Original Article

Self-Reported Respiratory Symptoms and Associated Risk Factors Among Quarry Workers in Gusau, Zamfara State, Northwest Nigeria

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Article History
Submitted: 06/10/2024; Accepted: 12/10/2024: Published: 23/11/2024

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ABSTRACT

Quarry workers are exposed to inhalable dust particulate matter during excavating, chiselling, cutting, loading and transportation of the quarried stones. Stone dust exposure is associated with respiratory symptoms like cough, dyspnoea and chest pain. This study assessed self-reported respiratory symptoms and associated risk factors among quarry workers in Gusau so as to be able to educate the workers on the burden of their respiratory morbidities and its preventions. This cross-sectional study was conducted among 307 quarry workers in Gusau between July and August 2022. The respondents were selected using a systematic sampling technique. Data was collected using an interviewer-administered questionnaire and analysed using IBM SPSS version 25. Chi-square test was used to assess associations between socio-demographic characteristics and self-reported respiratory symptoms, and data were presented in tables and charts. The mean age of the respondents was 29.8 ± 10.7 years, and a little above one-third, 111 (36.2%), had worked for over ten years. A hundred and twenty-one (39.4%) of the respondents reported at least one respiratory symptom. The commonest symptom reported was nasal congestion 74 (24.1%), followed by morning cough 68 (22.1%). Number of hours worked per day (aOR 2.46, 95% CI = 1.40 - 4.34) and duration of work in the quarries (aOR 4.89, 95% CI: 2.53 - 9.43) were the predictors of the respiratory symptoms among the workers. This study revealed a high burden of respiratory symptoms among the respondents, with nasal congestion being the commonest symptom. Hours worked per day and duration of work in the quarries were predictors of respiratory symptoms. Hence, there is a need for state regulatory authorities to educate and enforce the practice of working for only 8 hours a day and use of PPE.

Keywords: Gusau, Quarry workers, Respiratory symptoms, Self-reported

INTRODUCTION

Quarrying is the process of breaking down stones from rocks found on or below the land surface for building and construction purposes.[1] The quarrying products have significantly improved human livelihood and are the bedrock of several industries, including cement, road, and construction companies.[3] In Nigeria, the industry was one of the most important contributors to the state's and nation's economy in terms of employment, direct and indirect revenues, exports and investments.[4]

Respiratory symptoms quarry workers are commonly afflicted with include cough, shortness of breath, chest pain, nasal stiffness, and wheezing, among others.[1, 5] Worldwide incidences of pneumoconiosis and other occupational chronic respiratory diseases have been estimated at 453,000 and 2,631,000 cases per year, respectively.[6] Such morbidities reduce physical activity, productivity

Article Access
Website: www.wjmbs.org
10.5281/zenodo.13992739

How to cite this article
Shehu A, Raji MO, Ka'oje AU, Azees AS, Akogwu HS, Daninna MZ, Bello MB, Bello MM, Abdul'aziz MD, Illo HG, Yakubu M, Abubakar AB. Self-Reported Respiratory Symptoms and Associated Risk Factors Among Quarry Workers in Gusau, Zamfara State, Northwest Nigeria. West J Med & Biomed Sci. 2024;5(4):194-203.. DOI:10.5281/zenodo.13992739

and work capacity and cause work absenteeism.[7] These morbidities also impose enormous costs, impoverish workers and their families, and dramatically increase health care expenditures.[8 9 10] Higher prevalence of respiratory symptoms experienced by quarry workers have been attributed to poor safety practices among the quarry workers and low use of personal protective equipment (PPE) either due to non-availability or low perception of its benefits.[7,11] A study carried out in Brunei Darussalam among quarry workers reported that dry cough (26.1%) was the commonest respiratory symptom among the workers, followed by cough (8.7%), shortness of breath (4.3%), and chest discomfort (4.3%).[12] In another study conducted in Ogun state, Nigeria, the respiratory symptoms that the quarry workers suffered were predominantly cough (26.0%), catarrh (20.0%) and sinusitis (15.0%).[13]

The provision of PPE is the commonest condition that enables workers to comply with its use.[14] The most common constraining factor in using PPEs, even when available, is said to be as a result of a perceived low risk to hazard.[14] In Abia and Ebonyi States, Nigeria, it was reported that although the majority of the quarry workers knew that their job exposed them to health hazards, there was low usage of PPE among them.[15] Factors responsible for poor occupational safety and health services in developing countries include poverty, illiteracy, lack of training, cheap labour, and inadequate implementation of existing legislation.[16] A study conducted in West Bank-Palestine among stone-cutting workers, cigarette smoking, long duration of work and non-usage of PPE were factors associated with a higher risk of respiratory symptoms.[2] Another study carried out among quarry workers in Edo, South-south Nigeria, reported that factors associated with respiratory symptoms among quarry workers were duration of work, indoor cooking and smoking.[1]

Dust with particulate matter (PM) size <5µm is colourless, odourless, non-irritating, and does not cause immediate health effects; hence, it usually goes unnoticed by the quarry workers in the workplace.[17] Thus, the workers may not protect themselves. Eight of the fourteen LGAs in Zamfara State have some level of informal stone quarrying, and the sites often lack the necessary oversight from the safety officers.[18] Workers in these sites are invariably exposed to hazards unknowingly, which has huge consequences on their health, aside from economic cost. Consequently, this study was set up to assess the prevalence of self-reported respiratory symptoms and associated risk factors among quarry workers in Gusau metropolis. It is believed that findings from the study will help create awareness among the workers on the hazardous effects of dust exposure and the need to take necessary precautions by limiting exposure and the use of PPEs.

MATERIALS AND METHODS

Study Area

The study was conducted in Gusau metropolis, Zamfara State, Northwestern Nigeria. It shares borders with Sokoto state and the Niger Republic to the north, Katsina state to the east and Kaduna, Niger and Kebbi states to the south. With a population growth rate of 3.7% Gusau metropolis has a projected population of 528,400 as of 2021 based on the figures from the 2006 population census and an estimated area of 3364 km² (2,090 m²).[4,18]

Study Design

This cross-sectional study was conducted among quarry workers in Gusau between July and August 2022. All quarry workers who had worked for at least one year were included in the study. Workers with established respiratory morbidities, e.g., tuberculosis, asthma etc., were excluded from the study.

Sample Size Determination

The Cochrane formula for cross-sectional studies $n = \frac{z^2pq}{d^2}$ [19] was used to calculate the minimum sample size. A prevalence of 64.9% (0.649) for respiratory symptoms among quarry workers from a previous study conducted in Zaria was used as "p".[20] Adjustment was made for finite population (n_f) using the formula $n_f = \frac{n}{1+\frac{n}{N}}$ since the estimated number of workers engaged in quarry work in Gusau metropolis was put at 1304, and allowance was made for 10% attrition rate. Therefore, a total of 307 respondents were recruited for the study.

Sampling Technique

The study was conducted in Gusau metropolis which has three (3) quarries. All the quarries were included in the study because two out of the three quarries had numbers of workers less than the sample size. Respondents were selected from each of the three quarries by proportionate allocation of workers. A systematic sampling technique was used to select 307 respondents from the quarries.

Data were collected using a structured interviewer-administered questionnaire adapted from the United Kingdom Medical Research Council Questionnaire on respiratory symptoms.[2,21-24] The questionnaire was pretested, validated and administered to the study respondents at their workplaces by the researchers using Android phones with installed Open Data Kit software.

Data analysis

Data analysis was done using IBM® SPSS version 25. Socio-demographic variables were summarised using mean with standard deviation and frequencies with percentages. A Chi-square test was performed to assess the association between independent socio-demographic/work profiles and self-reported respiratory symptoms. Binary logistic regression was used to determine the predictors of respiratory symptoms among the workers. The level of significance was set at $\alpha = 0.05$.

Ethical Consideration

Ethical approval was obtained from the Health Research Ethics Committee of the Ministry of Health of Zamfara State (ZSHREC01122021). Permission was sought from the heads of all the quarries. Informed consent was obtained from the study respondents after explaining the purpose of the study, the right to accept or refuse participation, and the guarantee of confidentiality.

RESULTS

The mean age of the respondents was 29.8 ± 10.7 years. Out of the 307 respondents, one hundred and three (33.6%) were in the 25 - 34 age group, and these were in the majority. Most 196 (63.8%) of the respondents had worked for between one and ten years at the quarries. The majority of the respondents, 168 (54.8%), were single, and about half 159 (51.8%) had formal education. Fifty-six (18.2%) of them smoked cigarettes, while 31 (10.1%) used addictive drugs (Table 1).

Of the 307 respondents, a hundred and twenty-one (39.4%) reported at least one respiratory symptom. The commonest symptom reported was nasal congestion 74 (24.1%), followed by morning cough 68 (22.1%). (Table 2).

The proportion of respondents with respiratory symptoms was significantly higher among respondents that were 35 years and above, 51 (52.0%), compared to those that were less than 35 years, 70 (33.5%) ($p = 0.002$). Similarly, the proportion of respondents with respiratory symptoms was significantly higher among respondents who smoke cigarettes, 31 (55.4%), compared to those who do not, 90 (35.9%), ($\chi 2 = 7.29$, $p = 0.007$). Likewise, the proportion of respondents with respiratory symptoms was significantly higher among respondents who worked for more than ten years 91 (57.6%), compared to those who had worked for fewer years (20.1%), ($\chi 2 = 45.07$, $p = 0.001$) (Table 3).

Respondents who worked more than 8 hours a day were about 2.5 times more likely to have respiratory symptoms than those who worked for 8 hours or less (aOR 2.46, 95% CI: 1.40 - 4.34, $p<0.002$). Respondents who had worked for more than ten years were about five times more likely to have respiratory symptoms than those who had worked for ten years or less (aOR 4.89, 95% CI: 2.53 - 9.43, $p = 0.001$) (Table 4).

Less than half of the respondents, 143 (46.6%), used hats, and only a few 12 (3.9%) used face masks. None used ear muffs/plugs or overall gowns (Figure 1).

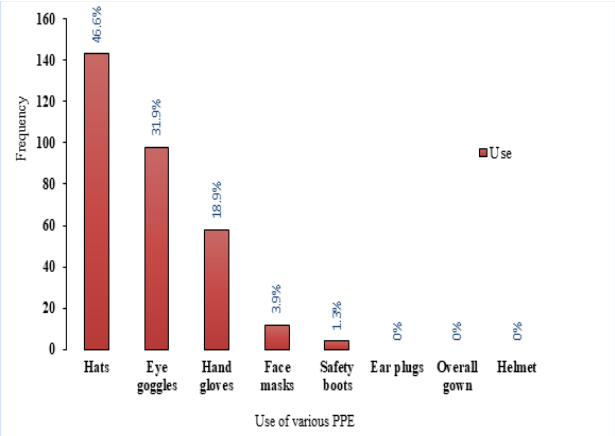
The reasons given by the respondents for not using PPE were that there is no need for PPE (63.5%), high cost (34.9%), discomfort (22.2%), not provided (19.0%), slowing down of work process (17.5%), and not protective (4.8%) (Figure 2).

Table 1: Respondents' so cio

Table 1: Respondents socio-demographic characteristics

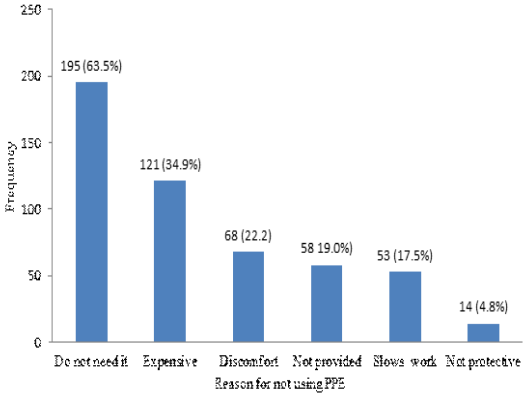
Variables	Frequency (n=307)	Percentage
Age group (years)		
< 15	20	6.5
15 - 24	86	28.0
25 - 34	103	33.6
35 - 44	70	22.8
45 - 54	21	6.8
≥ 55	7	2.3
Sex		
Male	307	100
Tribe		
Hausa/Fulani	307	100
Religion		
Islam	307	100
Marital status		
Married	130	42.3
Single	168	54.8
Separated	1	0.3
Divorced	4	1.3
Widowed	4	1.3
Educational status		
Quranic only	148	48.2
Primary	93	30.3
Secondary	57	18.6
Tertiary	9	2.9
History of cigarette smoking		
Yes	56	18.2
No	251	81.8
Duration of smoking		
1-5 years	32	57.1
> 5 years	24	42.9
Use addictive drugs*		
Yes	31	10.1
No	276	89.9
Work hours per day		
1-8	148	48.2
>8	159	51.8
Duration of work (in years)		
1 - 10	196	63.8
> 10	111	36.2
workplace safety training		
Yes	30	9.8
No	277	90.2

*Tramadol, Indian hemp etc.
**Multiple responses



*Multiple responses

Figure 1: Reported use of various PPE by the respondents



*Multiple responses.

Figure 2: Reasons given by the respondents for not using PPE

Table 2: Prevalence and type of respiratory symptoms among the respondents

*Symptoms	Frequency	Percentage
Reported at least one symptom	121	39.4
Nasal congestion	74	24.1
Morning cough	68	22.1
Morning cough without expectoration	56	18.2
Morning cough with expectoration	52	16.9
Phlegm production	51	16.6
Chest pain	28	9.1
Difficulty in breathing	22	7.2
Difficulty in breathing on exertion	21	6.8
Attack of wheezing or whistling in the last twelve months	19	6.2
Chest illness which kept the client from usual activities for as much as one week in the past three years	4	1.3
Ever woke up at night with an attack of difficulty in breathing in the last twelve months	3	1.0
Difficulty in breathing at rest	2	0.7

*Multiple responses

Table 3: Factors associated with respiratory symptoms

Variables	Respiratory symptoms n (%)		[a] Test statistic, p-value
	Yes	No	
Age (years)			
< 35	70 (33.5)	139 (66.5)	χ2 = 9.61,
‥	51 (52.0)	47 (48.0)	p = 0.002
Marital status			
Married	69 (53.1)	61 (46.9)	χ2 = 17.63,
Unmarried*	52 (29.4)	125 (70.6)	p =0.001
Educational status			
Formal	61 (38.4)	98 (61.6)	χ2 = 0.15,
Informal	60 (40.5)	88 (59.5)	p = 0.697
Smoking			
Yes	31 (55.4)	25 (44.6)	χ2 = 7.29,
No	90 (35.9)	161 (64.1)	p = 0.007
Use of addictive drug			
Yes	17 (54.8)	14 (45.2)	χ2 = 3.44,
No	104 (37.7)	172 (62.3)	p = 0.064
Job descriptions			
Quarry workers	109 (41.0)	157 (59.0)	χ2 = 2.04,
Administrative Staff	12 (29.3)	29 (70.7)	p = 0.153
Training			
Yes	11 (36.7)	19 (63.3)	χ2 = 0.11,
No	110 (39.7)	167 (60.3)	p = 0.746
Daily working hours			
‥	38 (25.7)	110 (74.3)	χ2 = 22.59,
> 8	83 (52.2)	76 (47.8)	p = 0.001
Work days per week			
≤ 5	16 (24.6)	49 (75.4)	χ2 = 7.56,
> 5	105 (43.4)	137 (56.6)	p = 0.006
Duration of work			
≤ 10	30 (20.1)	119 (79.9)	χ2 = 45.07,
> 10	91 (57.6)	67 (42.4)	p = 0.001

[a] Pearson's chi-square test. *(single, separated, divorced, and widowed).

Table 4: Predictors of respiratory symptoms among respondents

Variables	aOR	95% Confidence Interval		p-value
		Lower	Upper	
Age (<35yrs* vs ≥ 35yrs)	0.75	0.35	1.59	0.445
Marital status (married* vs unmarried)	0.73	0.37	1.46	0.374
Smoking (yes* vs no)	0.74	0.31	1.73	0.487
Number of working hours per day ((≤ 8* vs >8)	2.46	1.40	4.34	0.002
Number of working days per week (≤ 5* vs >5)	1.03	0.49	2.19	0.935
Duration of working experience (≤ 10 years* vs > 10yrs)	4.89	2.53	9.43	0.001

*Reference value aOR- adjusted odds ratio

DISCUSSION

Workers' health status determines their productivity, and workplace exposures affect workers' health.[25, 26] This connection between work and health is well documented in literatures.[25, 26] However, what workers do or fail to do determines if their health will be affected by their work. This study assessed how stone quarrying affects workers' respiratory health and the factors contributing to these conditions. We found a high burden of respiratory symptoms among our study population, with more than a third reporting having at least one respiratory symptom. Nasal congestion was the most common of all the respiratory symptoms reported by our respondents, with one out of every four reporting this symptom. The prevalence of nasal congestion in this study is similar to the 27.0% reported in Edo, Nigeria,[1] but lower than the 52.3% reported in Zaria, where nasal congestion was also the most common respiratory symptom reported by the workers.[20] However, in another study in Kerman, Iran, a lower prevalence of nasal congestion was reported compared to findings in our study, with only a fifth of the workers, 20.1%, reporting nasal congestion.[9] Similarly, in a study in Bangladesh, nasal congestion was also the most common respiratory symptom reported by the workers.[27] In another study in Brunei, cough was the most prevalent symptom reported by quarry workers, in contrast to findings in our study, and this could be a result of the dust size generated in the quarry.[12]

More than one-fifth of the respondents in this study had a cough. A similar proportion of cough was reported in Edo, 23.7%, Iran, 23.9%, Brunei 26.1% and Bangladesh 28.3%.[1,9,11,12] The high prevalence of cough among the respondents in this study could affect the quarry's productivity, as some employees might experience fatigue that prevents them from working due to illnesses.[1] However, the prevalence of cough was much lower than the 40.7% reported in Ebonyi, Nigeria.[7] This difference could be because the workers in Ebonyi may have reported more coughs to benefit from the lung function tests (spirometry and chest roentgenography) that are probably offered for those with coughs.[7]

Chest pain was another major symptom reported by respondents in this study, with as many as one in ten respondents having this symptom. This is similar to the 10.8% reported in Zaria[20] but lower than the 47.6% reported in Ebonyi and 35.5% reported in Edo all in Nigeria.[1,7] Compared to other studies outside Nigeria, the prevalence of chest pain in this study is higher than the 4.3% reported in Brunei but lower than the 17.8% reported in Palestine.[2,12] Reasons for this disparity could be due to the size of the dust particles workers are exposed to, and the duration for which they have been exposed to this hazard as both are associated with a type of respiratory symptoms developed by workers exposed to dust in the workplace.[30]

Few respondents (7.2%) in this study had difficulty in breathing, similar to the 6.5% reported in Ebonyi, 7.9% in Edo, 4.3% in Brunei, and 4.6% in Bangladesh.[1,7,11,12] Exposure to comparable dust particulate matter with similar chemical properties could be the cause of the similarities with these studies. The difficulty in breathing in this study is lower than the 23.9% reported in Iran.[9] The difference in the Iranian study may be because the majority (74.6%) of the stone carvers work indoors, inhaling more dust due to poor ventilation. The difficulty in breathing could affect the quarry's productivity, and some employees might experience various comorbidities that keep them from working owing to illness. Furthermore, continuous dust exposure without respiratory prevention could predispose affected workers to COPD, silicosis, lung cancer or mortality.[13] Very few respondents reported wheezing, similar to 5.2% reported in Ebonyi, 10.5% in Edo, 2.3% in Bangladesh, and 3.8% in Palestine.[1,2,7,11] The similar respondents' ages in the quarries may be the cause of the similarity. On the contrary, the finding in this study is lower than the 17.4% reported in Iran.[9] The fact that the bulk of the workers in the Iran study performed their job indoors may account for the difference. The few respondents who wheezed might be dealing with partial airway obstruction, breathing difficulties, sleep disturbances, and physical weakness.[29] The wheezing may go away on its own or may worsen and indicate a serious ailment like asthma,

pneumonia, heart failure, and more.[29]

Factors associated with the respiratory symptoms were marital status, smoking, working hours, work days per week and duration of work. However, number of working hours per day and duration of work were the factors that predicted the respondent's likelihood of having respiratory symptoms. Working more than 8 hours a day in the quarries increased the likelihood of respiratory symptoms by 2.5-fold. This could be because respondents who worked for more than 8 hours daily had more exposure to dust due to the long hours they had worked. Similarly, working for more than ten years in the quarries increased the likelihood of respiratory symptoms by fivefold. A similar study in Ebonyi reported that workers with more than ten years of exposure duration had a higher degree of respiratory function impairment and concluded that occupational health hazards were time-dependent.[30] Understandably, the longer the duration of work, the more years of exposure there are, hence the respiratory morbidities.

Less than half of the respondents used hats, safety goggles, and hand gloves. Very few workers used face masks and safety boots but did not use earmuffs or overalls. Most workers who did not use the PPE said they do not need it. The other reasons for workers' low utilization of PPE were being expensive, causing discomfort, and not being provided among others.

Findings from this study showed that almost all of the respondents had no training on safety measures before the commencement of work in the quarries. This finding is comparable to a study in Kenya, which established that lack of workers' training (95%) was among the major contributing factors affecting the implementation of OSH measures in quarries.[150] The low utilization of PPE in this study may have greatly increased respondents' morbidities.[31]. A study in Kenya established that management lacked commitment to workers' occupational safety and health (OSH) and concluded that it was the top contributing factor affecting the implementation of OSH measures in quarries.[32]

CONCLUSION

The study found a high prevalence of respiratory symptoms among quarry workers with nasal congestion being the commonest respiratory symptoms. Working hours per day and duration of work were the factors that predicted the respondent's likelihood of having respiratory symptoms. Hence, there is a need for state regulatory authorities and quarry employers to educate and enforce the practices of not working beyond 8 hours a day and use of PPE.

Recommendations

State regulatory authorities and quarry employers should educate and enforce the practices of not working beyond eight hours a day and use of PPE.

Limitations of this Study

A limitation of this study is that it depends on information from the study respondents to estimate the reported respiratory symptoms. This may be prone to recall bias due to self-reporting of respiratory symptoms. This was minimized by making the data collection process confidential and ensuring that the respondents were adequately briefed on the purpose of the research.

Acknowledgements

Our appreciation goes to all the respondents who participated in the survey.

Conflict of Interest

None was declared by the authors.

Authors' Contributions

SA conceptualized the study, and contributed to data collection, analysis and manuscript writing. RMO and KAU contributed to designing the study, research instrument and preparation of the final draft of the manuscript. AAS, AHS, DMZ and BM contributed to designing the study and data collection. BMM, AMD, and IHG contributed to the review of literature, data analysis and interpretation. YM and ABA contributed to the review of the literature and preparation of the final draft of the manuscript. All the authors were involved in the writing of the manuscript at the draft and the revision stages, and have thoroughly read and approved the final version.

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