

PARTICULATE MATTER, HAZARD AWARENESS AND SELF-ADHERENCE AMONG SETRACO QUARRY WORKERS IN UGWUELE, UTURU, NIGERIA

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Abstract

Exposure to particulate matter (PM) is a major health hazard in explorative industries. This is exacerbated by observed low hazard awareness and self-adherence measures among quarry workers. Specifically, this quantitative paper examined whether safety policy adopted by management of quarry industry have led to self-adherence to safety, to determine if knowledge of particulate hazard promotes safety-adherence to safety, and to uncover whether cardiorespiratory symptoms experienced by quarry workers are resultant effects of exposure to PM among quarry workers. 28 purposively selected middle aged, male workers without history of underlying illness, and who have been working for a minimum of three years at Setraco quarry in Ugwuele, Uturu, Nigeria, were sampled. Three formulated hypotheses were tested with Pearson's Chi-square statistical tool (χ^2). Results showed that flexible safety policy ($\chi^2 = 1.95$; $df = 1$; $N = 28$; $P = <0.05$) and inadequate information on the health implications of PM ($\chi^2 = 11.97$; $df = 1$; $N = 28$; $P = <0.05$) influenced low-self-adherence, while cardiorespiratory symptoms experienced by quarry workers are results of exposure to PM ($\chi^2 = 6.61$; $df = 1$; $N = 28$; $P = <0.05$). The study recommended a re-evaluation of corporate safety policy through the incorporation of health officials in safety training programmes. This will aid the development of self-consciousness on the implications of PM to workers' health.

Keywords: Hazard awareness, Particulate matter, Quarry, Self-adherence.

Introduction

The quest for industrialization has placed increasing demands for mineral resources including limestone and rocks used for agricultural, domestic and industrial purposes. The demand has increased the numbers of quarries and quarrying operations in Nigeria in recent times. Quarrying operations involve the evacuation of over burden, driving, blasting, crushing and removal of over burden rock minerals (Oguntoke, Aboaba and Gbadebo, 2009). The Nigerian mining industry is largely divided into small scale, middle scale and large scale and their capacities are determined by the level of mechanization and human capacity found at each level. The Nigeria quarry industry comprises of workers who are majorly under-schooled, thus lacking the requisite formal education and job training for safety and efficiency. These workers, after recruitment, are given basic job related training before deployment. The industry, which

nature is characterized by mineralogical emission of dust and other industrial wastes into the air poses threat to workers' health as they may not fully appreciate the importance of a safe workplace and adherence to safety procedures, since they are exposed to job hazards including Particulate Matter (PM). Oginyi (2010) remarked that, without adequate safety training and development of self-consciousness on the implications of PM to human health, quarry workers will be exposed to several life threatening occupational health hazards.

Job Hazard is any work situation which constitutes a threat to human and environmental health (Faremi, Ogunfowokan, Mbada, Olatubi and Ogungbemi, 2014). Hazards include sources and situations which are capable of leading to undesired consequences, including damages to life, health and the environment. Quarry workers make use of explosives, chemical compounds and mixtures that are prone to decomposition and which generates gas, heat and sudden pressures required to excavate rocks. Quarry site hazards may be physical, biological, ergonomic, stress related or chemicals emitted from industrial facilities. From the foregoing, hazard-awareness is a cognitive learning behaviour which emanates from an individuals' ability to identify existing threats to human and environmental health through training, observation and identification.

Awareness of the implications of none adherence to safety is a major strategy for ensuring workers' performance (Oginyi, 2010; Sufiyan and Ogunleye, 2012; Faremi, et al 2014). Udeh and Nwogwugwu (2020: 62) remarked that, "a safe workplace is an ideal condition for organizational productivity, as workers cannot achieve their full potentials in an unsafe environment. To attain a safe work environment, concerted effort is geared towards improving workers' knowledge by developing their consciousness to safety". Awareness is the holistic enhancement in the behaviour, experience, physical and mental alertness of workers to dangers of workplace hazards. Safety awareness is unachievable where workers do not sufficiently appreciate the risk factors associated with exposure to PM without recourse to management sanctions. When this occurs, exposure to PM may threaten the quality of workers' life and performance. Sick workers may be relieved of their jobs, with attendant emotional and economic implications on family dependents.

A safe workplace is a requirement for sustainable development and productivity because it minimizes workplace accidents, reduces workplace injuries, diseases, and promotes employee participation in the attainment of organization goals (Jilcha and Kitaw, 2016). Despite these importance of safety at work, there is the prevalence of occupational hazards among blue-collar workers (Omotosho, Bamidele, Salaudeen, Saromi and Adeomi, 2012; Faremi, Ogunfowokan, Mbada, Olatubi and Ogungbemi, 2014; Udeh and Nwogwugwu, 2020), and quarry workers are not exempted. Oguntoke, et al (2009) averred that quarrying is a high risk job with serious impacts on the air, water, soil, earth surface, flora and fauna and human beings. It is a solid mineral in the form of dust generated during crushing operations and they are usually suspended in the air. Pollutions resulting from these dusts have been linked to medical complications which include irregular heartbeat, aggravated asthma, impaired lung function, and increased respiratory symptoms such as irritation of the airways, coughing or difficulty in breathing, non-fatal heart attacks and premature death in people with lung disease (Praznikar and Praznikar, 2012). The resultant health challenges may continue to debilitate workers'

productivity until they become symptomatic, leading to untimely death. Although, there is scarcity of data on PM related mortality rate, safety and awareness of hazard implications among workers in Nigerian organized quarry industry, several studies have given contradictory results on safety and self-awareness and in the Nigerian explorative industry. Sufiyan and Ogunleye (2012) discovered a high level of self-awareness among quarry workers in Sabon-Gari, Kaduna State, Nigeria, while Aigbokhaode, Isah and Isara (2011) were contradictory when they revealed that, quarry workers in rural communities of Edo State do not have optimal awareness of quarry hazards nor appreciate the importance of the use of safety equipment and self-awareness to their health. These incongruities brand this study significant and expedient as it examined the level at which PM hazards militate against safety-adherence among quarry workers, and unravel the prevalent symptoms of cardiorespiratory ailment among quarry workers in Ugwuele, Uтуру. Aside the impact of PM on workers' health, Oguntoke et al (2009), Ajayi Adeoye, Bekibele, Onakpoya and Omotoye (2011) agree that PM is a major health hazard for administrative concern, while Aigbedion (2005) and Sufiyan and Ogunleye (2012) opined that host communities also suffer from its devastating effects. Efforts at promoting workplace safety will be futile if workers do not exhibit self-consciousness of the hazards caused by exposure to PM, and the importance of self-adherence as the first step towards ensuring workers safety from PM hazards in quarry sites.

Self-adherence is a medical concept which has assumed several meanings. In simple term, self-adherence is a cognitive decision made in response to considerations of symptoms and process involved in exposure to medical risk (Shuldham, Theaker, Jaarsma and Cowie, 2007). Deaton (2000) explained that it is an explicit behaviour initiated by people on their own desire. This behavior is initiated with the intention of improving health, ensuring safe working condition and preventing ailments and diseases. We align with Settineri, Frisone, Merlo, Geraci and Martino (2019) who explained that, adherence is the extent to which an individual aligns with recommendation suggested by a medical professional for health and safety.

From the foregoing, self-adherence is a behaviour initiated as a result of deliberate effort of employees to appreciate the consequence of exposure to PM and comply with safety procedures without subjection to managements enforcement guidelines. Self-adherence is compliance with workers' willingness to adhere to quarry safety rules irrespective of management's enforcement measures. Unfortunately, several factors militate against self-adherence. These include: age, information, perception, socio-economic factors, culture, educational attainment, beliefs and social support (Settineri et al, 2019).

However, particulate matters are solid and liquid particles made of organic and inorganic substances suspended in the atmosphere. PM are distinguished by sizes, ranging from PM₁₀: less than 10 diameter (coarse fraction), PM_{2.5}: less than 2.5 (fine fraction) and PM_{0.1}: less than 0.1 diameter (ultra-fine fraction) (Praznikar and Praznikar, 2012), and their chemical compositions are determined by emission sources, meteorological conditions and aerodynamic diameter. PM below 10 micrometers is prevalent in quarries and they pose great complications on human health due to their capacity to get deep into human lungs and bloodstreams.

PM may be introduced into the air through primary and secondary sources. Anthropogenic sources are primary sources for the dissemination of PM, while secondary PM is

formed from chemical processes (Owoade, Olise, Ogundele, Fawole and Olaniyi, 2016). Primary particles are microscopic solid or liquid droplets emitted in quarries, with severe complications on human health. Exposure to PM is a risk factor for cardiovascular mortality, cardiac arrhythmia, myocardial infraction, myocardial ischemia, heart failures and death (Praznikar and Praznikar, 2012). Quarry workers may overlook symptoms such as occasional chest pain, productive and unproductive cough and cardiovascular symptoms owing to flexible safety policy, ignorance, beliefs, economic status and other factors.

Objectives of the Study are to:

1. Unravel whether poor knowledge of PM hazards militates against safety-adherence among Quarry Workers in Ugwuele, Uturu.
2. Find out if exposure to PM is responsible for the prevalent symptoms of cardiorespiratory ailment among quarry workers in Ugwuele, Uturu.

Hypotheses

1a. Ho: There is no significant relationship between Poor knowledge of PM hazards and safety-adherence among quarry workers in Ugwuele, Uturu.

2a. Ho: Exposure to PM has no significant relationship on prevalent symptoms of cardiorespiratory ailment among quarry workers in Ugwuele, Uturu.

Theoretical Framework

This paper is anchored on the hierarchical theory of needs propounded by Abraham Maslow (1943) in his book 'Theory of Human Motivation'. This hierarchy theory of needs states that people are motivated to fulfill basic needs before progressing to other or more advanced needs. Maslow believed that people have natural desire to be self- actualized, which is their ultimate goal and in order to realize this goal, a number of basic needs must be met such as the need for food, safety, love and self- esteem. These needs are in five different levels and demonstrated in a pyramid diagram below.



Figure 1: Maslow's Hierarchy of Needs

From the diagram above, the lowest need is the physiological needs which are apparently vital to man irrespective of its placement at the pyramid. Examples of the physiological needs include food, water, breathing, and homeostasis. Following the movement up on the pyramid is Security and Safety needs, here the requirements start to become a bit more complex as the need for security and safety becomes man's primary need. People want to control and order their lives. Hence, man's behavioral pattern yearns for the basic security and safety needs which include financial security, health and wellness, safety against accidents and injury. Maslow's proposition in general was that other things being equal, people tend to satisfy their lowest level of felt need before moving on to higher-level needs.

In light of this, it is clear that consequent upon employment, quarry workers tend to seek for these basic needs from the lowest to the apex. The need for security and safety cannot be over emphasized as it is the primary need, or else, the dream of self-actualization among quarry workers will not be realized. Huitt (2007) argued that in the absence of safety need and low self-actualization, individuals may develop posttraumatic stress, depression, anxiety, illness and death. Workers who cannot adequately meet their physiological needs, may be passive to safety rules and disregard the need for strict adherence to safety measures initiated by management. Therefore, self-actualization enables workers to attain commitment to the actualization of organizational objectives. Maslow's theory of human motivation is most appropriate for the study because it pinpoints and addresses the basic needs of quarry workers in Ugwuele, Uturu. This necessarily is because, the attainment of security and safety concerns of workers can motivate performance as their health will be guided against injuries and their wellbeing will enhance productivity.

Methodology

This study was conducted with the aide of self-administered questionnaire as seen in a study on determinants of knowledge and safety practices of occupational hazards of textile dye workers in Sokoto (Nneka et al., 2017). The quantitative survey was carried out among 28 purposively selected quarry workers at Setraco Nigeria limited, Ugwuele in Uturu, Abia State, Nigeria. The respondents comprise of middle aged male staff made up of machine operators and field workers with a minimum of three years working experience at the quarry company. Purposive sampling was adopted for the study. This is because, the respondents have spent substantial working years in the organization, and are less likely to have co-existing morbidity that may lead to PM related health hazards. Therefore, all respondent do not have a history of underlying illness prior to their employment at the quarry. This measure was taken to eliminate chances of having respondents who may confuse previously established health symptoms with PM induced health condition.

Due to the demanding job schedule of respondents, the study was conducted during work hours. It adopted snowball sampling selection technique which covered 28 respondents. In consideration of the educational status of respondents, responses were gathered using face-to-face interview method administered with a close-ended questionnaire. Pearson's Chi-square (χ^2) statistical tool was used to test the three stated hypotheses in order to predict the relationship between the independent and dependent variables, and results are presented thus:

Data Presentation and Discussion of Findings

The data are presented and discussed in line with the objectives of the study.

Table 1: Socio-Demographic Characteristics of Respondents

Description	Demographic Variable	n=28	%= 100
Age	18-28	3	11.0
	29-38	7	25.0
	39-48	10	35.0
	49-58	8	29.0
	Total	28	100
Gender	Male	28	100
	Female	0	0
	Total	28	100
Marital status	Married	22	78.6
	Single	6	21.4
	Total	28	100
Highest Educational attainment	None First School leaving certificate	2	7.1
	First school leaving certificate	5	17.9
	Senior School Certificate	21	75.0
	Total	28	100

Source: *Field Survey, 2021*

Out of the 28 distributed copies of questionnaire, all (100%) were returned. Table 1 shows clearly that majority of the quarry workers in the study departments such as crane operators, blasters and all categories of pit workers fall within the age bracket of 39-48 years (35.0%). Majority of the respondents 22 (78.6%) are married, while 6 (21.4%) are single. The table also indicates the respondents' educational qualification which shows that majority 2(7.1%) do not possess first school leaving certificate, 5 (17.9%) has First School Leaving Certificate, while 21 respondents constituting a majority (75.0%) possess Senior School Certificates.

Hypotheses Testing

1a. Ho: There is no significant relationship between Poor knowledge of PM hazards and safety-adherence among quarry workers in Ugwuele, Uturu.

2a. Ho: Exposure to PM has no significant relationship on prevalent symptoms of cardiorespiratory ailment among quarry workers in Ugwuele, Uturu.

Table 2: Poor Knowledge of PM Hazard and Safety-Adherence among Quarry Workers in Ugwuele, Uturu

Reasons	Yes	No	No idea	Total
Inadequate information	8 (6.43)	1 (1.79)	1 (1.79)	10
Not necessary	2 (1.93)	0 (0.54)	1 (0.54)	3
Not convenient	6 (5.79)	1 (1.61)	2 (1.61)	9
Often forget	2 (2.57)	1 (0.71)	1 (0.71)	4
Not available	0 (1.29)	2 (0.36)	0 (0.36)	2
Total	18	5	5	28

Source: Field survey 2021.

Fcal=11.967; ftab=15.507

$\chi^2 = 11.97$; df= 1; N= 28; P= <0.05. Decision= Accept H_i

Hypothesis 2 shows that inadequate knowledge of PM hazard is responsible for the poor state of safety-adherence among quarry workers in Ugwuele, Uturu. We therefore reject the Ho and accept the Hi which states that poor knowledge of PM hazards has significant relationship on safety-adherence among quarry workers in Ugwuele, Uturu ($\chi^2 = 11.97$; df= 1; N= 28; P= <0.05). The finding also showed that inadequate information on the health implications of exposure to PM is responsible for low safety-adherence among quarry workers. This discovery is in line with a study conducted by Oginyi (2010) which summed that inadequate information on protective measures is responsible for the poor disposition of quarry workers to protective measures. The findings of this hypothesis have further proved that safety training on the use of personal protective equipment and other basic safety devices are inadequate to instill safety consciousness and self-adherence among Ugwuele quarry workers. The study also contradicts previous findings conducted by Sufiyan and Ogunleye (2012) which observed that there is high level of safety awareness among quarry workers in Nigeria. We uncovered dearth of self-compliance among quarry workers who regard PM training as a routine requirement for employment, without demonstrating serious self-consciousness on the implications of PM on human cardiorespiratory system.

Table 3: Exposure to PM Hazards and Prevalent Symptoms of Cardiorespiratory Ailments among Quarry Workers in Ugwuele, Uturu

There is no significant relationship between exposure to PM hazards and prevalent illnesses

Symptoms	Yes	No	No idea	Total
Dyspnea	2 (2.14)	1 (0.54)	0 (0.32)	3
Palpitation	2 (1.43)	0 (0.36)	0 (0.21)	2
Orthopnea	1 (0.71)	0 (0.19)	0 (0.11)	1
Paroxysmal Nocturnal Dyspnea	2 (2.14)	1 (0.54)	0 (0.11)	3
Productive cough	4 (4.29)	1 (1.07)	1 (0.64)	6
Dry cough	7 (6.43)	1 (1.61)	1 (0.96)	9
Chest pain	2 (2.86)	1 (0.71)	1 (0.43)	4
Total	20	5	3	28

Source: Field survey 2021

Fcal=6.6135; ftab=21.026

$\chi^2 = 6.61$; df= 1; N= 28; P= <0.05. Decision=Accept H_0

Table 3 shows the relevant cardiorespiratory ailments associated with exposure to PM hazards. The symptoms were listed in order to determine the predominant cardiorespiratory challenges bedeviling quarry workers in Ugwuele, Uturu. The hypothesis which states that exposure to PM has no significant relationship with widespread symptoms of cardiorespiratory ailment among quarry workers in Ugwuele, Uturu, was rejected, while the H_0 was accepted ($\chi^2 = 6.61$; df= 1; N= 28; P= <0.05). Specifically, dry cough was found to be the prevalent cardiorespiratory symptom that affects quarry workers in the organization of study. The result corroborates a similar study conducted by Omotosho et al., (2012) among workers of Obajana Cement Factory in Kogi State Nigeria, which showed that, mere awareness of PM hazards does not lead to a reduction in health risk among blue-collar workers. Implicitly, awareness must be matched with safety consciousness and compliance through extensive training. Low safety-compliance on the implications of long term exposure to quarry dusts and neglect of intermittent medical checkups are responsible for the prevalent cardiorespiratory risk factors which include aggravated asthma, impaired lung function, and increased respiratory symptoms such as irritation of the airways, coughing or difficulty in breathing, non-fatal heart attacks, stroke and premature death (Praznikar and Praznikar, 2012).

Conclusion

Quarry workers are exposed to many high risk factors which include exposure to PM. The study shows that quarry company safety policy and measures are flexible. Flexible safety enforcement without concomitant sanctions against erring workers has adverse effect on instilling self-

adherence and awareness of the dangers of PM to human health. Moreover, managements' safety policy undermines focus on safety culture, which is: to instill cognitive awareness of self-preservation in the workplace. We conclude that there is need to adopt scientific training methods when imparting knowledge of the risk factors associated with low self-adherence and exposure to PM hazard to quarry workers. This is important because, inadequate safety education cannot enhance safety consciousness and self-adherence among quarry workers.

Recommendations

Based on the foregoing, we recommend that:

- Management of quarry industry should re-evaluate their safety policy with a view to attaching stringent measures against safety violators.
- Quarry organizations should go beyond induction training and organize retraining on the implications of exposure to PM on human health.
- The educational status of field workers in quarry sites should be considered when organizing safety trainings. Training should not be ambiguous, but should reflect the need to extol self-awareness over enforcement.
- There is need to incorporate public health officials in future training sessions on the dangers of low self-adherence to safety precautions. This will enable quarry workers to have professional information on the various implications of poor self-adherence and its resultant implications on workers' health and productivity, household and organization.

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