Assessment of Hazards and Safety Practices in Food and Beverage Industry in Nigeria

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ABSTRACT

The assessment of safety hazards is fundamental to an effective risk management in any industry. Food and beverage production involves a variety of industrial processes with associated hazards. Effective safety practices are used to reduce workplace hazards and promote safety in the work environment. This paper evaluated safety hazards and safety practices in the food and beverage industry (FBI) in South-South, Nigeria. A structured questionnaire designed in accordance with World Health Organization standard was administered to a total of 144 workers, out of which 134 (93.0%) were completed and returned. The questionnaire was fashioned to extract information on types of hazards, awareness of safety hazards, implementation of hazards and risks control measures and the effectiveness of safety hazards and risk management programmes in the food and beverage industry. A modified four-point Likert Scale was used to analyze and evaluate the questionnaire. A Proportional Importance Index (PII) was used to rank each factor variable in the questionnaire. The study identified the major hazards in the FBI as working at height (with PII = 3.3, respondents = 91%); high voltage areas (PII = 3.1 and respondents = 90%), loud noise (PII = 3.0, respondents = 80%), machines and equipment vibration (PII = 2.8, respondents = 69%) and faulty machines and equipment (PII = 2.7, respondents = 65%). The level of awareness on safety

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hazards amongst the workers was statistically significant ($p < 0.05$, 95%CI; PII = 3.1 - 3.6). The outcome of intervention showed that FBI-2 improved from 79.62% to 96.82%, FBI-3 improved from 89.81% to 96.18%, FBI-4 improved from 78.34% to 95.54% on worker's knowledge on the assessment of hazards and risk in the FBIs. There was effective implementation of safety hazards and risks management programmes and controls in the FBI. Administrative control measures are used to reduce hazards and workers make adequate use of personnel protective equipment. There is need to evaluate the risks associated with identified high ranking hazards and develop a risk management framework for the industry based on ISO 31000 and other relevant safety regulations and guidelines.

1. INTRODUCTION

The issue of occupational safety and health remains a source of concern to many business organizations. Alabelewe [1] reported statistics from the International Labour Organization (ILO) which indicated that 240 workers die every hour in the world resulting in about 6,000 daily work-related deaths globally. Safety hazards pose a great challenge to many industries today due to lack of safety awareness [2] lack of proper workplace hazard assessment and identification techniques as well as effectiveness of implementation of hazard control programmes. All these have contributed variously to several industrial accidents resulting in various degrees of injuries to workers, loss of man hours, damage to equipment and low productivity [2]. The importance of safety in workplace environment in Nigeria has been emphasized by various research studies [3,4,5,6,7,8]. This is because of the potential hazard and risk factors that doubtlessly characterize every work environment and their negative impacts on a company's overall performance. Despite all these, there is still lack of understanding and awareness of occupational hazards in many workplaces in Nigeria [5] which have caused accidents in many industries resulting in fatalities and injuries [3,9]. The Food and Beverage Industries (FBI) provide livelihood to millions of people in the country either directly or indirectly. It has also contributed significantly to the country's foreign exchange. According to the report, the ILO estimated that occupational accidents and diseases caused about 4% loss in global Gross Domestic Product (GDP) annually; and yearly work related accidents and injuries cost an estimated amount of $2.8 trillion globally. The process industry all over the world has been considered to be most hazardous [1]. Thus, safety and health issues should be the primary concern of every business organization as safety and productivity are interwoven. Okwuche and Nwaogazie [6] in their work: Assessment of Safety Management Practices in Construction Industries stated that in a study carried out in 2014, out of 40 contractors, accidents and injury rates were high in Nigeria construction industry and the study recorded 2 accidents per 100 workers and 5 injuries per 100 workers. These are due to unsafe act practices arising from poor assessment of safety hazards. Thus, it is a necessity to assess and evaluate hazards and risk status of the FBI in Nigeria so as to divulge the fundamental occupational safety hazards, close out the gaps and improve safety performance in the industry. Therefore, this study is carried out to evaluate safety hazards and safety practices in the FBI in South-South, Nigeria. The study identified hazards, assessed safety awareness, implementation of hazards control measures and effectiveness of safety hazards and risk management programmes in the industry.

2. METHODOLOGY

A non-probability purposive sampling technique was adopted in the data gathering process. Representative samples were obtained using sound judgment of the study population [10]. Workers with proven specific knowledge of hazards and risks in the industry that can provide reliable information were purposely chosen for the study.

2.1 Determination of Sample Size and Selection of Respondents

Four food and beverage companies were selected for the study, one Brewery Company, two bottling companies and one food processing company. The sample size was determined using formula for sample size determination proposed by Krejcie and Morgan [11]. The formula is given as:

$$S = \frac{\chi^2 NP(1-P)}{d^2(N-1) + \chi^2 P(1-P)} \qquad (1)$$

where:

S = Required sample size;
χ^2 = The table value of chi-square for 1 degree of freedom at the desired confidence level;
N = The total population size;
P = The population proportion (assumed to be 0.50 because it would provide maximum sample size); and
d = The degree of accuracy expressed as a proportion (0.05).

Based on computed sample size, a total of 144 questionnaires were self-administered to both management staff and workers of the FBI, out of which 134 (93%) were completed and returned which were found to be adequate for the cross-sectional study.

2.2 Data Collection

Data collection was done with the aid of a well-structured self-administered questionnaire [12,13]. The questionnaire comprises of five (5) sections; Section A provided the general background information of respondents (demographic information); Sections B identifies the different categories of hazards in the FBI; Section C assesses the awareness levels of the workers on the safety hazards in the FBI; Section D evaluates the implementation of safety hazards and risk control measures in the FBI; while Section E evaluates the effectiveness of hazards and safety control programmes in the FBI. The sections of the questionnaire were structured and evaluated using a modified four-point Likert Scale in the following format: Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) with ratings such as 4, 3, 2 and 1, respectively assigned to each of the options.

The questionnaires were administered to both management staff and workers in the food and beverage industry. Cronbach's alpha coefficients were used to test the reliability and consistency of the items in the research instrument. Inspection was carried out by Certified Inspectors in the selected FBIs using modified inspection checklist to support data obtained from questionnaires. Two months intervention was carried out by FBIs Safety Managers through batch-wise awareness training of workers on identification of hazards and implementation of

risk control measures; aimed at reducing the risk associated with identified hazards. Post inspection was carried out two months after intervention to determine the expected level of improvement after intervention. The time lag between pre-inspection and post inspection was six months. The checklist used for the post inspection was analyzed. FBI-1 was used as the control group to prove the benefit of intervention beyond reasonable doubt and, as such, no intervention was carried out.

2.3 Data Analysis

The collected data from the questionnaires were processed, coded and analyzed using XLSTAT-2018, Premium version software developed by Addinsoft [14]. Percentage of responses, mean, standard deviation, and Pearson product correlation coefficient were determined. Background information of the respondents was computed and presented in percentage. A non-parametric Mann Kendall statistic was used to determine the degree of agreement among the raters or respondents. The Kendall's concordance coefficient, W ranges from 0 to 1 [15].

The reliability of the questionnaire instrument was evaluated using Cronbach alpha coefficient formula [16,12]. For Cronbach alpha coefficient, Equation (2) was used to estimate the factors in scale size in reliability.

$$\alpha = \frac{K}{K-1}\left(1 - \frac{\sum_{i=1}^{K}\sigma_{Y_i}^2}{\sigma_X^2}\right) \qquad (2)$$

Where K is the number of items in the measurement, σ_X^2 is the variance of the observed total scores, and $\sigma_{Y_i}^2$ is the observed variance for i^{th} item. The standardized Cronbach's alpha was computed using Equation (3) [12]:

$$\alpha_{s\tan dardized} = \frac{K\bar{r}}{(1+(K-1)\bar{r})} \qquad (3)$$

where,

K is same as above, $\bar{r}$ is the average inter-item correlation, that is, the mean of $K(K\text{-}1)/2$ coefficients in the upper triangular (or lower triangular) of the correlation matrix. To analyze the data, each item statement was coded and

assigned weights according to their respective rating. At the end, the responses to the item statements were summed across the items to obtain a total impact score.

2.4 Proportional Importance Index (PII)

A Proportional Importance Index (PII) was derived from the Relative Importance Index (RII) and used to determine the proportional importance of each score. The RII is a technique used to rank factor variables to determine their relative importance in a system [17,18,19]. It is a better tool for ranking variables than using descriptive statistics such as mean and standard deviation. According to Muhwezi et al. [19], RII values ranged from 0 to 1 (0 ≤ RII ≤ 1). The RII is computed using Equation (4):

$$RII = \frac{\sum W}{A * N} \quad \text{for} \quad (0 \le RII \le 1) \quad (4)$$

where:

W is the weight given to each factor by the respondents;
A is the highest weight; and
N is the total number of respondents.

The proportional importance index is a modification of Equation (4) by the researchers of this study and it takes into account the effect of the weights on each score as given in Equation (5). The values of PII ranged from 1 to 4 (1 ≤ PII ≤ 4) corresponding to the four point Likert scale. The PII was used to rank each statement variable using the scores by respondents as shown in Table 1.

$$PII = \frac{\sum_{i=1}^{n} F_i W_i}{\sum_{i=1}^{n} F_i} = \frac{F_1 W_1 + F_2 W_2 + F_3 W_3 + ... + F_n W_n}{F_1 + F_2 + F_3 + ... + F_n}$$

$$(5)$$

For $(1 \le PII \le 4)$ and $W_1 - W_4 = 4 - 1$

Where,

W = Likert weights given to each factor;
F = frequency of respondents (score);
n = minimum weight; and
i = 4,....1).

3. RESULTS

3.1 Demographic Features of Respondents

The demographic characteristics of the respondents are presented in Table 2. The general background information of the respondents is presented.

3.2 Reliability of the Questionnaire Instrument

Cronbach's alpha test result indicates that all the items in the questionnaire instrument are consistent and reliable as shown in Table 3.

3.3 Identification of Safety Hazards in the FBI

The study assessed and identified safety hazards in the FBI. Kendall's Concordance Coefficient; W was computed for the Sections B, C, D and E of the questionnaire and result presented in Table 4. The trend in agreement among the respondents on the types of hazards identified in the FBI is shown in Fig. 1, while the most common high ranking hazards identified in the industry are shown in Fig. 2.

The rankings obtained for the hazards according to the PII are presented in Table 5.

3.4 Assessment of Safety Hazards and Risk Awareness in the FBI

The study assessed safety hazards and risks awareness level among workers in the FBI. The trends in agreement and disagreement among respondents on hazards and risk awareness in the FBI is shown in Fig. 3.

Table 1. Proportional Importance Index (PII) scale and coding

	PII	Ranking	Comment/Code	Risk	Interpretation
1	1.0-2.0	5		Rare	Rare
2	2.1-2.5	4		Unlikely	Occasional
3	2.6-3.0	3		Possible	Sometimes
4	3.1-3.5	2		Likely	Often
5	3.6-4.0	1		Very Likely	Always

Source: [19]

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Table 2. Respondents socio-demographic characteristics

Variable	Option	Frequency	Percentage (%)
Gender	Male	131	98
	Female	3	2
	Total	**134**	**100**
Age	Under 25 years		
	25-30 years	10	7
	31-35 years	29	22
	36-40 years	59	44
	Above 41 years	36	27
	Total	**134**	**100**
Educational qualification	Primary/Secondary		
	OND	17	13
	HND/BSc	68	51
	M.Eng/MSc	48	36
	Others	1	1
	Total	**134**	**100**
Employment Status	Full time	124	93
	Part time	8	6
	Casual staff	2	1
	Total	**134**	**100**
Working experience	Under 1 year		
	1-5 year	21	16
	6-10 year	44	33
	11-15 year	43	32
	Above 16 years	26	19
	Total	**134**	**100**
Job Motivation factor	Job Security	37	28
	Good salary	24	18
	No job alternative	11	8
	Good Working conditions	59	44
	Others	3	2
	Total	**134**	**100**

Table 3. Reliability coefficients of questionnaire's items (α)

Section				Acceptable range
B*	**C***	**D***	**E***	
0.89	0.99	0.97	0.99	0.8 and above [20,21].

B*, C*, D*, and E* are the sections of the questionnaire containing: B* = parameters for identification of safety hazards; C* = parameters for assessment of safety hazards and risk awareness; D* = parameters for the implementation of safety hazards and risk control measures; and E* = parameters for assessment of the effectiveness of safety hazards and risk management programmes

Table 4. Computed Kendall's concordance coefficient, W

Parameter	Questionnaire section			
	B	**C**	**D**	**E**
N	12	11	11	11
Kendall's W	0.625	0.845	0.891	0.837
Chi-Square	22.5	27.881	29.389	27.614
Asymp. Sig.	0.000	0.000	0.000	0.000
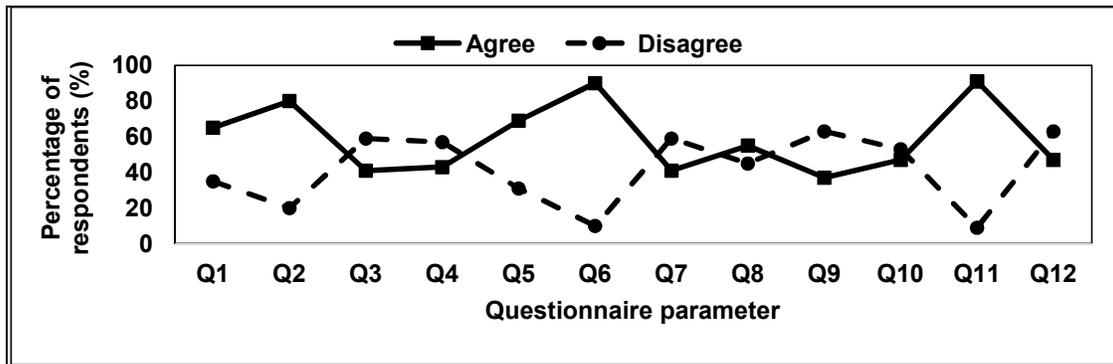
Fig. 1. Trends in agreement and disagreement among respondents on hazards identification in the FBI
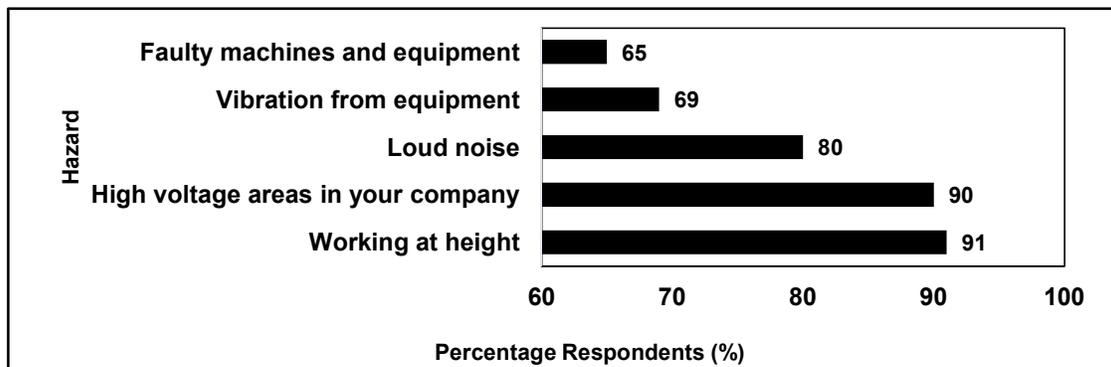
Fig. 2. Identified major hazards in the FBI

Table 5. Ranking of identified hazards in the FBI using PII

| S/No	Questionnaire parameter	PII	Occurrence	Rank	Interpretation
1	Some of the running machines and equipment are not always in good condition in your workplace.	2.7		3	Sometimes
2	Occasionally, there is loud noise in your workplace.	3		3	Sometimes
3	There are damaged electrical cables in your workplace.	2.4		4	Occasional
4	Chemical spills are seen within the workplace.	2.4		4	Occasional
5	There is vibration from equipment in your workplace.	2.8		3	Sometimes
6	There are high voltage areas in your company.	3.1		2	Often
7	There are unguarded machineries in your workplace.	2.4		4	Occasional
8	There is exposure to radiation in your workplace.	2.5		4	Occasional
9	Flammable substances such as petrol, solvents and explosive chemicals are not properly stored in your company.	2.2		4	Occasional
10	There is poor lighting/visibility in your company.	2.3		4	Occasional
11	Workers work at height in your workplace.	3.3		2	Often
12	There are flying cables and unwanted items (scarps) within the workplace.	2.5		4	Occasional
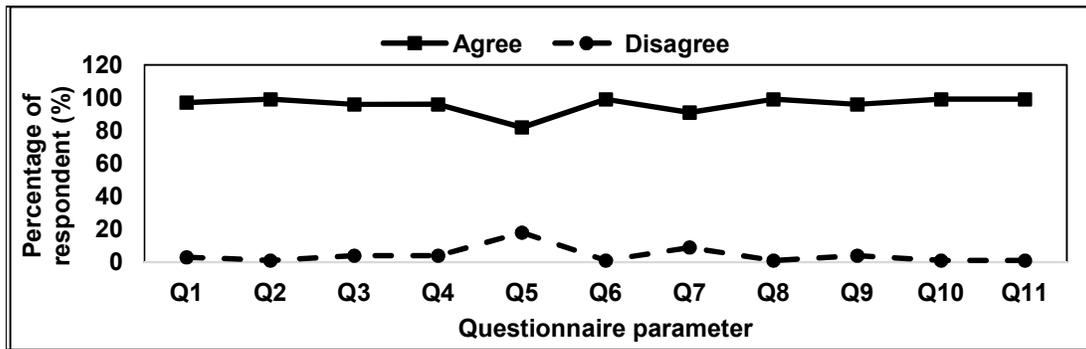
Fig. 3. Trends in agreement and disagreement among respondents on hazards and risk awareness in the FBI

The level of awareness on safety hazards and risk among workers in the FBI are presented in Table 6.

3.5 Implementation of Safety Hazards and Risk Control Measures in the FBI

The implementation of safety hazards and risk control measures in the FBI are presented. The trends in agreement and disagreement among respondents on the implementation of hazards and risks control measures in the FBI are shown in Fig. 4. The ranked implementation of hazards and risks

control measures in the FBI computed using PII are shown in Table 7.

3.6 Assessment of the Effectiveness of Safety Hazards and Risk Management Programmes in FBI

The trends in agreement and disagreement among respondents on the effectiveness of hazards and risk management programmes in the FBI is shown in Fig. 5. The effectiveness of safety hazards and risks management and control measures in the FBI evaluated using PII and is shown in Table 8.

Table 6. Ranking of hazards and risk awareness in the FBI using PII

| S/No	Questionnaire parameter	PII	Occurrence	Rank	Interpretation
1	You are familiar with workplace safety hazards and risk.	3.4		2	Often
2	Your company has Occupational Safety Hazards and Risk Policy.	3.6		1	Rare
3	You are aware of the type of safety hazards and risk associated with your line of duty	3.4		2	Often
4	Your company regularly runs in-house safety hazards and risk training programme at least once a year.	3.4		2	Often
5	Your company also sponsors staff for external training programme on safety hazards and risk at least once a year.	3.1		2	Often
6	You are aware of the safety hazards and risk drills carried out in your company.	3.5		2	Often
7	You are familiar with the use of Material Safety Data Sheets (MSDS) in your company.	3.3		2	Often
8	You are very familiar with hazards and risk control measures used in your company.	3.5		2	Often
9	You are conversant with safety hazards and risk audit conducted in your company.	3.3		2	Often
10	Your company has effective hazards and risk control mechanism in place.	3.5		2	Often
11	Safety hazards can cause accident(s) in the workplace.	3.4		2	Often
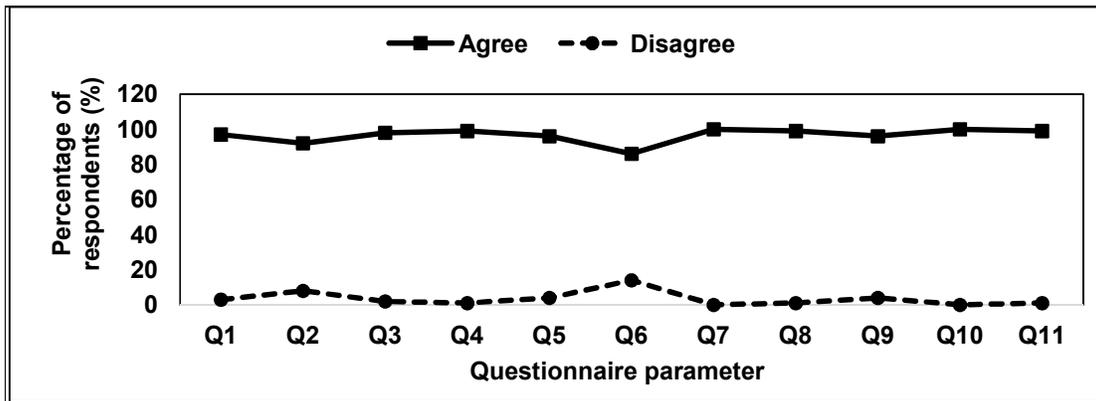
Fig. 4. Trends in agreement and disagreement among respondents on the implementation of hazards and risk control measures in the FBI

Table 7. Ranking of implementation of hazards and risk control measures in the FBI using PII

S/No	Questionnaire parameter	PII Occurrence	Rank	Interpretation
1	You have received in-service safety hazards and risk training in the last two years.	3.3	2	Often
2	You have attended conferences, workshops or seminars on safety hazards and risk since you were employed.	3.2	2	Often
3	Management provides workers with operating safety manuals.	3.4	2	Often
4	Supervisor usually conducts safety hazards and risk briefing with workers each day before start of work.	3.5	2	Often
5	Management carries out in-house safety hazards and risk training programme for workers every year.	3.4	2	Often
6	Management also sponsors staff for external training programme on safety hazards and risk every year.	3.2	2	Often
7	Management provides suitable Personnel Protective Equipment (PPE) for workers.	3.6	1	Always
8	You usually follow safe work procedures while carrying out your duties.	3.5	2	Often
9	Your company usually carries out prompt repairs of damaged equipment and electrical systems.	3.3	2	Often
10	You regularly make use of the PPE provided for you while carrying out your duties.	3.6	1	Always
11	You always make use of Material Safety Data Sheets when handling chemicals.	3.4	2	Often

3.7 Impact of Intervention Programme on Hazards Identification and Risk Control Measures in the FBI

After the pre-inspection, high level of Satisfactory (S) performance was seen from the pre-inspection checklist analysis carried out (Table 10). Unsatisfactory (U) performance was observed especially for FBI-2 and FBI-4. FBI-2 improved from 79.62% to 96.82%, after the intervention, FBI-3 improved from 89.81% to 96.18%, FBI-4 improved from 78.34% to 95.54%. The trend of the level of improvement is as shown in Fig. 6.
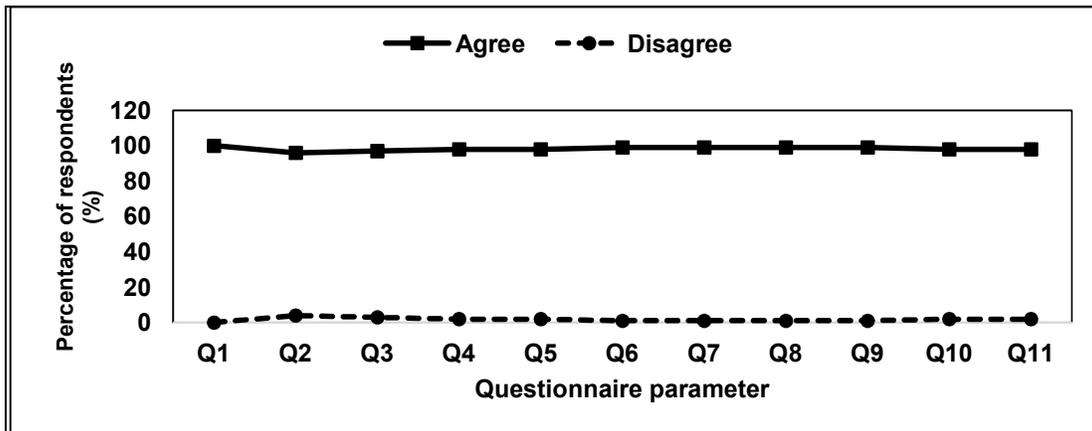
Fig. 5. Trends in agreement and disagreement among respondents on the effectiveness of hazards and risk management programmes in the FBI

Table 8. PII Distribution on the effectiveness of hazards and risks management programmes in the FBI

S/No	Questionnaire parameter	PII	Occurrence	Rank	Interpretation
1	The use of operating safety manual has helped to minimize accident cases in your company.	3.5		2	Often
2	Participation in HSE training/workshop/seminar programmes has increased your knowledge on safety hazards and risk in the workplace.	3.5		2	Often
3	The use of material safety data sheets has helped in minimizing chemical spills and exposure in your company.	3.3		2	Often
4	Use of personnel protective equipment (PPE) has assisted in reducing cases of accidents in the company.	3.5		2	Often
5	Outcomes of the safety hazards and risk programmes have helped to minimize hazards and risk in your company.	3.4		2	Often
6	The conduct of safety hazards and risk audit has assisted in identifying potential hazards in the work environment.	3.4		2	Often
7	Methods used to control hazards and risk has helped to protect workers and reduce cases of accidents and injuries among workers.	3.4		2	Often
8	Compliance to safe work procedures while carrying out your duties has reduced workplace accidents arising from negligence to safe operations.	3.5		2	Often
9	Prompt repairs of damaged machines/equipment and electrical systems have reduced cases of accidents arising from machines and electricity in the workplace.	3.4		2	Often
10	The conduct of regular safety meetings has assisted in improving safety practices among workers.	3.5		2	Often
11	Regular safety hazards and its risk audits have helped in identifying areas of safety hazards and risk weakness in the company.	3.5		2	Often

4. DISCUSSION

The findings of the study are discussed in line with the results obtained. Also discussed are the limitations of the Methodology and the merits and demerits of using the Questionnaire and Pre and Post Inspection observation approach and ways to improve on the study.

4.1 Respondents Characteristics

The statistical demographic features of the respondents (Table 2) showed that majority of the respondents are males which means that the FBI is male gender dominated. This could possibly be ascribed to the fact that the industry is labour intensive involving high level of physical activities such as use of machines, lifting heavy loads, and production operations. This result agrees with finding by [21] which in their study stated that majority (97.84%) of the workers in a bottling company in Nigeria are males. The result on age distribution implies that the respondents have good knowledge of safety hazards and safety practice in the FBI. A study by Schumacher [22] found significant association between age and the level of exposure to occupational hazards and risks. Also, a significant association has been found between the ages of workers and the level of exposure to occupational hazards and risks in the industry [23].

Educational qualification indicates that majority of the respondents are holders of first degrees followed by masters degree, implying that they are well educated and may thus have sound knowledge of safety hazards and risk in the FBI.

Employment status shows that majority of the respondents are full time staff and actively participating in safety programmes in the FBI. The levels of experience of the respondents show that majority of the respondents have long years of working experience in the FBI and are therefore very conversant with issues of industrial safety hazards and risk management. Although different factors were responsible for the respondents joining the FBI, good working conditions and job security were found to be the most attractive factors responsible for many of them joining the industry. This implies that most of them have the assurance that they will keep or retain their job up to retirement.

4.2 Identification of Safety Hazards in the FBI

The identification of safety hazards in the FBI was evaluated and result from respondents indicates that 65% agreed that some machines and equipment are faulty and not in good working condition; 80% confirmed that there is loud noise in the work place; only 41% consented that there are damaged electrical cables in the workplace; while 43% said that there are chemical spills within the work environment. On the issue of vibration, 69% agreed that there is vibration from equipment in the workplace; 90% confirmed the hazard of high voltage area; 41% said there are unguarded machines; while 55% confirmed the hazard of radiation exposure. Concerning flammable substances and explosive chemicals, only 37% agreed that there is poor lighting system; 91% confirmed the hazard of working at height; while 47% agreed that there are flying cables and unwanted items in the work environment. There was no definite trend in agreement among the respondents on the types of identified hazards in the FBI as shown in Fig. 1. However, the computed Kendall's Concordance Coefficient was 0.625, the Chi-Square (χ^2) value was 22.5 and the p-value was < 0.000 (p < 0.05, 95%CI.) as shown in Table 4. This shows that there is a reasonable degree of agreement among the respondents on the identification of safety hazards in the food and beverage industry. This finding agreed with the studies of [22,23] who identified similar hazards in the process industries.

Proportional Importance Index (PII) as shown in Table 5 indicates that the hazards of working at height and high voltage areas happened often in the FBI industry (PII = 3.3 and 3.1 respectively) and thus may likely pose serious risk to workers. Workers in the FBI are frequently exposed to these two hazards at short intervals of time. The hazards of loud noise, machines and equipment vibration and faulty machines and equipment occurred sometimes in the FBI (PII = 3.0, 2.8 and 2.7 respectively). Workers are exposed to these hazards in certain cases and thus constitute possible risk in workplace. Other identified hazards in the FBI occurred occasionally at irregular intervals and unlikely pose serious risk in work environment. The percentage proportion of workers exposed to identify high ranking hazards in the food and beverage industry based on PII rating scale are shown in Fig. 1.

Table 9. Data collected by certified inspectors using inspection checklist

Checklist parameter		Pre-inspection				C*	Post - inspection		
		FBI-1*	FBI-2	FBI-3	FBI-4	FBI-1	FBI- 2	FBI-3	FBI-4
A	**Machinery**								
	All guards in place and fully operational	S*	S	S	U	S*	S	S	S
	Belts and pulleys in good condition	S	S	S	S	S	S	S	S
	Oiling, cleaning, and adjusting	S	U	S	S	S	S	S	S
	Oil leaks	S	U	U	U	S	S	S	S
	Safe operational manuals	S	S	S	U	S	S	S	S
	Maintenance records	U*	S	S	S	U*	S	S	S
	Lock-Out/Tag-Out kits in place	S	U	U	S	S	S	S	S
	Loosed parts	S	S	S	S	S	S	S	S
	Unusual noise	S	S	S	S	S	U	U	U
	Worn out parts	S	S	S	S	S	S	S	S
	Abandoned machines	U	U	U	S	U	S	S	S
	Dismantled machines	S	U	S	U	S	S	S	S
	Malfunctioning machines	S	S	S	U	S	S	S	S
	Operator's area free from debris and scrap	S	S	S	U	S	S	S	S
B	**Pressure Equipment**								
	Boilers	S	U	S	S	S	S	S	S
	Air receivers	S	S	S	S	S	S	S	S
	Air compressors	S	S	S	S	S	S	S	S
	Air blowers	S	S	S	S	S	S	S	S
	Air driers	S	S	S	U	S	S	S	S
	Gas cylinders and hoses	S	S	S	S	S	S	S	S
	Carbon dioxide(CO_2) plant	S	S	S	S	S	S	S	S
K	**Bulletin boards**								
	Only safety and health materials posted	U	U	U	S	U	S	U	S
	Possible hazards displayed	S	U	U	S	S	U	U	S
	Control for such hazards captured	S	U	U	U	S	U	U	S
	Copies of incident Report forms available	S	S	S	S	S	S	S	S
	Updated Safety Committee meeting minutes	S	U	S	S	S	U	S	S
	Updated MSDS file	U	U	S	S	U	U	S	S
	List of current Safety Committee members	U	S	S	U	U	S	S	S

Checklist parameter	Pre-inspection				C*	Post - inspection		
	FBI-1*	**FBI-2**	**FBI-3**	**FBI-4**	**FBI-1**	**FBI- 2**	**FBI-3**	**FBI-4**
Schedule for Safety Committee meetings	U	S	S	S	U	S	S	S
Neat, attractive and visible	S	S	S	S	S	S	S	S
Display regularly changed	S	S	S	S	S	S	S	S
TS (Total Satisfactory)	144	125	141	123	144	152	151	150
TU (Total Unsatisfactory)	13	32	16	34	13	5	6	7

S = Satisfactory, *U* = Unsatisfactory, *C* Control Group = and FBI-1* = Food and Beverage Industry No. 1. Source: Modified from accident prevention programme for sawmills and woodworking operations; Sawmill APP Sample. Doc .Retrieved 15/07/18*

Table 10. Pre – and post-inspection checklist analysis

	Pre-inspection					Post inspection			
	FBI- 1	**FBI- 2**	**FBI- 3**	**FBI-4**		**FBI- 1***	**FBI- 2**	**FBI- 3**	**FBI-4**
TS	144	125	141	123	TS	144	152	151	150
TU	13	32	16	34	TU	13	5	6	7
TS + TU	157	157	157	157	TS + TU	157	157	157	157
% S*	91.72	79.62	89.81	78.34	% S*	91.72	96.82	96.18	95.54
% U*	8.28	20.38	10.19	21.66	% U*	8.28	3.18	3.82	4.46

% S* = Percentage Satisfactory = [(TS/(TS+TU))*100] (6)
*% U* = Percentage Unsatisfactory = [(TU/(TS+TU))*100] (7)*
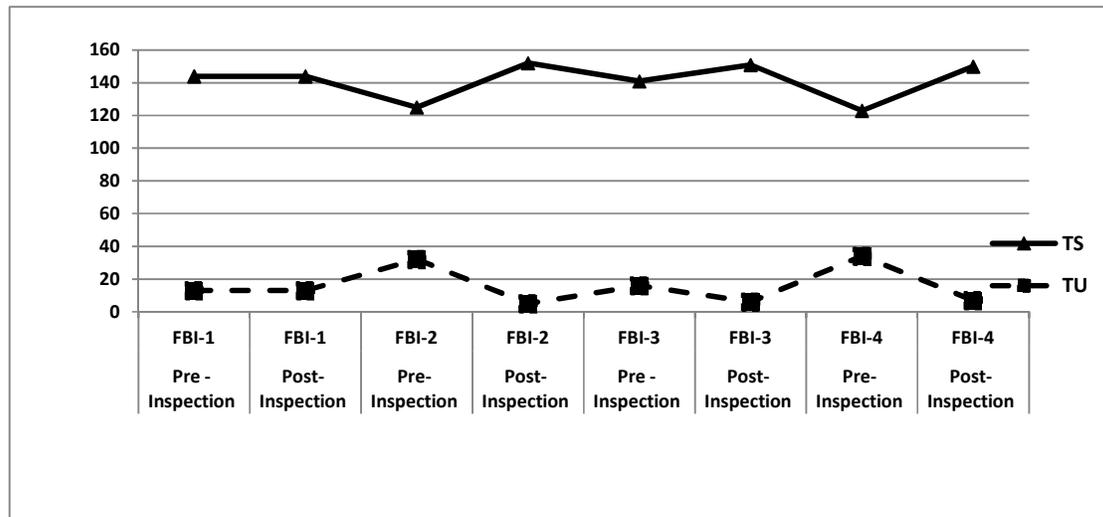
Fig. 6. Trends in the level of improvement after intervention

This finding corroborated with the studies by [24,25,26] who variously identified the hazards of loud noise and vibration, falls from height, chemical exposure, high voltage, chemical spills in the manufacturing industries. The finding also agreed with finding by Ugorji [27] who identified the hazard of loud noise and vibration in the manufacturing sector in Enugu, Nigeria. It further agreed with the results of Reinhold [28] who identified falls from height as one of the major hazards responsible for accidents in industries in Nigeria and [4] who identified falls from height as responsible for 12.6% deaths in factories in Nigeria.

4.3 Safety Hazards and Risk Awareness in the FBI

The level of hazards and risks awareness amongst workers in the FBI was evaluated and the results from respondents indicate that 97% of the respondents are familiar with workplace safety hazards and risk; 99% are aware of the Occupational Safety Hazards and Risk Policy of the companies; 98% are aware of the type of safety hazards and risk in the workplace; 96%

are aware of the in-house safety hazards and risk training programme in the companies; while, 82% confirmed that the companies sponsor staff for external training programmes. On safety drills, 99% said they are aware of the safety hazards and risk drills in the companies; 91% are familiar with the use of Material Safety Data Sheets (MSDS); while, 99% are familiar with hazards and risk control measures. On the issue of audit, 96% are aware of the safety audit conducted in the companies; 99% confirmed the effectiveness of hazards control mechanisms in the companies; while, 99% are also aware that hazards can cause accident in workplace.

A high percentage of the respondents agreed on most of the items in the questionnaire as indicated in Fig. 3. The computed Kendall's Concordance Coefficient was 0.845, the Chi-Square (x^2) value was 27.881 and the p-value was < 0.000 (p < 0.05, 95%CI.) as shown in Table 4. This shows that there is a high degree of agreement among the respondents on safety hazards and risk awareness in the food and beverage industry. The PII values fall between 3.1 and 3.6 (Table 6), occupational safety

hazards and risk policy is ranked 1 indicating that the workers are aware of its availability. Others are ranked 2 indicating that the workers are often aware of their availability. The level of awareness amongst workers in the FBI is statistically significant ($p < 0.05$, 95%CI.). This implies that there is a high level of awareness among the workers on safety hazards and risks in the FBI which has positively influenced their behaviors toward ensuring a safe working environment [29,30]. The PII evaluation shows that workers in the FBI are often aware of the safety and risk issues in their workplace. This could be attributed to the occupational safety hazards and risk policy maintained in the industry. Similar result was obtained by Reinhold [30] in a study amongst workers in a paint factory in Lagos, Nigeria.

4.4 Implementation of Safety Hazards and Risk Control Measures in the FBI

The implementation of safety hazards and risk control measures in the FBI was evaluated in order to determine management commitment to safety hazards and risk management programmes in the FBI. Result shows that majority of the respondents consented that they have received in-service training on safety hazards and risks in the companies; 92% confirmed attending conferences, workshops or seminars on safety hazards and risk; 98% agreed that management provides workers with operating safety manuals. Most of the respondents (99%) confirmed that supervisors usually conduct daily safety hazards and risk briefings with workers before commencement of work; while, 96% accepted that management organizes yearly in-house training programmes for workers. Majority (86%) confirmed that management sponsors staff for external safety hazards and risk training programme; while, 100% consented that management provides adequate Personnel Protective Equipment (PPE) for workers. Most of the respondents (99%) agreed that they follow safe work procedures; 96% confirmed that management promptly carries repairs of damage equipment and electrical systems; 100% agreed that they make use of the PPE provided for them; and finally 99% confirmed that they make use of Material Safety Data Sheets (MSDS) when handling chemicals.

The computed Kendall's Concordance Coefficient was 0.891, the Chi-Square (χ^2) value was 29.389 and the P-value was < 0.000 ($p < 0.05$, 95%CI.) as shown in Table 4. This shows that there is a high degree of agreement among

the respondents on the implementation of safety hazards and risk control measures in the food and beverage industry. The PII values fall between 3.2 and 3.6, the provision and use of PPEs are ranked 1 indicating always available, while others are ranked 2 indicating often on the PII scale. The implementation of safety regulations and providing a practical means and measures for accomplishing safety in the FBI will reduce associated safety hazards and risk and hence safety of workers [30]. The evaluation of the implementation of safety hazards and risk control measures indicates that workers in FBI often receive in-service training, attend conferences/ workshops and most times management sponsors staff for external training programmes. This finding is contrary to finding of [30] which showed that there is lack of training on workplace safety hazards amongst workers in paint factories in Lagos, Nigeria. As part of the implementation of safety hazards and risk control measures,

Supervisors often conduct daily safety hazards and risk briefing with workers each day before start of work. Management in FBI always provides PPEs for workers which are always used when carrying out their duties. Awodele et al. [30] reported low implementation of safety hazards and risk control measures in paint factories in Lagos, Nigeria.

4.5 Effectiveness of Safety Hazards and Risk Management Programmes in the FBI

On the issue of the effectiveness of safety hazards and risks management programmes in the FBI, results indicate that all the respondents (100%) confirmed that the use of operating safety manual has helped to minimize accident in the industry; almost all the respondents (96%) agreed that participation in HSE training/workshop/seminar programmes has increased their knowledge of workplace safety hazards and risk; 97% accepted that the use of material safety data sheets has helped to minimize chemical spills and exposure in the companies; 98% agreed that the use of PPE has helped to reduce accidents in the industry; 98% confirmed that the outcomes of safety hazards and risk programmes have helped to minimize hazards and risk in the industry; 99% consented that the conduct of safety hazards and risk audit has assisted in identifying potential hazards in the work environment. Respondents also stated that the methods used to control hazards and risk have helped to protect workers and reduce

cases of accidents and injuries among workers and compliance to safe work procedures while carrying out their duties has reduced workplace accidents arising from negligence to safe operations. They further confirmed that prompt repairs of damaged machines/equipment and electrical systems have reduced cases of accidents arising from machines and electricity in the workplace. Similarly, 98% agreed that the conduct of regular safety meetings has assisted in improving safety practices among workers; and that regular safety hazards and risk audits have helped in identifying areas of safety hazards and risk weakness in the companies.

The computed Kendall's Concordance Coefficient was 0.837, the Chi-Square (χ^2) value was 27.614 and the p-value was < 0.000 (p < 0.05, 95%CI.) as shown in Table 4. This shows that there is a high degree of agreement among the respondents on the effectiveness of safety hazards and risk management programmes in the food and beverage industry. The PII values are between 3.4 and 3.5 ranked 2 indicating often based on the PII scale. The effectiveness of safety hazards and risks management programmes in the FBI indicates that compliance to safe work procedures and the use of operating safety manual often have helped to minimize accidents. Management also enforced the use of material safety data sheets which has helped to often minimize chemical spills. In many instances workers participation in regular safety meetings, HSE training/workshop/seminar programmes has helped to increase their knowledge of safety hazards and risk in the workplace. The outcome of safety hazards programmes and the conduct of safety hazards and risk audit have many times helped to minimize hazards and risk in the FBI. These are all administrative control measures effectively implemented to reduce risk of hazards and ensure safety of workers [31,26]. Also, the use of PPE frequently has helped to reduce cases of accidents and ensure workers safety. The use of PPE is the last hazards control approach in the hierarchy of controls [31,26] and it is used together with other control measures implemented to control hazards in the FBI. In addition, prompt repairs of breakdown machines and equipment were engineering control measures [31,26] that have effectively reduced hazards in the FBI.

4.6 Intervention on Hazards and Risk Control Measures in the FBI

The study carried out a walk through inspection to support the data from questionnaires and

unsatisfactory levels of existing hazards for the FBIs was significant (Table 10), which initiated the need for intervention(awareness on the assessment of hazards and risk control measures). In the post- inspection done, the outcome of intervention was significant (Table 10). FBI-2 improved from 79.62% to 96.82%, FBI-3 improved from 89.81% to 96.18%, FBI-4 improved from 78.34% to 95.54% and the trend of improvement after intervention is shown in Fig. 6. This finding agreed with the result of the study by Odibo et al. [32] who reported in their study that there was significant positive contribution of safety awareness intervention on the attitude of workers toward industrial hazards and risk.

4.7 Methodological Limitations

The following are considered some of the identifiable limitations:

a) It was impossible to achieve 100% retrieval of questionnaires submitted as some of the respondents were not available during the retrieval period. Only 93% was retrieved though rate of response was sufficient and provided ample proportion of data for analysis and interpretation;

b) It took time to reach an agreement and execution of the inspection for each of the selected FBI by the Certified Auditors as they were not readily available due to their previous engagements with other clients;

c) Several FBIs were visited to determine their representativeness as ideal samples given that selection was not by random sampling and also, securing approvals for entering any of the FBI premises took some time; and

d) Duration of initial intervention was one month but extended to two months as the selected process industries were in full control.

4.8 Merits and Demerits of Using the Questionnaire and Pre-and Post-inspection Observation Approach and Ways to Improve the Study

4.8.1 Merits and demerits of using the questionnaire and pre- and post-inspection

Questionnaire is used to gather information about an organization for analysis but is based on the respondent's opinion (occasionally subjective), and may not be a 100% reflection of

the actual situation. As such, it is backed up with checklists used for carrying out pre and post inspections to validate the questionnaire response analysis. Pre inspection, though important in revealing issues in the workplace may not be adequate as the ultimate goal is to see improvement. Intervention is implemented and its merits are the expected levels of improvement. Post inspection is carried out after intervention, using one of the representative samples as control to prove the benefits of intervention beyond reasonable doubt.

4.8.2 Ways to improve the study

The following ways are suggestions to improve the study:

a) The issues raised in study limitations should be addressed by prospective researchers; and
b) In addition to checklist approach, industry records on accidents, near miss, injuries, fatalities and their causes, etc where available should be obtained and analysed to back up questionnaire response results,

5. CONCLUSION

The following identified factors - working at height, high voltage, loud noise, vibration and faulty machines and equipment are top in the hierarchy of hazards which constitute possible workplace risk to the exposed workers in the FBI in Nigeria. An adequate level of safety practices in the industry is present due to the high level of awareness on safety hazards and risks among the workers and the effectiveness of implementing control measures. Workers are trained on workplace safety hazards management, while policies on occupational safety hazards and risk are implemented and enforced. Administrative control measures are used to reduce hazards and workers make adequate use of personal protective equipment provided by management. Intervention carried out improved worker's awareness on identification of hazards and risk in the FBIs. Given the high ranking hazards that dominate the industry, there is need to analyze the risks associated with identified high ranking hazards and develop a risk management framework for the industry based on appropriate safety regulations and guidelines such as ISO 31000.

CONSENT

Before undertaking data collection the consent of the study sample was obtained with an official (formal) letter addressed to the managements of the studied food and beverage companies. The managements and workers were assured of the confidentiality of the data and information given by the participants. In view of this, it was agreed that the four food and beverage companies considered in this study be coded as FBI-1, FBI-2, FBI-3 and FBI-4. Thus, due process was followed in the data gathering process of the study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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