

## Research Article

# Evaluation of Awareness on Radiation Protection and Knowledge about Ionizing Radiation among Patients Awaiting Radiological Examinations: A Cross-Sectional Survey

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Received: July 30, 2019; Accepted: September 04, 2019; Published: September 11, 2019

## Abstract

The main purpose for this article is the evaluation of the level of knowledge about ionizing radiation and radiation protection among patients who waiting for the radiological examinations in the radiology department of King Fahad Medical City. A questionnaire with a total of 9 questions was distributed amongst patients waiting for radiological examination at King Fahad Medical City hospital. Completed 400 questionnaires which tested patients' information about ionizing radiation, harmful effects, and protection from these effects was applied by radiology intern. Of the participants, the majority of the education level belonged to university educated participants (52.3%). Unemployed patients (52.5%) was the highest one among the employment category. mean age, 35.36 ± 12.75 years; age range, 75 – 9 years who accepted to be participant. This study found 19.0% of the participants realized that the US use ionizing radiation, moreover, 18.0% of the patients also believed MRI use ionizing radiation. while 31.8% of them had no idea. The result suggests that patients' awareness about fetal anomaly risk associated ionizing radiation was very high. The study concluded that most of patients underwent radiological examinations previously. They had insufficient information about ionizing radiation. It would be appropriate to include lessons about radiation and side effects in waiting rooms of each department, informative brochures that explain safety procedures and common concerns should be made available to all patients.

**Keywords:** Ionizing radiation; Radiation effects; Radiation protection

## Introduction

X-ray had been discovered by Wilhelm Conrad Rontgen in December 1895. Since that radiation is an accepted and fundamental part of medical practice. Many disorders in daily practice have been evaluated by the radiological examinations. The benefits of ionizing radiation are already clearly visible in medical therapy and diagnosis [1]. Ionizing radiation possesses a beneficial as well as the destructive potential of the living organism. The benefits of exposing the patient to radiation should outweigh the risk involved. In simple term, ionizing radiation is when the beam of radiation passes through matter causing ionization by removal orbital electron from the atom, this molecular change can cause cellular damage which may cause abnormal cell function, that varies depending on the dose and the duration of exposure [2].

Radiation exposure can cause death in some living cells and modify others. Usually, cells try to repair the damage. If the repaired is not perfect, that eventually can result in adverse biological effects that occur later. Radiation effects could be classified into stochastic and non-stochastic effects. Stochastic effect (mainly cancer and genetic effects) occurs by chance and their probabilities increases with dose.

Non-stochastic effects Severity of this effect varies with dose. Examples are erythema, cataract of the eye lens and infertility [2].

Radiation exposure has been associated with cancer of many organs such as in the thyroid, bone, breast, lung and in the skin.

In terms of breast cancer induction which discussed in the literature [3]. Radiation-induced cancer is not different from cancer that arises spontaneously [4]. Several studies showed the patient's awareness were insufficient about ionizing radiation and their effects on the human body [5-8].

The aim of this study was to determine and evaluate the knowledge about ionizing radiation and radiation protection among patients waiting for radiological examination. The result of this study would be valuable to the public to better understanding about ionizing radiation and take their attention to the importance of ionizing radiation in their life. Also for the hospitals and medical practitioner to evaluate their patient's background about radiation, and take place to improve the policy to test out new approaches.

## Materials and Methods

A cross-sectional survey performed between 8 and 22 April 2018 among patients who referred for the radiological examinations to the radiology departments of the King Fahad Medical City hospital.

The study included 400 patients (210 [52.5%] female and 190 [47.5%] male; mean age, 35.36 ± 12.75 years; age range, 75-9 years)

**Table 1:** Unemployed 210 (52.5%). Sociodemographic characteristics of participants.

Characteristics	n=400	%
<b>Gender</b>		
Male	190	(47.5%)
Female	210	(52.5%)
<b>Level of Education</b>		
Illiterate	8	(2.0%)
Primary school	35	(8.8%)
Secondary school	45	(11.3%)
High school	103	(25.8%)
University	209	(52.3%)
<b>Employment</b>		
Employed	190	(47.5%)
Unemployed	210	(52.5%)

who accepted to be participant.

A questionnaire with a total of 9 questions was distributed amongst patients awaiting for radiological examination at King Fahad Medical City hospital. Completed 400 questionnaires which tested patients' information about ionizing radiation, harmful effects and protection from these effects was applied face to face by radiology intern before the radiological examination. The participants were asked for the following informations: demographic data, including their age, gender, marital status, employment, education level [low education level: illiterate, primary and secondary school educated; high education level: high school and university educated]. Which imaging modality use ionizing radiation, what are the harmful effects of ionizing radiation, what is the most type of radiation could cause cancer, which modality could be used safely for pregnant women, what they should do for protection from radiation were investigated, which modality could expose the patient to more radiation: a single CT scan or a generic X-ray. The participants were asked for their opinion of performing mammography for women who under 40 years if it is completely safe? and performing more CT scan in a single person raises the radiation risk?. Also, they are asked if they Would go for a CT scan or X-ray just for personal doubt even if in absence of medical indication?. Participants were not allowed to use any materials or sources during the survey.

A questionnaire was a combination of yes-no-no idea and multiple-choice questions, concerning the knowledge of ionizing radiation, harmful effects and radiation protection from these effects.

### Statistical analysis

A descriptive analysis has been used to describe categorical and continuous variables. Data were analyzed statistically by the t-test and Chi-square. This would describe the significance of the association between patients and response to their knowledge.

## Results

The lists of sociodemographic characteristics of participants are summarized in Table 1. The majority of the education level belonged to university educated participants 209 (52.3%). Unemployed patients 210 (52.5%) was the highest one in the employment category. Distribution of the multiple-choice answers of the survey is summarized in Table 2.

Most of patients 301 (75.3%) underwent radiological examinations previously and 165 (41.3%) of participants known that radiography and CT 126 (31.5%) use x-ray. only 42 (10.5%) of them

known that mammography uses x-ray. Many of patients known that effects of radiation could cause cancer 83 (20.8%) and fetal anomaly 197 (49.3%). Only 55 (13.8%) of the participants reported that x-ray is the most type of radiation cause cancer and 217 (54.3%) had no idea. The participants believed that Ultrasonography (US) 174 (43.5%) and Magnetic Resonance Imaging (MRI) 22 (5.5%) could be used safely for pregnant women, but 178 (44.5%) had no idea. 149 (37.3%) of them known that CT contained more radiation than radiography, and 194 (48.5%) had no idea about this issue.

The participants respond a good knowledge about protected them self against harmful effects of radiation, most of the participants 181 (45.3%) were aware that the relative should not stay with the patient in the examination room if it is unnecessarily for protection. 167 (41.8%) of them known that they should Cover the sensitive areas with lead (Pb) plaques, and 162 (40.5%) of them aware that they should avoid repetition by following the technologist's instructions.

Interestingly, 19 (4.8%) of patients declared that thick cloths could protect them from the harmful effects of x-ray, and 104 (26.0%) had no idea.

Distribution of (yes-no-no idea) answers of the survey are summarized in Table 3.

163 (40.8%) of the participants considered that performing mammography for women who under 40 years is safe, and 185 (46.3%) had no idea. 206 (51.5%) of the participants believed that performing more CT scan in a single person raises the radiation risk, and 144 (36.0%) had no idea.

109 (27.3%) of the participants answered that they Would go for CT scan or X-ray just for personal doubt even if in absence of medical indication and most of them 291 (72.8%) would not.

## Discussion

This study found 19.0% of the participants realized that the US use ionizing radiation, moreover, 18.0% of the patients also believed MRI use ionizing radiation, while 31.8% of them had no idea about which modality use ionizing radiation. It was a surprising result about 68.8% over 400 participants did not know that ionizing radiation not used in MRI or US. This leak of knowledge could lead to increased unnecessary anxiety level when they or relatives should undergo MRI or US examinations. Which means there is a big responsibility at the first place on the referring physician who orders the radiological examination, to educate their patients by telling them a general information about the exam that about to do. This must be done before ordering any radiological examination. Although, for the radiologists, technologists and radiology nurses to explain every procedure to the patients before carrying it out. This would help to relieve fears on the part of patients and get full cooperation which would further help to reduce repeated investigations [9]. This result was higher than the findings in Asefa study [10] which showed this misunderstanding of the patients, they found (16.8%) and (8.3%) of the clients incorrectly assumed that ultrasound and MRI examinations are classified under ionizing radiation modalities. Which means there is a need to do more effort to educate our patients about that issue.

The majority of the participants was females and only 10.5% of them known that mammography uses ionizing radiation. This important

**Table 2:** Distribution of the multiple-choice answers of the survey.

Questions	n=400	Responses (%)
<b>Underwent for radiological examination previously?</b>		
Yes	301	(75.3%)
No	99	(24.8%)
<b>Which modality use ionizing radiation? (you can mark more than one)</b>		
Ultrasonography	76	(19.0%)
Radiography	165	(41.3%)
CT	126	(31.5%)
MRI	72	(18.0%)
Mammography	42	(10.5%)
I DO NOT KNOW.	127	(31.8%)
<b>Which of the following could be seen as an adverse effects of radiation? (you can mark more than one)</b>		
Cancer		
Fetal anomaly	83	(20.8%)
Cataract	197	(49.3%)
Cell death	19	(4.8%)
Skin lesions	38	(9.5%)
I DO NOT KNOW.	33	(8.3%)
<b>Most type of radiation cause cancer:</b>		
X-rays	55	(13.8%)
Microwave	47	(11.8%)
Ultraviolet	94	(23.5%)
I DO NOT KNOW.	217	(54.3%)
<b>Which of the following could be used safely for pregnant women? (you can mark more than one)</b>		
Ultrasonography	174	(43.5%)
Radiography	43	(10.8%)
CT	14	(3.5%)
MRI	22	(5.5%)
Mammography	23	(5.8%)
I DO NOT KNOW.	178	(44.5%)
<b>Which modality expose to more radiation: a single CT scan or a generic X-ray?</b>		
CT scan	149	(37.3%)
Generic X-ray	57	(14.2%)
I DO NOT KNOW.	194	(48.5%)
<b>Which of the following should do for protection from harmful effects of X-ray? (you can mark more than one):</b>		
Cover the sensitive areas with Pb plaques.	167	(41.8%)
Follow the technologist's instructions to avoid repetition.	162	(40.5%)
Wearing thicker clothes.	19	(4.8%)
Do not stay in the examination room unnecessarily "for relative"	181	(45.3%)
I DO NOT KNOW.	104	(26.0%)

**Table 3:** Distribution of the (yes-no-no idea) answers of the survey, n=400.

Questions	Yes	No	I DO NOT KNOW
Do you think that performing mammography for women who under 40 years is safe?	163 (40.8%)	52 (13.0%)	185 (46.3%)
Do you think that performing more CT scan in a single person raises the radiation risk?	206 (51.5%)	50 (12.5%)	144 (36.0%)
Would you undergo a CT scan or X-ray just for a personal doubt even if in absence of a medical indication?	109 (27.3%)	291 (72.8%)	

point should be known by the patient. There is misunderstanding and that could be improved by increasing the communication between medical practitioner and patients for providing high-quality patient care and radiological services.

With regard to adverse effects of radiation, this result suggests that patients' awareness about fetal anomaly risk associated ionizing radiation was very high, almost half (49.3%) of the participants mentioned fetal anomaly, this was higher than the findings in Asefa study 4.9% [10]. In addition, (20.8%) indicated cancer could be a consequence of radiation imaging. However, this was inconsistent with the Asefa study (64.0%). This might be explained by the fact that our patients are highly educated but most of them are not in the medical field.

Not all forms of radiation are able to cause ionization such as radio waves, microwaves and Ultraviolet rays. Unlike what the study found that (23.5%) of the responders believed that Ultraviolet rays are the

most type of radiation could cause cancer. Even with the fact that UV is highly genotoxic and the most prominent and ubiquitous physical carcinogen in our natural environment but does not penetrate the body any deeper than the skin [11]. While only (13.8%) of them were chosen x-ray. On the other hand, almost half of the participants had no idea.

Most of the participants (44.5%) had no knowledge about which modality could be used safely for pregnant women. However, this finding was lower than Asefa study (90.2%) [10] and Düzeyleri study in Turkey (73.2%) [5]. Followed by US (43.5%), this might be because most of the women follow up by the US during the pregnancy. Only (5.5%) of the participants were aware of the fact that MRI is safely used for a pregnant woman. While in Asefa [10] findings imply that clients were unaware of safe radiation imaging during pregnancy, only a few clients (8.3%) correctly mentioned ultrasound and Very few (1%) mentioned MRI as a safe imaging modality during pregnancy. This shows that our patients more aware of this issue, and

that might be due to the difference in economic characteristics of the two population.

Another important point which needs attention was their belief that wearing thick cloths could protect them from the harmful effects of x-ray. Interestingly, (4.8%) of patients declared that. This finding was higher than Asefa study [10] which indicated by (3.6%) patients.

Answers regarding patients' awareness of risks from CT, more than half 50% of the participants known that performing more CT scan in a single person raises the radiation risk, while (48.5%) of them were not aware that performing a single CT scan could expose the patient to more radiation compared to a generic X-ray. In a survey preforming by Di Piazza and colleagues [12] which studying Patients' knowledge and awareness of radiation dose and risks from CT. They found that over 47 patients, 90% of them known that performing more CT scan in a single person raises the radiation risk. While more than 50% of their patients aware that performing a single CT scan could expose the patient to more radiation compared to a generic X-ray. This difference could be due to the difference in socio-demographic in the sample size. They suggested that awareness of the patients about ionizing radiation and harmful effects should be improved to prevent unnecessary CT examinations to protect them from increasing lifetime cancer risk.

In Conclusion, education is the most important factor to increase the level of public' awareness about ionizing radiation and harmful effects. Government, Ministry of Health, hospitals and any health care providers has responsibility to giving information by publish and deliver informative brochures, organize meetings, conferences, even TV programs and through social media.

Most of patients underwent radiological examinations previously. They had insufficient information about ionizing radiation. It would be appropriate to include lessons about radiation and side effects in waiting rooms of each radiology department, informative brochures that easily explain safety procedures and common concerns should be made available to all patients. Also, suggested to include an informative part about the exam with each request paper.

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