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RESEARCH ARTICLE

ASSESSMENT OF RADIOLOGY HEALTH WORKERS'KNOWLEDGE,ATTITUDES AND PRACTICES OF RADIATION PROTECTION PRECAUTIONS IN MAKKAH CITY, SAUDI ARABIA.

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Abstract

The exposure to radiation from medical procedures has become a topic of recent public and scientific discussion.Strict adherence to the radiation exposure guidelines is mandatory when using X-rays for disease detection in order to minimize its harmful effects. **Aim:** The main aim of this study was to assess radiology health workers' knowledge, practices, and attitudes of radiation protection precautions in Makkah City, Saudi Arabia. **Subjects and methods:** Descriptive cross section research design was used in the conduction of this study in different governmental and private hospitals.Random sample 283radiology health workers were participated in this study. One standardized questionnaire was used.**Results**: The majority of studied participants had good knowledge, practices, and attitudes regarding radiation protection precautions in Makkah City, Saudi Arabia. **Conclusions:** The present study's findings revealed that, the highest percentages of study participants were aware about radiation protection precautionsin Makkah City, Saudi Arabia. **Recommendations:** Designing and implementing a comprehensive training program to all healthcare workers as doctors, nurses and all personnel contact with radiology area. Replication of the study on larger sample and different healthcare workers will be beneficial to decrease health hazards associated with radiation.

Introduction:-

Radiation protection is the science and art of protecting people and the environment from the harmful effects of ionizing radiation. It is also described as all activities directed towards minimizing radiation exposure of patients and personnel during x-ray exposure***(Elamin, 2013)***.The objective of radiation protection is to define how one can protect individuals, their descendants and the human race against the potential risks of ionizing radiation ***(UcheEze, et al., 2013).***

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Radiography (also called radiologic technology) includes conventional x-ray imaging as well as additional imaging modalities such as fluoroscopy, mammography, ultrasound (US), computed tomography (CT), magnetic resonance imaging (MRI), nuclear medicines (NM) and radiation therapy (RT). Radiography is an essential diagnostic tool of modern medicine.Within a hospital, radiologists, radiology and nuclear medicine technicians, and others involved in the performance of x-ray and computed tomography (CT)scan examinations, have an increased risk for radiation exposure than the general hospital population***(Salama, et al., 2016)***.

Treatment of a patient depends on the accurate and precise production of radiographic images and successful interpretation of these images. Various injuries and conditions can be treated when the exact diagnosis is known to the physician. Therefore, a radiographer must be well educated and trained to achieve this goal. A highly qualified and skilled radiographer is a significant member of the health care staff. He could provide appropriate services using imaging techniques, and evaluates radio- graphs of technical quality***(Alaamer, 2012)***.

Despite the recent wide radiation applications in medicine, it can be hazardous if not properly handled. A careful balance between the benefits of enhancing human health, and the risks related to the radiation exposure of radiographers, patients, and the public, has to be involved in the practice of diagnostic and interventional radiation. X-rays have the potential for damaging healthy cells and tissues. After interaction of ionizing radiation with biological tissues through various mechanisms, the ions caused by such interactions can affect normal biological processes. Improper protection against high exposures of ionizing radiation can lead to death, cancer, skin burn, cataract, and radiation infertility (deterministic effects)***(Adejumo et al., 2012)***.

In addition, although the low dose of radiation exposure may cause no observable damage, the probability of chromosomal damage in the germ cells, with the consequence of mutations giving rise to genetic damages (stochastic effects), can make such doses significant for large populations. Accordingly, the need for radiation protection exists, in all medical facilities and for all radiation equipment types ***(Johnston et al., 2011).***

The characterization of medical applications, in terms of occupational exposures, is sometimes done by reporting an average annual individual dose for all exposed and/or measurably exposed workers. In practical radiation protection, this approach is, however, meaningless, as individual doses in the medical field differ substantially. During the evaluation of dosimetric data one needs information about the distribution of the yearly doses. When individual monitoring is used as a tool in practical radiation protection, it is important to know if the order of magnitude of the individual dose is defined by the nature of the procedure, the individual workload, the level of radiation protection measures, or the methodology of the assessment***(Covens,et al., 2007)***.

Occupational exposure is the result of radiation exposure at work, and personal dosimetry is an important tool to ensure compliance with regulatory or generally accepted dose limits. Radiation safety is the main health issue of concern to health-care facilities. Ionizing radiation is a known carcinogen at high doses, and clinical symptoms are known to be associated with the chronic low-dose exposure. The use of ionizing radiations in medicine is expanding rapidly due to the introduction of new ionizing radiation oriented diagnostic and therapeutic practices. Radiographic imaging is extremely valuable as a diagnostic tool in medicine, but ionizing radiation also carries well-known potential risks***(Salama, et al., 2016)***.

Radiation exposure poses hazards for healthcare providers as well as patients, and it may have somatic and genetic effects. Monitoring of radiation doses received by staff in radio-diagnostic centers is of great importance to the radiographers in their effort to protect themselves, patients, and the general public from the untoward effect of excessive radiation***(Salama, et al., 2016)***.

The as low as reasonably achievable (ALARA) principle, which emphasizes utilizing techniques and procedures to keep exposure to a level as low as reasonably achievable, should be followed to minimize the risk of radiation exposure to medical professionals. Personnel shielding options (e.g., two-piece wraparound aprons, thyroid shields, and eye protection) should be used to effectively attenuate scattered x-ray levels***(Greenlee, et al., 2011)***.

Significance of the study:-

Legislations for X-radiation protection of the environment andworkers in industries and health care in developing countriesare either nonexistent or unimplemented because of lack ofconcern, inadequate manpower, and logistics***(Agbor and Azodo, 2017)***.The exposure to radiation from these diagnostic X-raysexerts adverse effects on humans,

and these effects are classified as deterministic and stochastic effects. In order to protect the employees against occupational exposure to radiation, appropriate technical education and training suitable for effective protection of tools and equipment should be provided. These measures must be in accordance with national regulatory codes. So, this study aimed to assess the awareness of radiation protection precautions among radiology health workers in MakkahCity, Saudi Arabia.

Aim of the study:-
The main aim of this study was to assess radiology health workers' knowledge, practices, and attitudes of radiation protection precautions in Makkah City, Saudi Arabia.

Subjects and Methods:-
Research design:-
A descriptive cross section study design was used in the conduction of this study, during the period from December 2016 to February 2017.

Setting:-
The study was conducted in different government andprivatehospitals, in Makkahcity, Saudi Arabia.

Subjects of the study:-
Random sample (283) of radiology health workers were selected for this study from previously mentioned setting . Out of 400 questionnaire only 283 were completed. The response rate were (70.75%) selected.

Tool of data collection: A structured questionnaire was designed for data collection by researchers based on review of literature. It included four parts.

First part : included socio-demographic data of the study subject as age, gender, Nationality , marital status , Type of hospitals ,Duration of Employment (years), Average working hours\ day and which department you work in?.

Second parts: Included knowledge about radiation protection, Response of radiographers to radiation safety compliance. It composed of 4 staments.

Third part: Revealed thepractice of radiation protection, applicability & convenience of radiation protection policies, procedures & PPE (Personal Protective Equipment). It composed of 5 staments.

Fourth parts : Compromised of attitude, assessment of the work place safety requirements. It included 7 staments.

Ethical consideration:-
Before any attempt to collect data, an official approval to conduct the study was obtained from all hospitals included in the studyEthical research committee in all hospitals. Each participant was notified about the purpose of the study, the right to refuse to participate in the study. Anonymity and confidentiality of the information gathered was ensured.

Statistical analysis:-
Data were revised, coded, entered, analyzed and tabulated using SPSS version 19. Both descriptive statistics (frequency, percentage, mean and standard deviation) P value less than 0.05 was considered significant.

Results:-

Table 1: This table representedsocio -demographic characteristics of studied sample, as evident from the table, most of participants (51.9%) were female, nearly about two thirds of study participants (59.0%) were Saudi, and (63.3%) of study participants were married. The majority of study participants (85.9%), worked in government hospitals. Regarding working hours, the majority of study participants (81.6%) worked about 6-9 H\Day. Concerning departments, nearly about one third of study participants (36.0%) worked in General x-ray.The age of study participants were 32.5±7.2.

Table 2: Revealed participants' knowledge about radiation, this table showed that (96.8%) of participants were aware about the radiation hazards, (73.1%) of participants were aware about radiation safety standards, (97.9%) of

participants knew the importance of radiation safety and (88.3%) knew about wearingPersonal Protective Equipment (PPE) during any imaging.

Table 3: Demonstrated participants' practices about radiation.This table revealed that most of participants have the Lead aprons and lead gloves in their department with percentage (82.7% and 73.5% respectively), while, the percentage of use is (68.2%), the integrity of checking periodically was (65.4%) and most of participants (68.9%) answered more than 2m about the distance from radiological device without protection during the procedure (meter).

Table 4: Illustrated participants' attitudes about radiation.This table demonstrated that, (65.0%) of participants have the personal monitoring records, it is checking periodically (59.7%) and it does not recorded high reading with (65.4%), (67.1%) of participant have Environmental monitoring records with percentage (67.1%) , (92.2%) have a safety written policy in their department, (94.3%) of participants answer yes about the lead plaster/lead lining of walls and doors and if there is a safety warning signs with percentage (94.3% and 97.2% respectively).

Table (1):- Socio -demographic Characteristics of Studied Sample (N=283).

Socio –demographic Data	N	%	Total
Sex:			
Male	**136**	**48.1%**	
Female	**147**	**51.9%**	**283 100%**
Nationality:			
Saudi	**167**	**59.0%**	
Non-Saudi	**116**	**41.0%**	**283 100%**
Marital Status:			
Married	**179**	**63.3%**	
Single	**81**	**28.6%**	**283 100%**
Divorce	**23**	**8.1%**	
Type of Hospitals:			
Government	**243**	**85.9%**	
Private	**40**	**14.1%**	**283 100%**
Average working Hours\Day:			
3-5 Hours\Day	**39**	**13.8%**	
6-9Hours\Day	**231**	**81.6%**	**283 100%**
9-12 Hours\Day	**13**	**4.6%**	
Department:			
MRI	**53**	**18.7%**	
CT	**66**	**23.3%**	
General x-ray	**102**	**36.0%**	
US	**40**	**14.1%**	**283 100%**
Fluoroscopy	**22**	**7.8%**	
Age : (X ± SD)	**32.5±7.2**		
Experience: (X ± SD)	**2.8±1.3**		

Table (2):- Knowledge about Radiation among Study Sample (N=283).

Statements	Yes		No		Total
	N	%	N	%	
Awareness of radiation hazards.	274	96.8%	9	3.2%	
Awareness of radiation safety standards.	207	73.1%	76	26.9%	
The Importance of radiation safety.	277	97.9%	6	2.1%	**283 100%**
Knowledge about wearing (PPE) Personal Protective Equipment during any imaging	250	88.3%	33	11.7%	

Table (3):- Practice about Radiation among Study Sample (N=283).

Statements	Yes		No		Total
	N	%	N	%	

Is there the Lead aprons in your department ?	234	82.7%	49	17.3%	**283 100%**
Is it used?	193	68.2%	90	31.8%	
Is there the Leaded gloves in your department?	208	73.5%	75	26.5%	
Is integrity checking periodically?	185	65.4%	98	34.6%	
the distance from radiological device without protection during the procedure (meter):	**N**		**%**		**283 100%**
Less than1m	29		10.2%		
From 1-2 m	59		20.8%		
More than 2 m	195		68.9%		

Table (4):- Attitude about Radiation among Study Sample(N=283).

Statements	Yes		No		Total	
	N	%	N	%		
Do you have personal monitoring records?	**184**	**65.0%**	**99**	**35.0%**	**283**	**100%**
Is it checking periodically?	**169**	**59.7%**	**114**	**40.3%**	**283**	**100%**
Is it recorded high readings?	**98**	**34.6%**	**185**	**65.4%**	**283**	**100%**
Is there any Environmental monitoring records?	**190**	**67.1%**	**93**	**32.9%**	**283**	**100%**
Is there a safety written policy ?	**261**	**92.2%**	**22**	**7.8%**	**283**	**100%**
Is there lead plaster/lead lining of walls and doors ?	**267**	**94.3%**	**16**	**5.7%**	**283**	**100%**
In your department, is there a safety warning signs ?	**275**	**97.2%**	**8**	**2.8%**	**283**	**100%**

Discussion:-

This cross-sectional descriptive study included 283healthcare workers, with the aim of assessing radiology health workers' knowledge, attitudes and practices of radiation protection precautions in Makkah City, Saudi Arabia. The results of the present study showed good knowledge, attitude, and practice for radiation protection, This is better than what was reported in a similar study in Tehran Province (Iran) which found knowledge of radiation protection issues among radiographers in that country to be poor***(Shohreh, 2015),*** but it was consistent with study reported in Lagos (Nigeria) which foundRadiographers in Lagos, Nigeria, exhibited a very good understanding of the issues pertaining to radiation protection ***(Cletus, 2013)***.

In this study, the maximum age of participants is 54 years old, with the employment of 6 years and the minimum is 21 years old, with the employment of 1 year.The female is represented 51.9% and the male 48.1%, most of participants were Saudi with percentage 59.0% and the non-Saudi formed 41.0%, the participants ranging between married, single and divorce with percentage 63.3%, 28.6% and 8.1% respectively.Most of participants were working in governmental hospitals by 85.9% percentage and the private hospitals represented 14.1%.The highest rate of work for participants was 6-9 Hours\Day in general x-ray with percentage 81.6% and 36.0% respectively.

Regarding knowledge about radiation safety we observed that; the majority of study subjects were aware about radiation hazard and safety; whereas 96.8% of participants were aware about radiation hazards and the awareness about importance and standard of radiation safety is 97.9%, 73.1% respectively, this study' result wasconfirmed by ***Paolicchi, et al.,(2016)*** who reported that almost all participants (95 %) showed an awareness of the need to communicate to the patient the possible risks related to radiation exposure. But this study was disagree with ***Melaih, and Mishah(2008)***who revealed that the nurses in general don't have enough knowledge about radiation safety and protection principles.

The participants wearing Personal Protective Equipment during examinations by percentage 88.3%,this result was not coincided with ***(UcheEze, et al., 2013)***who mentioned that only 50% of respondents were observed to wear radiation dosimeters during the period studied.

Regarding the practice about radiation, there are lead aprons in the departments by percentages 82.7% and it were using with 68.2% , This result is coincided with ***Elamin, (2013)***who mentioned all the hospitals either governmental or private have lead rubber aprons. All the governmental hospitals had gonadal shield although none is using them on a routine basis,in study reported by ***(UcheEze, et al., 2013)***who indicated that in particular, gonad shields were available in all the centers studied but were either deliberately or inadvertently ignored in government hospitals.

It is mandatory, according toInternational Commission on Radiological Protection(ICRP) radiation safety standardsfor gonads shields to be used for the protection of the gonads when the pelvis is not part of the anatomical area being examined. Their use is more essential when women of child bearing age in whom early cyesis is suspected come for x-ray examinations.Most of the radiology departments have lead gloves by percentage 73.5% and it were using with 53.7%, table3, this result disagreed with ***Ahmed et al., (2015)*** they said: only (22.7%) use lead gloves and this behavior will protect the radiographers themselves.

Replacing a lead apron averts an increase in dose due to defects in the apron. Therefore, the replacement cost of the lead apron is the amount spent to avert the dose due to a defective lead apron, *(Kent, 2001)*.In this researchthe integrity was checking periodically by percentage 65.4% and did not checking by 34.6%, this result was not consistent with, ***Oyar, et al., (2012)*** who revealed that considering the use of radiation protectionaprons in clinics, we have seenthat personnel are not aware of the importanceof preservation and storageconditions, and for this reason, they donot heed the rules for using, preservingand cleaning aprons.

Radiation dose rates increase or decrease according to the inverse square of the distance from the source.Understanding the inverse square law can help personnel in decreasing their exposure to scattered radiation. The inverse square law states that exposure at a distance from a point of radiation is inversely proportional to the square of the distance, ***(Erica et al., 2011)***in this research the distance from radiological machines in the most departments are more than 2m by percentage 68.9%, this result was confirm by ***Abdellah et al., 2015)*** who indicated that the 28 physicians (35%) were standing at a distance of two metersor less from source point without protection.

Related to attitude of radiation, 65.0% of participants have personal monitoring records and it is checking periodically by 59.7%, this result was confirm with Rania M. et al, (2015) they said: (98.7%) of the staff have periodical radiation dose check from their TLDs (wearing TLDs during their work hours), also in the research written by ***Meenakshisundaram, et al.***who mentioned that about 200 radiation workers are issued Thermo Luminescent Dosimeters (TLD) every month and their dose records are well documented in a computerized dose management system with a feature to view the dose history of an individual at any given time.

According to the ALARA (As Low As Reasonably Achievable) principle, it is possible to considerablylower the dose of ionizing radiations during tests. ***Asl, et al., (2013)*** stated thatthe study results showed34.6% of this monitoring recorded high reading while 65.4% did not recorded high reading.Almost; all the x-ray departments have lead lining the wall and door and have safety written policy by percentage 94.3%, and 92.2% respectively. The radiology departments using the safety-warning signs by percentage 97.2%, this result was agree with***Dehaghi, et al., (2015)***who reportedthataccording to the obtained results, 71% of the described radiology departments generally used warning signs, 67.1% of the radiology departments have environmental monitoring records, this result not coincided with ***Elamin,(2013)***who concluded thatthe results of this study reveals low personal and environmental radiation monitoring by hospitals in Khartoum State as only (20.7 %).

Limitation of the study:-

The most remarkable limitation of the present study was that all data in this study was obtained through cross-sectional, self-report surveys, which could lead to common method variance Therefore, it is suggested that these results be used cautiously.

Conclusions:-

The present study's findings revealed that, the highest percentages of study participants were aware about radiation protection precautions. The majority of studied participants had good knowledge, practices, and attitudes regarding radiation protection precautions in Makkah City, Saudi Arabia.

Recommendations:-

Based on the findings of this study, the following recommendations are proposed:-

1. Designing and implementing a comprehensive training program to all healthcare workers as doctors, nurses and personnel contact with radiology area.
2. Replication of the study on larger sample and different healthcare workers will be beneficial to decrease health hazards associated with radiation.

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