Contributing Risk Factors for Chronic Health Conditions among Oil Drilling Workers: A Predictive Modeling Approach

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ABSTRACT

Chronic health conditions among oil drilling workers represent a significant occupational health challenge in the oil and gas industry. Previous studies have described the prevalence of occupational health outcomes, but there is a need to understand how contributing factors affect chronic health outcomes. This study adopted a cross-sectional design aimed at identifying and quantifying contributing risk factors associated with chronic health conditions among oil drilling workers using logistic regression modelling. A total of 350 oil drilling workers across the Niger Delta region participated in the study. Structured questionnaires captured data on work-related factors (physical job demands, work control/autonomy, exposure frequency), organisational factors (supervisor support, organisational stress support, PPE usage), personal factors (smoking status, exercise frequency), and demographic characteristics (age, years of experience). Logistic regression analysis was employed to examine associations between predictor variables and chronic health outcomes. Results revealed that exposure frequency emerged as the strongest work-related predictor (OR = 2.11, 95% CI: 2.10-2.13, $p < 0.001$), with each unit increase associated with 111.4% increased odds of chronic health conditions. Organisational stress support demonstrated substantial protective effects (OR = 0.51, 95% CI: 0.50-0.51, $p < 0.001$), reducing health risk odds by 49.4%. Personal factors showed that smoking increased risk by 29.1% (OR = 1.29, $p < 0.001$), while exercise frequency decreased risk by 29.4% (OR = 0.71, $p < 0.001$). Age group emerged as the strongest demographic predictor, with each unit increase associated with 64.9% increased odds (OR = 1.65, 95% CI: 1.63-1.66, $p < 0.001$). These findings provide evidence that chronic health conditions among oil drilling workers are influenced by multiple interacting factors across work-related, organisational, personal, and demographic domains, supporting the necessity of multifaceted approaches to occupational health management.

Keywords: Risk factors, protective measures, logistic regression, occupational health surveillance, oil drilling workers, predictive modelling

INTRODUCTION

Occupational health issues amongst oil drilling workers are a critical occupational health problem that affects the well-being of workers, their performance, as well as organisational performance. Oil drilling operations subject workers to several occupational hazards such as physical demands, chemical exposures, noise, heat stress, and psychosocial stressors (Benson et al., 2021). Recent studies have shown that the prevalent occupational hazards in the oil and gas industry are ergonomic hazards, physical hazards, and chemical hazards (Benson et al., 2021; Eyayo, 2014). Prolonged exposure to these occupational hazards could lead to chronic health issues and diseases. Toxicological study has shown that drilling fluids are highly toxic to the skin and cause skin irritation, contact dermatitis, epidermal keratinisation, pronounced proliferation of germinative layer cells, and changes in haematological parameters (Mamyrbayev et al., 2025). However, certain contributing factors increase or reduce the chances of developing chronic health issues. Studies done in mining industries,

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which have similar occupational risk profiles to those of the drilling operations, have provided evidence that the outcomes of work injury depend on both the personal (age, negative affectivity, job dissatisfaction) and the sociotechnical (physical hazards, safety climate) factors (Paul, 2009; Onder, 2013). Understanding how the contribution of factors influences the chronic health outcome provides comprehensive strategies of health protection that would be effective in reducing both the workplace and individual determinants.

Previous research investigating occupational health in the oil and gas industry has usually been concerned with the description of the prevalence of occupational health outcomes or discovering the relationship between single exposures and outcomes (D'Andrea and Reddy, 2018; Benson et al., 2021; Oyamienlen et al., 2023). While previous research has documented the prevalence of various health issues in the oil and gas industry, a quantitative understanding of modifiable risk factors and protective measures remains limited. Few studies have employed multivariate modelling approaches, such as logistic regression analysis, to understand the contributing factors that influence injuries and accidents in the mining and construction industry (Paul, 2009; Onder, 2013; Kale & Baradan, 2020). However, such an approach has rarely been adopted in the oil and gas industry, especially for drilling operations. Such analytical approaches are necessary to identify independent predictors and to develop integrated predictive models that can inform risk stratification and targeted interventions. This study aimed to comprehensively identify and quantify risk factors and protective measures associated with chronic health conditions among oil drilling workers in the Niger Delta.

MATERIALS AND METHODS

Study Area

The study was conducted in the Niger Delta region, where most of the drilling operations occur in Nigeria. The study area is in the Southern region of Nigeria, as shown in Figure 1. Oil companies in the nine states in the Niger Delta region participated in the study. The region is characterised by a network of rivers, mangroves, swamps, and tributaries with a land area of about 70,000Km2. About 90% of the country earning is from the export of petroleum production obtained in the region. However, extensive oil exploration activities have led to severe environmental challenges, including oil spills, gas flaring, and land degradation, which have adversely impacted both the ecosystem and public health. The region's unique environmental and socioeconomic challenges, combined with the high prevalence of occupational health issues among oil field workers, make it an appropriate focus for investigating the chronic effects of oil drilling exposure on worker health.

Data Collection

This study adopted a quantitative research approach using a cross-sectional study design. It involved the distribution of questionnaires on a one-time basis to workers in the drilling department in the oil and gas companies. A total of 385 questionnaires were distributed to oil and gas workers in drilling operations across the Niger Delta region. The sampling technique utilised for the study was a purposive sampling method. The inclusion criteria were that workers must be in a drilling operation department and they must have been on the job for more than three years. The structured questionnaire was developed to capture information across various contributing factors that could influence the chronic health outcome. The contributing factors measured were (1) demographic characteristics (age, gender, educational level, employment type, years of experience); (2) work-related factors (physical job demands, work control/autonomy, exposure frequency, working hours); (3) organizational factors (supervisor support, organizational stress support, PPE usage frequency); (4) personal factors (smoking status, exercise frequency). Also, respondents reported whether they experienced health outcomes due to exposure to the drilling hazards. The outcome was then categorised as chronic if the respondent stated that the health outcome had been persistent for more than 6 months.

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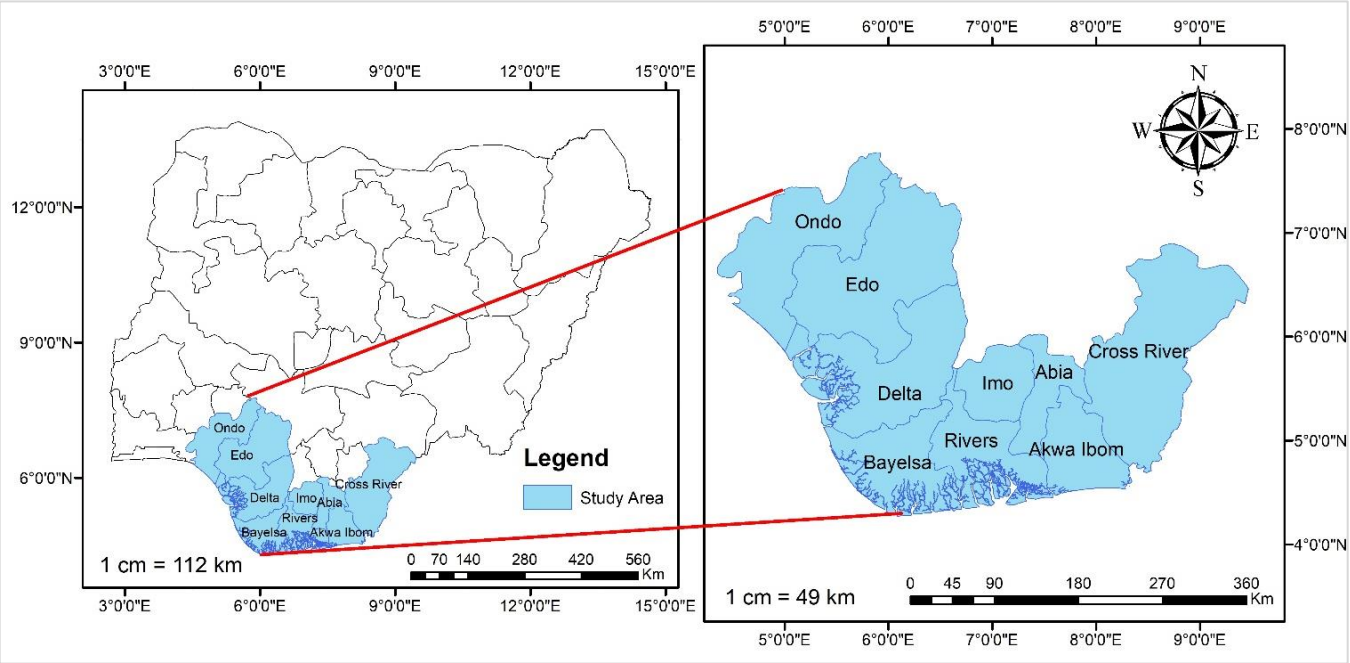

Figure 1: Map of the study area where survey sampling took place

Data Analyses

Data were analysed using SPSS Statistics (version 26.0). Logistic regression analysis was used to understand the magnitude of the contributing factors in predicting the chronic health outcome, as shown in Equation 1. The chronic health outcome was the binary outcome, while the contributing factors were the predictor variables. Individual models of the contributing factors were modelled against the outcomes as shown in Table 1.

$$\text{logit}(p) = \ln\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n \quad 1$$

where p denotes the probability of developing chronic health issues, $\beta_0$is the intercept term, $\beta_1, \ldots, \beta_n$are the regression coefficients, and $X_1, \ldots, X_n$represent the predictor variables.

Table 1: Logistic Regression Models Examining Factors Associated with the Development of Chronic Health Issues

Model	Contributing factors	Predictor Variables	Outcome Variable
Model 1	Work-related factors	Physical job demands; Work control/autonomy; Exposure frequency	Developing a chronic health issue (Yes/No)
Model 2	Organizational factors	Supervisor support; Organisational stress support; PPE usage frequency	Developing a chronic health issue (Yes/No)
Model 3	Personal factors	Smoking status; Exercise frequency	Developing a chronic health issue (Yes/No)
Model 4	Demographic factors	Age group; Years of experience	Developing a chronic health issue (Yes/No)

Results

Work-Related Contributing Factors

Table 2 presents the logistic regression analysis results of work-related factors. Three work-related variables

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were evaluated: physical job demands, work control/autonomy, and exposure frequency.

Physical job demands showed a significant positive association with chronic health issues, with each unit increase in job demands associated with 17.9% increased odds of developing chronic health conditions (OR = 1.18, 95% CI: 1.17-1.19, $p < 0.001$). This finding confirms that higher physical workload contributes independently to chronic health risks. Work control/autonomy showed a significant protective effect, with each unit increase in worker autonomy associated with 7.6% decreased odds of developing chronic health issues (OR = 0.92, 95% CI: 0.92-0.93, $p < 0.001$). This suggests that workers with greater decision-making authority and task control experience reduced health risks, possibly through better ability to manage work pace and methods. Exposure frequency emerged as the strongest work-related predictor, with each unit increase in exposure frequency associated with 111.4% increased odds of developing chronic health issues (OR = 2.11, 95% CI: 2.10-2.13, $p < 0.001$). This substantial effect size highlights the critical importance of exposure frequency in determining health outcomes and emphasises the need for interventions to reduce exposure frequency. The work-related factors model achieved 74.49% classification accuracy with three variables, demonstrating good predictive performance. Exposure frequency was identified as the most influential factor based on the magnitude of its odds ratio.

Table 2: Logistic Regression Results for Work-Related Contributing Factors (N=350)

Variable	β	OR	95% CI	p-value	Sig.
Physical Job Demands	0.164	1.179	[1.172, 1.185]	<.001	***
Work Control/Autonomy	-0.079	0.924	[0.920, 0.929]	<.001	***
Exposure Frequency	0.749	2.114	[2.102, 2.127]	<.001	***

Note. β = unstandardized coefficient; OR = odds ratio; CI = confidence interval; Sig. = significance level. ***p < .001. Interpretation: Physical Job Demands increases risk by 17.9% per unit increase; Work Control/Autonomy decreases risk by 7.6% per unit increase; Exposure Frequency increases risk by 111.4% per unit increase.

Organisational Contributing Factors

The results of the logistic regression of organisational factors are given in Table 3. Three predictor variables of the organisation were measured, namely supervisor support, organisational stress support, and the frequency of using PPE. Supervisor support showed a strong protective factor as one unit increase in supervisor support resulted in a reduction in the odds of developing chronic health problems by 38.2% (OR = 0.62, 95% CI: 0.61-0.62, $p < 0.001$). This result may indicate that supportive supervision contributes to reducing the health risk potentially by increasing safety implementation, responding to hazard control promptly, providing resources and assistance, and increasing worker morale and psychological health. The protective effect of organisational stress support was even greater, with every one-unit increment of organisational support in coping with work-related stress being linked with 49.4% reduced odds of acquiring chronic health problems (OR = 0.51, 95% CI: 0.50-0.51, $p < 0.001$). This high level of protective effect outlines the paramount role that institutional mechanisms play in managing workplace stress in alleviating chronic health effects. Companies that offer stress management programs, counselling services, effective workloads management, and amiable working conditions seem to offer substantial safeguards to the wellbeing of workers. The frequency of use of PPE exhibited an inverse positive relationship with chronic health problems where the frequency of use of PPE in 1 unit was linked to 42.1% increment in the probability of a health problem development (OR = 1.42, 95% CI: 1.41-1.43, $p < 0.001$). This is a surprising result, but it could be the reality of reverse causality, in which employees who are more inclined to believe that they are at higher risk of health or who have already contracted health problems wear PPE more often. Alternatively, it can also point towards the fact that the use of PPE will not work to prevent chronic health issues by itself, and the use of PPE without other measures to ensure that hazards are controlled, or that the workers in the professions where the wearing of PPE is a regular topic are by virtue more frequently exposed. Using three variables, the organizational factors model classified 69.05%. The strongest factor was found to be organizational stress support in terms of the magnitude of odds

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ratio, which means that it is extremely important to health protection.

Table 3: Logistic Regression Results for Organizational Contributing Factors (N=350)

Variable	β	OR	95% CI	p-value	Sig.
Supervisor Support	-0.482	0.618	[0.611, 0.624]	<.001	***
Organisational Stress Support	-0.681	0.506	[0.503, 0.509]	<.001	***
PPE Usage Frequency	0.351	1.421	[1.410, 1.432]	<.001	***

Note. β = unstandardized coefficient; OR = odds ratio; CI = confidence interval; Sig. = significance level. ***p < .001. Interpretation: Supervisor Support decreases risk by 38.2% per unit increase; Organisational Stress Support decreases risk by 49.4% per unit increase

Personal Contributing Factors

Logistic regression analysis examining personal lifestyle factors is presented in Table 4. Two personal factors were evaluated: smoking status and exercise frequency. Smoking status demonstrated a significant positive association with chronic health issues, with each unit increase in smoking status associated with 29.1% increased odds of developing chronic health conditions (OR = 1.29, 95% CI: 1.23-1.35, $p < 0.001$). This finding confirms the well-established link between tobacco use and adverse health outcomes, suggesting that smoking compounds the occupational health risks already faced by oil drilling workers. The combination of smoking-related health effects and occupational exposures may have synergistic impacts on chronic disease development. Exercise frequency showed a substantial protective effect, with each unit increase in physical exercise frequency associated with 29.4% decreased odds of developing chronic health issues (OR = 0.71, 95% CI: 0.70-0.71, $p < 0.001$). This protective effect is comparable in magnitude to the risk increase from smoking, highlighting the importance of regular physical activity in mitigating chronic health risks. Exercise likely provides multiple protective mechanisms including improved cardiovascular health, enhanced immune function, stress reduction, better sleep quality, and increased overall physical resilience that may buffer against occupational hazards. The personal factors model achieved 64.63% classification accuracy with two variables. Exercise frequency was identified as the most influential protective factor based on odds ratio magnitude, suggesting that promoting physical activity among oil drilling workers represents a valuable intervention strategy.

Table 4: Logistic Regression Results for Personal Contributing Factors (N=350)

Variable	β	OR	95% CI	p-value	Sig.
Smoking Status	0.256	1.291	[1.231, 1.354]	<.001	***
Exercise Frequency	-0.348	0.706	[0.704, 0.708]	<.001	***

Note. β = unstandardized coefficient; OR = odds ratio; CI = confidence interval; Sig. = significance level. ***p < .001. Interpretation: Smoking Status increases risk by 29.1% per unit increase; Exercise Frequency decreases risk by 29.4% per unit increase.

Demographic Contributing Factors

Table 5 shows the outcome of the logistic regression of the demographics. Two direct variables were tested; they were age group and years of experience. The age group showed strong positive correlation with the chronic health issue with the difference in odds of developing chronic health issues increased by 64.9 with one unit rise in the age group (OR = 1.65, 95% CI: 1.63-1.66, $p < 0.001$). This effect size is large, meaning that the elderly workers are at a relatively high risk of developing chronic health issues. The association is probably a combination of several processes such as accumulation of exposure to occupational stress with age, age-related

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physiological alterations making individuals more exposed to environmental stressors, possible cohort influence, and natural age-associated growth of chronic illness in populations in general. Experience also demonstrated a positive association with chronic health problems with a one unit increase in the category of experience increasing odds of having chronic health problems by 9.0 percent (OR = 1.09, 95% CI: 1.08-1.10, p = 0.001). Though the difference in effect size with age is not as high, this result supports the hypothesis that longer time of service in oil drilling operations is positively related to the risk of health problems even after adjusting for the age. This implies that there is a contribution of long-term occupational exposure to the development of chronic conditions, which is independent of the role of aging, and these relationships are cumulative, as the hypothesis of cumulative exposure-response relationships suggests. With two variables, the demographic factors model had an accuracy of 63.27 in classification. The most significant demographic characteristic that turned out was an age group, which indicates the significance of age-stratified health monitoring and age-specific interventions.

Table 5: Logistic Regression Results for Demographic Contributing Factors (N=350)

Variable	β	OR	95% CI	p-value	Sig.
Age Group	0.500	1.649	[1.635, 1.664]	<.001	***
Years of Experience	0.086	1.090	[1.081, 1.099]	<.001	***

Note. β = unstandardized coefficient; OR = odds ratio; CI = confidence interval; Sig. = significance level. ***p < .001. Interpretation: Age Group increases risk by 64.9% per unit increase; Years of Experience increases risk by 9.0% per unit increase.

Table 6: Model Summary of Contributing Factors

Model	Number of Variables	Accuracy (%)	Most Influential Factor	Strongest OR
Work-Related Factors	3	74.49	Exposure Frequency	2.114
Organizational Factors	3	69.05	Organizational Stress Support	0.506
Personal Factors	2	64.63	Exercise Frequency	0.706
Demographics	2	63.27	Age Group	1.649

Note. OR = odds ratio. Each model was evaluated using logistic regression. The Full Model combines all predictor categories and achieves the highest classification accuracy (77.55%).

DISCUSSION

The exposure frequency was identified as the strongest contributing predictor, which indicates that the duration that a drilling worker is exposed to the drilling hazards can seriously result in the worker developing chronic health issues. Mamyrbayev et al. (2025) in their study found that exposing rats multiple times to drilling fluid resulted in dermal health issues. They found that subacute dermal exposure to drilling fluids to rat resulted in lower consumption of food and water by the rats. It was also observed that haematological parameters, such as eosinophilic counts, increased. The drilling fluid also impacted serum enzyme levels (ALT, AST, ALP, GGT, and LDH) in the rat. Similarly, work demand was found to impact the outcome of chronic health issues among the drilling workers. Increased work demand resulted in more chronic health issues faced by the workers. Workload requirements, excessive working hours, and emotional labour have been linked to anxiety disorder, depression, hypertension, and cardiovascular disease (Benson et al., 2021; Eyayo, 2014). The substantial protective effects of organisational stress support identified in this study reflect broader evidence of psychosocial factors as important determinants of occupational health outcomes. Mearns & Reader (2008) in their study reported that a higher social support resulted in workers developing a positive safety behaviour. Better safety behaviour by workers tends to lead to fewer accidents and health issues, showing the need for

good organisational support (Gadalla et al., 2024). Companies with strong stress management advocacy in terms of supervisor assistance, employee assistance programs, and workplace social support can cushion employees not only against the psychological effects of work stressors but also against their physical effects, which will lessen the overall impact of chronic diseases.

The emergence of age as the strongest demographic predictor shows the important of worker age as contributing factor. Older drilling workers have 27.50 times higher odds of developing chronic health conditions compared to younger workers. The observation that smoking status was found to be the strongest predictor of personal contributing factor highlights the importance of workers having a good personal lifestyle.

CONCLUSION

This study provides quantitative evidence on contributing risk factors for chronic health conditions among oil drilling workers. Work-related factors, particularly exposure frequency, emerged as primary determinants of chronic health outcomes. Organisational factors, especially stress management support, demonstrated substantial protective effects. Personal lifestyle factors, including smoking and exercise, showed comparable effects to some occupational factors, highlighting the importance of personal health promotion. Demographic factors, particularly age, identified high-risk populations requiring enhanced surveillance and protection.

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