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Original Research Article

The use of safety practices to reduce occupational injury among solid mineral miners in Southwest, Nigeria: an examination of the health belief model

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ABSTRACT

Background: The mining industry requires measures at reducing the increasing incidence of occupational injury. The behavioural change towards the use of preventive and safety measures are required. The health belief model concept analyses behavioral change towards the use of preventive measures required to reduce occupational injury. The aim of the study was to use the health belief model to describe miners safety practices in Southwest, Nigeria.
Methods: A descriptive cross-sectional study using a structured survey was employed. The consenting staff of the mining industry completed a pretested self-administered questionnaire. Data were analysed using descriptive and inferential statistics. The level of significance was taken as $p \leq 0.05$.
Results: A total of 73 (60.8%) of the respondents had various forms of occupational injury. The self-efficacy ($\chi 2=4.232$; $p=0.040$) had a statistically significant association with occupational injury and was also a predictor (OR=2.3; p=0.042; 95% CI=1.03-4.97) of injury. The factor that positively affects workers use of personal protective equipment was one health belief model component: self-efficacy ($\chi 2=9.509$; $p=0.009$). The socio-demographic factors associated with self-efficacy were age ($\chi 2=4.135$; $p=0.042$) of the respondents, gender ($\chi 2=5.720$; $p=0.017$) and monthly income ($\chi 2=6.047$; $p=0.014$).
Conclusions: The conviction to successfully use the personal protective equipment have a better effect on increasing the rate of preventive behaviour among miners.

Keywords: Health belief model, Miners, Nigeria, Occupational injury, Personal protective equipment

INTRODUCTION

An occupational injury is any injury that occurs to a person specific to the occupational demands or requirements, and the injury can be fatal or non-fatal injury.[1,2] The impacts of the injury can cause serious health and safety problems and prolonged absence from work hence, the need to inculcate a safety culture in the workplace.[1,3] The mining industry has a high incidence rate of fatal injuries among all industry divisions infact, it is considered one of the most dangerous occupations with severe socio-economic consequences for workers and the society.[4,5]

Despite the investment of money and introduction of technology from the conventional solid mineral mining to mechanised open cast mining the incidence of injuries remains relatively unchanged.[6]

The risk of injury is higher among workers with no formal education, poor health status, health-related behaviours such as smoking and alcohol abuse.[7,8] Poor health status results in deteriorated physical and mental abilities and thus in injury. Similarly, workers are often poorly trained with low motivation, with no safety training, and do not use Personal protective equipment (PPE) or adopt proper safety behaviors. Hence, they are prone to so many injuries. One measure of curbing and reducing the increasing incidence of occupational injury is behavioural change especially towards use of preventive and safety measures.

Theoretical frameworks are used in research to predict, explain behavior and behavioral interventions toward improved health outcomes.[9] Theory-driven strategies for occupational safety are currently needed to reduce occupational injury. Occupational safety behaviour are activities involved in the process of identifying and using safety measures which include specific actions such as use of personal protective equipment, awareness of hazard and danger of the workplace and more broadly compliance and adherence to safety measures to reduce occupational injury.[10]

The Health belief model (HBM) is a comprehensive, well-tested social-cognitive framework that is suitable for explaining and predicting occupational safety behavior. The applications of the HBM can help in understanding the factors influencing miners' safety behavior and facilitate strategies to prevent occupational injury and thereby promote safety at workplace.[10] The health belief model includes perceived threat (perceived susceptibility and perceived seriousness), cost benefit analysis (perceived barriers and perceived benefits), cue to actions and modifying and enabling factors (self-efficacy).[9,10]

According to the HBM, individual perceptions such as perceived seriousness of occupational injury, perceived benefits and perceived barriers are more likely to affect the preventive actions such as using personal protective equipment, avoiding slippery ground which can prevent occupational injury.

In addition, perceived barriers such as inconveniences in wearing personal protective equipment or other coworkers making fun of the use of the personal protective equipment can prevent adoption of safety practices. In contrast, the perceived benefit of wearing personal protective equipment prevents future health problems and exposure to the kinds of hazards caused by the job may result in more effective use of personal protective equipment. This model promotes an ability to weigh benefits and make changes when confronting a health risk.

The HBM provides a framework for understanding the potential influence on an individual's decision to adopt safety practices at workplace. The aim of the study was to use the health belief model to describe miners safety practices in Southwest, Nigeria. The objectves of this study was to determine the relationship between the health beleif model concepts and occupational injury, and determine the component of the health belief model that predicts occupational injury.

METHODS

This study was conducted in the mining industry in Ose local government area in Ondo State, southwest, Nigeria. Ose Local Government lies on longitude 5°50 E and latitude 7°22 N with a population of 144,901 and a total area of 1,465 km.[11] The company occupies a landmass of about 9.2 hectares in Owalafo, in Afo community of Ose local government, and deals in stones tiles whose finished products are stone tiles and slabs. It has a staff strength of one hundred and sixty-four workers. The different work sections are; quarry, hydraulics, infra-red, polishing, welding, maintenance, powerhouse, administration, and the health center.

A descriptive cross-sectional design was used for this study between 1st September, 2020 and 31st December, 2020. Quantitative data were collected using a pretested self-administered structured questionnaire.

Ethical approval was obtained from the Research and Ethics Committee of Federal Medical Centre, Owo, Ondo-State. Permission was obtained from the management of the mining company to have access to the factories and the workers. Respondents were given information about the aims and objectives of the research and their role in it. The respondents were assured of the confidentiality of the information given and the data collected were entered and kept in a password protected computer.

One hundred and twenty consenting staffs were recruited for the study using simple random sampling. The consenting working staff filled a pretested self-administered structured questionnaire which were distributed consecutively during their break period and were filled at their convenience.

The survey questions were tested for content validity and internal validity (reliability). The content validity of the self-administered structured questionnaire was reviewed by a consultant community health physician prior to administration. Based on their endorsements, modifications to the questionnaire were made.

Similarly, Cronbach's Alpha and reliability coefficient of the health belief model constructs were calculated. The reliability score for each of the components of the health belief model was avergely 0.70. The reliability score (Cronbach alpha) of adherence tool was 0.91. A pilot study was also done and result reviewed with the consultant

community health physician before acceptance for the present study. The questionnaire filled during the pilot study were not included in the final analysis of the study.

Based on these questions, mean scores of perceived susceptibilities, perceived severity, perceived benefits, perceived barriers, cues to action, and perceived self-efficacy were calculated to classify the respondents into two groups; above the mean and below the mean.

The pretested self-administered structured questionnaire had questions organized into ten sections (A-J). Section A asked questions related to the socio-demographic characteristics (age, sex, marital status, highest level of education, and average monthly income) of the participants. Section B provided information on the knowledge of respondents on occupational injury (awareness of dangers associated with their work, awareness of safety measures to prevent injuries, and if available at the place of work, awareness of the type of injury sustained and use of personal protective equipment); section C revealed information about the work-related injuries sustained, if they have ever had an injury at work-place, type of injury sustained at work-place, the effect of the injury on their job function and Section D asked questions related to the availability of safety standards, protective equipment (helmet, face mask, goggle, ear muffle, hand gloves, protective apron, and boots) and if the protective equipments were used.

Section E-J were in Likert scale and scored- 1=not relevant, 2=somewhat relevant, 3=quite relevant, 4=very relevant, then during analysis not relevant and somewhat relevant merged to disagree and quite relevant and very relevant merged to agree.

Section E asked questions related to perceived susceptibility and included questions such as- I believed my chances of developing an occupational illness are great, I have a good chance of getting an occupational injury during my career. Section F revealed information on perceived severity and questions asked were- If I developed an occupational illness my career would be in jeopardy, my financial security would be endangered if I developed an occupational illness.

Section G was on perceived barriers involving questions such as- Wearing personal protective equipment is just too inconvenient for me, my coworkers would make fun of me for wearing personal protective equipment. Section H focused on perceived benefits and entails questions like- Wearing personal protective equipment will prevent future health problems for me, personal protective equipment prevents exposure to the kinds of hazards caused by my job. Section I was on cues to action and questions include- Posters in my shop serve as important reminders to wear personal protective equipment, the threat of disciplinary action is an important factor in ensuring I wear personal protective equipment. Section J asked questions related to self-efficacy and included questions such as- I am confident that I will remember to use personal protective equipment at m work place, I am confident that the personal protective equipment I use is the proper equipment to protect me from hazards at work

The perceived susceptibility and perceived benefit scores were computed for 6-item Likert questions ranging from 1 to 4 points per question on perceived susceptibility and perceived benefit. The points were added for each and the total noted. The scores were categorised as 'yes' if respondents score ≥15 points and 'no' if score was <15 for perceived susceptibility and 'yes' if respondents score ≥17 points and 'no' if score was <17 for perceived benefit using the mean score of perceived susceptibility and perceived benefit as the break-off point for each. The perceived severity and barrier scores were computed for a 7-item Likert questions ranging from 1 to 4 points per question on perceived severity and barrier. The points were added for each and the total noted. The perceived severity and barrier score were categorised as 'yes' if respondents score ≥16 points and 'no' if score was <16 for each using the mean score of perceived severity and barrier as the break-off point for each. The cues to action and self-efficacy scores were computed for 8-items Likert questions ranging from 1 to 4 points per question on cue to action and self-efficacy. The points were added for each and the total noted. The scores were categorised as 'yes' if respondents score ≥22 points and 'no' if score was <22 for cues to action and 'yes' if respondents score ≥23 points and 'no' if score was <23 for self-efficacy using the mean score of cues to action and self-efficacy as the break-off point for each.

The data obtained from the questionnaires used for the study was analysed using the Statistical package for social sciences (SPSS) for Windows version 22. The age range, education qualification, marital status, monthly income, length of services, occupational injuries and safety measures were presented in frequency distribution tables with percentages; continuous variables like age, income and length of service were expressed as mean±standard deviation.

The Chi-square (χ^2) was used to compare occupational injury and risk factors. Multivariate analysis was done using logistic regression to evaluate components of health belief model (perceived susceptibility, perceived seriousness, perceived barriers, perceived benefits, cue to actions and self-efficacy) that are independently associated with occupational injury. Odd ratio and 95% confidence interval (95% CI) were presented and used as measures of strength of association. Results were considered to be significant at $p \leq 0.05$.

RESULTS

The response rate of the staff was 72.7%, majority, were males 109 (90.8%) and 11 (9.2%) females giving male to female ratio of 9.9:1. The age range of the respondents was 18-48 years with a mean age of 28.9 (5.8) years. The age

group less than 35 years accounted for more than three-quarters of the respondents, 102 (85.0%).

Majority, 78 (65.0%) of the respondents had below tertiary level of education of which 75 (96.2%) of them had secondary school leaving certificate while only 3 (3.8%) had no educational qualification. The income range of the respondents was ₦20,000-₦69,000 with a mean income of ₦38,877.9 (₦13,510.3). Eight (6.7%) of the respondents had worked more than five years with the company while 75 (62.5%) had stayed less than two years with the company. The mean length of employment of the respondents was 12.9 (9.2) months (Table 1).

Table 2 showed the respondents intention to use personal protective equipment using the health belief model. More than three-quarters of the respondents, 93 (77.5%) believed that their job is hazardous and 78, (65.0%) believed they could die from occupational injury while 111 (92.5%) believed that their career is in jeopardy if they developed occupational injury. Ninety-one (75.8%) believed that they could develop occupational injury, yet only 77 (64.2%) are concerned about occupational injury. Most of the respondents, 111 (92.5%) believed they will benefit by wearing personal protective equipment yet more than three-quarters, 92 (76.7%) still required regular and frequent education on the importance of PPE so as to improve the use.

Majority, 115 (95.8%) were aware of the safety measures set by the employer but sixty-eight (56.7%) found it inconvenient using the safety measures and fifty-eight (48.3%) feels the personal protective equipment interferes with their work. Ninety-eight (81.7%) were worried about occupational injury.

Having personal protective equipment at location of the hazard is critical to it use among 111 (92.5%) of the respondents, while seeing others wearing the personal protective equipment will make 90 (75.0%) of the respondents use the PPE. Ninety-five (79.2%) agreed they have the cabability and enablement to use the PPE even though 116 (96.7%) are aware of work place danger. The relationship between self-efficacy and use of safety measures was statistically significant (χ^2=9.509; p=0.009).

Table 3 revealed the relationship between the health belief model and occupational injury. It revealed that the self-efficacy (χ^2=4.232; p=0.040) was the component of health belief model that had a statistically significant association with occupational injury.

It is also seen that self-efficacy is the major predictor of occupational injury among the participants (OR=2.3; p=0.042; 95% CI=1.03-4.97). The odd of having an occupational injury is twice in participants who have no conviction that they can successfully execute the preventive measures (no self-efficacy) when compared with participants with self-efficacy.

Perceived susceptibility

The overall perceived susceptibility of occupational injury was calculated using the mean score. The mean score of perceived susceptibility of occupational injury was 15.7 (3.9). Sixty-six (55.0%) of the respondents were above the mean score and they perceived themselves susceptible to occupational injury.

Perceived benefits of safety measures of occupational injury

The study participants also reported the benefit of safety measures at work place. Ninety-three (77.5%) of the respondents agreed with the importance of safety measures to prevent injury at workplace.

Perceived severity of occupational injury

The perceived severity of occupational injury was measured and 53 (44.2%) respondents were concerned about the severity of injury at workplace.

Perceived barrier of safety measures

Fifty-two (43.3%) of the respondents do have barriers to measures of safety against occupational injury.

Cues to action to occupational injury safety measures

More than three-quarters (75.8%) of the respondents had cues to act on occupational injury safety measures.

Self-efficacy of use of safety measures

Eighty-two (68.3%) of the respondents believed they have the enabling ability (self-efficacy) to use the safety measures. The mean score of self-efficacy was 23.0 (6.7).The socio-demographic factors associated with self-efficacy are shown in Table 4. Age (χ^2=4.135; p=0.042) of the respondents, gender (χ^2=5.720; p=0.017) and monthly income (χ^2=6.047; p=0.014) were the sociodemographic factors that had a statistically significant association with self-efficacy.

The older age group 16 (88.9%) had greater conviction that they can successfully execute the preventive measures (self-efficacy) than the younger age group. The males 78 (71.6%) had higher self-efficacy than the females, likewise those with higher income 56 (76.7%), longer length of service 33 (73.3%) and pre-tertiary level of education 56 (71.8%) had greater self-efficacy.

Table 1: Sociodemographic distribution of the respondents.

Variables	Numbers (%)
Age range (years)	
<35	102 (85.0)
≥35	18 (15.0)
Marital status	
Single	72 (60.0)
Married	46 (38.3)
Separated	2 (1.7)
Educational qualification	
Pre-tertiary	78 (65.0)
Tertiary	42 (35.0)
Monthly income (Naira)	
<30,000	47 (39.2)
≥30,000	73 (60.8)
Length of service (months)	
1-24	75 (62.5)
≥25	45 (37.5)
Total	120 (100)

Table 2: Respondent's use of PPE using the HBM.

Perceived PPE used related health beliefs	N (%)
Perceived susceptibility	
Chance of having occupational injury in the future is high	
Agree	91 (75.8)
Disagree	29 (24.2)
Currently, having occupational injury is a strong possibility	
Agree	77 (64.2)
Disagree	43 (35.2)
Perceived severity	
Solid mineral mining is hazardous	
Agree	93 (77.5)
Disagree	27 (22.5)
Death could occur from solid mineral mining	
Agree	78 (65.0)
Disagree	42 (35.0)
Career could be in jeopardy if developed occupational injury	
Agree	111 (92.5)
Disagree	9 (7.5)
Perceived barriers	
Concerned about the inconveniences of using the safety measures	
Agree	68 (56.7)
Disagree	52 (43.3)
Concerned about the PPE interference with work	
Agree	58 (48.3)
Disagree	62 (51.7)
Perceived benefit	
Wearing the PPE will protect from occupational injury	
Agree	111 (92.5)
Disagree	9 (7.5)
Cues to action	
Will use the PPE if well informed of the importance of the use	
Agree	92 (76.7)
Disagree	28 (23.3)
Will use the PPE if others are seen using it	
Agree	90 (75.0)

Continued.

Perceived PPE used related health beliefs	N (%)
Disagree	30 (25.0)
Will use the PPE if around the location of the hazard	
Agree	111 (92.5)
Disagree	9 (7.5)
Self-efficacy	
Have the capability and enablement to use the PPE	
Agree	95 (79.2)
Disagree	25 (20.8)

Note: PPE-Personal protective equipment.

Table 3: Relationship between the HBM and occupational injury.

Variables	Have had occupational injury		P value	Odd ratio	95% CI
	Yes	No			
	N (%)	N (%)			
Perceived susceptibility					
Yes	41 (62.1)	25 (37.9)	0.749		
No	32 (59.3)	22 (40.7)			
Perceived severity					
Yes	33 (62.3)	20 (37.7)	0.775		
No	40 (59.7)	27 (40.3)			
Perceived benefit					
Yes	57 (61.3)	36 (38.7)	0.195		
No	16 (59.3)	11 (40.7)			
Perceived barrier					
Yes	32 (61.5)	20 (38.5)	0.849		
No	41 (60.3)	27 (39.7)			
Cue to action					
Yes	57 (62.6)	34 (37.4)	0.473	2.263	1.031-4.967
No	16 (55.2)	13 (44.8)			
Self-efficacy				1	
Yes	55 (67.1)	27 (32.9)	0.040		
No	18 (47.4)	20 (52.6)			

Table 4: Socio-demographic factors associated with self-efficacy.

Variables	Self-efficacy		P value	Odd ratio	95% CI
	Yes	No			
	N (%)	N (%)			
Age (years)					
18-34	66 (64.7)	36 (35.3)	0.042	0.298	0.061-1.457
35-48	16 (88.9)	2 (11.1)		1	
Monthly income (Naira)					
20,000-30,000	26 (55.3)	21 (44.7)	0.014	0.452	0.184-0.981
30,001-70,000	56 (76.7)	17 (23.3)		1	
Gender					
Male	78 (71.6)	31 (28.4)	0.017	3.679	0.938-14.429
Female	4 (36.4)	7 (63.6)		1	
Educational qualification					
Pre-tertiary	56 (71.8)	22 (28.2)	0.267		
Tertiary	26 (61.9)	16 (38.1)			
Length of service (months)					
1-24	49 (65.3)	26 (34.7)	0.362		
≥25	33 (73.3)	12 (26.7)			

DISCUSSION

The present study described the safety practices of miners in Ose local government, Ondo State, Southwest, Nigeria using the Health Belief Model. The respondents in the present study were dominated by males and this finding was similar to other studies.[12-17] This was expected as the mining work is physically exerting.

This study showed majority perceived that they could develop injury at work (high perceived susceptibility), similarly, most respondents believed that they could die from the injury sustained at work (high perceived severity).

Despite knowing the benefits of using the personal protective equipment majority still requires frequent reminder to improve it use (cue to action). The findings were similar to what was reported in a study in Anambra, Nigeria.[18] Majority required frequent reminder on use of safety measures despite understanding the risk and severity of occupational injuries.

In the present study, majority (76.7%) of the workers perceived that they would use the personal protective equipment. This is unexpected, other studies showed that workers show low intention to use safety measures.[19,20] The difference could be due to the fact that in our study, few workers (56.7%) perceived the use of PPE as inconvenient and only (48.3%) found the use of PPE interfering with their work. Similarly, the high cost of the PPE might account for non-availability of the PPE in some workplace.[18] The HBM had successfully been used to explain predictors of the use of PPE among workers. The study revealed that about three-quarter (75.8%) perceived that they are susceptible to injury at place of work. The perceived susceptibility was not a significant predictor of injury at workplace among the respondents in the study. This was similar to what was reported in other studies.[21,22]

The barrier to the use of PPE in the present study include the inconveniences of the PPE as it reduces physical flexibility and the interference of the PPE with work. This was in congruent with other studies, where additional barrier was the limited availability of PPE which thereby makes workers not to give priority to safety measures.[19,23-25] This was not a predictor of occupational injury in our study. However, there is need to identify how to encourage workers to use PPE despite the inconveniences of working with this equipment. The component of the HBM that was a predictor of occupational injury in our study was self-efficacy. This was however, different from other studies where perceived benefits and perceived barriers were the predictors of occupational injury.[21,22] The effectiveness of PPE in reducing occupational injury and maintaining health of workers has been an important factor in the use of PPE but the conviction and enablement (self-efficacy) of the use of the PPE is extremely important.[26]

When the self-efficacy in regression model was done, the age of the respondents, gender and monthly income were significant factors and predictors of self-efficacy. The older age group had greater conviction of successfully using the PPE, similarly, the male and respondents with higher income had more conviction of successfully using the PPE.

The younger age group had more injury at workplace than the older age group in the present study. This is could be that the older age group were given less injury-prone jobs due to their decrease aerobic and musculoskeletal capacity and lower physical work capacity. It could also be that the younger age group had risk-taking behaviours with less experience and unlike the older age group who are more experience.

The finding was similar to other studies in Kenya, Nigeria and China.[13-17] The present study was however contrary to what was reported in France where occupational injury was more common among older age group.[27] The study in France involved all work industry and was dominated by the older age group while the present study involved only the mining industry, this could therefore account for the difference in the studies.

This study revealed the conviction to use the PPE successfully (self-efficacy) was higher among the males than females. This is not unexpected because the difficult job specifications the males perform within the workplace, and the more exerting and injury-prone tasks they engaged in warrant the use of the PPE.

The present study demonstrated that the respondents with pre-tertiary level of education had more conviction of successfully using the PPE (self-efficacy) though not statistically significant. This was in concordance with study in China where education had no significant relationship with use of PPE.[17] This was however different from studies in Kenya and Nigeria.[14,16] The result from our study is confounding, as it is expected that higher level of education increases knowledge seeking behaviour and thereby increases use of safety measures. Similarly, the information behaviour of educated respondents could be influenced by their positive attitudes towards what others feel about their actions.[15]

The limitations of the present study included the use of one mining company due to the COVID-19 pandemic therefore an encompassing study might be required in post COVID-19 period. Although the health belief model provides a framework for understanding factors operating at the individual level to influence the decision to adopt safety measures, it does not examine factors operating beyond the individual level, nor does it include the role of community and health system characteristics in shaping this decision.

CONCLUSION

The significant association between occupational injury and component of the health belief model revealed that health belief model concepts can be applied to bring about

positive behavioural change in the reduction of injury at workplace. Similarly, the conviction of the participants in successful execution of required behavioural change (self-efficacy) to produce expected outcome which in this case is adoption of preventive and safety measures is highly encouraging. Therefore, the health belief model concepts should be applied in reducing occupational injury.

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