

## Associated Between Knowledge Of Protection For Patients And Risks Factors To Use Of Plain X-Ray And Magnetic Resonance Imaging Among Emergency Physicians And Health Care Working In X-Ray Department In Public Sector Hospitals At Saudi Arabia 2023

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### Abstract

#### Background

*The use of X-rays and Magnetic Resonance Imaging in medical diagnostic radiology has increased globally. The medical use of X-ray and Magnetic Resonance Imaging for diagnosis of illness is subject to the principles of justification and optimization for the protection of exposed individuals. Medical X-ray and Magnetic Resonance Imaging accounts for the largest exposure of humans to man-made ionizing radiation. Exposure of individuals can lead to long-term stochastic effects. Over exposure of humans in interventional procedures can also lead to deterministic effects such as skin burns in the short term. Even though, measures are put in place to protect the operators of the X-ray and Magnetic Resonance Imaging equipment, including radiologists, there are no systems to protect patients undergoing radiological examinations. 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 Associated between knowledge of protection for patients and risks factors to Use of Plain X-Ray and Magnetic Resonance Imaging Among Emergency Physicians and health care working in X-Ray department in Public Sector Hospitals at Saudi Arabia 2023. Method's: 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, knowledge of Risks Associated with the Use about radiations imaging, during the August to September 2023. Results: show the remaining socio-demographic characteristics of the participant regarding age most of participants 40-50*

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years were (33.0%) the gender majority of participants were (59.0%) were male the department the most of participant radiology were (44.0%). **Conclusion:** The emergency Physicians and health care working in the public sector tertiary care hospitals of Saudi Arabia seem to lack the knowledge of Risks Associated with the Use of Plain X-Ray, Computed Tomography, and Magnetic Resonance Imaging regarding the hazards of radiations and the necessary safety measures required to be undertaken during radiations imaging.

**Keywords:** Associated, knowledge, protection, patients, risks factors X-Ray, Magnetic Resonance Imaging, Emergency Physicians, Hospitals, Saudi Arabia.

## Introduction

Emergency Physicians and health care working in X-Ray department in Public Sector Hospitals at Saudi Arabia 2023 In November 1895, Von Rontgen of Wurzburg, Germany, discovered the X-ray while working with a Crookes' tube [1]. In 1896, Henri Becquerel also discovered radioactivity while working on X-ray [2]. Radiology is the scientific use of X-rays and other high energy radiations for diagnosis and treatment [3]. Radioactive material or device is any substance that emits electromagnetic waves. [4]The emission of electromagnetic particles is called radiation and the disintegration or breaking down of the atoms into ions is called ionization.[5] Electromagnetic waves that are capable of disintegrating atoms into ions are known as ionizing radiations. The knowledge of the harmful effects of ionizing radiation has since been documented.[6] However, accidents that result in people getting injured still persist irrespective of the considerable development in radiation safety [7]. Every material in nature has energy called the latent energy, which is an inherent property of the material. All materials have a fundamental elementary unit known as the atom. Each atom has subdivisions know as protons, neutrons and electrons.[8] When the atoms of a particular substance have an unequal number of protons and neutrons, the substance is rendered unstable in electromagnetic energy and will therefore emit the excess energy in order to become stable. A radioactive material is therefore any substance that is unstable due to an unequal number of protons and neutrons and will release energy in a process called radioactive decay in order to be stable. [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 the 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 at 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 Physicians and health care working in X-Ray department in Public Sector Tertiary Hospitals at Saudi Arabia during the period of study in 2022 .

## **Selection criteria:**

### **A- Inclusion criteria:**

- The study included emergency Physicians and health care working who in the radiology department to X-Ray, Computed Tomography, and Magnetic Resonance Imaging and were willing to participate in the study.
- Both males and females.
- All nationalities.

### **Exclusion criteria:**

- We excluded emergency Physicians and health care working 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 ( $\chi^2$ ) to test for the association and the difference between two categorical variables were applied. A p-value  $\leq 0.05$  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	%
<b>Age</b>		
<30	57	19
30-40.	81	27
40-50.	99	33
>50	63	21
<b>Gender</b>		
Male	177	59
Female	123	41
<b>Marital status</b>		
Single	81	27

Married	156	52
Divorced	33	11
Widow	30	10
<b>Department</b>		
Radiology	132	44
Emergency department	117	39
Radiotherapy	51	17
<b>Medical specialty (cadre)</b>		
Doctor	57	19
Nurse	63	21
Imaging scientist	81	27
Radiographer	33	11
Physicist	39	13
Biomedical engineer	27	9
<b>Length of practice (in years)</b>		
<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**

<b>Knowledge of Risks Associated</b>	<b>N</b>	<b>%</b>
<b>How can you assess your own level of knowledge on imaging methods?</b>		
Very little	36	12
Moderate	99	33
Good	144	48
Very good	21	7
<b>What is the source of your information on imaging methods? You can select multiple choices.</b>		
Medicine school training	36	12
Specialty training	96	32
Individual interest- based research	54	18
Radiological courses or seminars	87	29
Other	27	9
<b>Do you routinely consider the risks associated with direct radiography for the patient before ordering</b>		

Yes	213	71
No	87	29
<b>Do you routinely consider the risks associated with computed tomography for the patient before ordering</b>		
Yes	201	67
No	99	33
<b>Do you routinely consider the risks associated with magnetic resonance imaging for the patient before ordering</b>		
Yes	195	65
No	105	35
<b>Do you routinely pay attention to radiation exposure before you order a direct radiography</b>		
Yes	231	77
No	69	23
<b>Do you routinely pay attention to whether the examination was performed already for the same indication before ordering direct radiography</b>		
Yes	207	69
No	93	31
<b>Do you routinely pay attention to radiation exposure, before you order a computed tomography scan</b>		
Yes	243	81
No	57	19
<b>Do you routinely pay attention to contrast-induced nephropathy, before you order a computed tomography scan</b>		
Yes	231	77
No	69	23
<b>Do you routinely pay attention to contrast agent allergy, before you order a computed tomography scan</b>		
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**

<b>Table 2 continued Knowledge of Risks Associated</b>	<b>N</b>	<b>%</b>
<b>Do you routinely pay attention to whether the examination was performed already for the same indication before ordering computed tomography?</b>		
Yes	177	59
No	123	41
<b>Do you routinely pay attention to radiation exposure, before you request a magnetic resonance imaging?</b>		
Yes	198	66
No	102	34
<b>Do you routinely pay attention to contrast-induced nephropathy, before you request a magnetic resonance imaging?.</b>		
Yes	225	75
No	75	25
<b>Do you routinely pay attention to contrast agent allergy, before you request a magnetic resonance imaging</b>		
Yes	201	67
No	99	33
<b>Do you routinely pay attention to whether the examination was performed already for the same indication before requesting magnetic resonance imaging</b>		
Yes	147	49
No	153	51
<b>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?</b>		
Yes	213	71
No	87	29
<b>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?</b>		
Yes	186	62
No	114	38
<b>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</b>		
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



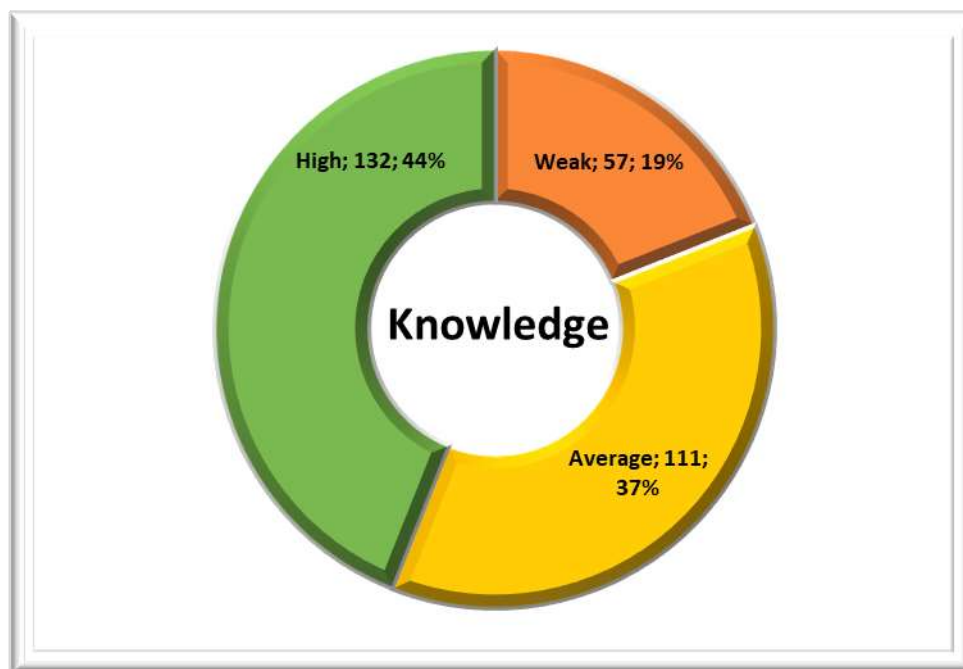
ordering computed tomography the majority of participant answer Yes were (59.0%) followed by No were (41.0%), regarding routinely consider the risks associated with computed tomography for the patient before ordering the majority of participant answer Yes were (67.0%) followed by No were (33.0%), regarding 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
<b>Weak</b>		57	19	6-15.	10.011±2.271
<b>Average</b>		111	37		
<b>High</b>		132	44		
<b>Total</b>		300	100		
<b>Chi-square</b>	<b>X<sup>2</sup></b>	29.94			
	<b>P-value</b>	<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<sup>2</sup> 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  $\pm$ SD(10.011 $\pm$ 2.271)  $\chi^2$  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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