
- Identification, assessment and control procedures.
- First aid, incident reporting and emergency procedures.
- Material safety data sheets, labelling and signs.
- Health surveillance and reasons for doing it.
- Good personal hygiene practices

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