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**Research Article**

# Assessment of Radiation Safety Measures in Some Selected Radio-Diagnostic Centers in Gombe State, North Eastern Nigeria

Mohammed Anas[1], Robinson Ebbi Donald[2], Agboje Azuka Anthonio[3], Nzotta Christian C[4]

[1]Radiology Department, State Specialist Hospital Gombe, Gombe State
[2]Department of Radiology, Rivers State University Teaching Hospital, Port Harcourt Rivers State
[3]Radiology Department, Living Word Mission Hospital Aba, Abia State
[4]Department of Radiography and Radiological sciences, College of Health Science and Technology, Nnamdi Azikiwe University, Nnewi Campus, Anambara State

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**Abstract:** Background: The radiation risks to workers, public and to the environment that may arise from unsafe practices have to be assessed and, if necessary, controlled. Objective: The study is aimed to assess procedural radiation protection measures and to explore challenges faced by radio-diagnostic centres on safety operations of radiation protection practices. Method: A prospective cross-sectional survey was conducted among 26 radio-diagnostic workers in some centres in Gombe State, Nigeria. The questionnaire consists of three sections which include socio-demographic and work related information, procedural safety and safety operations. The data were analyzed using SPSS version 20.0 and descriptive statistics such as frequency and percentage were obtained. Results: More than two-third of the respondents, 61.5% (n=16) closed their x-ray room door during exposure and majority of the respondents, 92.3% (n=24) always move the patient's feet away from the couch or table during positioning of the ambulant patient for upper extremity. Those respondents that use gonadal shield on patient's were 26.9% (n=7). Majority of the respondents 76.9% (n=20) don't have a radiation safety officer/radiation safety adviser (RSO/RSA) at their facility. More than two-third of the respondents, 80.8% (n=21) have never attended any training. All the participants 100% (n=26) have no radiation exposure monitoring device at their facility. Conclusion: Procedural safety was adequate in all the facilities, except for the non-usage of the gonad shied by almost all of the respondents, while safety operations are poor in most of the radio-diagnostic centres.

**Keywords:** Radiation safety measures, Radio-diagnostic, Radiation monitoring device



## INTRODUCTION

Ionizing radiation can induce detrimental biological effects in humans especially the highly radiosensitive organs and exposure to radiation due to radiologic investigation is the major source of man-made radiation exposure (Robinson, E. D., & Nzotta, C. C. 2019). Although there are many beneficial applications of ionizing radiation in medicine and research, as it's use increases so does its potential health hazards to both the patients and the staffers. Therefore, occupational radiation protection measures against deterministic and stochastic effects are necessary for all individuals who work in the diagnostic imaging departments.

The fundamental protocol of radiation protection is the avoidance of the radiation, however where the use outweighs the potential harm, the dose must be reduced using the fundament radiation protective measures of time, distance and the use of protective shields (https://en.wikipedia.org Radiation protection). Employing the ALARA principle which is an acronym for "As Low as reasonably achievable" has become imperative in radiation protection (https://en.wikipedia.org Radiation protection). Radiation protection is the science and practice of reducing harm to human beings from exposure to radiation. In all radiological investigations it is important to have some idea of the risk associated with the use of ionizing radiation (IAEA. 2007), this will enable management provide required protective devices to mitigate this risk.

Radiology staffers require appropriate and continuous radiation monitoring with the use of personal radiation dosimeters like film badge and or thermoluminescence dosimeter (Rahman, N. *et al.*, 2008). There is the need for appropriate education and training of personnel on the use of these protective devices against ionizing radiation (Rahman, N. *et al.*,

***Corresponding Author:** Mohammed A

2008; & European Commission. 2000). Education and training are required for radiation protection during practice, with appropriate regulation as implemented in most countries. With a view to ensuring the protection of people and the environment from harmful effects of ionizing radiation, the International Atomic Energy Agency (IAEA. 2007) safety standards establish fundamental safety principles, requirements and measures to control the radiation exposure to people (IAEA. 2007).

In recent studies conducted by Eze *et al.,* (2013) and Nkubli *et al.,* (2013), identified poor radiation protection mechanisms in terms of safety practices and procedural controls in Nigeria population, hence the need for this study to ascertain the status of practice of radiation protection in some of the radio-diagnostic centres in Gombe state, North eastern Nigeria.

## MATERIALS AND METHODS

This study was a prospective cross-sectional survey of procedural radiation protection measures and safety operations of radiation protection practices of some selected radio-diagnostic centres in Gombe State, North Eastern Nigerian from July to September 2019. Ethical clearance was obtained from research and ethical committee of Federal Teaching hospital Gombe. A total of 30 questionnaires was distributed of which 26 were returned completed. A 13 numbered close-ended well-structured questionnaire was distributed in all the centres, and the validity of the questionnaire was tested by three senior radiographers. The data collected were analyzed using the Statistical Package for the Social Sciences (SPSS) version 20.0 and presented in tables and charts.

## RESULTS

The age distribution of the participants shows that 34.6% (n=9) of participants are between the ages of 20–30years, 53.8% (n=14) are between the ages of 31-41years and 11.5% (n=3) are between the age of 42-52years (table 1). Most of the participants were males accounting for 84.6% (n=22) while females were 15.4% (n=4) as illustrated also in table 1. Concerning the academic qualifications of the participants, 23.1% are X-ray technicians; 3.8% has diplomas in radiography and Master degree while 69.2% of the respondents holds a Bachelor of science degree in radiography (figure 1). According to figure 2, the respondents with work experience of 1-3 years have the highest frequency in occurrence, 53.8% (n=14), while those with work experience of 10 years and above appeared to be the least, 11.5% (n=3). Those respondents with work experience of 4-6 years and 7-9 years are 19.2% (n=5) and 15.4 (n=4) respectively, as shown in figure 2.

Concerning the procedural safety in the radio-diagnostic centres, participants response on closing of x-ray room door during exposure revealed that more than two-third of the respondents, 61.5% (n=16) closed their x-ray room door during exposure, 7.7% (n=2) do not closed their x-ray room door during exposure while 30.8% (n=8) of the respondents does but not always (figure 3).

Majority of the respondents, 92.3% (n=24) always move the patient's feet away from the couch or table during positioning of ambulant patients for upper extremity, while only 7.7% (n=2) of the respondents move the patient's feet under the X-ray couch or table to ease positioning as illustrated in figure 4. Figure 5 illustrates the use gonadal shield on patient's during procedures were the gonad are within 5cm of the primary beam. About 26.9% (n=7) use gonad shield during the procedure while 73.1 (n=19) don't use (figure 5).

More than two-third of the respondents, 80.8% (n=21) have never attended any training, whilst 19.2% (n=5) attended training (figure 6). The results in figure 6 illustrate that, majority of the respondents 76.9% (n=20) revealed that they don't have a radiation safety officer/radiation safety adviser (RSO/RSA) at their facility, while only about 23.1% (n=6) of participants have radiation protection officer. Also concerning RSO/RSA, 19.2% (n=5) revealed that the RSO/RSA have adequate knowledge and expertise to carry out their duty, and none of the respondents received initial and continuity training by the RSO/RSA as illustrated in figures 7. Regarding the number of radiation workers, almost all the respondents, 76.9.1% (n=20) revealed that they have adequate number of staff, whilst only 23.1% (n=6) of the respondents revealed that they don't have adequate number of staff as shown in figure 8.

**Table 1:** Age and Sex distribution of Participants

| VARIABLE | Frequency (N) | Percentage (%) |
|---|---|---|
| AGE GROUP (YEARS) | | |
| 20-30 | 9 | 34.6% |
| 31- 40 | 14 | 53.8% |
| 41-30 | 3 | 11.5% |
| SEX | | |
| MALE | 22 | 84.6 |
| FEMALE | 4 | 15.4 |

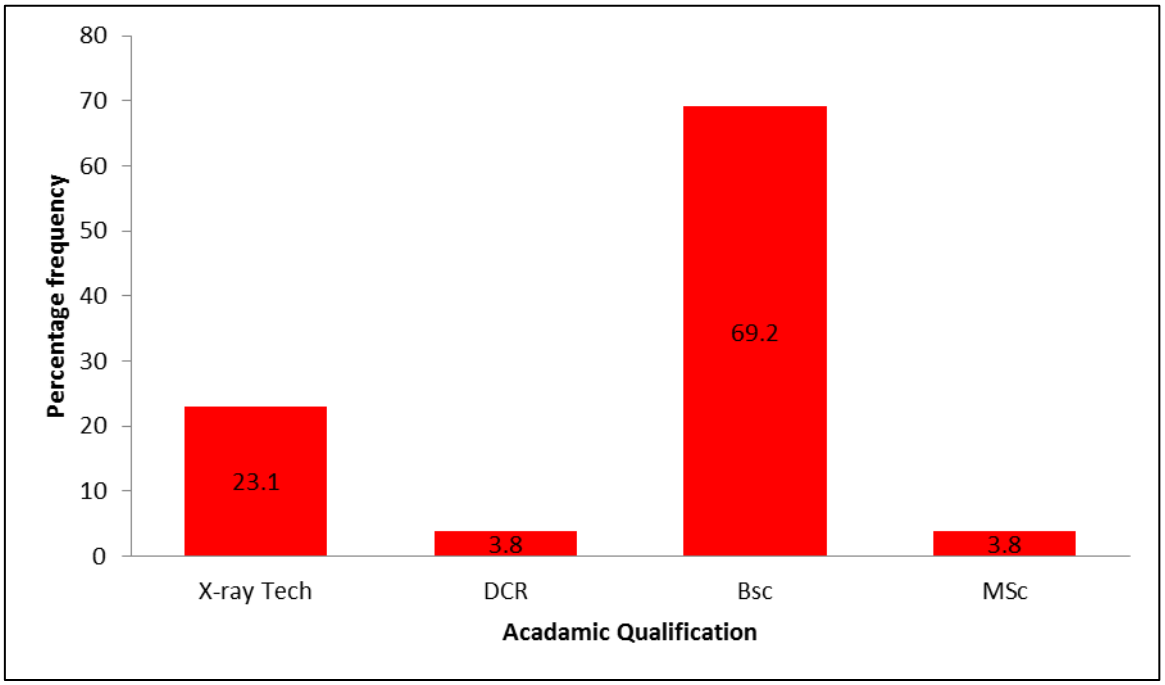


**Figure 1:** Participants academic qualifications

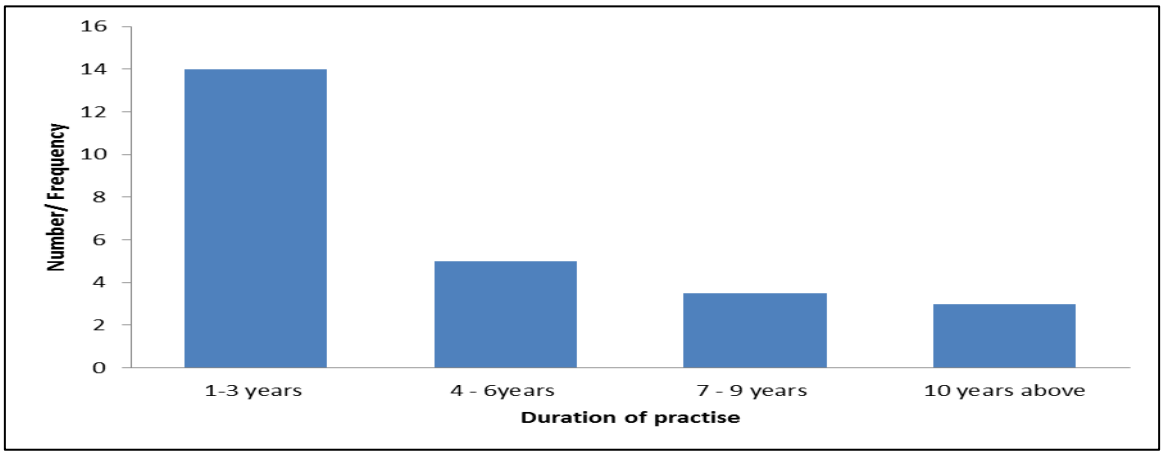


**Figure 2:** Participants duration of radiography practice

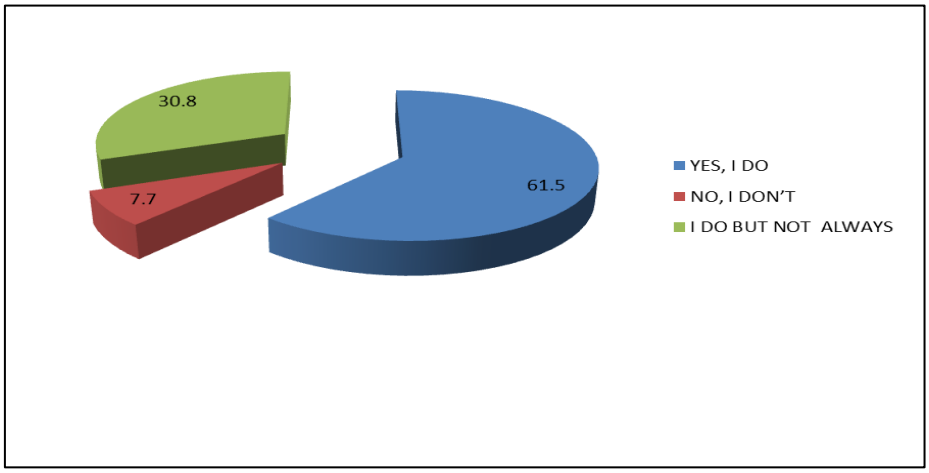


**Figure 3.** Participants response about the closing of x-ray room door during exposure

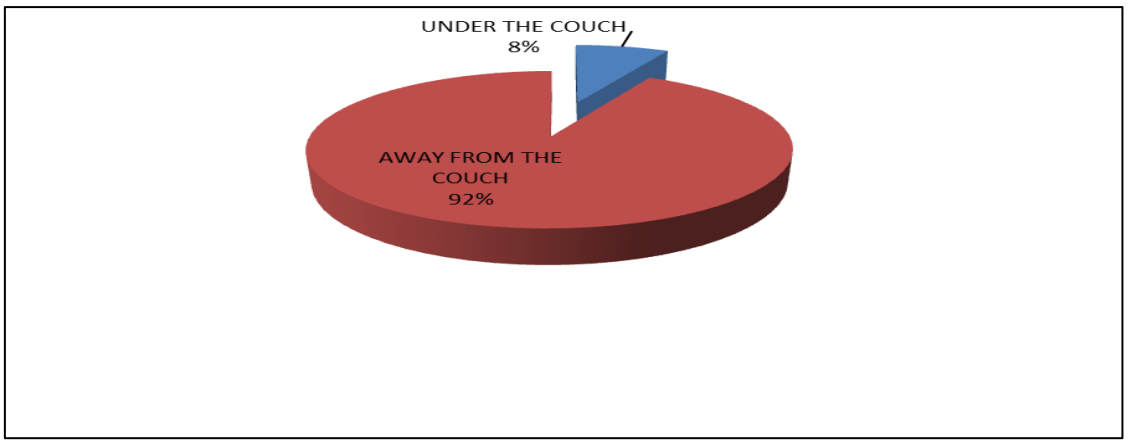


**Figure 4:** Positioning of ambulant patients for upper extrimity investigation

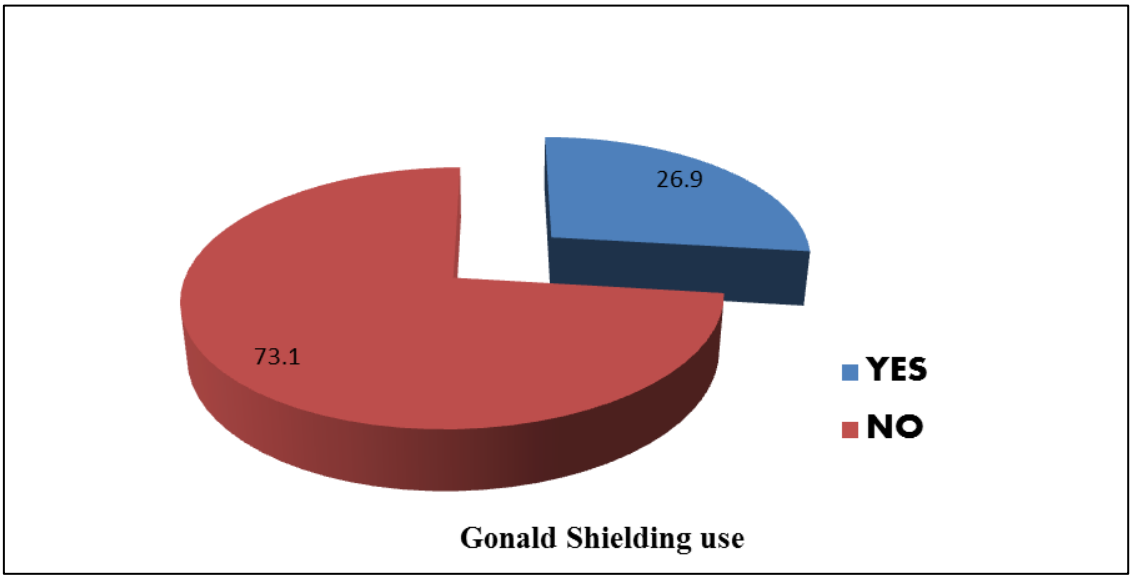


**Figure 5:** Participants response on the use of gonad shield.


**Figure 6:** Response concerning availability and training of Radiation safety officer/adviser and other staffer

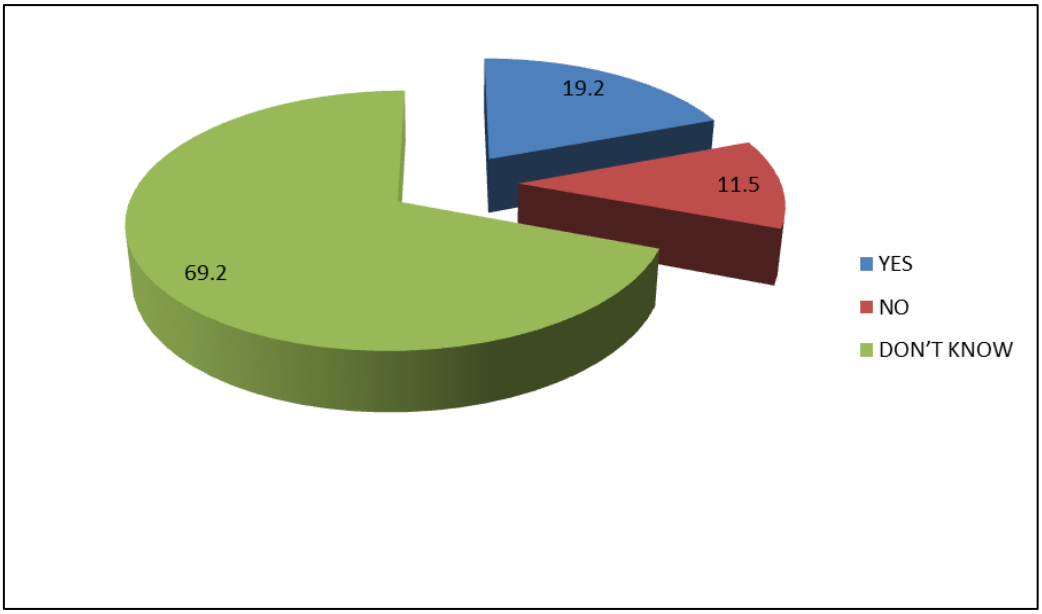


**Figure 7:** Participants response about the knowledge and expertise of RSO/RSA

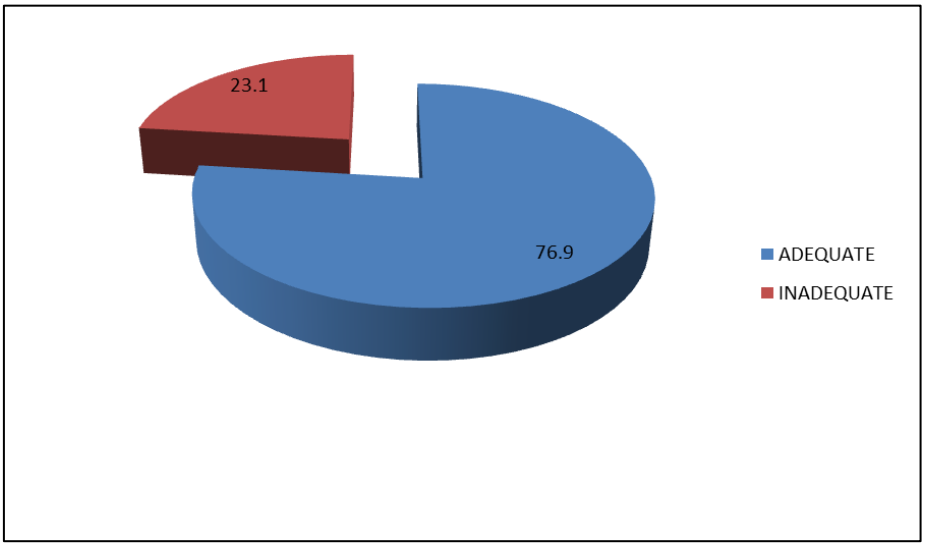


**Figure 8.** Participants response about availability of staff

## DISCUSSION

The result of this revealed that more than two-third of the respondents, 61.5% (n=16) closed their x-ray room door during exposure, 7.7% (n=2) do not closed their x-ray room door during exposure while 30.8% (n=8) of the respondents does but not always. Furthermore, the findings of this study showed that majority of the respondents, 92.3% (n=24) always move the patient's feet away from the couch or table during positioning of ambulant patients for upper extremity. This is a good radiation protection practice, in which the gonads are moved away from direct exposure to radiation. These results are similar with the study conducted by Samer *et al.*, (2016). The study revealed that 74.8% of participants have awareness about radiation protection issues, but it is only about 53.4% of participants follows the radiation protection practices. Also, 74.7% (n=136) of participants make sure that the x-ray door is closed during the examination (Khadoura, K. J. *et al.*, 2016).

Gonad shield is recommended for use on patients during medical diagnostic x-ray procedures when the gonads lie within or close to (about 5 cm from) the primary x-ray field, despite proper beam limitation. It is also recommended when the clinical objective of the examination is not compromised and when the patient has a reasonable reproductive potential (McKenney, S. *et al.*, 2019). This present study revealed that, those that use gonadal shield on patient's if they are carrying a procedure were 26.9% (n=7) and those that don't use it are 73.1 (n=19). The results are similar with the study conducted by Samer *et al.*, in 2016. Their study revealed that only about 16.5% (n=30) of participants use the gonadal shield to protect the patients gonads even if the doctor did not ask to protect these organs. This observation may be attributed

to the unavailability of gonad shield in only 15.9% of radio-diagnostic centres (Khadoura, K. J. *et al.,* 2016).

The result in figure 8 shows that the radiation protection advisers or officers are not available in the radio-diagnostic centres surveyed. About 76.9% (n=20) of study participants don't have radiation protection adviser in radio-diagnostic centres. This result is unsatisfactory and indicates that the approximately more than half of participants have negative practices towards radiation protection issues. This result is in consonance with the report of Okaro *et al.,* (2010). In their study to evaluation of personal radiation monitoring in radio-diagnostic centres in south-Eastern Nigeria, they found that radiation protection advisers are hardly available in the centres surveyed (Okaro, O. *et al.,* 2010). In that survey, radiation protection advisers were found in only four centres when ideally they should be seen in every radiology Centre (Okaro, O. *et al.,* 2010). Furthermore in this study, among the 23.1% (n=6) of the participant that has RSO/RSA at their facility, only 19.2 % (n=5) testify that the RSO/RSA have adequate knowledge and expertise to carry out his/her duty, and none of the respondents received initial and continuity training by the RSO/RSA.

The index study revealed that almost all the facilities have adequate number of staffers but more than two-third of the respondents, 80.8% (n=21) have never attended any training, whilst 19.2% (n=5) have has some training. However, the present study is at variance with the results of Samer *et al.,* (2016), in which the responses related to item about radiation protection course; show less than half of radio-diagnostic workers have participated in a radiation protection course (34.6%) (Eze, C. U. *et al.,* 2013).

In this study all the participants have no radiation exposure monitoring device at their facility. The result of this study is similar to a study conducted by Okaro *et al.,*. in 2010. The study revealed that personal radiation monitoring is available only in a few hospitals and in most cases does not cover all the radiographers on employment (Okaro, O. *et al.,* 2010). This finding agrees with the result of a previous survey carried out by Okpala (2004) which covered 28 x-ray centres in two states of south eastern Nigeria. The survey result showed that radiation monitoring was almost non-existent in the centres (Okpala, C. 2004). The result obtained was also in consonance with the study in radio-diagnostic departments in Erbil hospitals by Younis *et al.,*. (2014). Their result revealed that the personal monitoring (TLD badges) was not provided in the majority of departments (Younis, S. N. *et al.,* 2014). The result also agrees with the study by Adhikari *et al.,*. (2012) which conducted a study to evaluate the status of radiation protection at different hospitals in Nepal (Adhikari, K. P. *et al.,* 2012). They observed that personal monitoring for radiation workers cannot be easily determined (Adhikari, K. P. *et al.,* 2012), and 65% of radiation workers not monitored for radiation exposure due to insufficiently of monitoring devices (Adhikari, K. P. *et al.,* 2012).

## CONCLUSION

Ionizing radiation can induce detrimental biological effects in humans thus there is a need radiation safety measures in radio-diagnostic centres. Radiation monitoring devices and radiation safety officer/adviser were not available in most of the radio-diagnostic centres. Almost all the staff in the facilities had never attended any further training on radiation protection although procedural safety was adequate; there was non-usage of gonads shied by almost all of the respondents. Therefore, there is a need for corrective measures on safety operations such as rules, regulations and radiation protection act, to correct the compromises.

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