

Risk Factors for Occupational Physical Injuries among Workers in Onshore Oil Drilling Operations in Turkana County, Kenya

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Abstract

Objective: To establish the risk factors for occupational physical injuries among workers in onshore oil drilling operations in Turkana County, Kenya.

Design: Cross-sectional descriptive study.

Study Location: Turkana County, Kenya.

Methods: A cross-sectional descriptive study was conducted among 164 workers. Convenience sampling and systematic random sampling were used to select study participants. Data were collected through pre-tested semi-structured questionnaires. Data collected were analyzed using SPSS version 20. Multivariate logistic regression analysis was used to assess the relative effect of independent variables on the outcome variable. The level of significance was set at $p < 0.05$.

Results: The study established that duration worked in oil drilling industry ($\chi^2 = 11.557$, $df = 4$ $p = 0.021$), and level of education ($\chi^2 = 8.273$, $df = 3$ $p = 0.016$) were associated with the occurrence of physical injuries at bivariate analysis. Age (AOR = 0.354, $p = 0.014$, 95% C.I 0.154-0.811) and issues experienced while using personal protective equipment (PPE) (AOR = 3.652, $p = 0.053$, 95% C.I 0.984 - 13.553) were significant predictors to occupational physical injuries at logistic regression.

Conclusion: There is a clear interplay between risk factors; socio-demographic factors, environmental factors, and behavioral factors with the occurrence of physical injuries. This information could be tapped to formulate occupational health and safety specific intervention strategies for the oil and gas industry.

Keywords: Occupational Physical Injuries; Workers; Onshore Oil Drilling

What is already known about the subject?

Major causes of occupational injuries in onshore oil drilling operations result from a complex interplay of multiple risk factors. With the growth of oil exploration activities in Turkana County Kenya, and with the introduction of new technologies in oil and gas drilling, workers continue to face serious safety and health challenges brought about by exposures to occupational health hazards. Nevertheless, preliminary studies suggest that socio-demographic, environmental, behavioural factors and exposures to hazards are likely risk factors.

What are the new findings?

The duration worked in oil drilling industry ($\chi^2 = 11.557$, $df = 4 = 0.021$), and level of education ($\chi^2 = 8.273$, $df = 3 = 0.016$) were associated with the occurrence of physical injuries at bivariate analysis. Age (AOR = 0.354, = 0.014, 95% C.I 0.154 - 0.811) and issues experienced while using personal protective equipment (PPE) (AOR = 3.652, = 0.053, 95% C.I 0.984 - 13.553) were significant predictors to occupational physical injuries at logistic regression.

How might this impact on policy in the foreseeable future?

A multifaceted intervention strategy to safeguard the health and safety of workers in the oil and gas industry in Kenya that include dedicated hazard identification and control measures by stakeholders in order to reduce injury prevalence among oil drilling workers. Key players in the oil and gas exploration sector should consider sociodemographic factors when designing safety specific intervention strategies targeting oil drilling workers; there is need for greater awareness, and training of oil drilling workers, and adoption of multifaceted behavioral approaches to safety compliance like enhanced supervision, worker motivation and reward schemes, and availability of proper PPEs to every worker.

Introduction

Major causes of occupational injuries in onshore oil drilling operations result from a complex interplay of multiple risk factors [1,2]. Injuries are now recognized as a major work-related concern globally in that about 2% of the world's population is now disabled due to occupational injuries, and about 3 million deaths reported annually; with 66% occurring in developing nations [3]. In the US, non-fatal occupational injuries in the oil and gas industry are 49% higher than all the industries combined [4]. As of 2009, the prevalence of occupational injuries among mining workers in Zimbabwe was 37% [5]. A study in Kenya showed that 41% of occupational injuries and accidents were attributed to mining and construction [6]. Most of these occupational accidents and injuries, however, go unreported [6]. Oil and gas exploration activities in Kenya continue to grow as workers in the oil and gas industry adapt themselves to working conditions that are similar to conditions found in other sister sectors like mining.

Onshore oil drilling attracts varied workers that operate in isolated locations coupled with harsh environmental conditions. Such conditions influence occupational hazards, that give rise to occupational injuries. With the growth of oil exploration activities in Turkana County, and with the introduction of new technologies in oil and gas drilling, workers continue to face serious safety and health challenges brought about by exposures to occupational health hazards. The risk factors that may increase their vulnerability to these occupational injuries are however not clearly documented. There is a paucity of research studies that investigate occupational risk factors in the Kenyan oil and gas drilling industry. However, other studies conducted in Oman and Nigeria demonstrate that socio-demographic, environmental, behavioural factors and exposures to hazards are likely risk factors. As to whether these also do play in the Kenyan context was the central aim of this study.

Materials and Methods

Setting

The study was conducted in Turkana County. Turkana County covers approximately 77,000sq.kms and has a population of about 855,399 [7]. Turkana County was chosen because, compared to other counties, it is the only county in Kenya where active onshore oil drilling is presently being done.

Study design

This study employed cross-sectional descriptive study design.

Study population

The study population consisted of oil and gas operator service companies workers, drilling contractors workers, and those of drilling sub-contractors working in the three oil drilling sites within Turkana County (figures in parenthesis represent the number of oil drilling workers per site); Ekales 2 (83), Ngamia F (110) and Engomo (93).

Sampling technique

The initial sampling point was conveniently chosen (marked A, B, and C on the map for Ekales 2, Ngamia F, and Engomo, respectively), to start from one end of the study sites, such that subsequent sampling would continue from these points. Thereafter, systematic random sampling technique was used to select participants from a randomized sampling frame of a known sampling interval. The sampling interval was obtained by dividing the total population by the desired sample size.

Data analysis

Data collected were analyzed using SPSS version 20. Multivariate logistic regression analysis was used to assess the relative effect of independent variables on the outcome variable. The level of significance was set at < 0.05.

Ethical approval

Permission to carry out the study was sought from the Kenyatta University. Permission was also sought from the oil drilling sites where the study was done. Ethical approval was obtained from the Kenyatta University Ethical Committee. Permission was also sought from the National Commission for Science and Technology, and informed consent was sought from the study participants. Participation in the study was voluntary, and the participants were given an option of withdrawing from the study at will.

Results

A total of 164 respondents were recruited in the study. The study established that the duration worked in oil and gas industry $\chi^2 (4) = 11.557, = .021$ and level of education $\chi^2 (3) = 8.273, = .016$ of the respondents were significantly associated with the occurrence of occupational physical injuries whereas gender $\chi^2 (1) = 1.151, = .283$, age of respondents $\chi^2 (1) = 1.555, = .212$, and nationality $\chi^2 (3) = 5.240, = .073$ did not show significant association with the occurrence of occupational physical injuries as presented in table 1 below.

Variables	Categories	Occupational injury		χ^2 test	df	value
		Yes (%)	No (%)			
Gender	Male	16 (10.4)	138 (89.6)	1.151	1	0.283
	Female	0 (0)	10 (100)			
Duration worked in oil and gas industry	Less than 1 Year	1 (12.5)	7 (87.5)	11.557	4	0.021*
	1 - 2 years	1 (2.4)	41 (97.6)			
	2 - 3 years	4 (9.8)	37 (90.2)			
	3 - 5 years	2 (5)	38 (95)			
	Over 5 years	8 (24.2)	25 (75.8)			
Age	< 40	11 (8.3)	121 (91.7)	1.555	1	0.212
	> 41	5 (15.6)	27 (84.4)			
Education level	Primary and Secondary	0 (0)	49 (100)	8.273	3	0.016*
	Diploma	9 (16.4)	46 (83.6)			
	University	7 (11.7)	53 (88.3)			
Nationality	Kenyans	8 (7.2)	103 (92.8)	5.24	3	0.073
	Rest of Africans	2 (8)	23 (92)			
	Non-Africans	6 (21.4)	22 (78.6)			

Table 1: Cross-tabulation of socio-demographic factors with occurrence of physical injuries.

Figures in parenthesis are percentages.

*Significant at < 0.05.

Circumstances leading to occupational injuries

Carrying heavy load (31.3%), and slippery floor (31.3%), were the most common causes of occupational physical injuries. The study revealed that contact with hot surfaces of machines (12.5%), drill pipes (18.8%), and electrical cables/chains (6.3%) were other significant reported causes of occupational injuries (Figure 1).

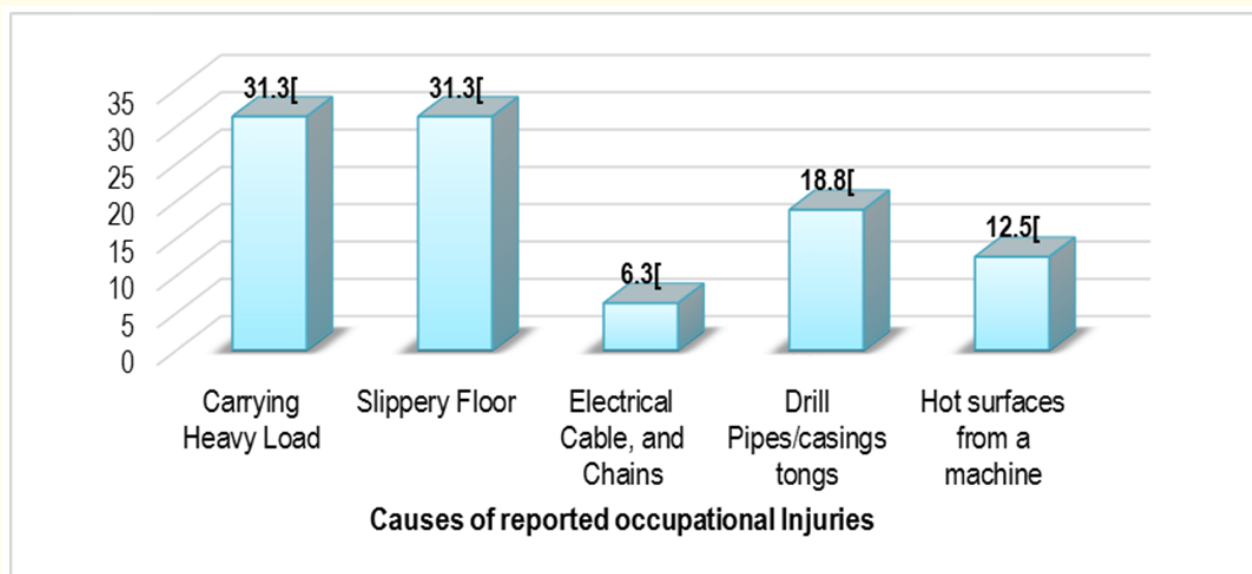


Figure 1: Causes of reported occupational injuries.

Worker perception of work environment

Regarding worker perception on workplace safety, (146) 89% of the respondents perceive their workplace to be safe while only, (18) 11% felt that working in the oil drilling sector was unsafe (Figure 2). Worker’s perception of their work environment seemed to have some influence on the occurrence of occupational physical injuries. During a Focus Group Discussion (FGD) one discussant said, ‘the drilling site is well guarded but we often experience revolt from the nearby community. Besides, we are many kilometers from home and anything can happen’. Another discussant added that ‘the work pressures from our immediate bosses are just too much such that you can easily make a mistake. The temperature here is also just too high for my liking’.

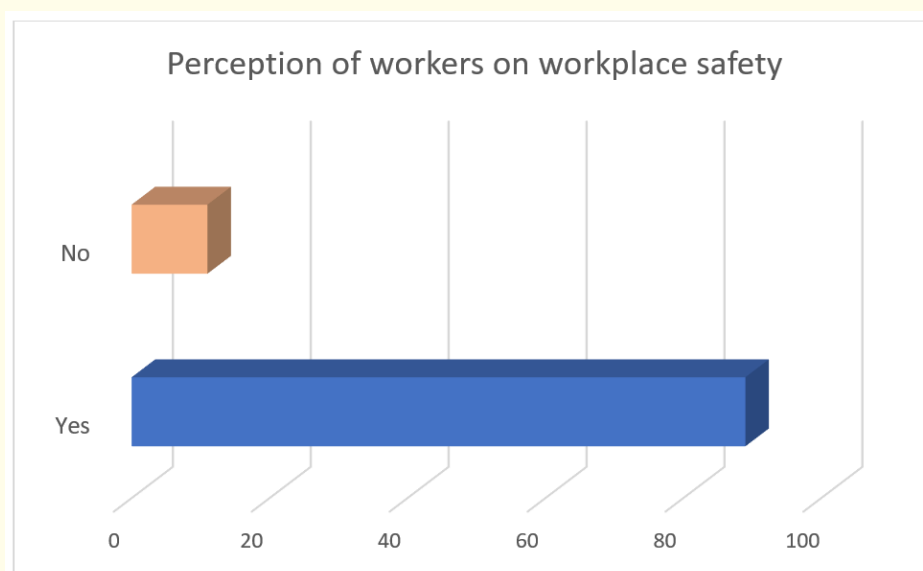


Figure 2: Worker perception of workplace safety

Time of injury occurrence

There was a strong relationship between the extent of occupational injuries and time of occurrence. From table 2 below, it can be observed that a most (12) 75% injuries occurred in the afternoon. Fewer injuries occurred in the morning (1) 6.25% and at night (3) 18.75% respectively.

Time of day	Frequency	(%)
Morning	1	6.25
Afternoon	12	75
Night	3	18.75
Total	16	100

Table 2: Distribution of physical injuries by time of day (n = 16).

Relationship between occupational risk factors and occurrence of occupational physical injuries

The significant factors from bivariate analysis (with < 0.05) were then subjected to multivariate analysis (logistic regression) to determine the relationship between occupational risk factors and occurrence of occupational physical injuries. Table 3 below shows that coefficients of age and whether the respondents experienced issues with the PPE provided were statistically significant. The odds of being injured increased by 0.014 times for the increase in age. Those who experienced issues with the PPE provided were 0.053 more likely to be injured.

Predictor Variables	B	Sig.	AOR	95% C.I. for EXP(B)	
				Lower	Upper
Age	-1.039	0.014*	0.354	0.154	0.811
Level of education	-0.352	0.228	0.703	0.397	1.246
Nationality	0.074	0.414	1.077	0.901	1.287
Duration worked in oil	-0.425	0.083	0.654	0.404	1.057
Aware of injured colleague last 2 months	-0.551	0.45	0.577	0.138	2.407
Activities that pose risk of injury	1.469	0.072	4.344	0.879	21.472
Period when training was Done	0.035	0.909	1.036	0.568	1.888
Experience issues with PPEs provided	1.295	0.053*	3.652	0.984	13.553
Occupational medical exam	0.845	0.327	2.329	0.43	12.624
Opinion on workplace safety	0.055	0.951	1.057	0.178	6.272
Aware of legal frameworks	-0.066	0.922	0.936	0.246	3.556
Participate in fire drills	-2.023	0.229	0.132	0.005	3.579
Constant	4.43	0.003	83.912		

Table 3: Binary logistic analysis on occupational risk factors and occurrence of occupational physical injuries.

*Significant at < 0.05.

Discussion

This study found that there was no significant relationship between gender (> 0.05) and occurrence of occupational physical injuries. This contradicts another study that found a correlation between education, gender, and work-related injuries among offshore oil drilling

workers [8]. In this study, male respondents (154) (93.9%) were significantly more than females (10) (6.1%). A similar study in Nigeria revealed that 87.10% of the respondents were males [9]. This is consistent with the findings reported in other earlier studies [10,11]. In this study, all the respondents (16) 10.4% who reported to have ever been injured were males. The possible explanation of this could be that oil and gas drilling is a predominantly male-dominated field involving repeated physical activities such as heavy lifting, carrying, pushing, and pulling of heavy loads.

The findings of this study showed a statistical association between age and occurrence of occupational physical injuries ($p = 0.014$) at binary logistic analysis. The odds of experiencing an occupational physical injury increases 0.354 times with an increase in age. The results from the current study revealed that (11) 8.3% of those who reported having ever been injured at work were aged below 40 years. This finding compares favorably with a study in Oman that demonstrated that onshore oil drilling workers aged under 30 years had the highest prevalence (52.4%) of occupational injuries [4]. This has a significant bearing as it implies that occupational injuries impacting younger workers can be due to lack of information, instruction, and training. Nonetheless, the safety of young workers could be assured through better safety training, tool and workstation design, engineering controls and proper use of personal protective equipment.

The current study showed that there was a significant relationship between duration worked in oil and gas industry ($p < 0.05$) and occurrence of occupational physical injuries. Further, according to this study, (8) 24.2% those who reported having ever been injured at work had over 5 years' experience in the oil and gas industry. The possible explanation of this could be that experienced workers are complacent and over-confident [12]. These findings are however different from another study that revealed that 23.42% of occupational injuries among oil drilling workers were sustained within the first five years on the job [8]. Inexperienced workers are more likely to be injured as they are still in the learning stages of their profession and are finding ways to cope with the physical job demands.

This study demonstrated that there was a significant relationship between the level of education ($p < 0.05$) and occurrence of occupational physical injuries. Most respondents with diploma education (9) 16.4% and below stand a higher chance of experiencing occupational injuries compared to those with university level of education. Another study found a strong correlation between education level and work-related injuries among oil rig workers [8]. One's education is more likely to increase workers safety and health practice thus prevents them from occupational injuries [13]. However, education by itself alone cannot reduce occupational injuries when the level of hazards is high and the use of reliable techniques and safe work organizations are limited.

The findings of this study indicated that slippery floors (31.3%) and carrying heavy loads (31.3%) were the most common causes of occupational physical injuries. Other significant reported causes of occupational injuries were; contact with hot surfaces of machines (12.5%), drill pipes (18.8%), and electrical cables/chains (6.3%). The findings concur with other studies that revealed that slippery surfaces, drilling tubes, inattention, and damaged tools were potential causes of occupational injuries [4,14,15]. However, results in another study established that direct impacts of hard metal objects (36.2%), jamming (23.2%), slips/falls (10.2%), contact with chemicals and hot surfaces (5.8%), and electrical shocks (3.6%) were common causes of physical injuries [12]. During focus group discussions, some workers were of the opinion that work pressures and high job demands from the employers are likely to cause injuries. A cross-sectional study among Croatian oil workers revealed that work stress can reduce safety and increase the likelihood of occurrence of injuries among onshore oil workers [16]. This is supported by a study done in Ghana [17]. Job stress can yield psychological and physiological alterations that may increase the likelihood of developing mental and physical problems, therefore, increasing the risk of sustaining more occupational injuries [13]. Nonetheless, improved understanding of the environmental factors responsible for occupational injuries could help oil drilling companies come up with suitable interventions.

Shift work is becoming more pronounced in the oil and gas drilling industry. The standard is 12hr shifts [8]. However, it presents notable occupational health and safety challenges [8]. The 12-hour work schedule may contribute to overexertion injuries, worsened by adverse weather conditions [18]. Most injuries in this study occurred during the afternoon session (12) 75% while the rest occurred

in the morning (1) 6.25% and at night (3) 18.75% respectively. These findings agree with another study [19]. The possible explanation of high injury prevalence in the day shifts especially in the afternoon could be due to fatigue, diminishing concentration, and the rush to finish work. These findings are however inconsistent with the results of another study where most injuries occurred in the early morning shift [12]. Night-shift work leads to desynchronization of the work and sleep periods with the circadian rhythm [8,20]. This leads to fatigue, and reduced alertness, hence increasing the risk of injuries [8]. Another study revealed that during the night shift, the injury risk rose 20% from the first to second hour, but then fell about 50% reaching the minimum at the end of the shift [21]. However, there is a slight increase in injury risk between 03:00 am and 04:00 am [21]. This study did not, however, go deeply in this aspect but the findings were very interesting and they will be considered in future research.

Conclusion

Workers in onshore oil drilling operations in Turkana County, Kenya were affected by physical injuries with the most common types being lacerations and cuts. Fingers and wrists were the commonly affected body parts. The number of days workers miss work due to the reported occupational physical injuries is important injury severity metric in terms of the direct and indirect costs incurred. It is, therefore, critical that oil drilling workers should be protected from occupational physical injuries that are a risk of infection, disability and fatalities.

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