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Predictors and Management of Hazards in the Southwestern Nigerian Sawmilling Industrial Environment

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Abstract
The study examined the relationship between personal characteristics of sawmill workers and the hazard they experienced it also determined the relationship between the use of appropriate signage and disaster history as well as the extent and factors in insurance patronage by sawmilling industries in response to possible disaster occurrence. A multi-stage sampling procedure was employed to select 54 small-scale sawmilling industries from 4 states in Southwestern Nigeria from which 256 workers were selected using disproportionate stratified random sampling. Two instruments were used to elicit information on personal characteristics and hazards experienced in the course of the work and efforts that have been put in place by both the workers and their employers at preventing and minimizing such hazards. The data collected were analyzed using descriptive and inferential statistics such as percentages, chi-square and binary logistic regression model. The odds of experiencing hazard were higher among respondents who were 30-39 years (OR = 1.10, p>0.05), 40-49 years (OR = 1.21; p>0.05) and ≥50 years (OR = 4.68; p>0.05) relative to those who were below 30 years of age. Respondents whose work designation was log/plank related (OR =0.43; p>0.05) and management/administration (OR = 0.57; p > 0.05) were significantly less likely to experience hazard relative to the ones with machine related designation while that of respondents with waste/ dust activities are more likely to experience hazards. Respondents with primary education (OR = 0.05; p< 0.05), junior secondary education (OR = 0.07; P <0.05), senior secondary education (OR = 0.08; P < 0.05), tertiary education (OR = 0.29; P > 0.05), were less likely to experience hazards, compared with those who did not have any education. Hazards were found to be less with respondents with more than 5 years of experience on the job. The use of 'Restricted area' and 'Maximum working load' signage were the significant predictors of disaster occurrence. Only 37% of the industries and 30% of the workers were insured. Significant relationship was not found between size of industries ($\chi^2_{(1,1)}$ =0.554,P>0.05) and insurance patronage as well as each of work designation ($\chi^2_{(3,1)}$ = 0.200,P>0.05) , income ($\chi^2_{(4,1)}$ = 0.453,P> 0.05) and insurance of workers.

Keywords; Industrial , Sawmilling , Environment ,Predictors ,Management

Introduction

Research efforts have focused largely on risk and hazards that are associated with sawmilling works globally (Akinyeye, Solanke and Oyadongha 2013; Bosan and Okapi, 2014).The sawmilling industry had a poor safety records (Health and Safety Executive,2023).Findings have shown that hazards experienced in sawmilling industries are similar at least in developing nations. For example, Ago, Umeokonkwo, Nnabu & Odunsanya (2016) in a Nigeria case identified occupational accident to include electric shock, cut by machine, chest infection, eye infection, skin irritation, injuries resulting from falling of log of wood. This was further supported by Jegede and Akarakiri (2015) who identified sawmilling hazards to include hand, feet and eye injuries as well as abnormal sneezing and continuous body pain. In Ghana's case Mitchual, Donkeh and Bih (2015) identified respiratory problems, cuts and pains among others as hazards experience in the wood processing industry. Mong'are, Mburu and Kiiyuka (2017) identified similar patterns for Kenya. Even though reported trends and cases are somewhat different in developed nations due to improved technology, research consensus still holds that sawmilling industries are often hazardous everywhere.(Albert, Cornelius, and John 2003; Alamgir, Tompa,

Kochoam and Demers 2007) . According to the occupational safety and health administration (OSHA, 2013), working in the sawmill is one of the most dangerous occupations in the United States. Despite these research effort, factors that predispose workers to this hazards are largely unexplored. And this is much more needed because identification of such predisposing factors would assist in minimizing and better management of the hazards. Identifying predictive factors would be cardinal in promoting and preventing incidences of such hazards. However the challenge with workplace safety in developing nations is due largely to lack of or low level of compliance to health and safety standards (Agbana et al, 2016). In identifying the causes of the hazards, it may also be necessary to examine the compliance level of sawmilling industries to safety practices. In a study by Jegede & Akarakiri (2015).availability and usage of protective instruments by sawmilling workers have been examined which obtained that protective instruments were seldom used, it remains to examine how the use of signage is related to disaster occurrence in the sawmilling industry. Use of protective instrument only protects the individual complying worker but the use of appropriate signage or the lack of it affects the industry altogether. For example, the lack of the signage "No smoking" portends great danger beyond individual workers but that of the whole industry. It may be necessary therefore to examine whether strong association exists between the use of appropriate signage and disaster history of sawmilling industries. Even though, hazards can at best be reduced to the barest minimal level, it cannot be totally eradicated. It is therefore consistent with best practices and an integral part of hazards or disaster management to make provision for insurance coverage of workmen and facilities in the industries. Therefore, this study is focused on examining the relationship between personal characteristics of sawmill workers and hazard experienced; determining the relationship between the use of appropriate signage and disaster history; and assessing the extent and factors in insurance patronage by sawmilling industries in response to possible disaster occurrence.

Materials and Methods

The study adopted a survey design with all the workers in small scale sawmilling industries in the southwest as population for the study. Multi- stage sampling procedure was employed. This involved the selection of 54 small- scale industries from 4 states of Ondo, Ekiti, Oyo, Osun in the southwestern Nigeria using disproportionate stratified random sampling with the states as stratification factor. A total of 256 sawmill workers were randomly selected from the said 54 sawmill industries.

Two instruments were employed to elicit necessary and relevant information for the study namely Sawmill Workers Questionnaire (SWQ).and Sawmill Observation Checklist (SOC). SWQ was used to elicit information from sawmill workers on types of hazards they are exposed to in the workplace, those they have personally experienced in the course of sawmilling activities and such effort that have been put in place by them as individuals and their employers at preventing and minimizing the occurrence of such hazards. SOC was used to examine the use of appropriate signage in the selected industries. Data collection spanned less than one month across the states. The resulting data were analyzed using descriptive statistics such as percentages and inferential statistics such as chi-square and binary logistic regression model.

The Study Area

The South Western Nigerian states are Lagos, Ogun, Oyo, Ondo, Ekiti and Osun , these states are the most developed area of its size in the country. These area is also referred to as the south west geopolitical zone of Nigeria and it lies between longitude 2 31 and 6 00 East and latitude 6 21 and 8 37 N having a total land area of 77,818 sqkm and a projected population of 28,767,752 in 2002 (NPC, 1991). This area is bounded in the East by Edo and Delta states, in the North by Kwara and Kogi states; in the West by the Republic of Benin and in the South by the Gulf of Guinea. It has 85 constituted Forest Reserves with a forest area cover of 793,266ha

The climate is tropical in nature and characterized by wet and dry seasons. The temperature ranges between 21c and 34c while the annual rainfall ranges between 1250mm and 1800mm. The wet season is associated with the southwest monsoon wind from the Atlantic Ocean, while the dry season is associated with the northeast trade wind from the

Sahara desert. In general, the climate is cool and the main features are a high but uniform temperature, heavy rainfall decreasing to moderate in the north, a high relative humidity and intense cloud cover.

Results

In determining the relationship between personal characteristics of sawmilling workers and hazards experienced. Efforts were made at eliciting information regarding personal disaster history of sawmilling workers. The identified hazard was examined in relation to specific personal characteristics of sex, age, work designation, educational background and sawmilling job experience of the workers. Using binary logistics regression model. The result is as stated in table 1.

Table 1: Multivariate analysis of predictors of hazard in sawmilling industry using Binary Logistic Regression

	B	Adjusted OR	P	95% C.I. for Adjusted OR
Sex				
Male [RC]	-	-	-	-
Female	-22.25	0.00	1.000	0.00
Age (in years)				
< 30	-	-	-	-
30-39	0.09	1.10	0.793	0.55 – 2.20
40-49	0.19	1.21	0.683	0.49 – 3.00
>=50	1.54	4.68	0.058	0.95 – 23.04
Work designation				
Machine related activities [RC]	-	-	-	-
Log/plank related activities	-0.84	0.43*	0.019	0.22 – 0.87
Waste/dust related activities	20.63	914302798.56	1.000	0.00
Management/Administrative control activities	-0.54	0.57	0.493	.13 – 2.71
Education [RC]				
None [RC]				
Primary	-3.04	0.05**	0.008	0.01 – 0.45
Junior secondary	-2.69	0.07*	0.017	0.01 – 0.61
Senior secondary	-2.57	0.08*	0.021	0.01 – 0.68
Tertiary	-1.24	0.29	0.327	0.02 - 3.45
Job experience				
< 5 years	-	-	-	-
5 – 9 years	0.33	1.36	0.355	0.70 – 2.76
10 – 14 years	0.07	1.07	0.892	0.39 - 2.94
>=15 years	-0.20	0.82	0.727	0.26 - 2.53

* p<0.05; ** p<0.01; *** p<0.001; OR – Odds Ratio; RC – Reference category or group (RC=1.00)

From table 1, the odds of experiencing hazard by female sawmill workers were zero relative to male workers (reference category). Also, the likelihood of experiencing hazard increases with age. Relative to respondents who were below age 30 years (reference category), the odds of experiencing hazard were higher among respondents who were 30-39 years (OR = 1.10, p>0.05), 40-49 years (OR = 1.21; p>0.05) and ≥50 years (OR = 4.68; p>0.05).

The table further revealed that respondents whose work designation was log/plank related were significantly less likely to experience hazard (OR =0.43; p>0.05); expectedly management/administration worker were also less likely to experience hazard (OR = 0.57; p > 0.05) relative to the ones with machine related designation which is the reference category. However, respondents with waste/ dust activities are more likely to experience hazards compared to the one handling machine related activities.

On educational background, respondents with primary education (OR = 0.05; p< 0.05), junior secondary education (OR = 0.07; P <0.05), senior secondary education (OR = 0.08; P < 0.05), tertiary education (OR = 0.29; P > 0.05), were less likely to experience hazards, compared with those who did not have any education (reference category). Finally, on job experience, respondents who had more experience on the job are less likely to experience hazard, relative to the ones with less than 5 years of job experience (reference category).

To determine the relationship between use of appropriate signage and disaster history of sawmilling workers. Five types of signage were identified namely "No handling", "High voltage", "Fire hazard", "Restricted area", "Maximum working load" signage. The Relationships between appropriate signage and disaster history were examined using Chi-square statistics. The results is as stated in table 2.

Table 2: Relationship between Use of Appropriate Signage and Disaster History

	Disaster History					
	Having Experienced		**Never Experienced**			
No smoking signage	**N**	**%**	**N**	**%**	χ^2	**P**
Used	2	40.0	3	60.0	0.055*	1.000
Not used	17	34.7	32	65.3		
High voltage signage						
Used	6	50.0	6	50.0	1.439	0.307
Not used	13	31.0	29	69.0		
Fire hazard signage						
Used	3	50.0	3	50.0	0.624*	0.653
Not used	16	33.3	32	66.7		
Restricted area signage						
Used	12	57.1	9	42.9	7.265	0.007
Not used	7	21.2	26	78.8		
Maximum working load signage						
Used	5	83.3	1	16.7	6.691*	0.017
Not used	14	29.2	34	70.8		
Total	**19**		**35**			

* Fisher's exact test used due to less than 5 expected counts

From table 2, there is no significant relationship between the use of "No smoking" signage and disaster occurrence ($\chi^2_{(1, 56)} = 0.55$, $P > 0.05$). On the use of "High voltage" signage, no significant relationship was found with disaster history ($\chi^2_{(1, 56)} = 1.439$; $P > 0.05$, furthermore, no significant relationship was found between the use of "Fire hazard" signage and disaster occurrence ($\chi^2_{(1, 56)} = 0.624$, $P < 0.05$)., however, significant relationship was obtained between the use of "Restricted area" signage and occurrence of disaster ($\chi^2_{(1, 56)} = 7.265$, $P < 0.05$). Finally, the use of a "maximum working load" signage was found to be significantly related to disaster occurrence ($\chi^2_{(1, 56)} = 6.691$, $P < 0.05$).

In examining Responses showed that only 2 (3.7%) of the 54 saw mill owners were aware of the existence of Nigeria Insurance Acts (2003). Only 18 (33.3%) of the 54 saw mill facilities were under one insurance policy or the other, the remaining 36 (66.7%) never insured the sawmill facilities. Furthermore, 20 (37%) of the 54 sawmilling industries had their workers insured, among these 20 sawmilling industries, 77 (30% in all) of all the 256 workers were under one insurance cover or the other. Only 10 of the 77 mentioned workers were involved in payment of insurance premium.

Further efforts were made to determine the relationship between size of industry and insurance patronage, the result using chi-square statistics is as stated in table 3.From table 3, significant relationship was not found between size of industries and insurance patronage ($\chi^2_{(1,1)} = 0.554$,$P>0.05$).In the same way no significant association was found between insurance patronage and each of work designation ($\chi^2_{(3,1)} = 0.200$) and income ($\chi^2_{(4,1)} = 0.453$,$P> 0.05$).

Table 3: Relationship between Size of Industry and Insurance patronage

	Facility Insurance patronage					
	No		Yes			
Size of industry	**N**	**%**	**N**	**%**	χ^2	**P**
< 10	23	69.7	10	30.3	0.351	0.554
≥ 10	13	61.9	8	38.1		
Total	**36**		**18**			

Table 4: Relationship between work designation, income and insurance coverage

	Insurance Coverage					
	No		Yes			
Work designation	**N**	**%**	**N**	**%**	χ^2	**P**
Machine related activities	104	60.8	67	39.2	4.639	0.200
Log/plank related activities	33	57.9	24	42.1		
Waste/dust related activities	13	72.2	5	27.8		
Management/Administrative control activities	9	90.0	1	10.0		
Income						
< N10,000	43	64.2	24	35.8	3.663	0.453
N10,000 - N20,000	64	66.0	33	34.0		
N20,000 - N30,000	30	51.7	28	48.3		
N30,000 - N40,000	15	62.5	9	37.5		
>N40,000	7	70.0	3	30.0		

Discussions

In this study, age was found to be a predicting factor of workforce hazards, as age increases with risk of sawmilling hazards. In other words, the most susceptible workers were the elderly. The United States Bureau of Labor Statistics (BLS) report (2011) has it that the most affected age was 44-54 years. This is similar to the finding in this study where those most affected are those of age 50 and above.

Machine and dust related activities were the most affected designated groups among the sawmilling workers while the least affected were those working with logs and planks, this is aside of administrative personnel who understandably had little to do with direct sawmilling activities . This is closely related to the previous findings as it was posted by HSE (2002) that machinery accidents remain one of the major causes of injury in sawmilling activities. These usually occur in the course of band saw blade or pulley cleaning procedures as well as round and sawn timber stacking.

Regarding education, those who had tertiary education were less likely to experience hazards compared to others with less education. The reason for this is quite apparent. This is because those with tertiary education were majorly involved in administrative or managerial schedules. Primary, junior, and senior secondary school certificate holders progressively differ significantly from those who had no formal education, who happen to be those who were most involved in waste/dust related activities. Coupled with the above is the fact that lack of formal education will hinder the workers from reading health and safety notices, posters and signals to avert dangers in the work place (Ochire-Boadu, Kuss & Lawe, 2014).

The study also showed that the more experienced a worker is on the job, the less the hazard he faces. This is also expected in every workplace, however, in this study, workmen majorly come in without formal training thus they acquired on the job experience which could be quite hazardous thus efficiency and risk- reduced delivery increases with time. A way to control for this factor is to organize pre-service training apart from needed and necessary routine in-service ones for machine-related workers in particular.

The fact that no significant relationship was found between the uses of "No smoking", "High voltage", and "Fire hazard" signage and disaster history would not imply that those signage were of less importance. It is almost accepted as a norm that the sawmilling environment is a "No smoking" environment. The mere fact that when or not "High voltage" and "Fire hazard "signage were used had no relationship with disaster history may be due to the fact that workers were already used to this warning, continuous use of the signage would still be relevant as there could not be excessive precautionary measure. However, "Restricted Area" and "Maximum working load" signage when neglected had relationship with the history of disaster. This result need to be interpreted with caution as efforts are still needed to probe into the type of disaster in this case, but the association of their non-usage with disaster provides a basis for further enquiry which is a major limitation of this study.

On the extent of insurance patronage, despite the Insurance Act of Nigeria (2005) which was established to encourage industrialist to insure both their property and staff as well as simplify the process of doing this, out of the 54 sampled sawmill, only 3.7 % of the owners were aware of the Acts that governs industrial insurance in Nigeria, awareness campaign by the various state and federal ministries of industries is urgently needed. Beyond this campaign, legislative efforts should be made at ensuring that workers and even facilities are insured just as instituted for automobiles in general. The modality for paying the premium also needs to be put in place so as not to precipitate unnecessary industrial crisis. A major challenge in this endeavor was that sawmill workers were largely viewed almost in all cases as casual workers owing to the fact that the sampled industries in this study were small scale, it thus becomes somewhat difficult to insist on insuring workers that were not reckoned with as regular employees of the industry. Thus a reworking of the entire industrial framework needs to be visited. Result has also shown that there is no significant association between size of industry and insurance patronage, larger industries sampled in this study do not differ from smaller ones, and the reason for this comparison was to identify among industries those that needed to be orientated towards insurance patronage. Finally, it was obtained that work designation as well as income did not discriminate when considering insurance coverage. All of these point to the fact that much still need be done when it comes to hazards and disaster management through risk management institutions. It would seem that insurance as culture is yet to be imbibed by small-scale industries in Nigeria. The

implications are that in the case of hazard occurrence medical treatment might become inaccessible to workers on one hand and the continuity of the affected industries might be jeopardized.

Conclusion

The study concluded that the predictive factors of hazards in Nigerian sawmilling industries could be obtained as sex, age, work designation and job experience since they individually predicts work hazards. It was also found that the use of signage such as 'Maximum work load', "Restricted area" were significantly related with disaster history while the use of signage such as "No smoking", "High voltage" and "Fire hazards" were not significantly related with disaster history. Insurance patronage in the management of sawmilling hazards were very low irrespective of size of industry and work designation.

The study recommends that training and retraining be done for sawmill workers to educate them on proper work ethics of a place like the sawmilling industry where the risk of hazards are very high. It is also recommended that the retirement age of sawmill workers be brought down so that the more active age group are those involved in the real industrial activities while the older groups be in the administrative sections of the job. Finally it must be made compulsory for all owners of sawmilling industries in the south west to register with a viable insurance company and their workers must also do same to insure their lives against accidents in the work place.

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