MJEN

MANAS Journal of Engineering
ISSN 1694-7398 | e-ISSN 1694-7398

Volume 8 (Issue 1) (2020) Pages 28-36

Modelling occupational health and safety risks among unskilled workers in construction industry

Hezekiah Oluwole Adeyemı[1,*], Olatilewa Rapheal Abolade[2], Ajibola Oluwafemi Oyedejı[2], Olanrewaju Bilikis Olatunde[1]

[1]Department of Mechanical Engineering, Olabisi Onabanjo University, Ago-Iwoye, Nigeria,
deyemi.hezekiah@oouagoiwoye.edu.ng, olatunde.bilikis@oouagoiwoye.edu.ng, ORCID: 0000-0002-5815-7321

[2]Department of Computer Engineering, Olabisi Onabanjo University, Ago-Iwoye, Nigeria,
abolade.raphael@oouagoiwoye.edu.ng, oyedeji.ajibola@oouagoiwoye.edu.ng

ABSTRACT

To enhance workers' protection in construction tasks, Occupational Health and Safety Risks (OHSR) needs to be properly recognized, assessed and controlled. This study modelled Health and Safety Risk (HSR) among unskilled workers in construction works. Data were collected from 150 subjects in 12 construction sites located in Southwest Nigeria. Variables considered to play key roles in HSR causation were measured with the questionnaire. All variables that correlated significantly ($p \leq 0.05$) to HSR on the tasks were noted by Spearman's rho correlation (Src) using SPSS software. The model prediction was adjusted by R2 and was validated by comparison with Human Professionals' Predictions (HPP). Model Cook's distance and its closeness to being normally distributed were evaluated. 37 attributes variables were initially collated with 13 predictor variables remained in the optimum model. Wrong work-methods, lack of work-control and harsh outdoor environment ranked among the strongest positive β coefficients (0.217, 0.127 and 0.126 respectively). The maximum coefficient of the adjusted R2 determination was 0.708. The histogram of the residuals suggested closeness to being normally distributed and 0.930 as the maximum Cook's distance. Comparison between the OHSR model and the HPP had strong Src strength. The OHSR showed a statistically significantly higher level of hazards' rating compared to HPP. OHSR model was developed and the performance was rated good, satisfied the study's objectives. The author recommended the development of measures at reducing β coefficients of all the predictor variables to minimize workplaces OHSR.

ARTICLE INFO

Research article

Received: 19.07.2019
Accepted: 27.05.2020

Keywords:
Unskilled,
safety,
model,
predictor,
variables,
occupation

Corresponding author

1. Introduction

Unskilled workers can also be referred to as labourers, low-skill workers, semi-skilled workers, low-qualified workers or menial workers [1]. Labourers fall among the group of workers that require no special training or experience for performing some works adequately. This group of workers perform physically demanding labour and assist skilled workers at construction, maintenance, and repair project sites [2]. Studies have shown that the unskilled workers are much more exposed to all categories of challenging physical activities than other sets of workers [3, 4, 5, 6]. Labourers have less autonomy, assigned less responsibility, and as a result, can be subject to lower job satisfaction [5]. According to the Bureau of Labour Statistics [7], labourers can be found on almost all construction sites, performing a wide range of tasks from the very easy to the hazardous. They can be found at building, highway, and heavy construction sites, residential and commercial sites, tunnel and shaft excavations, and demolition sites.

In construction works, the duties of labourers are to prepare worksites, digging and backfilling trenches and tunnel and shaft excavations, dismantle concrete and masonry retaining and bearing walls, use hand tools (e.g., shovels, picks, sledgehammers), mix and pour concrete, load and unload materials and equipment from trucks, help lift and place materials, assist skilled trades workers by readying and supplying needed tools, equipment, and materials [8]. Physical abilities common with the unskilled labourers include ability to lift heavy loads, walk and stand for extended periods of time, quickly bend, stretch, twist, or reach out with one's body, arms, and/or legs, move one's hands and arms to grasp or manipulate objects, access difficult to enter spaces (e.g. trenches, tunnels, cramped quarters), operate applicable hand tools, power tools, and equipment.

2. Literature review

There have been several studies conducted in the construction industry with a focus on the technique of enhancing workers' safety. Fabián and Gloria [9] presented the safety trends through an exploratory study which covered the year 1930 to 2016 and reported on the need for further possible efforts at zeroing down hazards in the industry. Peter et al. [10] identified factors such as management commitment, workers' involvement and strict enforcement of safety regulation as a way forward to enhancing safety in the industry. Omobolanle and Johnsmall [11] suggested the need for specific, strictly monitored and legislation to promote an occupational health and safety culture that would provide continuous health and safety performance improvement on projects. Chunlin et al. [12] detailed the need for allocation of sufficient personal protective equipment among workers and more effort from the relevant authorities at organizing unannounced site visits more frequently to improve the safety performance. Amick et al. [13] described the need to encourage occupational injury reporting and reduce risks through training and hazard identification and control strategies.

The association between some contributory factors and accidents among different groups of workers in construction sites, as highlighted by Yahya et al. [14], are grouped under; individual characteristics (e.g. age and experience, drug abuse), site condition (e.g. hazardous operation, weather, equipment, welfare service), workgroup (e.g. teamwork), supervision (e.g. safety engagement, effective enforcement), project management (e.g. safety leadership and communication). These factors create stress and anxiety and have negative consequences on workers' health and lifestyle [5], making them vulnerable to injuries and illnesses related to outdoor weather conditions, loud noise, fumes or dust, oily or wet environment, hazardous conditions (e.g., construction sites, heavy machinery) to mention few. Many who work as labourers for even a short period may suffer from permanent work injuries such as hearing loss, back injuries, eye injury, head injury, missing fingernails and skin scars [15]. These are usually caused as a result of their inexperience and lack of health and safety training [16]. Most of the tools used by labourers in construction works are often very heavy and there is little mechanical help for lifting and carrying, most especially, on small construction and renovation sites. Long hours of work are typical and these hours increase fatigue and stress, both of which contribute to traumatic injuries and musculoskeletal injuries [17]. Low-qualified workers have low-paid jobs and non-standard forms of contractual agreements, meaning that they often suffer from job insecurity.

Occupational Safety and Health [18], mentioned that the responsibility for promoting occupational health among workers rests with the management. The managements are to conduct assessments on all activities that may be hazardous to health, take appropriate measures to eliminate hazards or reduce risks, implement effective protective measures and provide information, training and supervision to safeguard the health of employees. The employees on their part should also comply with work regulations and instructions and carefully read and understand relevant information, carefully and properly use any material, tool, device and Personal Protective Equipment (PPE) provided and avoid taken harmful substances e.g. alcohol, cigarette.

Workplace hazards' prevention begins with having a clear understanding of those factors that play key roles in their causation and then formulate and implement an effective measure, on occupational health management, to reduce and control the hazards [18, 19]. In line with this view, this study attempted to model Occupational Health and Safety Risks (OHSR) among the unskilled workers.

The objectives were to identify the major factors that contribute to safety risk on the job, develop and validate a linear regression equation (model) capable of forecasting the safety level among the group of workers.

3. Materials and methods

3.1. Study Area and Subjects

The primary data for this study was collected among the low-qualified workers popularly refered to as labourers while performing some physical tasks among which are; cleaning building sites, unloading and loading equipment and supplies from trucks, building or dismantling scaffolding, mixing, pouring and spreading materials(concrete), helping tradespersons (such as bricklayers, cement finishers), installing utility piping, placing concrete, performing selective demolition, performing excavation work among others. Fifteen (15) construction sites located in Abeokuta and Lagos, the Southwest states of Nigeria were used for the study. Abeokuta is the largest city and capital of Ogun State in southwest Nigeria. It is situated 64 miles north of Lagos by railway or 81 miles by water. Lagos State is located on the southwestern part of Nigeria [20].

3.2. Data Collection Procedures

A mixed-methods research which involved qualitative and quantitative approaches was used in this study. The method helped to uncover the relationships between the measured variables through quantitative research with the use of questionnaire. The meanings among the participants were conveyed through a qualitative research approach. The questionnaire was designed to determine the more important variables that contribute to the focal problem, OHSR among the unskilled labourers. Respondents were requested to provide information related to their opinions on each of the identified attributes capable of influencing OHSR. The 150 subjects, involved in the study, were asked to rate the extent to which each of the variables can contribute to OHSR on a five scale point (1 represented 'not important contributor' and

5 represent 'very important contributor'). The semi-structured interview was conducted and interpreted, by personnel trained, in English, Pidgin and Yoruba languages as applicable to each subject. Each of the interview sessions lasting about 45minutes on average were taped and later transcribed. Before the interview commenced, all potential volunteers agreed, and consents were taken in oral and/or written form after they were informed that their participation in the study was voluntary. The purpose of the study and the confidentiality of the information provided were emphasized.

3.3. Development of Occupation Health and Safety Risk Model

This correlation design study proposed a multiple linear regression model to predict safety risk. Among all the primary variables collated, the predictor variables were identified after filtered out those variables that did not correlate significantly ($p \leq 0.05$) to the level of OHSR reported by the workers using Spearman's correlation analysis. The details of the subjects' responses were input into Statistical Package for the Social Sciences (SPSS) software [21] and an iterative process was performed. The prediction of the model was done by the adjusted R^2. The optimum model was selected through accepted regression modelling practices which included; maximizing the adjusted R^2, minimizing model variances, and inclusion of only variables that have been proven to be statistically significant through F-test ($p \leq 0.0001$) procedures.

3.4. Model Estimation and Diagnostics

The safety risk level was measured on Likert type 5-point scale from 1 to 5, where 1 = very low, 2 = low risk, 3=medium risk, 4= high risk, and 5= very high risk [22]. The other variables were measured on a 5-point scale of 1 to 5, where 1 = not important contributor and 5 = very important contributor. The calculation of the predicted safety risk level (Y) for any case was written as:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + \ldots + b_xX_x$$

Where Y = the predicted level of OHSR, a= intercept, b_1 to b_x = the predictor variables of the optimum model, X = the value of the coefficient of the variables.

The histogram of the residuals which suggests closeness to being normally distributed was conducted. Cook's distance value was also computed to find out the maximum value. According to Field [23], a good model should have its Cook's distance less than 1.0 value.

3.5. Model Validation

To test the quality of the model, the responses, of 15 randomly selected subjects, to predictor variables (in the optimum model) were used to compute the outcome, OHSR level using the model generated linear regression equation. The calculated ratings for each subject were given linguistic interpretations using a 5 point scale describing OHSR likelihood occurrences (1=Not likely, 2= Low, 3= Mild, 4= High, 5= Extremely high). These values and their linguistic interpretations were compared, for correlation strength, with the average ratings and the interpretations (to the same test data) suggested by two human ergonomics professionals drawn from academics environment using the same 5 points scale. Spearman's rho was used for significance tests of correlation coefficients at a *p*-value of 0.01. The independent sample t-test was also used to analyse the means of the unrelated groups (the model, and the human professional, mean values) at $p < 0.05$.

4. Results and discussion

4.1. Identified Attributes that Play Key Roles in OHSR Causation.

Table 1 shows the attributes identified as having tendencies of contributing to OHSR. These attributes were subdivided into health, environment, motivation, personal, work practices, equipment related and others. The highest rating (mean value of workers' reported safety risk level) (4.8) for each of the category of the attributes was found in the environment and the work practice related groups of attributes.

Table 1. *Mean ratings of identified attributes capable of influencing occupational health and safety risk among labourers*

RANK	REF.	ATTRIBUTES	MEAN SCORE
	A	**HEALTH-RELATED**	
1	VA-1	Poor use or lack of PPE	3.2
2	VA-2	Poor safety program	3.5
3	VA-3	Poor medical consideration	3.0
4	VA-4	Lack of health and training program	4.5
5	VA-5	Poor access to safety promotional program	4.2
6	VA-6	Poor access to safety information	4.5
	B.	**ENVIRONMENT RELATED**	
7	VB-1	Harsh outdoor environment	4.8
8	VB-2	Exposure to hazards	4.5
9	VB-3	Inhalation of harmful substances	4.4
	C.	**MOTIVATION**	
10	VC-1	Unattractive wages	3.5
11	VC-2	Lack of incentives	2.5
12	VC-3	Penalty and punishments	2.0
	D.	**PERSONAL**	
13	VD-1	Poor feeding	2.5
14	VD-2	Inadequate water intake	3.0
15	VD-3	Technical incompetence	2.5
16	VD-4	Inexperience	2.5
17	VD-5	Substances intake	3.0
18	VD-6	Weak adaptation to work environment	3.0
19	VD-7	Cultural background differences	2.0
	E.	**WORK PRACTICES**	
20	VE-1	High work-load	4.5
21	VE-2	Wrong work-methods	4.8
22	VE-3	Harsh supervision	3.0

23	VE-4	Unsafe work practices	2.5
24	VE-5	Lack of work control	2.6
25	VE-5	Inadequate rest	4.5
26	VE-6	Excessive grip force	3.8
27	VE-8	No provision for rest places	4.0
	F.	**EQUIPMENT**	
28	VF-1	Wrong tools	4.5
29	VF-2	Poor handling of tools/equipment/plants	4.5
30	VF-3	Weak equipment's hazard information	3.
	G.	**OTHERS**	
31	VG-1	Job insecurity	2.5
32	VG-1	Communication barriers	2.5
33	VG-1	Psychosocial environment/job title	3
34	VG-1	Poor safety inspections	3.0
35	VG-1	Lack of occupational health programs	3.0
36	VG-1	Communication and understanding of in-house rules and regulations	2.5
37	VG-1	Insurance policies	3.0

4.2. Predictor variables in the optimum multiple regression OHSR modelling

Given the large number of predictor variables in Table 1, Table 2 shows the reduced number of predictor variables that correlated significantly ($p \leq 0.05$) to the safety risk level identified through Spearman's correlation analysis. The partial *F* statistic of the independent variables was checked to identify and remove any of the variables that became insignificant. This was done, using the 'enter method on SPSS software linear regression platform, until the 13th model when no insignificant variables remained. The predictor variables are; poor use of PPE (VA-1), inadequate water intake (VD-2), poor access to safety promotional program (VA-5), no provision for rest place (VE-8), exposure to environmental hazards (VB-2), inhalation of harmful substances (VB-3), poor safety program (VA-2), substances intake (VD-5), high work load (VE-1), wrong work-methods (VE-2), lack of work control (VE-5), harsh outdoor environment VB-1), wrong tools (VF-1).

Table 2. *Coefficient for dependent variable 'occupational health and safety risk'*

Model 13	Unstandardized Coefficients		Stand. Coeff.	T	Sig.
	B	Std. Error	Beta		
(Constant)	1.080	.077		13.975	.000
Poor use PPE (VA-1)	.070	.020	.069	3.454	.001
Inadequate water intake (VD-2)	-.106	.050	-.020	-2.109	.037
Poor access to safety promotional program (VA-5)	.124	.035	.124	3.541	.001
No provision for rest places (VE-8)	-.069	.027	-.076	-2.531	.013
Exposure to environmental hazards (VB-2)	.061	.024	.064	2.532	.012
Inhalation of harmful substances (VB-3)	.052	.023	.057	2.233	.027
Poor safety program (VA-2)	.068	.030	.065	2.246	.026
Substance intake (VD-5)	.041	.017	.047	2.381	.019
Excessive use (VE-1)	.117	.027	.115	4.419	.000
Wrong work-methods (VE-2)	.217	.035	.227	6.266	.000
Lack of work control (VE-5)	.127	.029	.148	4.332	.000
Harsh outdoor environment VB-1)	.126	.035	.123	3.580	.000
Wrong tools (VF-1)	.088	.028	.083	3.152	.002

Fig. 1 shows the percentage contributions of all the predictor variables to OHSR in the model with two variables (VF-8 and VD-2) having a negative β coefficient, all others are positive as predictor VE-2 emerged the highest (21.7%) contributor.

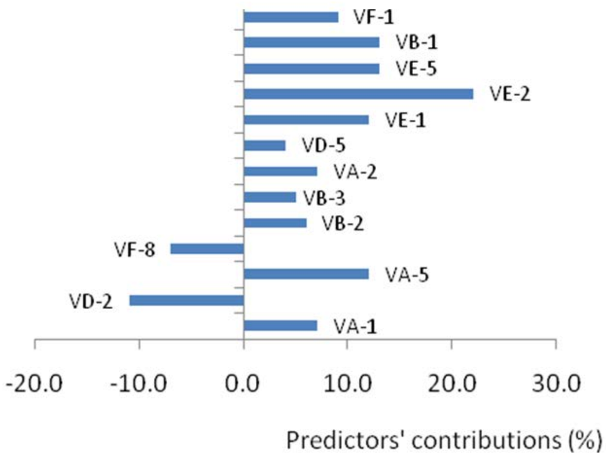

Figure 1. *Showing the percentage contributions of the predictor variables in the optimum model*

ANOVA result which assessed the overall significance of the model emerged ($F_{13,136}$ = 13.863, $p < 0.0001$. Hence since $p < 0.05$ the model is significant. The adjusted R square value of 0.708 derived from the optimum model shows that the model accounts for 70.8% of variance in the outcome variable. This suggested a very good model. Because the constant (beta zero) is included, the "unstandardized coefficients were used to generate the equation for the regression line:

$$Y = 1.080 + .070(VA-1) - .106(VD-2) + .124(VA-5) - .069(VE-8) + .061(VB-2) + .052(VB-3) + .068(VA-2) + .041(VD-5) + .117(VE-1) + .217(VE-2) + .127(VE-5) + .126(VB-1) + .088(VF-1) \quad (1)$$

Using this model, given values for all the predictor variables, the user can come up with a prediction for the "OHSR level".

4.3. Cook's Distance

The maximum value of the model Cook's distance was 0.930 with a standard deviation of 0.017. Since this value is less than the value of 1.0, it appears there is no major problematic case in the sample.

4.4. Normal Probability-Probability (P-P) Plot

Figure 2 described how closely the two data sets (the predictor and the OHSR variables) agreed. From the plot, most of the data points didn't fall exactly on the regression equation line. The residual, the vertical distance between a data point and the regression line, are minimal with some at zero points. The positive ones (above the regression line) have however appeared more than the negative (below the regression line). However, in the overall, there does not appear to be a severe problem with non-normality of residuals.

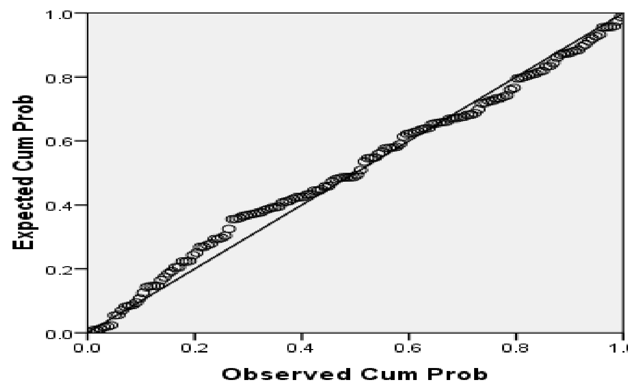

Figure 2. *Normal P-P plot of regression standard residual*

4.5. Model validation

Table 3 displays the results of 15 tested scenarios randomly selected from the numerous primary data collected. All the 13 predictor variables in the optimum model, the values of the predictors as reported by the subjects, the model result and the HEPP predicted values with linguistic interpretations are shown.

4.5.1. Percentages of similarity between OHSR model and HEPP

From Table 3, 60% of the total linguistic interpretations are the same (samples 2,3,5,6,7,8,9, and 14, 15) for all the samples. Whereas 40% had the model linguistic interpretations higher in level than those of the HEPP. However, in all the cases where the model predicted a higher level of OHSR occurrence, they are neighbourhood rankings. Figure 3 shows the relationship between the predicted values by the two sources (OHSR model and HEP). In the majority of the numeric values, those of HEP generally fall below that of the model.

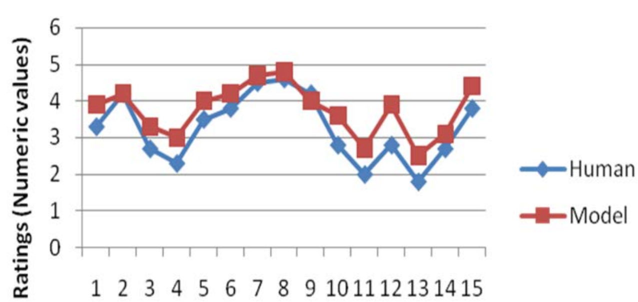

Figure 3. *Comparison of the OHSR model and the HEP values*

4.5.2. Statistic Test

a. Correlation

After comparing the result of predicted values of the model (using equation 1) with that of human professional subjective average ratings for correlation strength using Spearman's rho, a significant correlation of r = 0.965, p<0.01 was derived, suggesting a very strong correlation.

Table 3. *Percentages of similarity between OHSR model and HEPP*

Samples	a	B	c	d	e	f	g	h	i	j	k	L	m	HEP predictions		Model Predictions	
														Val.	Inter.	Val.	İnter
1	3	1	3	4	4	4	4	5	5	1	1	5	2	3.3	Mild	3.9	High
2	2	2	2	5	5	4	5	2	3	4	2	5	3	4.2	High	4.2	High
3	4	4	4	5	4	1	4	1	2	2	1	5	2	2.7	Mild	3.3	Mild
4	2	2	3	5	2	1	4	1	4	2	1	4	1	2.3	Low	3.0	Mild
5	2	2	2	4	4	5	4	2	2	3	2	4	5	3.5	High	4.0	High
6	2	2	2	3	5	3	5	1	3	4	3	3	4	3.8	High	4.2	High
7	3	3	3	4	2	3	3	2	5	5	2	5	4	4.5	E.H.	4.7	E.H.
8	2	2	2	4	5	5	5	5	5	4	4	4	4	4.6	E.H.	4.8	E.H.
9	3	3	3	5	4	2	4	3	3	3	2	5	4	4.2	High	4.0	High
10	3	1	3	5	4	1	4	1	5	1	2	5	2	2.8	Mild	3.6	High
11	4	4	4	4	1	1	5	1	1	1	1	4	1	2.0	Low	2.7	Mild
12	1	1	4	3	5	2	5	3	1	3	2	4	3	2.8	Mild	3.9	High
13	3	3	3	5	3	1	3	1	2	1	1	3	1	1.8	Low	2.5	Mild
14	2	2	2	5	2	3	3	1	3	2	3	2	2	2.7	Mild	3.1	Mild
15	4	3	4	5	2	3	2	3	3	4	4	4	3	3.8	High	4.4	High

a = VA-1, b = VD-2, c = VA-5, d = VE-8, e = VB-2, f = VB-3, g = VA-2, h = VD-5, I = VE-1, j = VE-2, k = VE-5, l = VB-1, m = VF-1,

b. Independent samples t-test

The t-test to determine the mean difference between the Model values and HEP values found that the Model predicted higher values of risk level (3.7533 ± 0.233) compared to HEP (3.2667 ± 0.18097), t (28) = -1.648, p = 0.197. Since p>0.05, there is no significant difference between groups.

A multiple linear regression model was carried out to model Occupational Health and Safety Risk (OHSR) among the unskilled workers. The model was suitable for predicting the outcome (F = 13.863, df = 18, p<.001). The coefficients for the explanatory variables are as presented in Table 2.

The predictor variables after the 13th iterative process include; poor use of PPE (VA-1), inadequate water intake (VD-2), poor access to safety promotional program (VA-5), no provision for rest shade (VE-8), exposure to environmental hazards (VB-2), inhalation of harmful substances (VB-3), poor safety program (VA-2), substances intake (VD-5), excessive use (VE-1), wrong work-methods (VE-2), lack of work control (VE-5), harsh outdoor environment VB-1) and using wrong tools (VF-1). Among the predictor variables, use of wrong work-methods had the strongest value (0.217) of the coefficient.

The regression parameters can be used to calculate the value of safety risk from the entire model or part. Considering the effects of using 'wrong work-methods', the predicted safety level when VE-2 = 1 (work method close to normal) is 1.080 + (.217*1) = 1.287. By comparing the predicted safety risk value when using 'wrong work methods' is considered 'unergonomics' (VE-2 = 5) is 1.080 + (.217*5) = 1.287= 2.165. There is therefore roughly a 1.0 score point gap between the highest and lowest rank of 'using the wrong work-methods' category alone which is a substantial difference in safety level. The VE-2 predictor has a positive β coefficient of 0.217 in the model, hence the risk of OHS increased with using unergonomics methods.

Veronica et al. [24] mentioned that workers in severe harsh outdoor environments are at risk of a range of heat-related illnesses. According to Occupational Safety and Health Administration [8], heat-related illness include majorly; heatstroke, heat exhaustion (with weakness, headache, and profuse sweating, among others, as symptoms), heat cramps (involuntary spasms of large muscle groups as symptoms), heat syncope (symptoms include fainting or lightheadedness) and heat rash (red bumps on the skin, feeling of the skin as symptoms). Working under harsh outdoor environment (VB-

1) was linked with positive β coefficient of 0.126 in the model and the increase of which will worsen the model predicting the outcome. Maintenance of productivity in hot environments without compromising workers' safety is however possible through the adoption of a flexible management approach, worker rotation or work-rest cycling [25].

Intake of substances (VD-5) is a predictor variable in the model with a positive β coefficient of 0.041. Injury is linked with substance (drug, alcohol etc.) intake, even minimal amounts use while working may increase a worker's risk of being injured on the job [26]. For all substances intake, the risk of injury increased with increasing rates of current and lifetime use [27]. As reported by America's Medicine Cabinet [28], while medications can help keep the body healthy, they also can cause serious problems when used incorrectly. Taking medications, the wrong way is an extremely costly and dangerous problem. It increases the chances of severe medical complications or even death. Drinking too much or at the wrong time of alcohol, as reported by Health and Safety Executive [29], can be harmful.

Exposure to harmful substances (VB-3) contributed a positive β coefficient of 0.053 to the outcome of the model. Dust, concrete crusted clothing and variety of oils, greases among others, can lead a worker to the potential for becoming sick, ill and disabled. By extension, such hazardous substance can be unknowingly brought back to the worker's home which can be unintentionally poisoning the total family. Construction Safety Council [30] stated that controlling a hazard at its source is the best way to protect workers. However, when engineering, work practices and administrative controls do not provide sufficient protection, employers must provide PPE to their employee and ensure its proper use. Poor use or lack of PPE (VA-1) was connected to positive β coefficient of 0.070 in the model and this value increased the output. The purpose of using PPE is to shield or isolate individuals from physical or biological hazards. When the right PPE is used in physical tasks, hazards are reduced. The use of filtering face-pieces, half-face respirators among others can be used to prevent dust, mists and other hazardous materials.

Workplace health promotion programs are employer-sponsored initiatives directed at improving the health and well-being of workers [31]. Such health programs enable workers to increase control over their health and its determinants, and thereby improve their health. Health promotion programs may include among others, awareness programs to make health information available and accessible to employees, lifestyle/behaviour change programs, and encouraging employees to take simple steps to reduce stress [32]. In a developing country like Nigeria, most of the low-qualified workers are illiterate who may not properly read the content of safety poster and instructions. In addition, labourers are often neglected in safety management intervention program. This is evident with the positive β coefficient of 0.041 contributions to the model output of poor access to safety promotional program (VA-5).

Using the wrong tools (VF-1) is an important positive predictor significant in the model. As mentioned by the Labour Institute and the United Steelworkers International Union [33], not having the proper tool to use and the proper training on how to use various tools can result in a worker being injured. As mentioned by the majority of the subjects studied, some of the common hand tools they use (e.g. shovel, digger, cutlass etc.) were self-provided some of which were improvised and may not be right for the various tasks been used for. As reported by the University of California [34], if a tool which does not fit is used in a way it was not intended, injury such as carpal tunnel syndrome, tendonitis or muscle strain resulting from repetitive movements, performed over time, can be developed.

There is the need for the development of ergonomics measures capable of reducing the values of the β coefficient of all predictor variable in the model. Such measure may include management's commitment at minimizing hazards from the source and enforcement of safe work practice regulations, the involvement of low-skilled workers in safety programs and training, provision and enforcement of necessary PPE usage on the construction sites among other measures. These measures will enhance the occupational health and safety of the group of workers.

5. Conclusion

This study evaluated significant predictor variables that contribute to the Occupational Health and Safety Risk (OHSR) among the low-qualified workers in construction tasks. The OHSR level among the group of workers can be predicted through the developed model presented in Table 1 or with the regression equation 1. The model used 13 variables which include; lack of appropriate PPE, inadequate water intake, poor access to safety promotional program, no provision for rest shade, exposure to environmental hazards, inhalation of harmful substances, poor safety program, intake of harmful substances, excessive use, wrong work-methods, lack of work control, harsh outdoor environment and using wrong tools. The predictor variables have positive β confident except 'water intake' and lack of rest places. The result of the developed model was suitable for predicting the outcome. The author recommended the development of ergonomics measures at reducing β coefficients of all predictor variables to minimize OHSR among the group of workers.

References

[1]. Davos K. "Matching Skills and Labour Market Needs: Building Social Partnerships for Better Skills and Better Jobs," World Economic Forum Global Agenda Council on Employment, Switzerland, (2014).

[2]. Machin S. "The Changing Nature of abour Demand in the New Economy and Skill-Biased Technology Change," Oxford Bulletin of Economics & Statistics, (63 Special Issue), (2001), 753-776.

[3]. Ahonen E. Q., Benavides F. G., Benach J. "Immigrant Populations, Work and Health - A Systematic Literature Review," Scand J Work Environ Health, 33(2), (2007), 96-104.

[4]. Garcia A., Lopez-Jacob M., Agudelo-Suarez A., Ruiz-Frutos C., Ahonen E. "Condiciones de trabajo y salud en inmigrantes (proyecto ITSAL): entrevistas a informantes clave," Gaceta Sanitaria, (2009), 91-98.

[5]. Alice B., Tony Z., Kerina T., Gicsuillermo H. "Occupational Health and Safety Risks for the Most Vulnerable Workers," Milieu Ltd, Brussels, (2011).

[6]. EU Occupational Safety and Health Authority, "Hazards and Risks Associated with Older Workers," Occupational Safety and Health Authority, (2011).

[7]. Bureau of Labour Statistics, "Occupational Outlook Handbook," Bureau of Labour Statistics, (2010).

[8]. Occupational Safety and Health Authority, "Code of Practice for the Construction Industry," Occupational Safety and Health Authority, (2006).

[9]. Sanchez F. A. S., Pelaez G. I. C. "Occupational Safety and Health in Construction: A Review of Applications and Trends," Industrial Health, 55(3), (2017).

[10]. Peter O., John U. E., Okechuhwu F., Okechukwu E. "Building Construction Workers' Health and Safety Knowledge and Compliance on Site," Journal of Safety Engineering, 5(1), (2016), 17-26.

[11]. Omobolanle A., Johnsmall W. "Impact of Occupational Health and Safety Legislation on Performance Improvement in the Nigerian Construction Industry," Procedia Engineering, 196, (2017), 785-791.

[12]. Chunlin W., Xiaowei L., Tao W., Yue W., Bibek S. "Safety Challenges and Improvement Strategies of Ethnic Minority Construction Workers: A Case Study in Hong Kong," International Journal of Occupational Safety and Ergonomics, 26(1), (2020), 80-90.

[13]. Amick III B. C., Hogg-Johnson S., Latour-Villamil D., Saunders R. "Protectin Construction Worker Health and Safety in Ontario, Canada: Identifying a Union Safety Effect," Journal of Occupational and Environmental Medicine, 57(12), (2015), 1337-1342.

[14]. Yahya K., Hassan A., Ebrahim H., Narmin H., Hamid B., Amir H. B. "Factors Influencing Unsafe Behaviours and Accidents on Construction Sites: A Review," Internationl Journal of Occupational Safety and Ergonomics, 20(1), (2014), 111-121.

[15]. Bureau of Labour Statistics, "Construction Labourers' : Occupational Outlook Handbook," U.S. Department of Labour, (2008).

[16]. Health and Safety Executives, "Employers' Perspections of the Health and Safety of Young," Health and Safety Executives, (2015).

[17]. Occupational Outlook Handbook, "Bricklayers and Stonemasons," (1998).

[18]. Occupational Safety and Health Branch Labour Department, "Occupational Health Guide- Good Health is Good Future," Occupational Safety and Health Authority, (2005).

[19]. Hinze J., Pederson C., Fredley J. "Identifying Root Causes of Construction Injuries," Journal of Construction Engineering and Management, 124(1), (1998), 67-71.

[20]. Akomeno U. O., Rasheed A. A. "The Lagos Megacity," (2016).

[21]. Statistical Package for Social Sciences (SPSS), "SPSS Regression Models," IBM SPSS, (2007).

[22]. Adeyemi H. O., Adejuyigbe S. B., Ismaila S. O. "Low Back Pain Assessment Application for Construction Workers," Journal of Engineering, Design and Technology, 13(3), (2015), 419-434.

[23]. P. Field, Discovering Statistics using IBM SPSS Statistics: And Sex and Drugs and Rock 'n' Roll, 4th ed., London: Sage, (2013).

[24]. Veronica M., Graham B., John D. S., Jens T. "Self-pacing as a Protective Mechanism against the Effects of Heat Stress," Ann. Occup. Hyg., 55(5), (2011), 548-555.

[25]. Brake D. J., Bates G. P. "Deep Body Core Temperatures in Industrial Workers under Thermal Stress," J Occup Environ Med, 44, (2002), 125-135.

[26]. R. Ramchand, A. Pomeroy and J. Arkes, "Effects of Substance Use on Workplace Injuries," RAND Corporation, Santa Monica, (2009).

[27]. Shipp E. M., Tortolero S. R., Cooper S. P., Baumler E. G., Weller N. F. "Substance Use and Occupational Injuries Among High School Students in South Texas," American Jurnal of Drug and Alcohol Abuse, 31(2), (2005), 253-265.

[28]. America's Medicine Cabinet, "Use Medicines Safely," ISMP America's Medicine Cabinet, (2010).

[29]. Health and Safety Executive, "A Guide for Employers on Alcohol at Work," Health and Safety Executive, (2011).

[30]. Construction Safety Council, "Health Hazards in Construction Workbook," Construction Safety Council, Illinois, (2012).

[31]. Goetzel R. Z., Shechter D., Ozminkowski R. J., Marmet P. F., Tabrizi M. J. "Promising Practices in Employer Health and Productivity Management Efforts: Findings from a Benchmarking Study," Journal of Occupational and Environmental Medicine, 49(2), (2007), 111-130.

[32]. Cook T., Campbell D. "Impact of Work Site Health Promotion on Health Care Costs and Utilization," Journal of Community Medicine, 16, (2009), 99-117.

[33]. Labour Institute and the United Steelworkers International Union Under Grant Number SH-17045-08-60-F-42, "Lessons Learned," 9(23), (2009), 1-14.

[34]. University of California, "Shop, Tool and Electrical Safety," University of California, California, (2012).