Original Article

Occupational hazards among medical radiation workers

Prince Ameh Ogenyi, Andrew England[1], Yusuf Aliyu, Joseph Dlama, Ahmed Hamza, Roswita Hamunyela[2], Maikudi Dauda[3]

Department of Radiology, Abubakar Tafawa Balewa University Teaching Hospital, Bauchi, [3]Department of Radiology, Asokoro District Hospital, Abuja, Nigeria, [1]Directorate of Radiography, University of Salford, Manchester, United Kingdom, [2]Department of Natural and Applied Sciences, Namibia University of Science and Technology, Windhoek, Namibia

Abstract

Objectives: The objective of the study was to determine the prevalence of occupational hazards among medical radiation workers in Northern Nigeria and to assess the adequacy of existing occupational safety measures in the region.

Materials and Methods: A prospective cross-sectional study of 139 medical radiation workers in six tertiary health-care institutions in northern Nigeria. Structured questionnaires were used to obtain vital information about the occurrence of occupational hazards, prevention and control measures. Data were analyzed using descriptive and inferential statistics using the computer software SPSS.

Results: Out of 159 questionnaires distributed 139 were retrieved giving a response rate 87.4%. Stress, direct contact with bodily fluids, and contrast media splashes were the three most prevalent hazards reported by 121 (87.1%), 78 (56.1%), and 72 (51.8%), respectively.

Conclusion: Medical radiation workers in Northern Nigeria face a wide range of occupational hazards, and therefore concerted efforts must be channeled toward mitigating these hazards.

Keywords: Hepatitis, infection control, safety, stress

Address for correspondence: Dr. Andrew England, Senior Lecturer Directorate of Radiography, University of Salford, United Kingdom.
E-mail: A.england@salford.ac.uk
Prince Ameh Ogenyi, Department of Radiology, Abubakar Tafawa Balewa University Teaching Hospital, Bauchi, Nigeria.
E-mail: jacobameh3@gmail.com

INTRODUCTION

An occupational hazard is any source of potential damage, harm, or adverse health effects on someone under certain conditions at work.[1] In this study, a hazard is referred to as being the actual harm or the health effect caused rather than the hazard.[1,2] For example, the disease pulmonary tuberculosis (TB) is categorized as a biological hazard.[1]

The International Labour Organization estimates that 160 million people across the world suffer from work-related diseases such as musculoskeletal diseases and mental health problems, whereas 270 million fatal and nonfatal work-related accidents result in over 350,000 casualties and over 2 million work-related deaths each year which are all attributable to occupational hazards.[2] A Washington-based study found that, from 1996 to 2000, over 3300 compensation claims were filed due to work-related hazards.[3] More recently, evidence from Sub-Saharan Africa indicates that health-care workers are frequently exposed to chemical, biological, physical, and psychosocial occupational hazards.[4-6] In these reports, workers are constantly in contact with patients, and this

Access this article online	
Quick Response Code:	Website: www.wajradiology.org
	DOI: 10.4103/wajr.wajr_1_17

How to cite this article: Ogenyi PA, England A, Aliyu Y, Dlama J, Hamza A, Hamunyela R, *et al*. Occupational hazards among medical radiation workers. West Afr J Radiol 2018;25:28-33.

exposes them to infections and thus requires the proper protective measures to reduce their risk of acquisition of disease or injury.

The risk of cancer among physicians and other persons exposed to ionizing radiation in the workplace has been the subject of study since the 1940s when increased mortality from leukemia was reported among radiologists compared to mortality among other medical specialists.[4-6] In fact, an extensive retrospective cohort study confirmed earlier reports and also noted excess mortality from other cancers.[4-6]

Within radiology, occupational health and safety is an important issue because of high rates of associated morbidity and mortality of exposed workers.[7,8]

Medical radiation workers are clinical practitioners and are primarily engaged in the use of radiation in the diagnosis and treatment of disease in the radiology department. These professionals face often a number of hazards in the workplace. Consequently, the purpose of this study was to determine the prevalence of occupational hazards among medical radiation workers and to assess the adequacy of occupational health safety and control measures employed in the radiological departments of tertiary health-care institutions in Northern Nigeria.

MATERIALS AND METHODS

A prospective cross-sectional study was undertaken for a period of 6 months, from May 2016 to October 2016.

Sample

A stratified convenience sampling technique was used for this study with the three major geopolitical zones in Northern Nigeria being considered; these include the North-East, North-West, and North-Central. Structured questionnaires were used to collect data from medical radiation workers at six major tertiary health institutions in Northern Nigeria. Agreement to participate in the study followed an explanation of aims of the study, and participants were informed that consent to participate was voluntary. Participants were allowed to withdraw from the study at any point without explanation.

Questionnaire design

Data were collected using self-administered 41-item structured questionnaires containing six sections. Questions revolved around demographics, biological hazards, nonbiological hazards, radiation hazards, and preventive/infection control measures. The validity and reliability of the questionnaires were assessed and confirmed by a team of experts with more than 10-year experience in research in radiology.

Statistical analysis

Data were analyzed using Statistical Package for the Social Sciences version 22 (IBM Inc., Armonk, NY, USA). Descriptive statistics including the mean, frequencies, and percentages were used to report quantitative data. Chi-square and Kendall's test were used for the inferential statistics.

RESULTS

A total of 159 structured questionnaires were distributed across six major tertiary health-care institutions in northern Nigeria and 139 were retrieved representing a response rate 87.4%. Data were collected from Abubakar Tafawa Balewa University Teaching Hospital, Jos University Teaching Hospital, Aminu Kano Teaching Hospital, State Specialist Hospital Bauchi, Federal Medical Center, Azare, and the National Hospital, Abuja. The respondents included 103 (74.1%) males and 36 (25.9%) females. The mean age of respondents was 34.5 ± 9.2 years.

Of the respondents, 36 (25.9%) radiologists, 59 (42.5%) were radiographers, 12 (8.6%) were X-ray technicians, 7 (5%) were medical physicists, and 25 (18.0%) were student radiographers [Table 1].

Table 1: Demographic data of respondents

Category	Frequency (%)
Radiologist	36 (25.9)
Clinical radiographer	59 (42.5)
X-ray technician	12 (8.6)
Student radiographer	25 (18.0)
Medical physicist	7 (5.0)
Gender	
Male	103 (74.1)
Female	36 (25.9)
Age	
21-30	61 (43.9)
31-40	37 (26.6)
41-50	35 (25.2)
>51	6 (4.3)
Marital status	
Single	68 (48.9)
Married	70 (50.4)
Divorced	1 (0.7)
Years of experience	
≤10	100 (71.9)
>10	39 (28.1)
Working overtime	
Yes	57 (41.0)
No	82 (59.0)
Daily hours of sleep	
≤6	68 (48.9)
>6	71 (51.1)
Pressure from work	
High	49 (35.3)
Moderate	79 (56.8)
Low	9 (6.5)
None	2 (1.4)

Participants were next asked to indicate prior levels of exposure to different occupational hazards [Table 2]. In terms of biological hazards, the most commonly encountered was direct contact with bodily fluids (72, 51.8%) whereas needlestick injuries were the least common (17, 12.2%). With regard to nonbiological hazards, respondents indicated that stress was the most common encountered (121, 87.1%) whereas fractures were the least (5, 5.0%).

Next, participants were asked about their levels of anxiety regarding acquiring cancer from working with ionizing radiation [Figure 1]. Over a third of respondents indicated that they strongly agreed with the statement that "they are worried about acquiring cancer from working with ionizing radiation." When combined with those would "agree" with the statement this increased to 62%. Participants were then asked to state their agreement to the statement "working with ionizing radiation makes me vulnerable" [Figure 2]. Similarly, a third of respondents indicated that they strongly agreed with this statement and when combined with those who "agree" this increased to 75%.

Participants were asked to score their levels of work-related pressures (stress) [Figure 3]. From the data, it was demonstrated that a third of participants felt that there were working under high pressure at work and just under half (49%) indicated that work-related pressure was at a moderate level.

Questions were presented to participants in relation to preventative and control measures for occupational hazards presented by employers [Table 3]. Positive responses were high for this series of questions with nearly three-quarters of respondents indicating that positive measures were in place by their employers. The lowest score was in relation to well-ventilated exposure rooms and offices which were only provided to 92 respondents (72.7%). In terms of personal protective measures, immunization was only

Table 2: While working as a radiation worker have you experienced any of the following hazards?

Biological hazards	Yes (%)	No (%)
Needle stick related injury	17 (12.2)	122 (87.8)
Cuts and wounds	33 (23.7)	105 (75.5)
Direct contact with bodily fluids	72 (51.8)	67 (48.2)
Air borne disease (TB, pneumonia)	59 (42.4)	80 (57.6)
Infectious diseases	57 (41.0)	82 (59.0)
Nonbiological hazards	**Yes (%)**	**No (%)**
Physical, psychological, sexual and or verbal abuse	65 (46.8)	74 (53.2)
Stress	121 (87.1)	18 (12.9)
Fractures	7 (5.0)	132 (95.0)
Trips and/or falls	35 (25.2)	104 (74.8)
Contrast spills and or splashes	78 (56.1)	61 (43.9)
Direct contact with fixer and developer/ solutions	72 (51.8)	67 (48.2)

TB – Tuberculosis

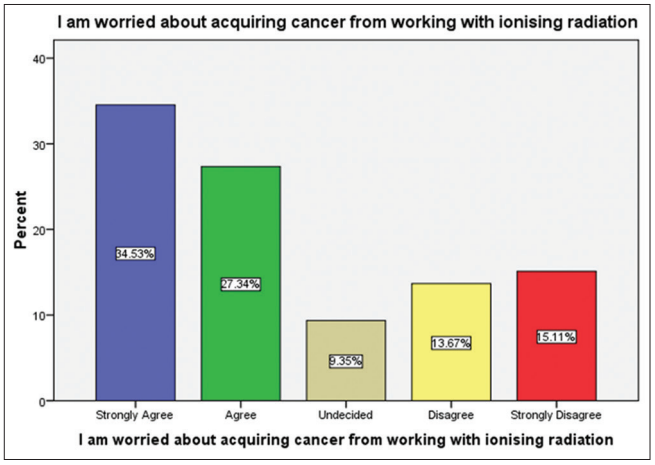

Figure 1: Bar chart illustrating respondents' opinions about radiation hazards

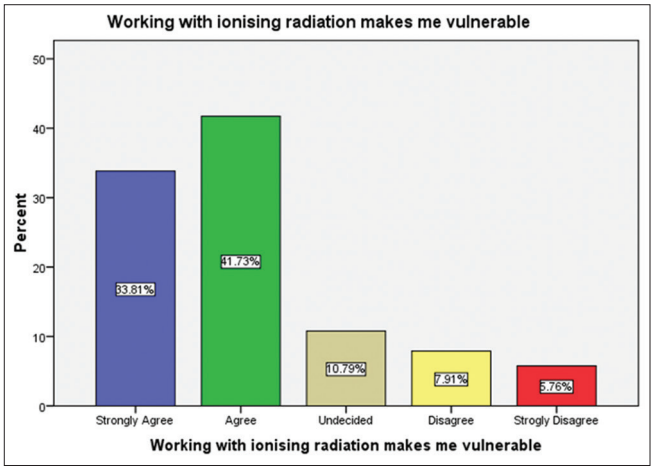

Figure 2: Bar chart illustrating respondents views about impact of radiation on their lives

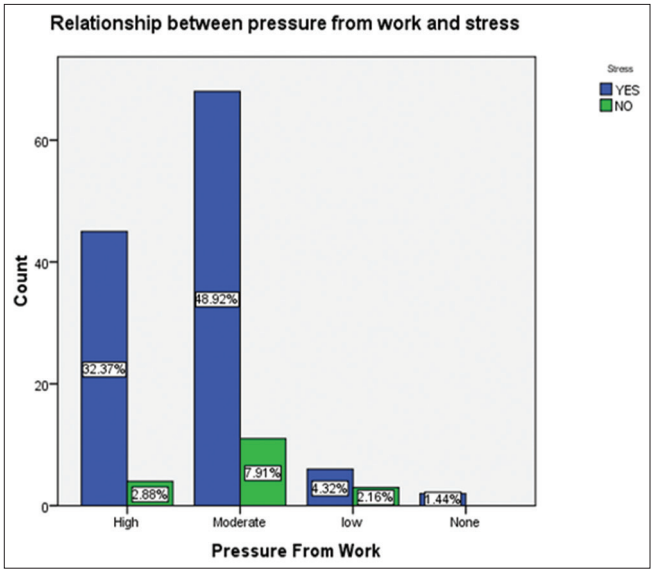

Figure 3: Bar chart illustrating relationship between pressure from work and stress

provided to less than half of the respondents. Face masks were provided for those patients with known or suspected TB in 103 (74.1%) of cases.

Infection control practices were raised with the participants [Table 4]. Good evidence of hand washing did exist although this was not indicated by all respondents and evidence was presented that this did not happen before and after every procedure.

The data were examined for a relationship between years of experience and direct contact with bodily fluids. Of those who had ≤10-year experience, only 53 (53%) reported direct contact with bodily fluids as a hazard, by comparison for those who had >10-year experience this was number was less (19, 49%) and not statistically significant ($P > 0.05$). When comparing years of experience with stress in the workplace, the following trends were noted. For those who had ≤10-year experience, 89 (89%) reported that they experienced stress in the workplace when compared to 32 (82%) who had >10-year experience ($P > 0.05$). The relationship between current age and stress in the workplace was investigated. Study data showed that there was no statistically significant correlation between age and stress (Kendall's tau 0.017; $P > 0.05$).

Table 3: Questions on preventive and control measures used by employers

Preventive and control measures by employers	Yes (%)	No (%)
Provision of occupational radiation monitoring devices	102 (73.4)	37 (26.6)
Safety and training on all universal precautions	114 (82.0)	25 (18.0)
Provision of lead apron, gonad and thyroid shield	129 (92.8)	10 (7.2)
Safety tools, equipment and machinery	117 (84.2)	22 (15.8)
Training on all imaging equipment used	111 (79.9)	28 (20.1)
Well ventilated exposure rooms and offices	92 (66.2)	47 (33.8)
Personal set of protective outfits/equipment	101 (72.7)	38 (27.3)
Separate areas and containers to dispose of medical waste	123 (88.5)	16 (11.5)
Personal protective measures		
Hepatitis B vaccination	63 (45.3)	76 (54.7)
Bacillus Calmete–Guerin vaccination	34 (24.5)	105 (75.5)
Hepatitis A vaccination	38 (27.3)	101 (72.7)
Use of facemask when attending to patients with TB	103 (74.1)	36 (25.9)

TB – Tuberculosis

Table 4: Specific questions on infection control practices

Hand washing	Yes (%)	No (%)
Before and after handling each patient	105 (75.5)	34 (24.5)
After handling soiled materials	122 (87.8)	17 (12.2)
When hands are very dirty	130 (93.5)	9 (6.5)
Before and after meals	131 (94.2)	8 (5.8)
After handling biological samples	128 (92.1)	11 (7.9)
After using gloves	127 (91.4)	12 (8.6)
Before and after every procedure	101 (72.7)	38 (27.3)

DISCUSSION

Medical radiation workers face a wide range of occupational hazards hence the need for this study. This study assessed for the first time; occupational hazards among 139 medical radiation workers in tertiary health-care institutions in Northern Nigeria. The mean age of respondents was 34.5 ± 9.2 years, and there were 103 (74.1%) males and 36 (25.9%) females involved in the study. In terms of years of experience, we found that 100 (71.9%) had <10-year experience, 57 (41%) were working regular overtime, nearly half of the respondents 68 (48.9%) slept for <6 h and 49 (35.3%) respondents indicated high work pressure. The majority of the respondents were radiographers 59 (42.5%), 36 (25.9%) were radiologists, 25 (18.0%) were student radiographers, 12 (8.6%) were X-ray technicians, whereas only 7 (5%) were medical physicists.

Numerous studies on occupational hazards have been conducted among different health-care workers in different countries, but unfortunately, these studies have not included medical radiation workers.[9-22] To the best of our knowledge, this is the first study in Northern Nigeria to provide adequate and reliable information on occupational hazards among medical radiation workers.

This study considered biological and nonbiological hazards in the radiology department. It also provided information on the infection control practices, occupational health and safety measures, and opinions of medical radiation workers regarding radiation hazards.

Previous studies on occupational hazards among health-care workers by the United States National Institute of Occupational Health and Safety, Amira and Awobusuyi in Lagos, Fernandes *et al.* in Brazil, Ndejjo *et al.* in Kampala, Osungbemiro *et al.* in Nigeria, Orji *et al.* in Nigeria, de Castro *et al.* in the Philippines, Adib-Hajbaghery in Iran, and Ziraba *et al.* in Uganda found that needlestick injury and stress were the two major hazards encountered by health-care workers.[9-11,15,20,23-25] Interestingly, this study also identified stress, i.e., 121 (87.1%) as the most prevalent nonbiological hazard among medical radiation workers in the region. This may be due to the paucity of licenced medical radiation professionals and enormous pressure from work that most medical radiation workers in the region undergo on a daily basis. It was evident that 81.3% of the respondents who identified stress had either high or moderate pressure from work. Unlike previous studies, however, this study found that, just a handful of medical radiation workers, 17 (12.2%) had needlestick injuries while working in the radiology department. This may

be insignificant but still an important issue that requires attention, especially with the Occupational and Safety Health Administration estimating that 5.6 million workers in the health-care industry and related professions were at risk of occupational exposure to blood–borne pathogens including HIV, hepatitis B virus (HBV), hepatitis C virus, and other potentially infectious materials.[16] While needlestick injuries may have been a major concern among other health-care professionals, we identified direct contact with body fluids 72 (51.8%) to be the most prevalent biological hazard among medical radiation workers in the region.

In this study, we learned that 78 (56.1%) radiation workers were exposed to radiographic contrast media splashes or spills and this was the second most prevalent nonbiological hazard after stress. Considering all biological and nonbiological hazards, we discovered that medical radiation workers were more predisposed to nonbiological hazards than they were to biological hazard with 45.3% respondents indicating that they had either fractures, trips, falls, contrast spill/splash, stress, psychological, verbal and physical abuse, and direct contact with fixer and developer solutions among others.

With regard to respondents' opinions about working with ionizing radiation, we found that 86 (61.7%) radiation workers were worried about acquiring cancer from working with ionizing radiation and 105 (75.54%) affirmed that working with ionizing radiation made them highly vulnerable. We decided to focus on these opinions particularly because it will be somewhat difficult to ascertain objectively through surveys that stochastic effects among medical radiation workers were primarily due to exposure to ionizing radiation.

Health and safety in the radiology department is a basic human right that employers and government should ensure for the workers.[22] In this study, we considered the adequacy of occupational health safety adopted by employers in the region. Based on results obtained, we can conclude that majority of the radiology departments in the region met required safety standards. This is evident in the 102 (80.9%) respondents who indicated that they had training on all imaging equipment and universal precautions, well-ventilated exposure rooms and offices, personal set of protective outfits from infection and ionizing radiation, efficient waste control system, and occupational radiation monitoring devices among others.

Existing literature[3,16,18] emphasizes the need to protect medical staff from infectious diseases through robust immunization programs and other infection control strategies. This study reveals that 33 (12.2%) had suffered cuts and wounds and 72 (51.8%) had direct contact with bodily fluid while attending to patients in the radiology department. Unfortunately, majority of these respondents 101 (72.7%) were not immunized against hepatitis A and 63 (45.3%) did not receive hepatitis B vaccination. The World Health Organization (WHO) study on global burden of diseases from sharp injuries among health-care workers showed that 37% of the hepatitis B among health-care workers were the result of occupational exposure. Infection with the HBV is 95% preventable with immunization but <20% of health-care workers in some regions of the world had received all three doses needed for immunity.[16] This was also an issue of concern in our study on medical radiation workers in the region. On the average, we established that about 80 (57.2%) medical radiation workers in the region were at risk of contracting hepatitis B, hepatitis A, pulmonary TB, and pneumonia among others. This was based on responses provided regarding immunization from infectious diseases.

Universal precautions against hospital-acquired infections remain important as far as occupational health and safety is concerned. Findings from this study indicate that about 121 (86.7%) of workers adhere to infection control practices through hand washing before and after every procedure, hand washing after handling each patients, and soiled materials. These findings agree with earlier studies by Ndejjo *et al*. among health-care workers in Kampala and Amosun *et al*. among Nurses in Nigeria.[11,13]

There are a few limitations of this study: We concentrated our study on medical radiation workers at tertiary health care institutions and so generalizing our results toward radiation workers in primary and secondary health-care institutions would not be advisable, especially regarding occupational hazard control measures employed by employers. Second, the results could have been affected by recall bias as respondents were required to recall past experience. Third, majority of the respondents had worked for <10 years and so results here may not be applicable to long-serving radiation workers. Nevertheless, this study provides vital information on occupational hazards among medical radiation workers in Northern Nigeria.

In the future, we shall be considering more experimental alternatives to determine radiation hazards among medical radiation workers.

CONCLUSION

The WHO calls on member states to develop national programs for health workers' occupational health and develop national campaigns for immunizing health-care workers against preventable infectious diseases. We, therefore, conclude that the prevalence of occupational hazards among medical radiation workers is perceptibly high and therefore special welfare packages and health plans must be adopted to ensure that medical radiation workers are adequately protected.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest

REFERENCES

1. Canadian Centre for Occupational Health and Safety. Hazard and Risk. Canadian Centre for Occupational Health and Safety Publication; 2016.
2. International Labour Organization. International Labour Standards on Occupational Safety and Health. International Labour Organisation Publication; 2016.
3. Shah SM, Bonauto D, Silverstein B, Foley M. Workers' compensation claims for needlestick injuries among healthcare workers in Washington State, 1996-2000. Infect Control Hosp Epidemiol 2005;26:775-81.
4. National Academies of Engineering and Sciences. Health Risks from Exposures to low levels of Ionising Radiation. Ch. 10. Northwest, Washington: National Academies Press; 2006. p. 189-206.
5. Nsubuga FM, Jaakkola MS. Needle stick injuries among nurses in sub-saharan Africa. Trop Med Int Health 2005;10:773-81.
6. Tinubu BM, Mbada CE, Oyeyemi AL, Fabunmi AA. Work-related musculoskeletal disorders among nurses in Ibadan, South-West Nigeria: A cross-sectional survey. BMC Musculoskelet Disord 2010;11:12.
7. Ajayi AD, Garba SN, Abdul AJ, Mfuh A. Use of protective devices and occupational hazards among nurses in ABUTH, Zaria. West Afr J Nurs 2006;17:14.
8. Bell JL, Collins JW, Tiesman HM, Ridenour M, Konda S, Wolf L, *et al*. Slip, trip, and fall injuries among nursing care facility workers. Workplace Health Saf 2013;61:147-52.
9. Amira CO, Awobusuyi JO. Needle-stick injury among health care workers in hemodialysis units in Nigeria: A multi-center study. Int J Occup Environ Med 2014;5:1-8.
10. Fernandes MA, Helena M, Marziale P. Occupational risks and illness among mental health workers. Acta Paul Enferm 2014;27:539-47.
11. Ndejjo R, Musinguzi G, Yu X, Buregyeya E, Musoke D, Wang JS, *et al*. Occupational health hazards among healthcare workers in Kampala, Uganda. J Environ Public Health 2015;2015:913741.
12. Masoudi Alavi N. Occupational hazards in nursing. Nurs Midwifery Stud 2014;3:e22357.
13. Amosun AM, Degun AM, Atulomah NO, Olanrewju MF, Aderibigbe KA. The level of knowledge regarding occupational hazards among nurses in Abeokuta, Ogun state, Nigeria. Curr Res J Biol Sci 2011;3:586-90.
14. Eljedi A. Prevalence and response to occupational hazards among nursing students in Gaza strip, Palestine: The role of personal protective equipment and safety regulations, scientific and academic publishing. Public Health Res 2015;5:32-8.
15. Osungbemiro BW, Adejumo OA, Akinbodewa AA, Adelosoye AA. Assessment of occupational health safety and hazard among government health workers in on do city, Southwest Nigeria. Br J Med Med Res 2016;13:1-8.
16. Ghosh T. Occupational health and hazards among health care workers. Int J Occup Saf Health 2013;3:1-4.
17. Department of Health and Human Services, National Institute for Occupational Safety and Health. NIOSH Alert: Preventing Needle Stick Injuries in Healthcare Settings. Publication No 2000-108. DHHS (NIOSH); 1999.
18. Clarke SP, Rockett JL, Sloane DM, Aiken LH. Organizational climate, staffing, and safety equipment as predictors of needlestick injuries and near-misses in hospital nurses. Am J Infect Control 2002;30:207-16.
19. Andersen LL, Clausen T, Mortensen OS, Burr H, Holtermann A. A prospective cohort study on musculoskeletal risk factors for long-term sickness absence among healthcare workers in eldercare. Int Arch Occup Environ Health 2012;85:615-22.
20. Orji EO, Fasubaa OB, Onwudiegwu U, Dare FO, Ogunniyi SO. Occupational health hazards among health care workers in an obstetrics and gynaecology unit of a Nigerian teaching hospital. J Obstet Gynaecol 2002;22:75-8.
21. Anozie OB, Anozie UJ, Lawani OL, Mamah E, Ajah LO, Nwali MI. Knowledge of occupational hazards and post exposure prohylaxis by hospital cleaners to HIV and other blood borne pathogens: Findings from ten hospitals in Abakaliki, Nigeria. American Journal of Clinical Medicine Research 2016;4:29-33.
22. Finnish Institute of Occupational Health. Occupational health of healthcare workers. Newsl Occup Health Saf 2009;12:79-81.
23. de Castro AB, Cabrera SL, Gee GC, Fujishiro K, Tagalog EA. Occupational health and safety issues among nurses in the Philippines. AAOHN J 2009;57:149-57.
24. Adib-Hajbaghery M, Khamechian M, Alavi NM. Nurses' perception of occupational stress and its influencing factors: A qualitative study. Iran J Nurs Midwifery Res 2012;17:352-9.
25. Ziraba AK, Bwogi J, Namale A, Wainaina CW, Mayanja-Kizza H. Sero-prevalence and risk factors for hepatitis B virus infection among health care workers in a tertiary hospital in Uganda. BMC Infect Dis 2010;10:191.