



Use of Personal Protective Equipment and the prevention of Industrial Mishaps in the United Cement Company of Nigeria (UNICEM), Calabar, Nigeria

¹Reham, Elijah O., ²Otu, Michael Abang and ¹Ukata, Bassey N.

¹Department of Environmental Health, College of Health Technology, Calabar, Cross River State, Nigeria:

²Department of GENERAL STUDIES, College of Health Technology, Calabar, Cross River State

Corresponding mail: Email ezeaji@yahoo.com

Abstract: This descriptive study explored use of personal Protective Equipment in the prevention of Industrial Mishaps in the United Cement Company of Nigeria (UNICEM) in Calabar, Cross River State, Nigeria. Four (4) hypotheses were formulated to direct the investigation. Two Hundred and Thirty (230) respondents drawn from the population of workers in various departments, Quarry, Health, Production, Electrical, Mechanical, Transportation, Security/ Surveillance and Occupational Health & Safety, of the company were used for the study. Data were collected using well designed and validated structured questionnaire. Data collected were subjected to statistical analysis using Chi-square (X^2) test statistics. Results obtained indicated a positive significant relationship between the use of PPE and prevention of industrial problems in terms of inhalation of cement dust, eye and ear disorders and workplace injuries. It was concluded that proper use of personal Protective Equipment leads to prevention of Industrial Mishaps. From this finding, it was recommended among others the management of cement industries should ensure that personal protective equipment is not only provided for workers but workers are monitored and supervised to ensure strict compliance on the usage by workers.

Keywords: personal Protective Equipment, Industrial Mishaps and Cement Company.

Introduction

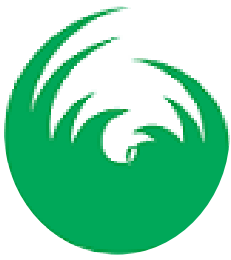
Safety remains a vital goal in every workplace, and the use of personal protective equipment (PPE) is fundamental in maintaining the safety of workers in all occupational environments. Werner (2009) stated that in the past, the need for individuals to protect themselves during work was strictly based on caution, as their lives were centered on agriculture with the use of crude implements that posed little or no risk to the user. As time progressed, the desire for more sophisticated goods and services became irresistible, leading to the emergence and proliferation of industries with advanced or more sophisticated production processes, inherently carrying risks to human safety.

The risks posed by production processes in industries tend to endanger human life. Therefore, for the safety of human life in industries, adequate protection of the human body is essential. The nature of protection depends on the kind of risk or hazard and the type of operation or processes involved in industries. Different operational procedures have inherent hazards that may or may not be noticed by the worker. In either case, workers should have all parts of the body, or essentially the parts prone to damage, protected. This necessitates the acquisition and compulsory use of specially designed devices for body protection against adverse conditions in the workplace (Abu-Allaban & Abu-Qudais, 2011).

International Academic Journal of Medical and Clinical Practice

An official Publication of Center for International Research Development

Double Blind Peer and Editorial Review International Referred Journal; Globally index
Available www.cirdjournal.com/index.php/iajmcp/index; E-mail: journals@cirdjournal.com



The use of Personal Protective Equipment (PPE) in every workplace is a statutory requirement, as it aims to ensure the safety of the worker. Refusal to use PPE has dire consequences, ranging from the loss of body parts to death. The purpose of personal protective equipment is to reduce employees' exposure to hazards when engineering and administrative controls are not feasible or effective in reducing these risks to acceptable levels. However, the Cement Manufacturing Industry has its own inherent hazards prejudicial to the health of the worker. Every production process leading to the manufacturing of Portland cement has one or several hazards, necessitating protection for workers within the factory against mishaps. Due to the numerous dangers workers are exposed to, wearing personal protective equipment is a must. Protection is required for the eyes, ears, face, nose, lungs, respiratory system, head, neck, arms, hands, fingers, legs, feet, and skin (Aribigbola & Fagbohunka, 2012).

Due to the enormity of hazards associated with industrial cement production, the entire body, from the crown of the head to the sole of the feet, ought to be protected. Various types of personal protective equipment, such as protective caps or helmets, earplugs or muffs, safety goggles, gloves, safety shoes and boots, leg guards and chaps, plastic face shields, face masks, and protective clothing (overalls), must be provided and worn by workers to shield them from mishaps inherent in the cement factory (Jain and Sunnil, 2008).

Personal protective equipment and prevention of dust inhalation

Fresh and unpolluted air is fundamental in an industrial environment, but industrial processes often emit substances into the air that can pollute it and make it harmful to workers. Hence, the use of personal protective equipment is necessary to avoid the inhalation of pollutants. Jain and Sunnil (2008) noted that air pollutants remain a major danger to industrial workers, and inhaling them into the respiratory system can cause various pathological disorders. The use of personal protective

equipment for the respiratory system aims to prevent routine pollution (non-emergency situations) with low concentrations of pollutants that produce chronic illness or discomfort after prolonged exposures, as well as crisis pollution hazards (emergency situations) with dangerously high concentrations that pose serious threats to life and health.

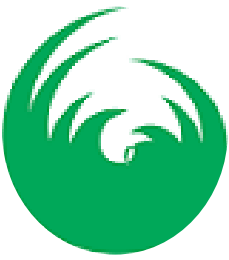
There are several types of respirators required to be worn by workers, depending on the conditions they are subjected to. Mechanical filter respirators, used as routine (non-emergency) respiratory protective equipment, consist of a face-piece covering the mouth and nose (and sometimes eyes), with a filter element to trap contaminants (Bhatia, 2011). Chemical cartridge respirators, suitable only in atmospheres not immediately dangerous to life, use canisters filled with absorbent material to clean the air before it reaches the nose (Obiom, 2009).

Air Line Respirators (ALR) are crucial for controlling dust and air pollutants in factories. This protective equipment supplies air to the worker through a pressure hose from an external fresh air source, obtained from the compressed air line of the plant/factory. Including a filter in the hose line helps remove oil droplets, water moisture, oil vapors, and particulate matter from the compressed air. Other types of respirators include Hose, Mask with Blower, Hose-Mask Respirator without Blower, Self-Contained Breathing Equipment (SCBE), and Gas Mask Respirator with a canister (Ambasht & Ambasht, 2008).

The cement industry is predominantly laden with dust not only within the vicinity but also in its environs. Persistent inhalation of cement dust by workers can result in industrial lung disease. To prevent this, as well as inhalation of other noxious gases, the appropriate respirator must be worn as necessary (Obiom, 2009).

Personal Protective Equipment and the Protection of Eyes

The protection of the face, especially the eyes, remains an essential goal in the use of personal protective devices in



the workplace. Asogwa (2010) maintained that personal protective equipment is capable of providing protection to the face and eyes against relatively heavy flying particles, radiated heat, and light. Noting that eyes are sensitive to bright light, radiation, laser beams, poisonous gases, poisonous liquids, flying solid objects, dust, etc., a simple method for protecting the eyes is through the use of safety goggles with appropriate specifications. Eyes of workers need special Personal Protective Equipment against exposure to flying particulate matter, dust, solid objects, liquids, chemical vapors or liquids, poisonous gases, ultraviolet rays, bright light produced by the striking of an electrical arc in electric welding, laser beams, x-ray beams, and infection.

PPE for eyes (safety goggles) should fit comfortably and offer maximum protection to the eyes. Materials used for making the protective equipment for the eyes should be noncorrosive, easy to clean, non-inflammable, and the transparent portion should give the widest possible field of vision without distorting light rays. For workers requiring corrective glasses, special goggles with the prescribed number must be provided. Asogwa (2010) noted that for protection against flying particles, safety goggles should fit closely around the eye socket, but adequate ventilation holes are necessary in the enclosures of the goggles. For exposure to irritating vapor, the goggle must completely enclose the eyes so that the vapor in the air does not make contact with the eyes. Arinola & Arinola (2007) stated that different types of eye protection equipment include goggles, chemical protection goggles, anti-contamination goggles, and dust protection goggles, which are commonly used in industries, including the cement industry.

Personal Protective Equipment and Protection from Noise Exposure

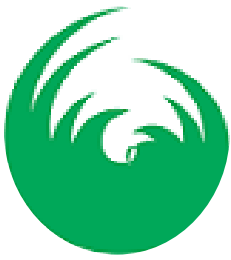
Sound waves are longitudinal pressure waves that propagate through air, water, and solids. Sound becomes apparent when the pressure waves reach the ears of the listener. Sometimes, the pitch of the noise is so high that

it causes either temporary or permanent hearing loss. The cement industry employs the use of heavy machinery and high-pitched noise, especially in the rotary kiln and at the packaging plant. Quarrying of rocks and other operations in cement industries exposes the worker to excessive noise damaging to their health. In most cases, industrial noise cannot be minimized to acceptable levels; hence, the need for PPE. The use of PPE provides workers protection against high and irregular sound waves by means of ear protectors covering the ears. Such devices reduce the sound reaching the ears to about 50 dB (Nkwa, 2009). Jain & Sunnil (2008) categorized ear protection equipment into three general types: earplugs, cushion or doughnut, and the helmet, which encloses the face and area of the head for maximum effectiveness against extremely loud and high-intensity sounds/noises.

Personal Protective Equipment and Protection of Foot and Leg

Legs and feet carry the weight of the body and need protection against falling objects, sharp objects, hot objects or heat, and chemical liquid splash. Rim-Rukeh (2009) asserted that the type of hazard varies with the operation and work area. Footwear also provides comfort to the worker and improves efficiency and welfare. Protective devices for legs and feet include safety shoes, safety boots, leg guards, and chaps.

Safety shoes are the most common foot protection devices used by workers. The shoe must be sturdy, durable, and comfortable, with a metallic toe-cover provided at the tip to enclose the toes completely. Safety boots cover the foot and part of the leg up to the knee or hip height and provide protection against continual wetting or chemical acids. Workers in a cement factory must wear safety boots to protect them during all production processes, especially to avoid walking on cement dust. Leg guards comprise guards for the foot, shin, and ankle. Foot guards are steel protection that covers the toes and the upper part of the foot, intended to protect against heavy falling objects that might crush,



puncture, or abrade the toe. Foot and shin guards provide protection for the shin and ankles, while heel and ankle guards prevent striking by material handling equipment or heavy objects. Shin guards, made of heavy fiber material, conform to the shape of the front of the leg and are used by workers in material handling and heavy machine operating industries, such as the cement industry. Chaps, thick trousers worn over ordinary trousers, provide protection to the front side of the legs of workers (Googled, 2015).

Methodology

This study was conducted in Calabar Municipal Local Government Area of Cross River State, Nigeria, which is part of Calabar Metropolis, the seat of Cross River State capital. Calabar Municipality is located in the mangrove ecological zone of the state at the edge of the Bight of Bonny. The population of the study comprised workers of United Cement (UNICEM) Company of Nigeria. The sample consisted of 230 subjects drawn from various departments in the company, selected using a systematic sampling technique. Variables such as gender, department, time-demanding schedule, and the nature of work of the respondents in the factory were taken into consideration during the sampling process.

A structured questionnaire titled "Use of Personal Protective Device and Prevention of Industrial Mishaps

Questionnaire (UPPDPIMQ)" was designed, consisting of 25 items. Section A included 5 demographic variables, while Section B consisted of 20 closed-ended items measuring the main variables: use of protective devices, inhalation of dust, eye problems, ear problems, and workplace injuries. A trial test with 20 workers not part of the study's sample was conducted to establish the reliability of the instrument. Cronbach's Alpha reliability statistics were used, yielding reliability estimates ranging from 0.70 to 0.89, confirming the instrument's reliability. Data collection was done through the direct administration of the instrument by the researcher with the assistance of research assistants recruited for the study, resulting in a 98% return rate. Chi-square statistics were employed for data analysis.

Analysis of Results

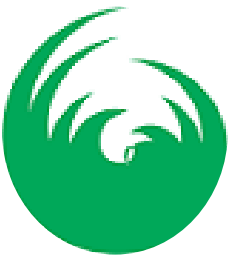
Hypothesis One: There is no significant relationship between the use of PPE and the prevention of the inhalation of dust among cement factory workers. The independent variable in this hypothesis is the use of PPE, while the dependent variable is the prevention of the inhalation of dust. Chi-square statistics were used for hypothesis testing since the variables were measured on a discrete scale. The results are shown in Table 1.

Table 1: Shows the relationship between the use of PPE and the prevention of inhalation of cement dust

Use of PPE	Inhalation of Cement Dust		Total	X ² tab	X ² cal
	Inhale	Not inhale			
Used	180(90%) a	20(10%) b	200 k	3.841	58
Not used	10(33%) c	20(67%) d	30 l		
Total	190 m	40 n	230 M		

Source: Field study. 2022.

$$X^2 = \sum \frac{(ad - bc)^2}{klmn} M = 58$$



Since $X^2_{cal} = 58 > X^2_{tab}$ at $\alpha, 0.05 = 3.841$, we therefore reject the null hypothesis (H_0) and conclude that there is a significant relationship between the use of PPE and the prevention of the inhalation of cement dust in the company. From Table 1 above, on the use of PPE and prevention of cement dust inhalation out of 230 respondents sampled, 200 said they used PPE, and out of these, 180 (90%) affirmed that this had prevented them from inhaling cement dust, while 20 (10%) said the use of PPE did not. On the other hand, out of the 20 who asserted that they did not use PPE, 10 (33%) said they did not breathe cement dust, while 20 (67%) said they did. The positive relationship means that as the use of

personal protective equipment increases, prevention of inhalation of cement dust among workers also increases and vice versa.

Hypothesis Two: There is no significant relationship between the use of PPE and protection of eyes among cement factory workers. The independent variable in this hypothesis is the use of PPE, while the dependent variable is the protection of eyes. The hypothesis was tested using Chi-square statistics since the variables were measured on a discrete scale. The results are shown in Table 2.

Table 2: Shows the relationship between the use of personal protective equipment and the protection of the eyes

Use of PPE	Protection eyes among cement factory workers		Total	X ² tab	X ² cal
	Protected	Not protected			
Used	165(88%) a	23(12%) b	188 k	3.841	35
Not used	20(48%) c	22(52%) d	42 l		
Total	185 m	45 n	230 M		

Source: Field Study, 2016.

$$X^2 = \sum \frac{(ad - bc)^2}{klmn} M = 35$$

Since $X^2_{cal} = 35 > X^2_{tab}$ at $\alpha, 0.05 = 3.841$, we therefore reject null (H_0) and conclude that there is a significant relationship between the use of PPE and the protection of eyes in the company. From the data available on table 2 on the use of PPE and eye protection, out of the total respondents of 230, 188 said they often put their PPE for eye protection and out of these, 165(88%) asserted that this action has truly help to protect their eyes, while 23(12%) said it did not. Contrary to this, out of the 42 of the 230 respondents who rarely put on their PPE, only 20(48%) affirmed that their eyes are protected due to the use of PPE while 22(52%) testified to the fact that their eyes are prone to frequent danger. The positive

relationship means that as the use of personal protective equipment increases, protection of eyes among workers in the industry also increases and vice versa

Hypothesis Three: There is no relationship between the use of PPE and ear protection against excessive noise among cement factory workers. The independent variable in this hypothesis is use of PPE while the dependent variable is ear protection against excessive noise. The hypothesis was tested using Chi-square statistics since the variables were measured on a discrete scale. The result is shown table 3.



Table 3: Shows the relationship between the use of PPE and ear protection against excessive noise.

Use of PPE	Ear protection against excessive noise		Total	X ² tab	X ² cal
	Protected	Not protected			
Used	155(79%) a	40(21%) b	195 k	3.841	27
Not used	13(37%) c	22(63%) d	35 l		
Total	168 m	62 n	230 M		

Source: Field Study, 2022.

$$X^2 = \sum \frac{(ad - bc)^2}{klmn} M = 27$$

Since $X^2_{cal} = 27 > X^2_{tab}$ at $\alpha, 0.05 = 3.841$, we therefore reject null (H_0) and conclude that there is a relationship between the use of PPE and ear protection against excessive noise in the industry. From the information available in table 3 above on the use of PPE and ear protection against excessive noise, out of 195 respondents who always use their PPE, majority of them 155(79%) said they had been protected from this industrial mishap while only 40(21%) confirmed that their use of PPE did not protect them from excessive noise. On the other hand, out of 35 of those who rarely made use of their PPE, only 13(37%) said that they had been protected from excessive noise while majority of them 22(63%) said they had not adequately protected from excessive noise in the industry.

The positive relationship observed means that as the use of personal protective equipment increases, ear protection against excessive noise among workers in the industry also increases and vice versa.

Hypothesis Four: There is no relationship between the use of personal protective equipment (PPE) and protection against foot and leg injury. The independent variable in this hypothesis is use of PPE while the dependent variable is protection against foot and leg injury. The hypothesis was tested using Chi-square statistics since the variables were measured on a discrete scale. The result is shown table 4.

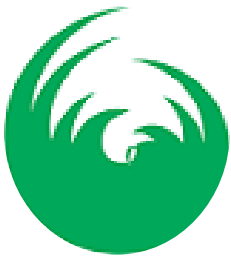


Table 4: Shows the relationship between the use of PPE and protection against foot and leg injury

Use of PPE	Foot And Leg Protection		Total	X ² tab	X ² cal
	Protected	Not protected			
Used	162(79%) a	23(12%) b	185 k	3.841	37
Not used	21(47%) c	24(53%) d	45 l		
Total	183 m	47 n	230 M		

Source: Field Study, 2016.

$$X^2 = \sum \frac{(ad - bc)^2}{klmn} M = 37$$

Since $X^2_{cal} = 37 > X^2_{tab}$ at $\alpha, 0.05 = 3.841$, we therefore reject null (H_0) and conclude that there is a relationship between the use of PPE and protection against foot and leg injury among workers in the industry. Data presented in table 4 on the use of PPE and protection against foot and leg injury, out of 185 of those who often use PPE, 162(88%) said this part of their bodies had been protected while 23(12%) said it is not. Similarly, out of 45 respondents who rarely use PPE, 21(47%) said they had been protected while 24(53%) of them said they never had any form of protection against foot and leg injury. The positive relationship observed means that as the use of personal protective equipment increases, workers protection against foot and leg injury in the industry also increases and vice versa.

Discussion of Results

Hypothesis 1: There is no relationship between the use of PPE and the prevention of the inhalation of dust among cement factory workers.

Information gathered in respect to the above hypothesis shows that many of the workers used PPE while at work thereby resulting to the prevention of cement dust inhalation. From the record, 200(87%) of the workers persistently used their PPE while 30(13%) did not. Therefore, Since $X^2_{cal} = 58 > X^2_{tab}$ at $\alpha, 0.05 = 3.841$, we therefore reject null (H_0) and conclude that there is a

relationship between the use of PPE and the prevention of inhalation of cement dust.

This attitude of the workers had led to the prevention of cement dust inhalation that may invariably lead to industrial lung disease (pneumoconiosis). This feat was achieved due to the management's commitment toward a better working condition for workers through the provision and enforcement of the use of PPE. This result above confirmed the observation of Rim-Rukeh (2009) that the proper and consistent use of PPE like dust mask can prevent the inhalation of particulate matters such as dust within the work environment. Similarly, said when the employers provide PPE for workers, it will help to prevent most industrial mishaps.

Hypothesis 2: There is no relationship between the use of PPE and the protection of the eyes

Data collected analysed in respect to this hypothesis shows that 188(82%) of the total sample used their PPE very often whereas on 42(18%) of the respondents said they rarely used their PPE, in order for the eyes to be protected from industrial mishap such as flying objects from entering the eyes the workers must use PPE (face shield). Hence, Since $X^2_{cal} = 35 > X^2_{tab}$ at $\alpha, 0.05 = 3.841$, we therefore reject null (H_0) and conclude that there is a relationship between the use of PPE and the protection of the eyes.



The trend in the factory reveals that the workers were provided with PPE and a good proportion of them used them. These findings supported the work of Bhatish (2011) who noted that regular use of PPE (face/eye shield) by workers during work can protect the face and eyes from dangers from falling or flying objects.

Hypothesis 3: There is no relationship between the use of ear muffs and ear protection

Information gathered in respect to the above hypothesis shows that 195(85%) of the total sample always use ear muffs in order to protect themselves against excessive noise while 35(15%) of the respondents affirmed that they sometimes used ear muffs. Therefore, Since $X^2_{cal} = 27 > X^2_{tab}$ at $\alpha, 0.05 = 3.841$, we therefore reject null (H_0) and conclude that there is a relationship between the use of PPE and ear protection. This trend is owing to the fact that the problem that occurs from exposure to excessive noise such as temporary or permanent deafness was prevented due to PPE use. These findings are in line with Oluwagbani (2013) and Obiom (2009) observations who noted that exposure to excessive noise in the work place can lead to hearing loss which can be prevented if workers are encouraged to use these life saving devices.

Hypothesis 4: There is no relationship between the use of PPE and foot and leg protections

Data collected and analysed in respect to the above hypothesis reveals that 185(80%) of the respondents put on their PPE for foot and leg protection as often as possible while 45(20%) rarely did this. Since $X^2_{cal} = 37 > X^2_{tab}$ at $\alpha, 0.05 = 3.841$, we therefore reject null (H_0) and conclude that there is a relationship between the use of PPE and foot and leg protection. This shows that many of the workers in the factory wear their foot and legs protective devices. The findings agree with Santa (2012) and Asogwa (2010) who said that like every part of the body, the foot and legs have to be protected as well. Hence, workers should be provided with PPE for this purpose and encouraged to use some. This is true in that every part of the body ought to be protected from

potential dangers in the work place, through proper use of PPE by workers.

Conclusion

It is pertinent to state that based on what has been discussed so far, as a result of a careful analysis of the collected data, it is hereby concluded that all the four null hypothesis postulated should be rejected and the alternative accepted.

In addition, regardless of whatever reasons why some factory workers chose not to use PPE given to them, proper awareness should be given and enforcement for compliance must be treated as a very important administrative strategy toward safeguarding the health of the workers.

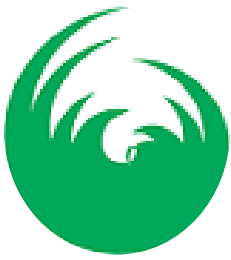
Recommendations

From the findings of the study, the researcher suggested measures to be put in place so as to enhance the prevention of industrial mishaps as applicable to cement industries.

- (1) Management of cement industries must ensure that PPE are provided for workers in cement factories
- (2) Strict compliance by workers should be ensured through proper enforcement
- (3) Governments should enact all enforced laws on the provision and utilization of PPE by the management and workers of cement factories alike.
- (4) Environmental health officers should be empowered to carry out their duties effectively such as industrial inspection.

References

- Abu-Allaban, M., & Abu-Qudais, H. (2011). Impact Assessment of Ambient Air Quality by Cement Industry: A Case Study in Jordan. *Aerosol and Air Quality Research*, 11, 802-810.



- Ambasht, R. S., & Ambasht, P. K. (2008). *Environment and Pollution*. New Delhi: CBS Publishers and Distributors.
- Aribigbola, A., Fatusin, A., & Fagbohunka, A. (2012). Assessment of Health and Environmental Challenges of Cement Factory on Ewekoro Community Residents, Ogun State, Nigeria. *American Journal of Human Ecology*, 1(2), 51-57.
- Arinola, A. M., & Arinola, O. G. (2007). *Understanding Community Health*. Ibadan: College Press and Publishers Limited.
- Asogwa, S. E. (2010). *A Guide to Occupational Health Practice in Developing Countries*. Enugu: Fourth Dimension Publisher.
- Berhe, A., Alemayehu, T., Fortuin, K. J. P. (2014). Environmental Impact Study of Cement Factory using a Multi-Criteria Analysis: Evidence from Messebo Cement Factory, Ethiopia. *Developing Country Studies*, 4(24), 151-161.
- Bhatia, S. C. (2011). *Environmental Pollution and Control in Chemical Process Industries*. New Delhi: Khama Publisher.
- Dokrun-Oyeshola, P. (2005). *Essentials of Environmental Issues: The world and Nigeria in Perspectives*. Ibadan: Daily Graphics Publications.
- Gull, N., Ali, M. Y. N., Hussain, A. N., Nawaz, R., & Mushta, S. K. (2013). Industrial Air Pollution and its Effects on Human's Respiratory System (A Sociological Studies of Bhoun Shugar Mill District Jhang, Pakistan), *Academic Journal of Interdisciplinary Studies*, 2(3), 535-545.
- Jain, R. K., & Sunnil, S. R. (2008). *Industrial Safety, Health and Environment Management System*. New Delhi: Khanna, Publishers.
- Nkwa, A. A. (2009). *Modern Environmental Sanitation*. Owerri: Ugooma Printing and Publishing Company.
- Obionu, C. N. (2009). *Synopsis of Occupational and Environmental Health*. Emper: Delta Publications (Nigeria) Limited.
- Oluwagbeni, B. F. (2013). *Themes and Issues in Occupation Health and Safety*. Ibadan: Hure Prints.
- Rim-Rukeh, A (2009). *Environmental Science: An Introduction*. Ibadan: Kraft Books Limited.
- Santra, S. C. (2012). *Environmental Science*. Kolkala: New Central Book Agency Limited.
- Werner, W. J. (2009). Corporate Social Responsibility Initiatives Addressing Social Exclusion in Bangladesh. *Journal of Health Population and Nutrition*, 27(4), 545-562.