IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 17, Issue 3 Ver.5 March. (2018), PP 71-77
www.iosrjournals.org

Assessment of Radiation Protection practices among University Students, Buraydah, Saudi Arabia.

Abdulrahman A. Al-Sayyari[1] , Sunil Kalagi[2],
[1]Assistant Professor, Radiologic Technology Department, Qassim University, Saudi Arabia
[2]Lecturer,Radiologic Technology Department, Qassim University, Saudi Arabia,
Corresponding Author: Abdulrahman Al-Sayyari

Abstract:*Radiation protection in medicine has unique aspects and is an essential element of medical practice.It is the science and art of protecting people and the environment from the harmful effects of ionizing radiation. Use of Ionizing radiation in medical imaging is one of the powerful diagnostic tools, and accurate knowledge of radiation protection will affect the radiographers safety behaviors during practice.The aim of the study is to assess Radiologic Technologist workers radiation exposure in routine radiology workflow and the extent of following the Radiation Protection principles in Buraydah city, Al-Qassim State, Kingdom of Saudi Arabia.Total of 110 radiologic technologist students who were posted in various hospitals were included in this study and datawas collected through well-structured pretested self-administered questionnaire and Thermo-luminescence Dosimetry (TLD) measurements were done at the end using TLD 4500 reader at Medical Physics Lab of Qassim University. The study was conducted during the period from Sep 2015to May 2016. In this study all participants were University undergraduate internship students from Radiologic Technology department. All the participants (100%)had used TLD cards as personal dosimeter.Majority of the participants(92%) were aware that lead apron should be used while taking radiographs and86% of the participants had the knowledge that doors and walls consists of lead.In this study, the TLD cards havingtwo chips of Lithium-Fluoride(Li-F) crystals were used to assess the Deep dose and Shallow dose exposures of radiologic technologists during routine work in Radiology department in Hospitals. All the radiation exposure measurements were found to be under the limits of Annual maximum permissible dose designated by International Commission on radiation Protection (ICRP) and King Abdulaziz City for Science and Technology (KACST) Riyadh, Saudi Arabia .Our study found that all the technologists followed the ALARA(As low as reasonably achievable) radiation safety principle successfully.*

Date of Submission: 26-02-2018 Date of acceptance: 15-03-2018

I. Introduction

The use of non-ionizing radiation has become very common in medicine since its discovery in 1895 by Wilhelm Conrad Rontgen[1].The use of medical imaging is rising, and approximately 3.3 billion of the 5 billion imaging examinations performed worldwide use ionizing radiation[2,3].Several medical imaging disciplines and specialties use ionizing radiation, including general diagnostic radiology, nuclear medicine, computed tomography (CT), fluoroscopy, and interventional radiology. In addition, specialties outside radiology such as urology, orthopedic surgery, gastroenterology, vascular surgery, and anesthesiology often use imaging examinations involving ionizing radiation.In USA the average annual radiation exposure is approximately 6.2mSv in which 3.1 mSv is coming from medical procedures[5,6]. Thus, diagnostic imaging contributes to the majority of artificial radiation exposure to humans. Exposure to ionizing radiation in diagnostic radiography could lead to hazards such as somatic and genetic damages[4,5,6,7].Radiologic technologists use radiation to provide quality medical imaging, but they must be aware of potential exposure to radiation's detrimental effects and Radiation safety principle ALARA(As Low As Reasonably Achievable)[8,9,10]. This can be achieved by maintaining three parameters i.e.Time, Distance, and Shielding[10,11]. By spending less time, keeping more distance and using appropriate shielding equipments, dangerous exposure levels can be avoided.The annual maximum permissible dose (MPD) recommended for designated radiation workers by International Commission on Radiological Protection (ICRP) is 20 mSv per year while that of the public is 1 mSv[11,12,13,14]. Along with ICRP, The International commission on Radiation Units and measurements (ICRU) in conjunction with International Atomic Energy Agency (IAEA) had provided series of documents on radiation safety standards. In Saudi Arabia, King Abdulaziz City for Science and Technology (KACST) is the authority to regulate and monitor the use of ionizing radiation for the national[15,16,17,18,19] .

The whole body dose takes into the Consideration of both Deep dose and Shallow dose[19,20,21,22].Shallow dose is the dose equivalent at a tissue depth of .007 cm; applies to external whole body surface or skin exposure. Deep dose is the dose equivalent at a tissue depth of 1 cm; applies to external exposure[20,21,22,23,24].Deep dose is greater than the skin dose at x-ray photon energy increases greater than 35kev. The shallow dose also known as skin dose will be more than the deep dose at the x-ray photon energies less than 35kev. As the energy increases, the penetration increases and much more dose is deposited beyond .007cm thickness of skin[25,26,27,28]. After 35keV photon energy, deep dose is higher (significantly around 60-100 keV) than the skin dose[28,29,30].

II. Material And Methods

This prospective comparative study was carried out among 110 radiographers who worked in various hospitals (King Fahad Specialist Hospital (KFSH) , Buraydah Central Hospital& Other Private Hospitals) in Buraydah city and some other hospitals in AL-Qassim Region , during the period from September 2015to May 2016.In this work, the

Tool of data collection: The study was conducted through a well-structured self-administered questionnaire consists from two parts:

The FirstPart: Knowledge regard protection (4 question).

The Second Part: Performance towards radiation safety (7question).

TLD: Thermo-luminescence Dosimetry (TLD) technique was used to measure the amount of radiation received by clinical technologists assigned respective TLD cards during routine work in Radiology department in Hospitals. All the TLD cards were read using Thermo-scientific Harshaw TLD 4500 reader available at Medical Physics Lab in Qassim University.

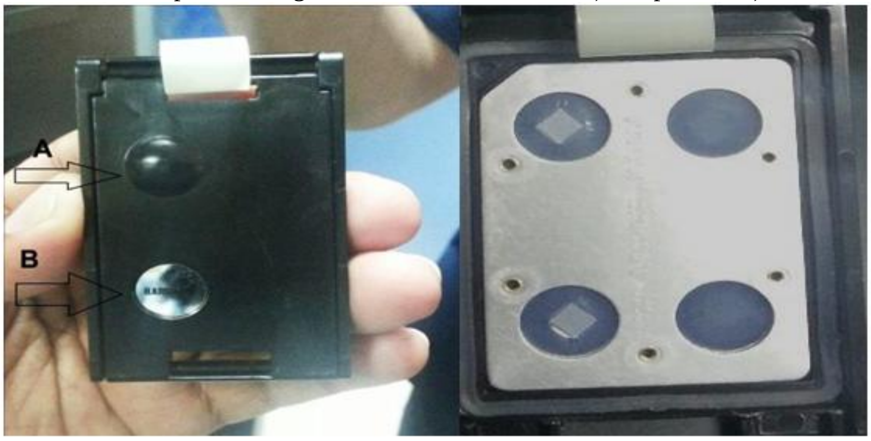
Method of the study: The objectives of the study and the benefit of its findings to radiographic technologists was explained to the participants before submitting the questionnaire. Their responses was only base on their subjective data and recent attitudes without referring to any books. Knowledge was assessed based on study participants understanding of radiation risks associated with diagnostic use of ionizing radiation to protect themselves from risks. Radiation protection performance was assessed by use of radiation signs during exposures times , using of protective equipments during work such as lead shield, gonad shields, thyroid cola , lead gloves and light beam diaphragm (LBD). The following table is used as guideline for Dose Limitation across Kingdom of Saudi Arabia[5,6,8,9,18] .

Table 1: Dose Limitation for workers and the public (excluding the patients)

Class of Person	Annual Limit of Effective dose in milli-sieverts (mSv)
Any employee aged 18 years or above	20
Trainee aged under 18 years	6
Other persons (including any person below the age of 16 years and all members of the public)	1
Employees directly involved with the Dental radiography (operators)	1
Employees not directly involved with the Dental radiography and for the member of the public	<1

TLD cards with Li-F crystals were used as Personal dosimeters for routine clinical work in Radiology department. All TLD's were measured by TLD 4500 reader at Medical Physics Lab in Qassim University, Buraydah, KSA. As the TLD is two element chip, we were able to measure Deep dose and Shallow dose using TLD 4500 reader.

Figure 1 : TLD Chipsconsisting Li-F formeasurement of A) Deep dose B) Shallow dose



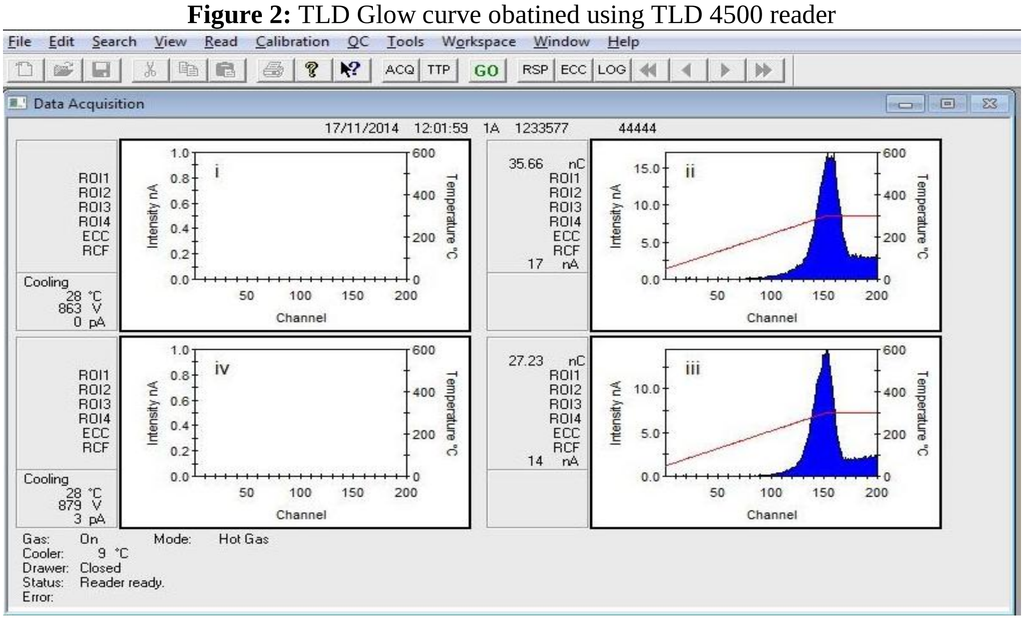
The 'Annealing' (heating) of the TLD chips were done using Nitrogen gas supply in the temperature range of 0-300 degree Celsius. As we heat the TLD chips, the chip releases the stored radiation energy in the form of light. The intensity of light released is measured in terms of 'Charge'. Using The TLD 'Glow Curve' we did the deep and shallow dose measurements. Glow curves indicate the amount of radiation exposure. It is measured in the units of 'Charge'.

The appropriate measured Charge is converted to equivalent dose. The following mathematical equation gives the approximate dose measurements.

Calculation of Dose: Measured Charge(Light released by TLD chip) = Dose x RCF;

∴Dose(microSv) = Charge (nC) / RCF (nC/microSv).

Figure 2: TLD Glow curve obatined using TLD 4500 reader



All the measurements and calculations used appropriate TLD 4500 device Reader calibration factor (RCF). In our study RCF for deep dose used was 0.0228192nC and for shallow dose was 0.019479nC.

III. Result

Table 2 : Knowledge of participants who had YES opinion regard protection during practice N=110

Variable	YES (Number & Percentage)
Knowing annual limitation dose for individuals.	100(91%)
Doors and walls consist of isolated materials such as lead for more protection.	95 (86%)
You know Dosimeter.	85 (77%)
Knowing radiation doses associated with commonly requested investigations.	105 (95%)

Table 3 : Performance of participants toward protection during practices **N=110**

Variable	YES (Number & percentage)
Wearing TLD during work	110 (100%)
Wearing lead apron during working hours	100 (92%)
Using light beam diaphragm ,cone and grid	80 (72%)
Using lead gloves during work	85 (76%)
Using Radiation signs during working hours	95(86%)
Wearing thyroid cola during work	70(63%)
Wearing Gonad Shield during work	90(81%)

Table 4: Measurement of Shallow dose across population N=110

Dose(mSv)	No.of People
0.2	7
0.4	45
0.6	25
0.8	15
1	7
1.2	7
1.4	4

Figure (3) Shallow dose/Skin Dose measurements across N=110.

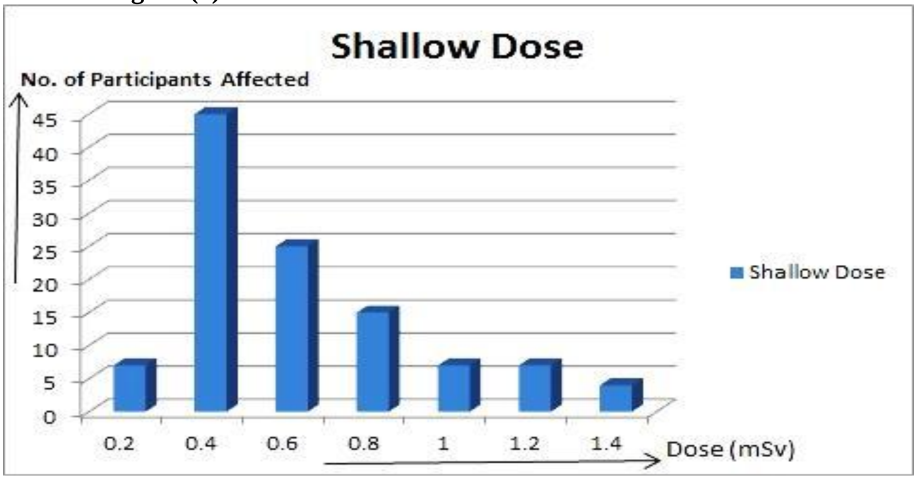
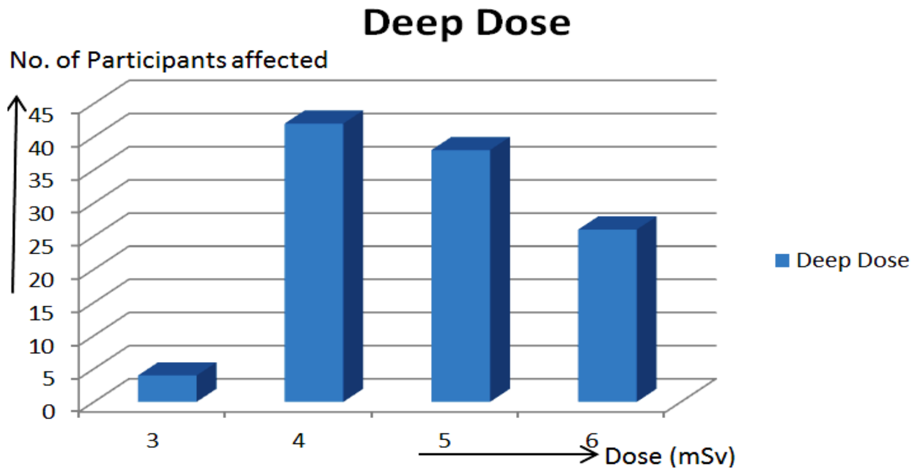


Table 5: Measurement of Deep dose across population N=110

No.of People	Dose(mSV)
4	3
42	4
38	5
26	6

Figure (4) Deep dose measurements across N=110.



Depending on the Medical Imaging device, amount of time spent, distance maintained and usage of appropriate shielding by the individual technologists in clinical radiology the deep dose and shallow dose varied slightly for all individuals.

IV. Discussion

In this preliminary descriptive study awareness was assessed by measures knowledge of radiographers towards radiation safety during practice in Buraydah City, Al-Qassim Region, Saudi Arabia. This study is first of its kind in Buraydah city to the best of our knowledge and very few similar studies were available for comparison worldwide. A total of 110 radiologic technology students responded to this study

Regarding usage of the TLD chips with card and measurement , all the participants (100%) in our study used successfully and this is much better that what was reported by Rania Muhammed etl.. and Mutyabule T Ketl.[3,24].Results from study by JafarFatahi et al.,[26]indicated that only (74.3%) of personnel were using these badges, highlighting the need for further supervision and emphasis. Regarding knowledge in this study (86%) of the respondents knew that doors and walls consist of isolated materials such as lead. Eze et al.,[25] reported a better attitude to wearing radiation dosimeters among a sample of industrial radiographers in Port-Harcourt, Nigeria. In this study and responded to the question about amount of annual dose limit for individuals and data analysis show that the majority of workers had correct answer (more than 90%). compared to the study done in Rania Muhammed [3] ,where only 75% had knew this knowledge. Knew radiation doses associated with commonly requested investigations (95%) answered with 'YES' table(2) , and this can be justified by presence of exposures charts in the radiology departments of the participants. Knowledge shall be assumed to be poor in this study if respondents' average score on five questions used to assess knowledge is less than three true questions, and according to the result (41.3%) had good knowledge regarding protection, fig (1). (92%) of the participants in this study wearing lead apron during work, while (8%) were not, table (3) , and they justified their performance by good reasons such as availability of enough numbers of lead apron in their departments compared to other study done byFatahi J et al., [26] where theirstudy revealed that there exist a shortage of lead apron (29%) and a low level of its use even when available; the gonad and thyroid shield and lead partition for mobile radiology were not used at all. Using of light beam diaphragm and other protective devices (cone & grid) have percentage of (72%) , table (2).Further, (76%) used lead gloves and this behavior will protect the radiographers themselves, table (3).Study by Margaret A et al[27]. reported that the size of the radiation field must be selected no larger than the size of the organ being photographed.[28] Limiting the size of the radiation field to the area of the organ being radiographed minimizes the patient's absorbed dose[29]. The results study by Fatahi-Asl J.et al , revealed that using of radiation field limitation was observed in only 43.7% of the cases[26].Thyroid protective shield used by (63%) in this study, table (2) ,while multiple authorities have investigated and clearly demonstrated the efficacy of protection equipment and the importance of shielding radiation-sensitive organs in reducing the absorbed dose[30,31].It is mandatory, according to International Commission on Radiation Protection (ICRP) radiation safety standards,[32] for gonads shields to be used for the protection of the gonads when the pelvis is not part of the anatomical area being examined. Excellent knowledge found among radiographers in this study,(81%) used gonad shields during work. In comparison with the other study performed in Rania Muhammed etl[3] where only 25.3% participants used gonald shields during work our study revealed that the radiographers had good discipline. Atomic Energy Organization of Iran, the gonad area must be shielded whenever in a primary radiation field or very close to a primary radiation field[34].Shielding the gonad can significantly reduce the radiation dose, and, as absorption by the gonad typically constitutes (20%) of the overall absorption dose of the body, these organs appear to be extremely sensitive to radiation, and prevention of the hereditary effects of ionizing radiation is not possible without protecting them. Therefore, gonad shielding must be routinely used in radiology labs[35] .Fatahi study revealed that gonad and thyroid shielding was never used for patients[26].

LiF-TLD measurements resulted in average deep doses of 4-6 mSv and Shallow doses of 0.5 - 2msV for the age group of adult in 20-24 years range. The technologists were successful in maintaining the exposure less than 30% of the dose limitsis 20 mSv per year while that of the public is 1 mSv table(1). As the technologists mostly worked with high energy x-ray devices they were exposed to high energy radiations and hence the measurement of deep dose is higher compared to the skin dose. The unwanted low-energy x-rays are usually found with high energy x-ray producing devices which does not contribute to the radio-diagnosis. Hence we see minimal shallow dose measurements.

V. Conclusion

The results obtained were compared with the diagnostic reference level set by International Atomic Energy Agency (IAEA) and International Commission for Radiological Protection (ICRP). Based on the measurements it's apparent that all the exposures are under the limits set by the KACST. All the technologists followed the radiation safety principle 'As Low As Reasonably Achievable' (ALARA) successfully. The quality of training program delivered by the staff at Qassim University has enabled the technologists to develop a passion for radiation protection. Frequent workshops and safety training programs at hospitals and educational institutes will further enhance the radiation protection skills of technologists.

Similar studies at regular intervals should be carried out in Buraydah city, AL-Qassim Region among hospital staff for strict adherence of standard radiation protection regulation protocol.

References

[1] S.B.Adejumo, N.K.Irurhe, O.A.Olowoyeye, A.Z.Ibitoye, C.U.Eze and O.D.Omiyi, 2012. Evaluation of Compliance to Radiation Safety Standard Amongst Radiographers in RadiodiagnosticCentres in South West, Nigeria. World journal of Medical Sciences 7(3): 194-196.

[2] Cletus ucheEze, LivinusChibuzoAbonyi, Jerome njoku, Nicholas kayoed Irurhe and OluwabolaOlowu. Nov-Dec 2013. Assesment of radiation protection practices among radiographers in Lagos, Nigeria. Nigerian Medical journal, 54(6): 386-391.

[3] Rania Mohammed Ahmed, Afaf Mohamed TahaElamin, Elsamani M, Wisal B Hassan, Mar-2015. Knowledge and Performance of Radiographers towards Radiation Protection, Taif, Saudi Arabia. IOSR Journal of Dental and Medical Sciences Volume 14, Issue 3 PP 63-68

[4] Ayşegül Yurt, BerrinÇavuşoğlu, TürkanGünay. 2014. Evaluation of Awareness on Radiation Protection and Knowledge About Radiological Examinations in Healthcare Professionals Who Use Ionized Radiation at Work. Molecular Imaging and Radionuclide Therapy 23(2): 48-53.

[5] Mohamed Anwar K. Abdelhalim Dec-2009. Patient dose levels for seven differentradiographic examination types. Saudi Journal of Biological Sciences 17, 115–118

[6] K. Al-Hadyan, S. Binjamaan, F. Mahyoub, G. Alsbeih& B. Moftah, 2013. Development of radiation monitoring services for radiation workers in Saudi Arabia. WIT Transactions on Biomedicine and Health, Vol 16: 95-103.

[7] F.O. Ujah, N.B Akaagerger E. H. Agba and T. J. Iortile. 2012. A comparative study of patients radiation levels with standard diagnostic reference levels in federal medical centre and bishop murray hospitals in Makurdi. Scholars Research Library, 4 (2):800-804.

[8] Rasheed Al-Owain, Yousef Aldorwish.Feb-Mar 2001. MEDICAL RADIOACTIVE WASTE MANAGEMENT IN SAUDI ARABIA. WM'01 Conference. Tucson, AZ.

[9] Abdulaziz S. Alaamer, 2012. Radiography Education and Training in Saudi Arabia. *Open Journal of Radiology* ,2, 134-140.

[10] Driscoll, C.M.H., Green, B.M.R., McKinlay, A.F. & Richards., D.J, 1983.Environmental Radiation Measurements Using Lithium Fluoride ThermoluminescenceDosemeters. Radiation Protection Dosimetry, 6(1-4), pp. 241–244.

[11] Nicholas Joseph Jr., 2006. Principles of Patient Radiation Protection & ALARA. CE essentials, Online Radiography Continuing Education for Radiologic X ray Technologist.

[12] Mohammad Sohelur Rahman, Aleya Begum, Md. Rezaul Karim Khan, Md. AshrafulHoque, M.M. Mahfuz Siraz.2015. Occupational Exposure to Ionizing Radiation in Interventional Cardiology Practices in Bangladesh during 2010-2014. Asian Business Consortium | MJMBR Volume 2: 127-131.

[13] Recommendations of the NATIONAL COUNCIL ON RADIATION PROTECTION AND MEASUREMENTS(NCRP) Report No.116.2009.Limitation of Exposure to ionizing radiation.

[14] G K Korir, J S Wambani, I K Korir. Dec-2011. Estimation of annual occupational effective doses from external ionising radiation at medical institutions in Kenya. SA JOURNAL OF RADIOLOGY . 116-119.

[15] ArkadiuszSzarmach, MaciejPiskunowicz, Dominik Świętoń, Adam Muc, Gabor Mockałło, JarosławDzierżanowski, Edyta Szurowska. Feb-2015. Radiation Safety Awareness Among Medical Staff. Pol J Radiol, ; 80: 57-61

[16] IK Indrajit.Jan-Mar 2010. Few useful websites safety. *Indian Journal of Radiology and Imaging, Vol. 20, No. 1, pp. 7577.*

[17] Z.Ibitoye, M.Aweda and N.Irurhe. 2011. Annual Effective Dose Status among the Radiation Staff of Lagos University Teaching Hospital, Lagos, Nigeria.

[18] Radiation Protection Center Database, Atomic Energy Research Institute, KACST, Riyadh , Saudi Arabia, 2008.

[19] Seeram, E., Fcamirt, R.T.R., Brennan, P.C., 2006. Diagnostic reference levels in radiology. Radiologic technology 77, 373–384.

[20] European Commission. Guidelines on education and training in radiation protection for medical exposures. Radiation Protection

[21] European Commission. Directorate General Environment, Nuclear Safety and Civil Protection. Luxembourg, 2000. URL: http://europa.eu.int/ com./environment/ rad prot.

[22] Noohi J.2009. Evaluation of personnel protection among radiographers in diagnostics radiology centers in Kerman(Iran). Environmental health conference,Iran. Available form : http:// www. cong. sbmu. ac.ir/ behdasht %20mohit%2012/521-B.pdf.

[23] Rehani, M., et al. "Radiation doses in cardiac angiographic procedures." Engineering in Medicine and Biology Society, 2000. Proceedings of the 22nd Annual International Conference of the IEEE. Vol. 4. IEEE, 2000.
[24] Health Physics Society Public Information Page (www.hps.org/publicinformation)
[25] Mutyabule TK, Whaites EJ. Survey of radiography and radiation protection in general dental practice in Uganda. Dento-maxilloRadiol. 2002;31:164–9. [PubMed]
[26] Eze CU, Okaro AO. Survey of personnel radiation protection, Rivers State, Nigeria. J Med Res Technol. 2004;1:8.
[27] Fatahi- Asl J, Tahmasebi M, Karami V. The Protection knowledge and performance of Radiographers in some hospitals of Ahvaz County. Jentashapir J Health Res 2013;4(5):405-412.
[28] Margaret A. Briggs-Kamara, Polycarp C. Okoye and Valentine B. Omubo-Pepple. Radiation Safety Awareness among patients and Radiographers in three Hospitals in Port Harcourt. Am. J. Sci. Ind. Res., 2013, 4(1): 83-88.
[29] Department of nuclear safety of Iran atomic energy organization. Special Recommendation for patient dose decrease 2009. Available at: URL: http:// www.aeoi.org.ir/inra. Accessed month day, year(Persian).
[30] Gorabi H .Christensen's physics of diagnostic radiology. 4th ed. Tehran: Jafari; 2010. P. 96. (Persian).
[31] Borhani P, Alizade M .[Evaluation of radiology personnel practice of Kerman university Med J HormozganUniv 2003; 6(4):51-8.
[32] Foley SJ, McEntee MF, Achenbach S, Brennan PC, Rainford LS, Dodd JD. Breast surface radiation dose during coronary CT angiography: reduction by breast displacement and lead shielding. AJR Am J Roentgenol 2011;197(2):367-73.
[33] Oxford, UK: ICRP Publication 93, Annals of the ICRP, Elsevier Publications; 2004. International Commission on Radiological Protection. Managing patient dose in digital radiology.
[34] Noohi J. Evaluation of personnel protection among radiographers in diagnostics radiology centers in Kerman(Iran). Environmental health conference 2009 Iran. Available form : http:// www. cong. sbmu. ac.ir/ behdasht %20mohit%2012/521-B.pdf.
[35] Perinciple of working with radiation protection against radiation, nuclear Immunity system of country, prepared by atomic energy organization of Iran, 2006. p:10. (Persian)
[36] Hohl C, Mahnken AH, Klotz E, Das M, Stargardt A, Mühlenbruch G, et al. Radiation dose reduction to the male gonads during MDCT: the effectiveness of a lead shield. AJR Am J Roentgenol 2005;184(1):128-30.

Dr. Al-Sayyari "Assessment of Radiation Protection practices among University Students , Buraydah, Saudi Arabia"IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), vol. 17, no. 3, 2018, pp 71-77