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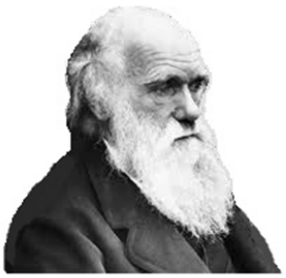

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Environmental Effects of Quarrying Activities in Akure, Ondo State, Nigeria

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ABSTRACT

This study investigated the particulate matters, noise generated and the impacts of the activities on the quarry workers. Three quarries and a control site were selected for this study. A particulate matter counter (CLJ-D particulate counter) was used to count suspended particles and a hand-held device (SL-4012 sound meter) was used to determine the noise levels at different distances away from the crushing point (0 m, 50 m, 100 m, 150 m and 200 m). A well-structured closed questionnaire was used to collect information about demographic, health implications and status of respondents working at the quarry site. Samchaise quarry has the highest total suspended particulate matter (691.82 μg/m^3 and 662.19 μg/m^3) for 0 m and 50 m sampling point respectively. For 100 m, 150 m and 200 m, Dortmond quarry has the highest total suspended particulate matter of 609.82 μg/m^3, 501.57 μg/m^3 and 450.34 μg/m^3 respectively. Dortmond quarry has the highest noise level (94.90 dB and 88.70 dB respectively) at 0 m and 50 m; Meanwhile, Ebenezer quarry has the highest noise level of 82.50 dB, 79.30 dB and 74.30 dB for 100 m, 150 m and 200 m respectively. Furthermore, out of the seventy (70) respondents interviewed, 22 (31.43%) of the workers had been working for over 5 years. Although, majority of the respondents 66 (94.29%) know the health implication of working in a quarry, only few respondents 6 (8.57%) used the protective gear always. In addition, 21 (39.62%) experienced catarrh monthly, headache 19 (35.85%) weekly, eyes ache 12 (22.64%), ear ringing 7 (13.21) at least daily, body ache 19 (35.85%) daily, skin itch 25 (47.17%) daily, and visual disturbance 10 (18.87%) daily. This study has shown that the quarry workers need to be trained and educated about the impacts of their activities in the environment.

***Keywords*:** Particulate matter, noise, quarry stones and health implication

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1. INTRODUCTION

The role of quarry activities in the economics of the world cannot be underestimated and it has tremendously contributed to present transformation and urbanization (Samba *et al*., 2022). Majority of the materials used by construction industries for buildings and roads such as limestone, granites, slate, sandstone, marble, and clay to make ceramic tiles are provided by quarry activities (Mohamed and Mohamed, 2013).

According to Adinkrah-appiah *et al*. (2016), these construction materials made up 80% of the total aggregate market and over 70% of the demand in aggregates results from major infrastructural projects such as highway and port construction, globally.

Due to the increase in population and urbanization, the demand for housing and accessible roads are on increase and this invariably increases the rate of exploitation on stones and other mineral resources.

Workers in a broad range of industries and professions may be exposed to different types of health risk at work, and the degree of the risk depends on individual worker (age, gender, and health status), geographic regions (rising in low- and middle-income countries), working conditions and environment. Injuries or illness incurred are resultant of physical, biological, chemical, or psychosocial hazards from noise, temperature, insect or animal bites, aerosols, blood-borne pathogens, hazardous chemicals, radiation, and occupational burnout (Oginyi, 2010; Josephine *et al.*, 2019).

In Africa, quarry activities entail blasting of rocks using explosive materials and these have negative impacts on the environment, giving rise to land degradation, loss of biodiversity, habitat destruction, air and noise pollution. Particulate matter or dust generated during the process travel by the air to the surroundings, hindering photosynthetic activities by covering the leaves surfaces and as well leading to chronic obstructive pulmonary disease and lung cancer in humans, when inhaled.

The distance travelled, their impacts on plant and human health depends on the local microclimate condition, particulate matter size, dust particle concentration and their composition (Bada *et al*., 2013). In addition, the mechanical processes of drilling, excavating (if underground), blasting or breaking of rock or ground for the mineral to be extracted, generate significant amounts of noise (Adiea *et al*., 2012; Samba *et al*., 2022).

In 2016, Hammersen *et al*. reported environmental noise as one of the risks to health, affecting mental health and well-being. Some of the noise outcomes are annoyance, sleep disturbance, cognitive impairment, adverse birth, hearing impairment, tinnitus, cardiovascular and metabolic effects. Therefore, the objective of this study is to assess the effects of quarry activities on the quarry workers.

2. MATERIALS AND METHODS

2. 1. Sampling locations

Three quarries were selected for this study (Figure 1), they are: Ebenezer quarry (lat. 7.278904, long. 5.24663), Dortmond quarry (lat. 7.342311 long. 5.249834) Samchase quarry (lat. 7.346386 long. 5.249817) while FUTA (lat. 7.306635, long. 5.13969) a location far from the quarries serving as the control site.

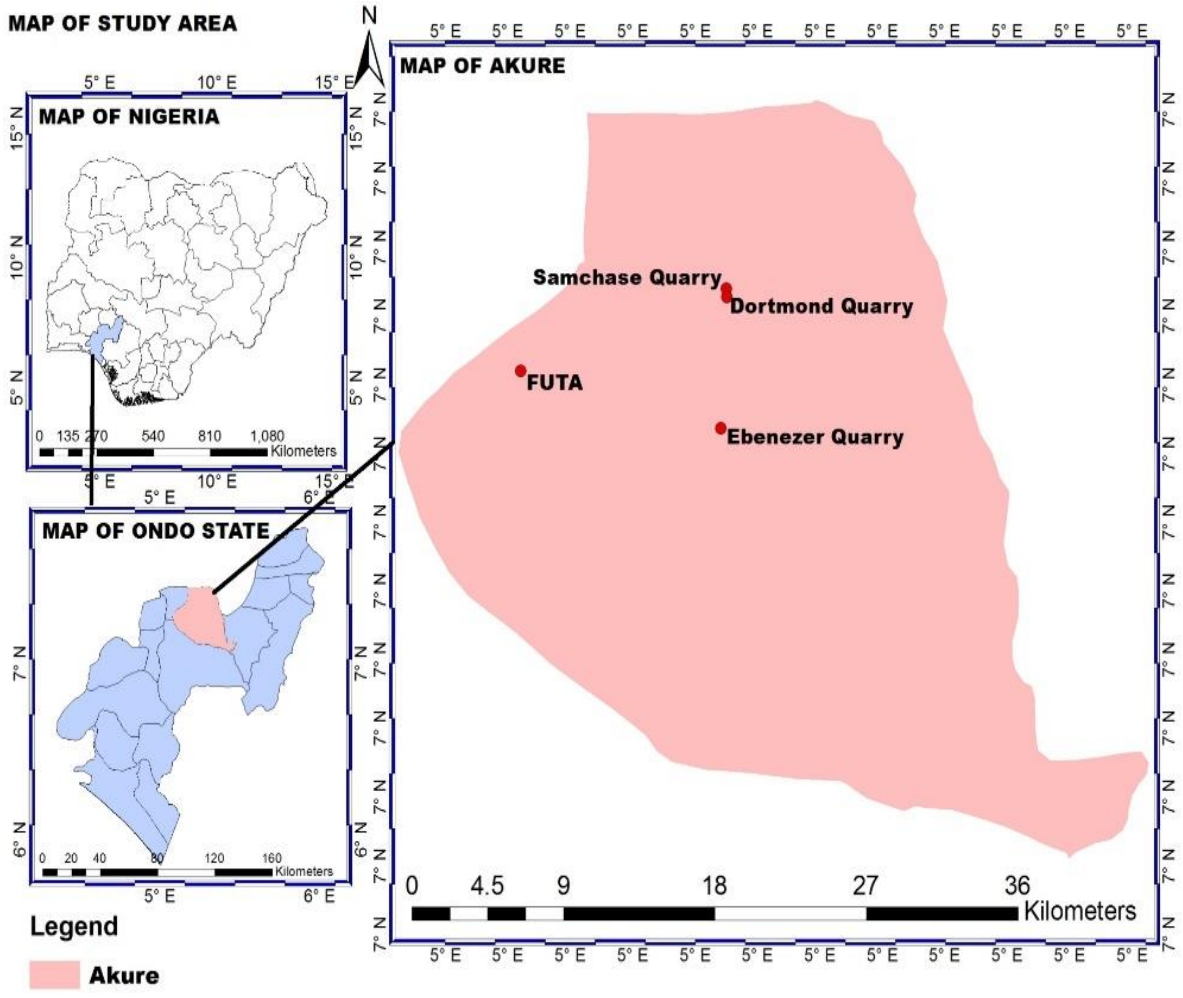

Figure 1. Map of Sampling Locations in Akure

2. 2. Air quality

A particulate matter counter (CLJ-D particulate counter) which can count six different particle sizes (0.3, 0.5, 1.0, 3.0, 5.0 and 10 μm) was used to count suspended particles at 0 m (crushing point), 50 m, 100 m, 150 m and 200 m away from the crushing point respectively. The concentration of each particle size in the air was recorded and the total concentration was determined by adding all the concentrations at each distance together. Readings were taken at the four cardinal points so as to arrive at a mean value for a specific point.

2. 3. Ambient noise level

A hand-held device (L.T. lutron SL-4012 sound meter) was used to determine the noise levels at different levels away from the crushing point (0, 50, 100, 150 and 200 m respectively). For the control, measurements were taken at distances away from the road side.

A well-structured closed questionnaire was used to collect information about demographic, health implications and status of respondents working at the quarry site.

2. 4. Data analysis

The data obtained were subjected to descriptive statistics using SPSS version 21 and graphs were made using Microsoft excel.

3. RESULT

Figure 2 shows the suspended particulate matter at Ebenezer quarry at different distances away from the crushing point. Particle size of 0.3 µm ranges from 134.11 µg/m^3 to 183.61 µg/m^3 of suspended particulate matter from 0 m to 200 m away from the crushing point. Meanwhile, particle sizes of 5 µm and 10 µm have suspended particulate matter from 1.24 µg/m^3 to 2.40 µg/m^3. In Figure 3 (Samchase Quarry), particle size of 0.3 µm ranges 161.29 µg/m^3 to 249.00 µg/m^3 of suspended particulate matter from 0 m to 200 m away from the crushing point.

Meanwhile, particle sizes of 3 µm upward are less than 17.60 µg/m^3 of suspended particulate matter from all distances. At Dortmond Quarry (Figure 4), particle size of 0.3 µm ranges 176.15 µg/m^3 to 310.96 µg/m^3 of suspended particulate matter from 0 m to 200 m away from the crushing point. Meanwhile, particle size of 5 µm and 10 µm have suspended particulate matter 1.03 µg/m^3 to 5.09 µg/m^3. At FUTA Quarry (Figure 5), particle size of 0.3 µm ranges from 152.02 µg/m^3 to 175.14 µg/m^3 of suspended particulate matter from 0 m to 200 m away from the crushing point. Meanwhile, particle sizes 0.5 µm upward are less than 25.10 µg/m^3 of suspended particulate matter from all distances. Figure 6 shows dust produced during crushing and drilling at quarry sites, and land degradation observed around the quarry sites was shown in Figure 7.

Compatatively, control site has the least total suspended particulate matter (179.97 – 214.91 µg/m^3) for all the sampling points. Samchaise quarry has the highest total suspended particulate matter (691.82 µg/m^3 and 662.19 µg/m^3) for 0 m and 50 m sampling points respectively. For 100 m, 150 m and 200 m, Dortmond quarry has the highest total suspended particulate matter of 609.82 µg/m^3, 501.57 µg/m^3 and 450.34 µg/m^3 respectively (Table 1).

The mean noise level (dB) at different sampling points in the locations (table 2) shows that for 0 m and 50 m from the crushing point, Dortmond quarry has the highest noise level (94.90 dB and 88.70 dB respectively). Meanwhile, Ebenezer quarry has the highest noise level of 82.50 dB, 79.30 dB and 74.30 dB for 100 m, 150 m and 200 m respectively. The noise level recorded in FUTA (control site) is 39.40 dB from 200 meters away from the road side to 45.40 dB roadside point.

Table 3 presented the demographic information of the respondents working at the quarry sites. Seventy (70) respondents were interviewed, of which 88.57% were male and 52.86% were 31 – 40 years old. Majority of the respondents were married 58 (82.86%), Yoruba tribe 46 (65.71%) and only 23 (32.86%) have tertiary education. At least 22 (31.43%) of the workers have been working for almost 5 years.

The knowledge about the health implications of the respondents was shown in Table 4. Some of the respondents 19 (27.14%) were not provided with protective gears, Samchase had the highest availability of protective gears 27 (45.0%) compared to others. The common protective gears provided were helmet 12 (17.14%), 16 (22.86%) of the respondents were provided with protective clothes (overall), 21 (30.0%) and 11 (15.71%) were given facemasks and boots respectively.

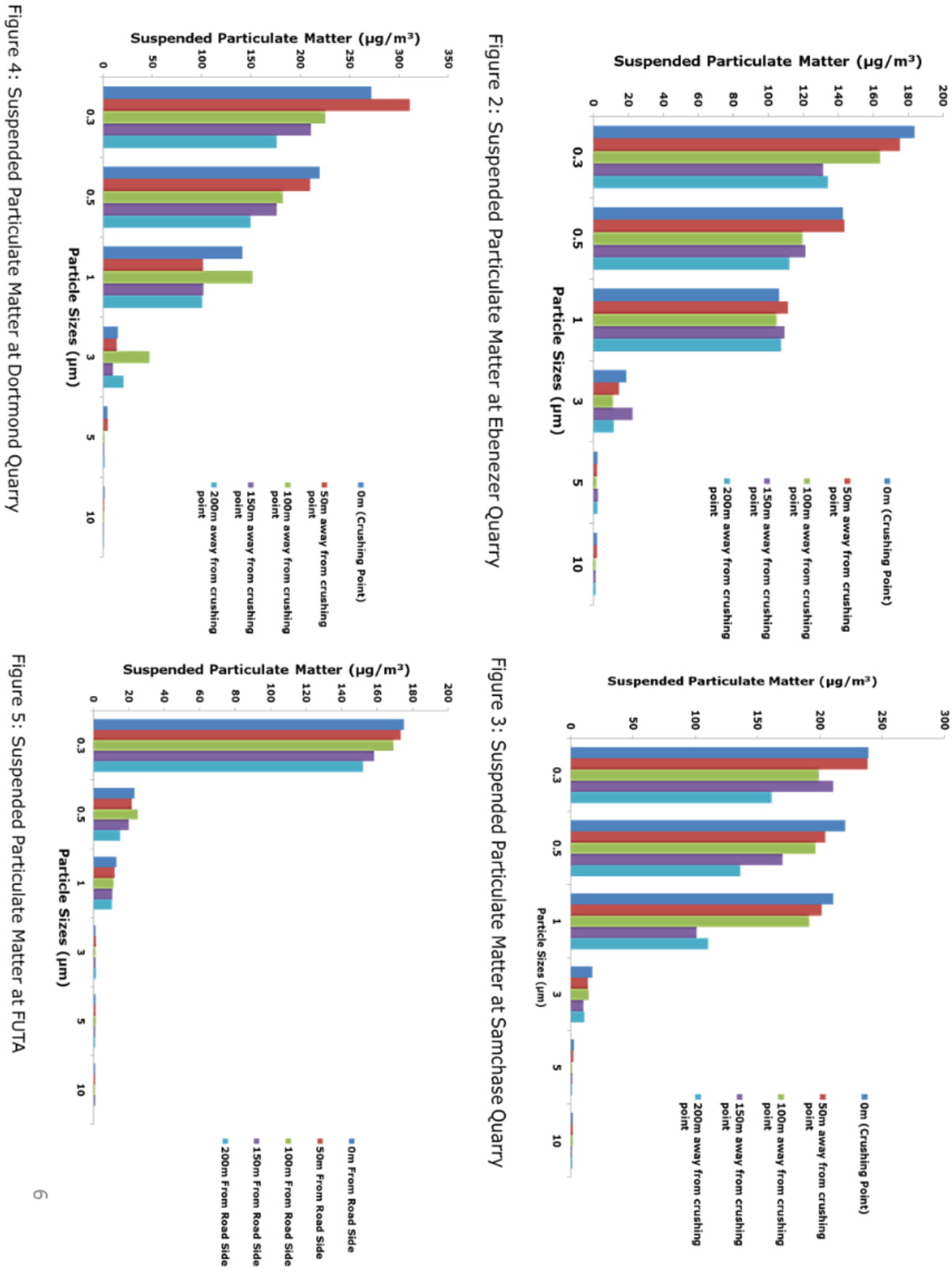

Figure 2: Suspended Particulate Matter at Ebenezer Quarry

Figure 3: Suspended Particulate Matter at Samchase Quarry

Figure 4: Suspended Particulate Matter at Dortmond Quarry

Figure 5: Suspended Particulate Matter at FUTA

Note: µm = micrometer, µg/m^3 = microgram per meter cube

Few respondents 6 (8.57%) used their protective gear always despite the fact that the majority of the respondents 66 (94.29%) know the health implication of working in a quarry. The health problems commonly experienced by quarry workers as reported during the interview are presented in Table 5. The results showed that 20 (37.74%) have cough monthly compare to 3 (17.65%) respondents from control site. Furthermore, 21 (39.62%) experienced catarrh monthly, headache 19 (35.85%) weekly, eyes ache 12 (22.64%), ear ringing 7 (13.21) at least daily, body ache 19 (35.85%) daily, skin itch 25 (47.17%) daily, and visual disturbance 10 (18.87%) daily. 0verall, the highest health problems was recorded in Ebenezer quarry (31.8%), followed by Dortmond and Samchase with 26.5% and 24.5% respectively, with the lowest value of 16.4% recorded at FUTA (control site). In Dortmond site (figure 8), 41.12% respondents have no health insurance while majority (77.8% and 94.44%) of the respondents in Samchase and Ebenezer site respectively, have no health insurance.

Table 1. Total Suspended Particulate Matter

Sampling Point (m)	Total Suspended Particulate Matter (µg/m^3)			
	Quarry			
	Ebenezer	Samchaise	Dortmond	Control
0	455.97	691.82	654.83	214.91
50	440.72	662.19	642.65	210.72
100	402.69	604.97	609.82	209.79
150	388.18	494.36	501.57	192.15
200	368.52	421.10	450.34	179.97

Figure 6. Dust Produced during Crushing and Drilling at Quarry Sites

Figure 7. Land Degradation caused by Quarrying Activities

Table 2. Mean Noise Level (dB) at different sampling points in the studied locations

Sampling Point (m)	Noise Level (dB)			
	Quarry			
	Ebenezer	Samchase	Dortmond	Control
0	94.20	90.40	94.90	45.40
50	86.10	86.90	88.70	41.90
100	82.50	79.10	79.10	41.00
150	79.30	75.80	72.20	39.90
200	74.30	70.20	64.90	39.40

Table 3. Demographic Information of respondents in the study sites (n = 70)

Variable		Location (%)				Total (%)
		Dortmond	Samchase	Ebenezer	Control	
Gender	Male	16 (94.12)	14 (77.78)	18 (100.00)	14 (82.35)	62 (88.57)
	Female	1 (5.88)	4 (22.22)	0 (0.00)	3 (17.65)	8 (11.43)
Age Range	20 – 30 yrs	3 (17.65)	5 (27.78)	1 (5.56)	5 (29.41)	14 (20.00)
	31 – 40 yrs	10 (58.82)	8 (44.44)	8 (44.44)	11 (64.71)	37 (52.86)
	41 – 50 yrs	4 (23.53)	4 (22.22)	5 (27.78)	1 (5.88)	14 (20.00)
	> 50 yrs	0 (0.00)	1 (5.56)	4 (22.22)	0 (0)	5 (7.14)

Marital Status	Single	2 (11.77)	5 (27.78)	1 (5.56)	3 (17.65)	11 (15.71)
	Married	14 (82.35)	13(72.22)	17 (94.44)	14 (82.35)	58 (82.86)
	Divorced	1 (5.88)	0 (0.00)	0 (0.00)	0 (0.00)	1 (1.43)
Level of Education	Primary	4 (23.53)	6 (33.33)	7 (38.89)	0 (0)	17 (24.29)
	Secondary	10 (53.82)	8 (44.44)	10 (55.56)	2 (11.77)	30 (42.88)
Tribe	Yoruba	14 (82.35)	13 (72.22)	7 (38.89)	12 (70.59)	46 (65.71)
	Ibo	0 (0)	1 (5.56)	5 (27.78)	3 (17.65)	9 (12.86)
	Hausa	0 (0)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
	Others	3 (17.65)	4 (22.22)	6 (33.33)	2 (11.77)	15 (21.43)
Years of working experience	1 – 5yrs	7 (41.18)	11 (61.11)	4 (22.22)	0 (0.00)	22 (31.43)
	6 – 10yrs	6 (35.29)	6 (33.33)	6 (33.33)	0 (0.00)	18 (25.71)
	11 – 15yrs	2 (11.77)	0 (0.00)	0(0.00)	0 (0.00)	2 (2.86)
	16 – 20yrs	1 (5.88)	1 (5.56)	7 (38.89)	0 (0.00)	9 (12.86)
	>20yrs	1 (5.88)	0 (0.00)	1 (5.88)	0 (0.00)	2 (2.86)
	Not applicable	0 (0.00)	0 (0.00)	0 (0.00)	17 (100.00)	17 (24.29)

Table 4. Knowledge of Respondents about Health implications of working in Quarry (n = 70)

Variable		Location (%)				Total (%)
		Dortmond	Samchase	Ebenezer	Control	
Are you provided with protective gear	Yes	9 (52.94)	11 (61.11)	14 (77.78)	0 (0.00)	34 (48.57)
	No	8 (47.06)	7 (38.89)	4 (22.22)	0(0.00)	19 (27.14)
	Not applicable	0 (0.00)	0 (0.00)	0 (0.00)	17 (100.00)	17 (24.29)
Protective gear	Helmet	5 (29.41)	6 (33.33)	1 (5.88)	0 (0.00)	12 (17.14)
	Overall	5 (29.41)	8 (44.44)	3 (16.67)	0(0.00)	16 (22.86)
	Facemask	5 (29.41)	10 (55.56)	6 (33.33)	0(0.00)	21 (30.00)
	Boots	4 (23.53)	3 (16.67)	4(22.22)	0(0.00)	11 (15.71)
	Goggle	0 (0.00)	0 (0.00)	0 (0.00)	0(0.00)	0 (0.00)
	Ear plugs	0 (0.00)	0 (0.00)	0 (0.00)	0(0.00)	0 (0.00)
	Not applicable	0 (0.00)	0 (0.00)	0 (0.00)	17 (100.00)	17 (24.28)
How often do you use them	Always	2 (11.77)	1 (5.56)	3 (16.67)	0(0.00)	6 (8.57)
	Sometimes	7 (41.18)	10 (55.56)	11 (61.11)	0 (0.00)	28 (40.00)

	Never	0(0.00)	0(0.00)	0 (0.00)	0 (0.00)	0 (0.00)
	Not applicable	8 (47.06)	7 (38.89)	4 (22.22)	17 (100.00)	36 (51.43)
Do you know the health implication of working in a quarry	Yes	15 (88.24)	16 (88.89)	18 (25.71)	17 (100.00)	66 (94.29)
	No	0(0.00)	1 (5.56)	0(0.00)	0(0.00)	1 (1.43)
	Not really	2 (11.77)	1 (5.56)	0 (0.00)	0(0.00)	3 (4.29)
	Not applicable	0 (0.00)	0 (0.00)	0(0.00)	0(0.00)	0 (0.00)

Table 5. Health Status of Interviewed Respondents (n = 70)

Variable		Location (%)				Control (%)
		Dortmond	**Samchase**	**Ebenezer**	**Total**	
Cough	Daily	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
	Weekly	0 (0.00)	3 (16.67)	2 (11.11)	5 (9.43)	0 (0.00)
	Every two weeks	3 (17.65)	3 (16.67)	5 (27.78)	11 (20.75)	3 (17.65)
	Monthly	7 (41.18)	7 (38.89)	6 (33.33)	20 (37.74)	3 (17.65)
	Quarterly	2 (11.77)	2 (11.11)	5 (27.78)	9 (16.98)	6 (35.29)
	Yearly	2 (11.77)	2 (11.11)	0 (0.00)	4 (7.55)	5 (29.41)
	Never	3 (17.65)	1 (5.56)	0 (0.00)	4 (7.55)	0 (0.00)
Catarrh	Daily	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
	Weekly	3 (17.65)	3 (16.67)	3 (16.67)	9 (16.98)	0 (0.00)
	Every two weeks	3 (17.65)	5 (27.78)	5 (27.78)	13 (24.53)	0 (0.00)
	Monthly	9 (52.94)	5 (27.78)	7 (38.89)	21 (39.62)	2 (11.77)
	Quarterly	1 (5.88)	4 (22.22)	3 (16.67)	8 (15.09)	7 (41.18)
	Yearly	0 (0.00)	1 (5.56)	0 (0.00)	1 (1.89)	6 (35.29)
	Never	1 (5.88)	0 (0.00)	0 (0.00)	1 (1.89)	2 (11.77)
Headache	Daily	3 (17.65)	6 (33.33)	5 (27.78)	14 (26.42)	0 (0.00)
	Weekly	6 (35.29)	5 (27.78)	8 (44.44)	19 (35.85)	2 (11.77)
	Every two weeks	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	3 (17.65)

	Monthly	5 (29.41)	3 (16.67)	1 (5.56)	9 (16.98)	3 (17.65)
	Quarterly	2 (11.77)	3 (16.67)	4 (22.22)	9 (16.98)	7 (41.18)
	Yearly	0 (0.00)	1 (5.56)	0 (0.00)	1 (1.89)	1 (5.88)
	Never	1 (5.88)	0 (0.00)	0 (0.00)	1 (1.89)	1 (5.88)
Eyes ache	Daily	1 (5.88)	2 (11.11)	4 (22.22)	7 (13.21)	0 (0.00)
	Weekly	3 (17.65)	1 (5.56)	1 (5.56)	5 (9.43)	0 (0.00)
	Every two weeks	1 (5.88)	0 (0.00)	0 (0.00)	1 (1.89)	0 (0.00)
	Monthly	4 (23.53)	4 (22.22)	4 (22.22)	12 (22.64)	0 (0.00)
	Quarterly	2 (11.77)	1 (5.56)	7 (38.89)	10 (18.86)	1 (5.88)
	Yearly	0 (0.00)	0 (0.00)	1 (5.56)	1 (1.89)	2 (11.77)
	Never	6 (35.39)	10 (55.56)	1 (5.56)	17 (32.08)	14 (82.35)
Ear ringing	Daily	3 (17.65)	3 (16.67)	1 (5.56)	7 (13.21)	0 (0.00)
	Weekly	2 (11.77)	1 (5.56)	4 (22.22)	7 (13.21)	0(0.00)
	Every two weeks	2 (11.77)	0 (0.00)	1 (5.56)	3 (5.66)	0(0.00)
	Monthly	2 (11.77)	1 (5.56)	2 (11.11)	5 (9.43)	0(0.00)
	Quarterly	1 (5.88)	0 (0.00)	6 (33.33)	7 (13.21)	0(0.00)
	Yearly	0 (0.00)	0 (0.00)	2 (11.11)	2 (3.77)	0(0.00)
	Never	7 (41.17)	13 (72.22)	2 (11.11)	22 (41.51)	17 (100.00)
Body ache	Daily	7 (41.17)	5 (27.78)	7 (38.89)	19 (35.85)	2 (11.77)
	Weekly	7 (41.17)	6 (33.33)	4 (22.22)	17 (32.08)	1 (5.88)
	Every two weeks	1 (5.88)	0 (0.00)	3 (16.67)	4 (7.55)	4 (23.53)
	Monthly	2 (11.77)	3 (16.67)	3 (16.67)	8 (15.09)	6 (35.29)
	Quarterly	0 (0.00)	4 (22.22)	1 (5.56)	5 (9.43)	4 (23.53)
	Yearly	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
	Never	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
Skin itch	Daily	9 (52.94)	6 (33.33)	10 (55.56)	25 (47.17)	0 (0.00)
	Weekly	1 (5.88)	1 (5.56)	1 (5.56)	3 (5.66)	0 (0.00)

	Every two weeks	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
	Monthly	2 (11.77)	5 (27.78)	1 (5.56)	8 (15.10)	0 (0.00)
	Quarterly	2 (11.77)	0 (0.00)	6 (33.33)	8 (15.10)	0 (0.00)
	Yearly	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	1 (5.56)
	Never	3 (17.65)	6 (33.33)	0 (0.00)	9 (16.98)	16 (94.12)
Visual disturbance	Daily	4 (23.53)	3 (16.67)	3 (16.67)	10 (18.87)	0 (0.00)
	Weekly	2 (11.77)	1 (5.56)	2 (11.11)	5 (9.43)	0 (0.00)
	Every two weeks	0 (0.00)	2 (11.11)	1 (5.56)	3 (5.66)	0 (0.00)
	Monthly	4 (23.53)	3 (16.67)	0 (0.00)	7 (13.21)	0 (0.00)
	Quarterly	1 (5.88)	1 (5.56)	5 (27.78)	7 (13.21)	0 (0.00)
	Yearly	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
	Never	6 (35.29)	8 (44.44)	7 (38.89)	21(39.62)	17 (100.00)

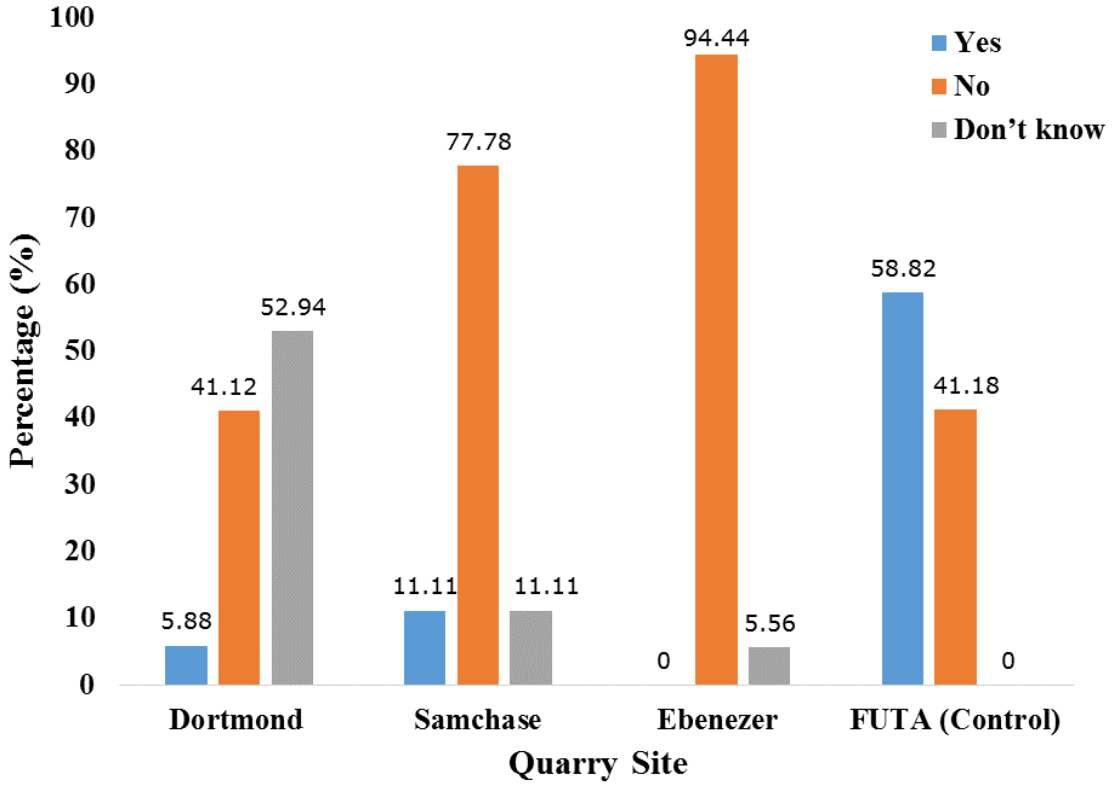

Figure 8. Health Insurance status of respondents

4. DISCUSSION

Quarry rock is placed third and fourth among the volume and value of non-fuel mineral commodities in the world respectively. However, its operation contributes to land degradation and presence of pollutants in the atmosphere which has negative impact on the environment (Ogbonna *et al*., 2018; 2020), especially, on the people working at the site or living close to the site. The result showed evidence of dust generated during the operation, is carried by the atmosphere and travels distances from the point of crushing to the neighbouring communities.

The dust or particulate matter (PM) generated are in sizes and this determines how far the dust will travel and how long it will be suspended in the air. The sizes are grouped into $PM_{2.5}$ (equal or less than 2.5 micrometers) and PM_{10} particles (equal or less than 10 micrometers) based on their aerodynamic diameter. These sizes are smaller when compared to the average diameter of a human hair which is 50-70 µm.

In the quarry sites studied, the $PM_{2.5}$ was discovered to the distance of 200 m from the point of crushing having total suspension of 93.70 to 310.96 µg/m^3. Meanwhile, PM_{10} that were detected are less than 50.00 µg/m^3 for all distances studied from the crushing points. $PM_{2.5}$ detected in this study is higher than the control site (10.49 to 175.14 µg/m^3) and 13.00 to 69.00 µg/m3 reported by Ogbonna *et al*. (2018) from quarry sites in Ngwogwo, Ebonyi State, Nigeria.

The PM_{10} (58 – 3185.30 µg/m^3) reported from Jammain, Palestine by Sayara (2016) between the distance of 500 – 700 m from the studied quarry site is higher than what was recorded between 0 to 200 m. This disparity may likely be due to the multiple quarry industries (reported to be more than 60 quarries and 40 stone cutting industries) situated at Jammain. The recorded $PM_{2.5}$ and PM_{10} in this study are above the standard recommendation (15.0 and 45.0 µg/m^3 per day, respectively) set by World Health Organisation and the exceedance of these suspended particulate matters are associated with high health risk. In 2015, Global Burden of Disease (GBD) revealed that $PM_{2.5}$ pollution accounts for 7.6% of the global total deaths, estimated to be 4.2 million deaths. Among the most common causes of death in the world, $PM_{2.5}$ pollution is ranked the fifth position (Xie *et al.*, 2018).

The noise detected at the crushing point, 200 m away from it, is 107.03% to 77.16% more than what was detected for the control site. This is above the permissible limit of 70 db at the industrial area and 55 db at the residential area specified by International Finance Corporation (IFC). Although noise cannot be eliminated from daily activities, it becomes a nuisance and increases health risk psychologically and physiologically when above permissible limits (Jarosińska *et al*., 2018). Depending on the work conditions (types of job and protective measures), how long and often been exposed to the source of the noise, determine its impact on the workers or residents around, resulting in potential hearing loss (Ismail *et al*., 2013; Gyamfi *et al*., 2016).

This study shows that male (88.57% of the respondents) are more involved in quarry activities than females, and this may be attributed to the fact that the activities require more strength and energy. Ezisi *et al*. (2017) recorded more females than males, and this may be because the study also considered other labourers who were not directly involved in stone processing. Despite the fact that the majority of the workers studied know the health implications of their work, only few (8.57%) of them always use the protective gears provided for them while some (27.14%) did not even have access to protective gears. This attitude may seem to reflect the educational level of the respondents, as their maximum level is secondary education.

This report is relatively low to the high compliance with protective devices of 80.3% reported by Sufiyan and Ogunleye (2012) in Sabon-Gari local government area, Kaduna State, Nigeria. Among other protective gears recorded in this study, goggles and ear plugs were not used by any of the workers. Resultantly, daily health issues mentioned by the respondents are eyes ache, ear ringing, body ache, skin itch and visual disturbance. Including cough and catarrh, more than half of the workers experience the listed health issues within a month. As years of exposure to inhalation of fine particulate matter ($PM_{2.5}$ or PM_{10}) may increase, these workers are likely to be at high risk of bronchitis, asthma, heartbeat issue, lung cancer, respiratory diseases and arteriosclerosis (Raaschou-Nielsen *et al*., 2016; Liu *et al*., 2018), and even experience hearing impairment at the latter part of their life due to noise pollution.

The average year of work experience recorded in this study is 8½, and yet more than three-quarter of the quarry workers have no health insurance. Coupled with the fact that the majority of the workers know the health implications of their work, compliance to safety guidelines is very poor among them. This is similar to the report from Jobin *et al*. (2017) as all the workers studied lacked health insurance schemes and none adhere to personal protective equipment. Segbenya *et al*. (2022) opined that the lack of institutional support for these workers in the form of free national health insurance seriously makes the workers' case very serious.

5. CONCLUSION

This study has shown that the quarry workers need to be trained and educated about the impacts of their activities in the environment. Furthermore, they should be mandated and monitored for the use of personal protective equipment. The modern technology and equipment that produce negligible noise, scrub, precipitate and filter particulate matters should be employed by the quarry industries to save the environment. Government should also financially support and implement a health insurance programme for people involved in quarry activities and other related jobs.

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