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Awareness of Hazards of X-Ray Imaging and Perception Regarding Necessary Safety Measures to be taken during X-Ray Imaging Procedures among Patients in Public Sector Tertiary Hospitals in Saudi Arabia 2022

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Abstract

Background: X-ray imaging is a common procedure performed on a regular basis for diagnostic purposes all over the world. The use of X-rays is increasing rapidly with the introduction of new radiation-oriented therapeutic practices. Although it carries significant diagnostic benefits, extensive exposure to X-ray imaging has been shown to be associated with multiple dose-dependent health risks. Awareness and knowledge among patients regarding the effects of X-ray imaging, therefore, becomes important. Through this study, we aimed to assess the knowledge and awareness of the hazards of X-ray imaging among different groups of patients visiting two of the public sector tertiary hospitals in Karachi, Pakistan. We also aimed to evaluate the necessary safety measures undertaken during X-ray imaging in these hospitals, and the perception of patients regarding the importance of these measures. To circumvent this problem therefore, this study was conducted to determine whether safety precautionary measures necessary for shielding patients contact to unsafe dose of radioactivity were being adhered to or not. Aim of the study: To assessment awareness of Hazards of X-Ray Imaging and Perception Regarding Necessary Safety Measures to be taken during X-Ray Imaging Procedures among Patients in Public Sector Tertiary Hospitals in Saudi Arabia 2022. Methods: This cross-sectional study was conducted among 300 participants from Public Sector Hospitals kingdom of Saudi Arabia. A validated self-administered questionnaire was used, emergency Physicians and health care working in X-Ray, and Magnetic Resonance Imaging department It includes questions on socio demographic variables, Hazards of X-Ray Imaging and in Public Sector Tertiary Hospitals, during the August to September 2022. Results: show the remaining socio-demographic characteristics of the participant regarding age most of participants 40-50 years were (33.0%) the gender majority of participants were(59.0%)

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were male the department the most of participant radiology were (44.0%).Conclusion: The patients visiting the public sector tertiary care hospitals of Karachi seem to lack the knowledge and awareness regarding the hazards of ionizing radiations and the necessary safety measures required to be undertaken during X-ray imaging. More awareness programs should be conducted to increase the level of patients' awareness to protect them from unnecessary health risks.

Key words: *Hazards, X-Ray, Perception, Safety Measures, Imaging, Procedures, Public Sector, Tertiary Hospitals, Saudi Arabia.*

Introduction

Radiations are categorized as ionizing and nonionizing. Ionizing radiations, like X-rays, possess sufficient energy to separate an electron from an atom or molecule, producing free radicals in the process which are chemically unstable and highly reactive [1]. The emergence of X-ray imaging in the late 1800s has been one of the greatest discoveries in medicinal science [2]. The use of X-rays and many other ionizing radiations is increasing rapidly and extensively with the introduction of new radiation-oriented therapeutic practices [3]. Due to the extensive use of X-ray imaging, its effects should be fully understood. The most important factor when discussing the effects of X-rays is not the amount at a point in the air (exposure) but the amount of energy absorbed by tissue (dose) [4]. The dose-dependent adverse effects of X-rays have been linked to cancer and have been a focus for many researchers studying cancer risk in adults and children [5]. It is estimated that radiation exposure during medical imaging may be associated with 1.5% to 2% of all cancers in the Saudi Arabia in the future [6]. Prior to any researches on X-rays, radiologists who were exposed to significant amounts of X-rays were shown to develop severe forms of dermatome's, cataract, hematological disorders and various cancers [7]. This led to the development of a radiation safety principle known as ALARA (As Low As Reasonably Achievable) to allow the use of radiation with lowest possible doses required to achieve the desired diagnostic effect [8,9]. The increasing use of imaging methods has led to discussions regarding excessive and unnecessary use. The discussions are mostly centered on increased healthcare cost, exposure to radiation, reactions to contrast material (allergy, contrast-induced nephropathy, nephrogenic systemic fibrosis), and crowding in hospitals related to tests [10] Knowledge among patients regarding the effects of Risks Associated with the Use of Plain X-Ray, Computed Tomography, and Magnetic Resonance Imaging Among emergency Physicians and health care working X-ray imaging, therefore, becomes important. This awareness may help to necessitate the development of a more complete doctor patient dialogue and effective patient participation in the clinical decision-making process [11]. By having the awareness of the effects of imaging procedure that is being conducted, the patient will tend to force the physician to explain the rationale behind his decision which will encourage a more justified use of imaging in patient evaluation (where benefits outweigh the risks).[12] In addition, more elaborate doctor-patient interaction due to better awareness may also diminish the tendency of physicians to avoid seeking informed consent, a tendency which has been reported frequently in the literature. Surveying patients' knowledge and experiences, and documenting their views regarding the services provided to them would, therefore, provide valuable insight which can help to improve the quality and safety of the healthcare system [13]

Literature Review

While radiations are extremely useful diagnostically, a study conducted in the UK estimated that up to 20% of medical X-rays ordered are not beneficial and only add to the

unnecessary exposure in patients, contributing to 100-250 cases of cancer each year in the region [14]

According to the study published by Papanicolas et al.2018 , in high-income countries the average number of magnetic resonance imaging (MRI) and mean computed tomography (CT) scans were 82 and 151 per 1000 persons, respectively. These numbers were 118 and 245 in the United States, respectively, and in terms of the number of radiological imaging, the United States is the second country with the highest rate of MRI and CT technology use, following Japan [15]

Study by OECD et al, 2015 in Turkey shows similar characteristics to the high-income countries in terms of overuse of radiological imaging methods. According to the Organization for Economic Co-operation and Development European Union (EU) Health Statistics report, between 2011 and 2014, Turkey ranked first in the number of MRI scans and 8th in the number of CT scans. The EU average increase in the use of CT was 49%, while the increase was 60% in Turkey. The EU average increase in the use of MRI was 38%, while Turkey had a 134% increase [16]

Study by Johary et al., 2018, reported an excess of radiation-induced cataracts for technologists who received an eye lens dose of 55.7 mGy on average with the interquartile range from 23.6 to 69.0 mGy. The excess risk for cataract associated with radiation exposure from low-dose and low dose-rate occupational exposures [17]

In Pakistan no study has yet been conducted to evaluate knowledge of X-ray imaging among the patients. also need to evaluate the necessary safety measures undertaken during X-ray imaging in these hospitals, and the perception of patients regarding the importance of these measures.[18] Currently, there is a lack of data on radiation exposure delivered to patients in Saudi Arabia, although radiobiology researchers and other researchers have addressed the association between the relatively high doses from CT and stochastic and deterministic effects. Nevertheless, still, there is a need to optimize the dose by introducing the diagnostic reference level .[19]

Staff exposure has a high amount of variability, according to Morcillo et al. 2022, probably due to the varied level of complexity [20]. According to the linear no-threshold (LNT), any radiation dose can cause biological effects (DNA damage) that may be harmful to the exposed person, and the magnitude or probability of these effects is directly proportional to the dose (delayed effects).[21] Somatic, genetic, and teratogenicity effects are the three types of effects. [22]

Rational

Exposure to radiation deposits energy that can ionise the media and cause tissue reactions at specific thresholds, and the intensity of the tissue reaction rises as the doses rise. The radiation damage at higher doses can lead to observable early effects and clinical symptoms. Cell death or dysfunction is a biological process for tissue responses. The overall knowledge of the patients visiting tertiary care government hospitals of Saudi Arabia regarding radiation and its hazards is unsatisfactory. Safety protocols are less implemented in these hospitals, probably due to limited of the Knowledge, to ensure the protection of patients from unnecessary repeated radiation exposure, educating patients as well as emergency Physicians and health care working may prove to be beneficial. Public awareness programs should be conducted on a regular basis, where electronic media could play a central role. Healthcare providers should be taught to make a justified decision of exposing their patient to radiation only when the benefit outweighs the risk.

Aim of the study

To assessment awareness of Hazards of X-Ray Imaging and Perception Regarding Necessary Safety Measures to be taken during X-Ray Imaging Procedures among Patients in Public Sector Tertiary Hospitals in Saudi Arabia 2022.

Methodology

Study Design

A Cross-sectional descriptive study

Study area

The study was carried out in Public Sector Tertiary Hospitals at Saudi Arabia, Saudi Arabia It has a holy value for all Muslims worldwide who travel to it annually to perform Hajj and to visit the Holy Masjid and Kaaba towards which Muslims turn in prayers.

Study Population

The study was conducted among emergency of Hazards of X-Ray Imaging and Perception Regarding in Public Sector Tertiary Hospitals in X-Ray department at Saudi Arabia during the period of study in 2022.

Selection criteria:

A- Inclusion criteria:

- The study included emergency health care working who in the radiology department to Hazards of X-Ray Imaging and Perception Regarding in Public Sector Tertiary Hospitals in X-Ray department.
- Both males and females.
- All nationalities.

Exclusion criteria:

- We excluded emergency Hazards of X-Ray Imaging and Perception Regarding in Public Sector Tertiary Hospitals in X-Ray department who refused to participate, had neurological disease (which made them unable to understand and answer our questions), did not have the capacity to give informed consent, and/or if they were unable to understand the communication language.

Sampling technique:

The researcher used Multi-stage random sampling technique, by using random number generator. Then simple random sampling technique was applied to select the Public Sector Tertiary Hospitals. Also, convenience sampling technique was utilized to select the participants in the study.

Data collection tool:

The questions which were used in the survey were based on similar studies in the literature and on past experience. The questionnaire was designed to find the answers to the following three questions:

1. Do emergency doctors and health care working consider their level of knowledge sufficient on imaging methods

2. Do emergency doctors and health care working evaluate the risks associated with the radiological test, before ordering an imaging method

3. Do emergency doctors and health care working explain the risks associated with the imaging method to the patients, and discuss the risks and benefits of the imaging with the patients?

Data collection technique:

The questionnaire consists of parts .

The first part of the survey contained data socio-demographic characteristics on the specialties of physicians and health care working the total duration of their work in the relevant specialties .

In the second part of the questionnaire, physicians were asked to evaluate their knowledge of Risks Associated with the Use of Plain X-Ray, Computed Tomography, and Magnetic Resonance Imaging “little”, “moderate”, “good” and “very good.”

In the third part of the survey, the physicians were asked to indicate one or more sources from which they obtained information on imaging methods.

The comprehensibility and clarity of the items in the questionnaire were tested by emergency Physicians and health care working , physicians from any specialty of internal sciences, physicians from any specialty of surgical sciences, radiologists by face-to-face interview. In order not to affect the results, the answers of these physicians were excluded from the study. Those who did not complete the questionnaire.

Data entry and analysis:

The Statistical Package for Social Sciences (SPSS) software version 24.0 was used for data entry and analysis. Descriptive statistics (e.g., number, percentage) and analytic statistics using Chi-Square tests (χ^2) to test for the association and the difference between two categorical variables were applied. A p-value ≤ 0.05 was considered statistically significant.

Pilot study:

Was piloted among 20 participants, after permission was taken through from the researcher, with some modification and preamble letter was issued to explain the aim of the study, request to participate, and appreciation for a response. Then, the questionnaire was validated by three consultants. A pilot study was conducted in one PHC in the same sector due to the similarity to the target group using the same questionnaire to test the methodology of the study. As a feedback, the questionnaire was clear and no defect was detected in the methodology.

Ethical considerations:

The ethical approval for this study was obtained from the ethical committee for health research (2022). The objectives of the study were explained to the participants and confidentiality was assured. Participation was voluntary. A written consent was obtained from the participants. Permission from the X-Ray, Computed Tomography, and Magnetic Resonance Imaging was obtained; permission from the Directorate Public Sector Tertiary Hospitals.

Budget: Self-funded

Result

Table 1: Distribution of socio-demographic characteristics of participant .(n-300)

	N	%
Age		
<30	57	19
30-40.	81	27
40-50.	99	33
>50	63	21
Gender		
Male	177	59
Female	123	41
Marital status		
Single	81	27
Married	156	52
Divorced	33	11
Widow	30	10
Department		
Radiology	132	44
Emergency department	117	39
Radiotherapy	51	17
Medical specialty (cadre)		
Doctor	57	19
Nurse	63	21
Imaging scientist	81	27
Radiographer	33	11
Physicist	39	13
Biomedical engineer	27	9
Length of practice (in years)		
<10 Years	117	39
>10 Years	183	61

The study included 300 patients, table 1 show the remaining socio-demographic characteristics of the participant regarding age most of participants 40-50 years were (33.0%) followed by 30-40 years were (27.0%) while , regarding the gender majority of participants were(59.0%) were male while female were (41.0%), regarding the marital status the most of participant were (52.0%) married while single were (27.0%) , regarding the department the most of participant radiology were (44.0%) while emergency department were (39.0%) while radiotherapy were (17.0%), regarding medical specialty most of participant imaging scientist were (27.0%) while nurse were (21.0%) while doctor

were (19.0%) but the radiographer were (11.0%), regarding the length of practice (in years) most of participant > 10 Years were (61.0%) while <10 years were (39.0%) .

Table 2: Distribution of knowledge of Risks Associated with the Use of Plain X-Ray, and Magnetic Resonance Imaging

Knowledge of Risks Associated	N	%
How can you assess your own level of knowledge on imaging methods?		
Very little	36	12
Moderate	99	33
Good	144	48
Very good	21	7
What is the source of your information on imaging methods? You can select multiple choices.		
Medicine school training	36	12
Specialty training	96	32
Individual interest- based research	54	18
Radiological courses or seminars	87	29
Other	27	9
Do you routinely consider the risks associated with direct radiography for the patient before ordering		
Yes	213	71
No	87	29
Do you routinely consider the risks associated with computed tomography for the patient before ordering		
Yes	201	67
No	99	33
Do you routinely consider the risks associated with magnetic resonance imaging for the patient before ordering		
Yes	195	65
No	105	35
Do you routinely pay attention to radiation exposure before you order a direct radiography		
Yes	231	77
No	69	23
Do you routinely pay attention to whether the examination was performed already for the same indication before ordering direct radiography		
Yes	207	69
No	93	31
Do you routinely pay attention to radiation exposure, before you order a computed tomography scan		

Yes	243	81
No	57	19
Do you routinely pay attention to contrast-induced nephropathy, before you order a computed tomography scan		
Yes	231	77
No	69	23
Do you routinely pay attention to contrast agent allergy, before you order a computed tomography scan		
Yes	255	85
No	45	15

The results presented in table (2) showed distribution of knowledge of Risks Associated with the Use of Plain X-Ray, Computed Tomography, and Magnetic Resonance Imaging regarding can you assess your own level of knowledge on imaging methods the majority of participant answer good were (48.0%) followed by moderate were (33.0%) while very little were (12.0%) but very good were (7.0%), regarding the source of your information on imaging methods the majority of participant answer Specialty training were (32.0%) followed by radiological courses or seminars were (29.0%) while individual interest- based research were (18.0%) while medicine school training were (12.0%), regarding routinely consider the risks associated with direct radiography for the patient before ordering the majority of participant answer Yes were (71.0%) followed by No were (29.0%), regarding routinely consider the risks associated with computed tomography for the patient before ordering the majority of participant answer Yes were (67.0%) followed by No were (33.0%), regarding routinely consider the risks associated with magnetic resonance imaging for the patient before ordering the majority of participant answer Yes were (65.0%) followed by No were (35.0%) , regarding routinely pay attention to radiation exposure before you order a direct radiography the majority of participant answer Yes were (77.0%) followed by No were (23.0%) , regarding routinely pay attention to whether the examination was performed already for the same indication before ordering direct radiography the majority of participant answer Yes were (69.0%) followed by No were (31.0%), regarding routinely pay attention to radiation exposure, before you order a computed tomography scan the majority of participant Answer Yes were (81.0%) followed by No were (19.0%) , regarding routinely pay attention to contrast-induced nephropathy, before you order a computed tomography scan the majority of participant answer Yes were (77.0%) followed by No were (23.0%) , regarding routinely pay attention to contrast agent allergy, before you order a computed tomography scan the majority of participant answer Yes were (85.0%) followed by No were (15.0%)

Table 2 continued Knowledge of Risks Associated

Table 2 continued Knowledge of Risks Associated	N	%
Do you routinely pay attention to whether the examination was performed already for the same indication before ordering computed tomography?		
Yes	177	59
No	123	41
Do you routinely pay attention to radiation exposure, before you request a magnetic resonance imaging?		
Yes	198	66
No	102	34

Do you routinely pay attention to contrast-induced nephropathy, before you request a magnetic resonance imaging?.		
Yes	225	75
No	75	25
Do you routinely pay attention to contrast agent allergy, before you request a magnetic resonance imaging		
Yes	201	67
No	99	33
Do you routinely pay attention to whether the examination was performed already for the same indication before requesting magnetic resonance imaging		
Yes	147	49
No	153	51
Do you routinely inform the patient regarding the risks associated with the imaging method and discuss the risks and necessity with the patient before ordering direct radiography?		
Yes	213	71
No	87	29
Do you routinely inform the patient regarding the risks associated with the imaging method and discuss the risks and necessity with the patient before ordering computed tomography?		
Yes	186	62
No	114	38
Do you routinely inform the patient regarding the risks associated with the imaging method and discuss the risks and necessity with the patient before ordering magnetic resonance imaging		
Yes	222	74
No	78	26

Table 2 continued Knowledge of Risks Associated showed regarding routinely pay attention to whether the examination was performed already for the same indication before ordering computed tomography the majority of participant answer Yes were (59.0%) followed by No were (41.0%), regarding routinely consider the risks associated with computed tomography for the patient before ordering the majority of participant answer Yes were (67.0%) followed by No were (33.0%), regarding routinely pay attention to radiation exposure, before you request a magnetic resonance imaging the majority of participant answer Yes were (66.0%) followed by No were (34.0%) , regarding routinely pay attention to contrast-induced nephropathy, before you request a magnetic resonance imaging the majority of participant answer Yes were (75.0%) followed by No were (25.0%) , regarding routinely pay attention to contrast agent allergy, before you request a magnetic resonance imaging the majority of participant answer Yes were (67.0%) followed by No were (33.0%), regarding routinely pay attention to whether the examination was performed already for the same indication before requesting magnetic resonance imaging the majority of participant Answer No were (51.0%) followed by Yes were (49.0%) , regarding routinely inform the patient regarding the risks associated with the imaging method and discuss the risks and necessity with the patient before ordering direct radiography the

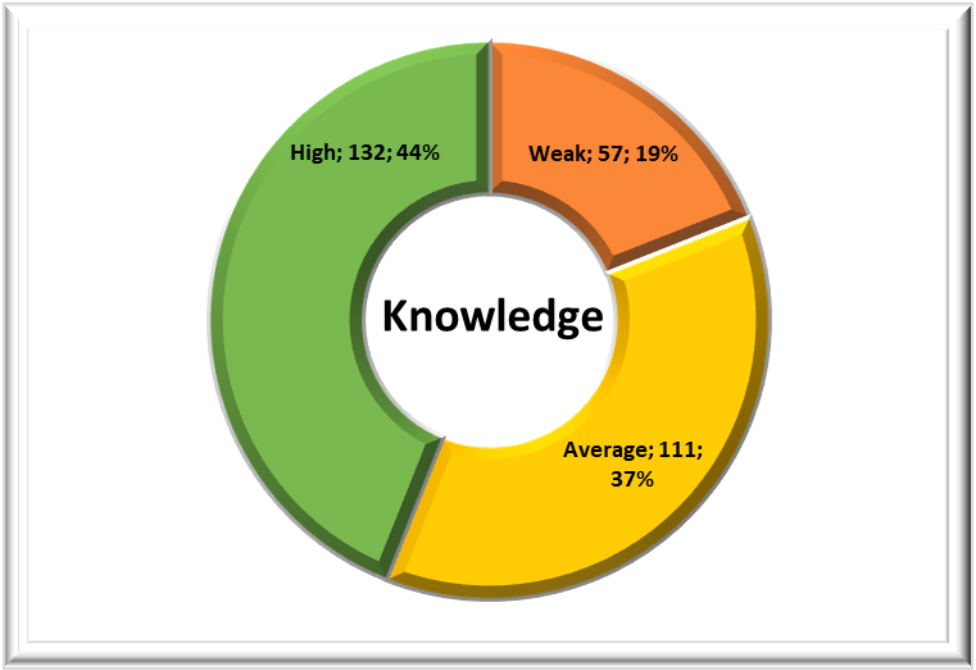
majority of participant answer Yes were (71.0%) followed by No were (29.0%) , regarding routinely inform the patient regarding the risks associated with the imaging method and discuss the risks and necessity with the patient before ordering computed tomography the majority of participant answer Yes were (62.0%) followed by No were (38.0%) , regarding routinely inform the patient regarding the risks associated with the imaging method and discuss the risks and necessity with the patient before ordering magnetic resonance imaging the majority of participant answer Yes were (74.0%) followed by No were (26.0%) .

Table 3: Distribution of knowledge of Risks Associated with the Use of Plain X-Ray, Computed Tomography, and Magnetic Resonance Imaging

		Knowledge		Score	
		N	%	Range	Mean±SD
Weak		57	19	6-15.	10.011±2.271
Average		111	37		
High		132	44		
Total		300	100		
Chi-square	X^2	29.94			
	P-value	<0.001*			

This table shows the majority of participant (44.0%) have high of the knowledge towards risks Associated with the Use of Plain X-Ray, Computed Tomography, and Magnetic Resonance Imaging followed by (37.0%) of participant average but weak were (19.0%) while Range(6 -15) and Mean ±SD(10.011±2.271) X^2 29.94 and a significant relation P=0.001.

Figure (1): Distribution of knowledge of Risks Associated with the Use of Plain X-Ray, Computed Tomography, and Magnetic Resonance Imaging



Discussion

Through this study, we aimed to highlight Knowledge of Risks Associated with the Use of Plain X-Ray, Computed Tomography, and Magnetic Resonance Imaging among Emergency Physicians and health care working in X-Ray department in Public Sector Tertiary Hospitals

In Public Sector Tertiary Hospitals at Saudi Arabia 2022, almost half of all ED visits in the Saudi Arabia resulted in at least one imaging examination, and about 1 in 6 patients were ordered to undergo CT [23]. MRI, which is one of the advanced imaging modalities, has been recently used by the emergency services especially in neuroimaging [24], similar In the study by Rosenkrantz et al., it was found that the use of CT as an advanced imaging method increased without any significant reduction in ultrasonography and plain radiography in the diagnosis of some diseases such as pneumonia and appendicitis. Furthermore, it was determined that use of diagnostic modalities including multiple imaging methods such as CT and ultrasonography or CT, radiography, and ultrasonography in the diagnosis of urinary calculi increased at the same visit [25] . EMPs should have a good knowledge of the imaging methods often used.[26] The study included 300 participant show the remaining socio-demographic characteristics of the participant age most of participants 40-50 years were (33.0%), regarding the gender majority of participants were(59.0%) were male, marital status the most of participant were (52.0%) married, department the most of participant radiology were (44.0%) while emergency department were (39.0%), medical specialty most of participant imaging scientist were (27.0%), length of practice (in years) most of participant > 10 Years were (61.0%) (See table 1)

Our results show that a high percentage of the study participants was aware of the term knowledge of Risks Associated with the Use of Plain X-Ray, Computed Tomography, and Magnetic Resonance Imaging, the study population demonstrated a high level of knowledge regarding the procedure and the harmful effects of X-ray imaging. (See table 2) regarding can you assess your own level of knowledge on imaging methods the majority of participant answer good were (48.0%), the source of your information on imaging methods the majority of participant answer Specialty training were (32.0%) , regarding routinely consider the risks associated with direct radiography for the patient before ordering the majority of participant answer Yes were (71.0%), regarding routinely consider the risks associated with computed tomography for the patient before ordering the majority of participant answer Yes were (67.0%), routinely consider the risks associated with magnetic resonance imaging for the patient before ordering the majority of participant answer Yes were (65.0%, routinely pay attention to radiation exposure before you order a direct radiography the majority of participant answer Yes were (77.0%), regarding routinely pay attention to contrast-induced nephropathy, before you order a computed tomography scan the majority of participant answer Yes were (77.0%) followed by No were (23.0%) , regarding routinely pay attention to contrast agent allergy, before you order a computed tomography scan the majority of participant answer Yes were (85.0%) followed by No were (15.0%)

These results are differing from those that we found in the literature. A study conducted in Hong Kong reported that 87.9% of the local patients were unaware of the fact that plain X-rays contain radiations [27]. Another study reported similar results, where 34% of participants did not know that imaging may expose them to radiations [28]. As opposed to these, a study reported 70.8% of participants showing an overall understanding of the imaging technique that they were undergoing [29]. Our study also demonstrated that the high were (44.0%) emergency Physicians and health care working in Saudi Arabia were Knowledge to the hazards of X-rays, showing of Knowledgeable to the risks of having cancer, anemia, burns, cataract, and fertility problems (Table 3). Similar findings have been reported in the literature. A study conducted in Nigeria reported a relatively higher percentage of participants (86.7%) who did not know about the dangers of X-ray imaging

[30]. Other studies have reported underestimation of cancer risk by the patients associated with imaging [31, 32]. in our study shows the majority of participant (44.0%) have high of the knowledge towards risks Associated with the Use of Plain X-Ray, Computed Tomography, and Magnetic Resonance Imaging followed by (37.0%) of participant average but weak were (19.0%) while Range(6 -15) and Mean ±SD(10.011±2.271) X2 29.94 and a significant relation P=0.001. (See label 3)

Conclusion

This study demonstrated average radiation protection practices despite good knowledge of radiation hazards among the participants, but radiation exposure and there is therefore need for periodic in-service training and regular monitoring of occupationally exposed health workers to ensure compliance with radiation safety regulations. The overall knowledge of the participants in the Public Sector Tertiary Hospitals at Saudi Arabia regarding radiation and its hazards is satisfactory. Safety protocols are less implemented in these hospitals, probably due to limited resources. To ensure the protection of participants from unnecessary repeated radiation exposure, educating patients as well as the health care providers may prove to be beneficial. Public awareness programs should be conducted on a regular basis, where electronic media could play a central role. Healthcare providers should be taught to make a justified decision of exposing their patient to radiation only when the benefit outweighs the risk. It has been suggested that participants exposure history must be maintained and updated after each exposure. Informed consent should be sought and a clear explanation of the imaging and its associated risks should be provided to each patient prior to the procedure.

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