Journal of Public Health and Environmental Research, 2(2):106–114, July-December: 2026.
DOI: https://doi.org/10.58612/jpher2212

Journal of Public Health and Environmental Research
ISSN (Online): 3108-3196

Journal homepage: https://www.fpub.org/journal-details.php?journal-id=41

Research Article

Prevalence and Factors Associated with Acute Respiratory Symptoms Among Oil and Gas Workers in Port Harcourt, Nigeria

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Article Info

Keywords: *Acute respiratory symptoms, Oil and gas workers, Adjusted odds ratio, Occupational health, Prevalence, Personal protective equipment, Port Harcourt, Nigeria.*

Received: *03.10.2026;*
Accepted: *01.11.2026;*
Published: *06.11.2026*

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Abstract

Background: This study assessed ARS prevalence and associated factors among oil and gas workers in Port Harcourt, Nigeria. **Methods:** A cross-sectional study involved 141 workers from selected oil-related facilities. Data were collected using an interviewer-administered questionnaire. ARS meant reporting at least one of four symptoms: cough lasting at least three months, shortness of breath, wheezing, or chest tightness/pain. Descriptive statistics, chi-square tests and multivariable logistic regression were used. Odds ratios included 95% CIs; $p < 0.05$ denoted significance. **Results:** Seventy-seven workers reported symptoms (ARS prevalence: 54.6%; 95% CI: 46.4–62.6). Shortness of breath was most common (36.2%), followed by wheezing (29.8%), prolonged cough (29.1%) and chest tightness/pain (27.0%). Associations involved exposure frequency (p = 0.003), daily exposure time (p = 0.017), employment duration (p = 0.015) and current smoking (p = 0.013). Adjusted analyses found lower odds among men than women (AOR = 0.32, 95% CI: 0.13–0.80; p = 0.014), and among workers reporting occasional (AOR = 0.30, 95% CI: 0.10–0.86; p = 0.025) or no exposure (AOR = 0.16, 95% CI: 0.04–0.56; p = 0.004), compared with daily/frequent exposure. Sometimes using personal protective equipment (PPE) (AOR = 3.97, 95% CI: 1.43–11.02; p = 0.008) and current smoking (AOR = 13.59, 95% CI: 1.38–133.59; p = 0.025) were associated with higher odds. Among symptomatic workers, 48.1% sought medical care. **Conclusion:** More than half reported an assessed symptom. Findings support workplace exposure reduction, appropriate respiratory protection, confidential reporting and occupational health assessment. Cross-sectional, self-reported findings cannot establish causality or confirm clinical diagnoses.

1. Introduction

Respiratory health is an important component of occupational health, particularly in workplaces where employees may inhale dust, fumes, vapours and combustion products. Oil and gas exploration, production, processing, maintenance and related support activities can expose workers to complex mixtures of airborne contaminants. The type and intensity of exposure may vary according to the task performed, the worksite, the effectiveness of control measures and the time spent in affected areas. Exposure to airborne pollutants is a recognised concern for workers in industrial settings, and occupational respiratory symptoms can serve as early indicators of potential workplace hazards [1]. However, symptoms alone cannot establish a clinical diagnosis or quantify lung-function impairment [2–4].

How To Cite: F.O. Nwamadi, A.I. Wegbom, Q.D. Atuzie, A.A. Ogba, and E. Umezuruike. Prevalence and factors associated with acute respiratory symptoms among oil and gas workers in Port Harcourt, Nigeria. *Journal of Public Health and Environmental Research*, 2(2):106–114, 2026. https://doi.org/10.58612/jpher2212

Studies in petrochemical and other industrial settings have investigated respiratory symptoms and pulmonary function among exposed workers. Sadeghi-Yarandi et al. [5], for example, assessed respiratory symptoms and pulmonary function among workers exposed to 1,3-butadiene in a petrochemical industry. Research involving oil-spill response workers has also examined lung function and longer-term respiratory outcomes following petroleum-related exposures [6, 7]. Other studies have documented respiratory symptoms or ventilatory-function changes among workers exposed to petroleum products, textile dust, quarry dust, traffic-related air pollution and combustion products [8–13]. Collectively, these studies indicate that respiratory health needs attention across diverse occupational settings.

In Nigeria's Niger Delta, oil production, gas flaring, oil spills and artisanal refining have raised concerns about environmental pollution and respiratory health. A systematic review and meta-analysis examined respiratory-related ailments among residents of Nigerian states affected by gas flaring [14], while Ephraim-Emmanuel et al. [15] investigated respiratory health effects associated with pollution from artisanal crude-oil refining in Bayelsa State. Research among artisanal refinery operators in Rivers State has also examined blood-gas patterns, providing further occupational context for understanding potential health effects in petroleum-related work [16]. In addition, Akpan et al. [17] reported data on respiratory symptoms and pulmonary impairment associated with exposure to non-combusted liquefied petroleum gas. Although these studies contribute to the regional evidence base, community residents and employees of selected oil and gas facilities are distinct populations. Their occupational tasks, exposure patterns, protective measures and access to workplace health services may differ.

Port Harcourt is a major urban centre in Rivers State and an important part of the Niger Delta's oil and gas economy. Evidence from other Nigerian occupational settings, including traffic, quarry, textile and charcoal workers, has demonstrated the value of assessing respiratory symptoms and, where possible, lung function among workers exposed to airborne hazards [9–11, 18, 19]. However, findings from these occupations cannot be assumed to represent workers in oil and gas facilities. Local evidence describing the prevalence and pattern of respiratory symptoms among oil and gas workers in Port Harcourt remains limited. A symptom-based assessment can help identify a burden that warrants further evaluation and inform occupational health priorities.

Effective occupational health programmes emphasise the identification and control of workplace hazards, appropriate respiratory protection and access to health surveillance [2, 3, 20, 21].

The hierarchy of controls prioritises eliminating or reducing hazards at source before relying on personal protective equipment alone, while respiratory-protection programmes should be appropriate to the hazards present [22, 23]. These principles are relevant to oil and gas workplaces where airborne exposures may occur.

The present study assessed the prevalence and common types of acute respiratory symptoms among oil and gas workers in Port Harcourt, Rivers State, Nigeria, and examined factors associated with symptom reporting. Occupational exposure and smoking variables were also considered as relevant covariates when interpreting demographic associations. The study focuses on self-reported symptoms rather than clinically confirmed respiratory diagnoses.

Studies among other Nigerian occupational groups have also examined the relationship between workplace air quality and respiratory symptoms, including among garri-processing workers in Ogbomoso [24].

In Nigeria's Niger Delta, oil production, gas flaring, oil spills and artisanal refining have raised concerns about environmental pollution and respiratory health [25].

2. Methods

2.1. Study design and setting

A cross-sectional study was conducted among oil and gas workers at selected oil-related facilities in Port Harcourt, Rivers State, Nigeria. The study was conducted at the selected oil-related companies, Halliburton and Nigeria LNG (NLNG) in Port Harcourt, Rivers State. Data were collected at one point in time; accordingly, the design supports estimation of symptom prevalence and cross-sectional associations.

2.2. Study population and sampling

The study population comprised workers engaged in oil and gas operations and related support activities in Port Harcourt. The final sample comprised 141 workers. The initial sample size was calculated using the single-proportion formula, with a 95% confidence level (Z = 1.96), estimated prevalence of 9.2% drawn from Ale et al. [26], and a 5% margin of error. The calculated minimum was approximately 128.4, increased by 10% to 141. The sampling procedure was multistage: operational sites were purposively selected based on relevance, eligible workers were identified, and workers were selected by simple random sampling within sites. The response rate was reported as 100%.

2.3. Sample size

The sample size for this study was determined using the standard single proportion formula:

$$n = \frac{(z^2 p(1-p))}{d^2}$$

Where,

n = required sample size, z = z score for 95% confidence level (1.96), p = estimated prevalence of acute respiratory disease = p=0.092 [26], d = acceptable margin of error (0.05).

Therefore,

$$n = \frac{3.8416 \times 0.092 \times 0.908}{0.05^2} = \frac{0.3209}{0.0025}$$

$$n = 128.4$$

With 10% contingency:

$128.4 \times 1.10 = 141$

2.4. Sampling technique

Stage 1: Operational sites within selected oil and gas facilities in Port Harcourt, Rivers State were purposively selected based on involvement in oil and gas activities, availability of eligible workers, and accessibility for data collection.

Stage 2: Eligible workers at each selected site were identified using the predefined inclusion and exclusion criteria.

Stage 3: The required number of eligible workers from each site was selected using simple random sampling, giving every eligible worker an equal chance of participation.

2.5. Data collection and study variables

Data were collected using a structured interviewer-administered questionnaire. Information covered socio-demographic characteristics, employment and job roles, occupational exposure, use of personal protective equipment (PPE), smoking and other environmental factors, respiratory symptoms, health surveillance, perceptions of workplace air quality, and healthcare-seeking behaviour.

The primary outcome was the presence of at least one of four assessed symptoms: cough lasting at least three months, shortness of breath, wheezing, or chest tightness/pain. A participant reporting one or more of these symptoms was classified as having ARS for this analysis. This operational definition is symptom-based and should not be taken to mean that the participant had a clinically confirmed acute respiratory disease. Individual symptom prevalence used all 141 participants as the denominator; because participants could report more than one symptom, symptom-specific percentages are not additive.

Explanatory variables included age, sex, marital status, educational attainment, monthly income, job designation, employment status and duration of employment. Occupational variables included main work environment, reported frequency of exposure to smoke, dust or fumes, daily hours spent in affected areas, PPE use, provision of respiratory protective equipment, and receipt of training on reducing health risks. Current smoking and selected environmental factors were also examined.

2.6. Statistical analysis

Data were coded and analysed using SPSS version 24. Descriptive statistics summarised participant characteristics and symptom prevalence. Prevalence estimates were presented with 95% CIs. Pearson's chi-square tests assessed associations between categorical variables and ARS. Binary logistic regression was used to estimate crude and adjusted odds ratios (ORs) with 95% CIs. The significance threshold was $p < 0.05$.

2.7. Ethical considerations

Ethical approval documentation was provided to the participating companies, permission was obtained from the companies, and written informed consent was obtained from all participants. Participation was voluntary, confidentiality was maintained, and identifying information was excluded from the dataset.

3. Results

3.1. Participant characteristics

Table 1: Socio-demographic and employment characteristics of respondents (N = 141)

Characteristic	N	%
Age <20 years	54	38.3
Age 20–30 years	61	43.3
Age 31–40 years	17	12.1
Age >40 years	9	6.4
Male	52	36.9
Female	89	63.1
Never married	115	81.6
Ever married	26	18.4
Secondary education or below	24	17.0
Tertiary education	117	83.0
Employment <1 year	89	63.1
Employment 1–5 years	39	27.7
Employment 6–10 years	9	6.4
Employment >10 years	4	2.8
Permanent employment	38	27.0
Contract employment	37	26.2
Casual employment	66	46.8

A total of 141 workers participated. The mean age was 23.3 years (standard deviation [SD] 7.3); median age was 20 years (interquartile range 18–26), and the reported age range was 16–48 years. Women constituted 63.1% (89/141) of the sample, while men constituted 36.9% (52/141). Most participants had never married (81.6%) and had tertiary education (83.0%). More than three-fifths (63.1%) had worked in the industry for less than one year. Casual employment was the most frequently reported employment status (46.8%).

The socio-demographic and employment characteristics of the respondents are presented in Table 1.

3.2. Occupational exposures and protective practices

Dust was the most commonly reported exposure affecting breathing (48.2%), followed by gas fumes (33.3%), smoke (29.1%), chemical vapours (26.2%) and oil spills (13.5%). For frequency of exposure to smoke, dust or fumes, 48.9% reported occasional exposure, 24.1% frequent exposure, 7.1% daily exposure and 19.9% no exposure. Most participants reported spending fewer than four hours per day in areas with smoke, dust or fumes (72.3%).

Most participants (76.6%) reported taking personal measures to reduce exposure. Always using PPE was reported by 58.9%, while 27.7% reported sometimes using PPE. A face mask or respirator was the most commonly reported protective item (66.7%); 21.3% reported using none of the listed items. Respiratory protective equipment was reportedly provided by the employer for 77.3% of participants, and 75.9% reported receiving information or training on reducing health risks.

The distribution of reported occupational exposures and protective practices among the respondents is shown in Table 2.

Table 2: Occupational exposure and protective-practice characteristics of respondents

Occupational characteristic	N	%
Dust exposure affecting breathing	68	48.2
Gas fumes	47	33.3
Smoke	41	29.1
Chemical vapours	37	26.2
Oil spills	19	13.5
Never exposed to smoke/ dust/fumes	28	19.9
Occasionally exposed	69	48.9
Frequently exposed	34	24.1
Daily exposure	10	7.1
Exposure area <4 h/day	102	72.3
Exposure area 4–8 h/day	35	24.8
Exposure area >8 h/day	4	2.8
Always uses PPE	83	58.9
Sometimes uses PPE	39	27.7
Rarely uses PPE	10	7.1
Never uses PPE	9	6.4
Employer provides respiratory protective equipment	109	77.3
Received risk-reduction training	107	75.9

3.3. Lifestyle, environmental context and health surveillance

Eleven participants (7.8%) reported current smoking, and 28.4% reported regular exposure to second-hand smoke. Gas was the main household cooking fuel for 87.2%. One in five participants (19.9%) reported a known allergy affecting breathing. Regarding occupational health surveillance, 37.6% reported a job-related medical examination in the preceding 12 months, while 15.6% reported ever having a lung-function test; 17.0% were unsure whether they had undergone such a test. Nearly three-fifths (59.6%) said they never reported respiratory symptoms to an employer or clinic.

3.4. Prevalence and types of acute respiratory symptoms

Seventy-seven participants reported at least one assessed symptom, giving an overall ARS prevalence of 54.6% (95% CI 46.4–62.6). Shortness of breath was the most common symptom (51/141; 36.2%), followed by wheezing (42/141; 29.8%), cough lasting at least three months (41/141; 29.1%) and chest tightness/pain (38/141; 27.0%). A total of 64 participants reported no assessed symptoms. Twenty-five reported one symptom, 21 reported two, 19 reported three, and 12 reported all four symptoms.

The prevalence and distribution of the assessed respiratory symptoms among the respondents are presented in Table 3.

Table 3: Prevalence and distribution of assessed respiratory symptoms of respondents (N = 141)

Respiratory outcome	N	Prevalence (%)	95% CI (%)
At least one assessed symptom	77	54.6	46.4–62.6
Shortness of breath	51	36.2	28.7–44.4
Wheezing	42	29.8	22.9–37.8
Cough lasting ≥3 months	41	29.1	22.2–37.0
Chest tightness/pain	38	27.0	20.3–34.8
No assessed symptom	64	45.4	37.4–53.6
One symptom	25	17.7	12.3–24.9
Two symptoms	21	14.9	10.0–21.7
Three symptoms	19	13.5	8.8–20.1
Four symptoms	12	8.5	4.9–14.3

3.5. Associations between participant characteristics and ARS

ARS prevalence was 59.6% among women and 46.2% among men; the bivariate association was not statistically significant (χ^2 = 2.38, p = 0.123). Prevalence increased descriptively across older age groups, from 53.7% among those younger than 20 years to 66.7% among those older than 40 years, but the overall association was not statistically significant (χ^2 = 1.59, p = 0.660). There was no statistically significant bivariate association with marital status, education, income, job designation, employment status or main work environment in the reported analyses.

Employment duration was associated with ARS (χ^2 = 10.42, p = 0.015). Symptom prevalence was 50.6% among workers employed for less than one year and 71.8% among those employed for 1–5 years. Exposure frequency was also associated with ARS (χ^2 = 13.63, p = 0.003): prevalence was 32.1% among those reporting no exposure, 50.7% among those reporting occasional exposure, 73.5% among those reporting frequent exposure and 80.0% among those reporting daily exposure. Daily time spent in smoky/dusty/fume-filled areas was associated with ARS (χ^2 = 8.17, p = 0.017), as was current smoking (χ^2 = 6.12, p = 0.013).

The bivariate associations between selected participant characteristics, occupational exposures and acute respiratory symptoms are summarised in Table 4.

Table 4: Selected bivariate associations with acute respiratory symptoms

Characteristic	ARS n/N (%)	χ^2	p
Age group		1.59	0.660
<20 years	29/54 (53.7)		
20–30 years	31/61 (50.8)		
31–40 years	11/17 (64.7)		
>40 years	6/9 (66.7)		
Sex		2.38	0.123
Male	24/52 (46.2)		
Female	53/89 (59.6)		
Employment duration		10.42	0.015
<1 year	45/89 (50.6)		
1–5 years	28/39 (71.8)		
6–10 years	4/9 (44.4)		
>10 years	0/4 (0.0)		
Exposure frequency		13.63	0.003
Never	9/28 (32.1)		
Occasionally	35/69 (50.7)		
Frequently	25/34 (73.5)		
Daily	8/10 (80.0)		
Daily hours exposed		8.17	0.017
<4 hours	50/102 (49.0)		
4–8 hours	26/35 (74.3)		
>8 hours	1/4 (25.0)		
Current smoking		6.12	0.013
No	67/130 (51.5)		
Yes	10/11 (90.9)		

3.6. Multivariable logistic regression

In the adjusted model, male workers had lower odds of reporting ARS than female workers (AOR 0.32, 95% CI 0.13–0.80; p = 0.014). Age was not independently associated with ARS (AOR per one-year increase 1.01, 95% CI 0.94–1.08; p = 0.773). Compared with daily/frequent exposure, occasional exposure (AOR 0.30, 95% CI 0.10–0.86; p = 0.025) and no reported exposure (AOR 0.16, 95% CI 0.04–0.56; p = 0.004) were associated with lower odds. Sometimes using PPE, compared with always using it, was associated with higher odds (AOR 3.97, 95% CI 1.43–11.02; p = 0.008). Current smoking was associated with higher odds (AOR 13.59, 95% CI 1.38–133.59; p = 0.025), although the confidence interval was wide.

The selected adjusted associations between participant characteristics, occupational factors and acute respiratory symptoms are presented in Table 5.

Table 5: Selected adjusted associations with ARS

Variable/comparison	AOR	95% CI	p
Male vs female	0.32	0.13–0.80	0.014
Age (per one-year increase)	1.01	0.94–1.08	0.773
Occasional vs daily/frequent exposure	0.30	0.10–0.86	0.025
Never vs daily/frequent exposure	0.16	0.04–0.56	0.004
Sometimes vs always using PPE	3.97	1.43–11.02	0.008
Rarely/never vs always using PPE	1.31	0.40–4.32	0.657
Current smoker vs non-smoker	13.59	1.38–133.59	0.025
Less than 1 year vs 1–5 years employed	0.43	0.16–1.15	0.093
$\geq$6 years vs 1–5 years employed	0.39	0.08–1.92	0.246
Received training vs no training	1.55	0.54–4.41	0.416

3.7. Health-Seeking Behaviour Among Symptomatic Workers

Among the 77 workers reporting at least one symptom, 37 (48.1%) had ever sought medical care and 40 (51.9%) had not. Among those who had sought care, private hospitals or clinics were the most commonly reported setting (51.4%), followed by public hospitals and company clinics (27.0% each); responses could include more than one care setting. Cost of care and lack of time were each reported as barriers by 37.7% of symptomatic workers. Other reported barriers included believing symptoms were not serious (27.3%), distance to a health facility (22.1%) and fear of job-related consequences (11.7%).

The healthcare-seeking patterns and reported barriers to accessing medical care among workers with acute respiratory symptoms are presented in Table 6.

Table 6: Selected Healthcare-Seeking Indicators Among Workers With ARS

Health-seeking indicator	N	%	Denominator/notes
Ever sought medical care	37	48.1	Symptomatic workers, N=77
Never sought medical care	40	51.9	Symptomatic workers, N=77
Private hospital/clinic	19	51.4	Among care seekers, n=37; multiple responses
Public hospital	10	27.0	Among care seekers, n=37; multiple responses
Company clinic	10	27.0	Among care seekers, n=37; multiple responses
Cost of care as barrier	29	37.7	Symptomatic workers, N=77
Lack of time as barrier	29	37.7	Symptomatic workers, N=77
Distance as barrier	17	22.1	Symptomatic workers, N=77
Symptoms not considered serious	21	27.3	Symptomatic workers, N=77
Fear of job-related consequences	9	11.7	Symptomatic workers, N=77

4. Discussion

In this cross-sectional sample of 141 oil and gas workers in Port Harcourt, 54.6% reported at least one of four assessed respiratory symptoms. Shortness of breath was most common, followed by wheezing, cough lasting at least three months, and chest tightness/pain. The finding indicates a substantial burden of self-reported respiratory complaints among the workers surveyed. The pattern is relevant to occupational respiratory-health research in petroleum-related and other industrial settings. Sadeghi-Yarandi et al. [5] assessed respiratory symptoms and pulmonary function among petrochemical workers exposed to 1,3-butadiene. Research among oil-spill response workers has also investigated respiratory symptoms, lung function and chronic respiratory outcomes after petroleum-related exposures [6, 7]. In Nigeria, studies have examined respiratory health among residents of communities affected by artisanal refining and respiratory ailments in gas-flaring states [14, 15]. These studies support the relevance of respiratory-health surveillance in oil-related contexts, but direct comparisons are limited by differences in population, exposure measurement, study design and symptom definitions.

Reported exposure frequency showed a gradient in symptom prevalence: 32.1% among workers reporting no exposure, 50.7% among those reporting occasional exposure, 73.5% among those reporting frequent exposure, and 80.0% among those reporting daily exposure. The adjusted model similarly showed lower odds of ARS among workers reporting occasional or no exposure compared with those reporting daily/frequent exposure. This pattern is compatible with an exposure-response interpretation, but the exposure measure was self-reported and broad.

PPE use was associated with symptoms in the adjusted model. Workers who sometimes used PPE had higher odds of ARS than those who always used PPE. Current smoking was associated with substantially higher adjusted odds of ARS (AOR 13.59; 95% CI 1.38–133.59). Smoking may contribute to respiratory symptoms and may occur alongside occupational exposures. The adjusted association between sex and symptoms should also be interpreted cautiously. Women had a higher crude symptom prevalence than men, although the bivariate difference was not statistically significant; after adjustment, male sex was associated with lower odds of ARS.

Most participants had not received a job-related medical examination in the previous 12 months, and only a minority reported ever having a lung-function test. In addition, 59.6% said they never reported respiratory symptoms to an employer or clinic. These observations suggest potential gaps in the reach of workplace health surveillance within this sample. Symptom reporting and screening should be confidential, accessible and linked to appropriate clinical assessment. Where indicated, objective testing such as spirometry can help distinguish symptom reports from measurable lung-function impairment.

Only 48.1% of symptomatic workers reported ever seeking medical care. Cost and lack of time were the most frequently cited barriers, while some workers did not consider symptoms serious and a smaller proportion reported fear of job-related consequences. These findings are important because symptom surveillance will have limited value if workers cannot access assessment or fear negative consequences from disclosure. Occupational health programmes can consider convenient clinic hours, clear confidentiality protections, non-punitive reporting, and referral pathways.

Strengths and limitations

A strength of the study is its focus on workers in selected oil and gas facilities, a group distinct from community residents living near oil-related pollution sources. It reports overall and symptom-specific prevalence, explores occupational and demographic correlates, and describes care-seeking among symptomatic workers. The use of confidence intervals and adjusted regression adds information beyond simple frequency counts.

Several limitations should be considered. First, the cross-sectional design prevents conclusions about temporal sequence or causality. Second, respiratory symptoms and exposure frequency were self-reported and may be affected by recall and reporting bias. Third, no quantitative air monitoring or spirometry results were reported, so inhaled dose and physiological impairment cannot be established. Fourth, selected sites and a sample of 141 workers limit generalizability to other facilities, job categories and the wider Niger Delta. Fifth, the smoking estimate is imprecise because few participants reported current smoking.

Implications for practice and research

Employers should prioritize identification and reduction of airborne hazards at source, appropriate ventilation and process controls, and respiratory protective equipment matched to the hazard and supported by fit-testing, training, maintenance and supervision. Routine occupational health surveillance should include confidential symptom assessment and access to clinical evaluation when indicated. Workers should receive clear information on respiratory hazards and how to report symptoms without fear of employment-related consequences. Smoking cessation support may be incorporated into broader worker health programmes.

5. Conclusions

More than half of the 141 surveyed oil and gas workers reported at least one assessed respiratory symptom, with shortness of breath the most common. ARS was associated in bivariate analyses with frequency of exposure to smoke, dust or fumes, time spent in affected areas, duration of employment and current smoking. In adjusted analyses, sex, exposure frequency, intermittent PPE use and current smoking were associated with symptom reporting, although some estimates—particularly for smoking—were imprecise. Fewer than half of symptomatic workers had ever sought medical care. These findings support improved workplace exposure control, appropriate and consistent respiratory protection, confidential health surveillance and accessible clinical assessment.

Recommendations

Based on the high prevalence of acute respiratory symptoms, oil and gas companies in Port Harcourt should introduce routine, confidential symptom screening as part of pre-employment and periodic medical examinations. Occupational health units must train staff to recognise and act on early respiratory complaints before they progress.

In view of the strong association between exposure intensity and symptoms, company management and safety departments should prioritise engineering controls that reduce ambient levels of smoke, dust and fumes at source. Where residual exposure remains unavoidable, daily time spent in high-exposure zones must be strictly limited. Consistent supply, fit-testing and supervised use of appropriate respirators should be made mandatory, with non-compliance treated as a safety violation rather than a personal choice.

Given the elevated risk among female workers and current smokers, human-resource and medical departments should ensure that respiratory-protection programmes and health education reach all workers equally, regardless of sex. Workplace smoking-cessation support, including counselling and access to nicotine-replacement therapy, should be offered free of charge and during paid time.

To address the low rate of care-seeking and the barriers of cost, time and fear of job consequences, company clinics must operate as confidential, non-punitive services. Clinic hours should accommodate shift patterns, and workers must be clearly informed that reporting symptoms will not affect employment status. Subsidised or free treatment for occupational respiratory complaints should be provided.

At the regulatory level, the Department of Petroleum Resources and the Federal Ministry of Labour should enforce quantitative exposure monitoring and mandatory respirator programmes across all oil and gas facilities in Rivers State. National occupational-health guidelines should explicitly include oil and gas workers in non-communicable disease surveillance.

Oil and gas companies should strengthen their occupational health and safety management systems through systematic hazard identification, risk assessment, implementation of control measures and continuous monitoring, in line with ISO 45001:2018 [27].

Where respirable crystalline silica exposure is identified, employers should implement appropriate exposure-monitoring and control measures, including engineering controls and suitable respiratory protection, in accordance with NIOSH recommendations [28].

Article Information

Ethical Approval: Ethical approval was obtained from the Research Ethics Committee of the Faculty of Basic Medical Sciences, Rivers State University (RSU/FBMS/REC/26/783).

Informed Consent: Electronic informed consent was obtained from all participants before they completed the online questionnaire.

Consent for Publication: Not applicable.

Data Availability: The dataset generated and analysed during the current study is available from the corresponding author upon reasonable request, subject to applicable ethical and confidentiality requirements.

Clinical Trial Registration: Not applicable.

Conflict of Interest: The authors declare no conflict of interest.

Funding: The authors received no specific funding for this work.

Acknowledgments: We sincerely acknowledge the participating oil and gas companies and research assistants for their cooperation and support throughout the research period. We also express our sincere gratitude to the individual study participants for their time and willingness to participate in this research.

Author Contributions: F.O.N. - Conceptualization, Methodology, Investigation, Data Curation, Formal Analysis, Resources, Writing – Original Draft, Writing – Review & Editing, Project Administration; A.I.W. - Conceptualization, Methodology, Formal Analysis, Writing – Review & Editing, Supervision, Project Administration; Q.D.A. - Conceptualization, Methodology, Writing – Review & Editing, Project Administration; A.A.O. - Methodology, Writing – Original Draft, Writing – Review & Editing, Project Administration; E.U. - Methodology, Data Curation, Writing – Original Draft, Writing – Review & Editing, Supervision, Project Administration.

AI Use Disclosure: Generative artificial intelligence, specifically ChatGPT by OpenAI, was used to assist with language refinement.

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