



**LEVEL OF AWARENESS ABOUT HAZARDS OF IONIZING RADIATIONS AMONG
MEDICAL STUDENTS AND STAFF OF RADIOLOGY DEPARTMENT OF A TERTIARY
CARE HOSPITAL IN A DEVELOPING COUNTRY**

**Muhammad Tayyeb MD, MBBS*¹, Ali Jaan MD, MBBS¹, Farhan Khalid MBBS¹, Hira Saleem MD, MBBS²,
Aniqa Raheem MBBS³, Aftab Sharif MBBS⁴, Ehtesham Zahoor MBBS⁴, Dania Rahim Qureshi MD, MBBS⁵**

¹King Edward Medical University, Lahore, Pakistan.

²Akhtar Saeed Medical and Dental College, Lahore, Pakistan.

³Shalamar Medical and Dental College, Lahore, Pakistan.

⁴Liaquat Medical and Dental College, Karachi, Pakistan.

⁵Dow International Medical College, Karachi, Pakistan.

***Corresponding Author: Muhammad Tayyeb MD, MBBS**

King Edward Medical University, Lahore, Pakistan.

Article Received on 29/04/2020

Article Revised on 19/05/2020

Article Accepted on 09/06/2020

ABSTRACT

Background: Ionizing radiation is a type of electromagnetic radiation that produces ionization in the substances that are irradiated. Exposure to these invisible radiations is inescapable for medical students and staff members during diagnostic and therapeutic purposes and it can cause various health problems. **Objective:** To assess the level of awareness of medical students and staff of Radiology Department about hazards of Ionizing Radiations. **Methodology:** We conducted a cross-sectional study in order to know about level of awareness regarding ionizing radiation risks in the staff members of the radiology department of Public Hospital Lahore and Medical students of Lahore from April 2016 to June 2016. The study included about 100 participants. A questionnaire was formulated and filled by the participants with 100% response rate. Final data were analyzed with the help of SPSS version 16.0 and the descriptive statistics e.g. percentage and frequencies were calculated. **Results:** Out of 100 participants, 80% were medical students while 20% were staff members of radiology department. 58 participants were confident in their knowledge of ionizing radiation and its hazards. 57 participants considered that CT scan is not a dangerous source of radiation and 85% of our participants were of the view that x. ray examination dose varies with age and size of body. 89% participants had an opinion that radiation badges are helpful in preventing radiation exposure. 30 participants said that ionizing radiations are used in MRI and 87% participants were of the opinion that there is a need to enhance awareness among the staff members of radiology department. **Conclusion:** Majority of the participants included in this study were aware of the harmful effects of excessive use of radiations on health but there is a proportion of medical students and staff members who are unaware of harmful effects of radiations and protective measures that must be used in radiological procedures. Major portion of people and staff observe negligence in adopting protective measures during radiological procedures. So, there is a need to enhance awareness among the people regarding life threatening and debilitating hazards of radiations so that they may adopt protective measures.

KEYWORDS: Awareness, Ionizing radiations, Hazards.

INTRODUCTION

Ionizing radiation is a type of energy emitted by spontaneous disintegration of radioactive substances in the electromagnetic waveform or as particles. Exposure to these invisible and undetectable radiations has some inescapable origins for a medical student such as; medical diagnostic and therapeutic purposes.^[1] Inadequacy in the disposition and disposal has rendered society vulnerable to countless harmful effects ranging from as little as skin irritation to infertility and malignancy.^[2] This research lays stress on the

momentousness of the spread of awareness about hazardous effects of ionizing radiations.^[3]

It has been verified that radiation exposure has a linear relationship with carcinogenesis as reported by various studies. In a research done in 2015 in Nigeria, out of 312 students 49% believed that ultrasonography and MRI emit ionizing radiations and 78% believed that excessive exposure to non-ionizing radiations has potential health hazards.^[4] In 2004 study held in U.S indicated that about 7% of the participants had been told about the

advantages and disadvantages of using CT scan while 47% participants knew that due to the increased radiation exposure there is an increase in the risk of cancer.^[5] In another study in 2014 about knowledge of the hazards of radiations in the intern doctors, MBBS students, and also the residents belonging to Madina-tul-Munawwara, it became clear that knowledge of participants of this study was inadequate in 98.4%.^[6] In Australia (2010) 58.4% of the participants were those who underestimated the doses of common radiological techniques. The knowledge of intern doctors was found better than any medical student.^[7] In August 2003 research done in UK by Shiralkar included 130 staff members of which 97% answers were underestimates of actual dose and 5% didn't realize that MRI doesn't use ionizing radiation.^[8] In April 2002, about 130 doctors of all grades were included with a criteria of passing marks of 50%, only 2% of the doctors were passed according to that criteria regarding doctors' knowledge of radiation exposure as reported in British Medical Journal.^[9] In a research done in London by Quinn AD *et al.*, about radiation protection awareness, out of the 120 non-radiologists 82 participated, of which 37% participants were those who had a course in radiation protection. Majority of the participants was unaware of the fact that there is annual limit of dose for the patients and most of them were unaware of the radio sensitivities of body organs.^[10] In 2014 research done for the evaluation of awareness, out of 92 participants including medical technicians, nurses, physicians along with other personnels, only physicians' knowledge radiation protection was found to be adequate.^[11] In 2014 in an assessment about radiation exposure awareness in diagnostic imaging techniques in the internees and the medical students of final year MBBS, results showed that 26.2% MBBS students were confident while 2.9% students were very confident in their knowledge of ionizing radiations.^[12] A research published in June 2005 in International Journal of Nuclear Radiology, it was estimated that almost 80% of the staff members were unaware of environmental radiations' amount that was found to be equal to one X-ray examination or a CT scan.^[13] The systemic survey about physicians knowledge of radiation dose and risks of CT was made in 2010 which represented that the knowledge gaps concerning the topics were evident.^[14]

The need for heed to this subject is paramount. With the increment of use of radiations, it has become a dire need that medical students and staff members must be aware

of the hazards of ionizing radiations. This awareness will help them in protecting the hospital atmosphere from fatal diseases like carcinomas, infertility, leukemias and genetic disorders that have become prevalent now. National and international efforts made in this regard have laid an utmost stress to the hazards and awareness of hazards of ionizing radiation.

METHODOLOGY

A cross-sectional study was conducted to know the level of awareness of students of Medical University Lahore and staff of Radiology Department of Public Hospital Lahore about hazards of ionizing radiations. The study duration was 3 months from April 2016 to June 2016. It included 100 participants, of them 80% were students and 20% were staff members at radiology department. Research synopsis was approved by Institutional Review Board. A questionnaire containing 40 questions was designed and filled by the participants after explaining possible risks and benefits. Participants were also ensured that their personal information like name and address will be kept confidential. Informed consent was taken. The response rate by the participants was 100%. Data were analyzed by using SPSS (software package for statistical analysis) version 16.0 and descriptive statistics like frequency and percentage were obtained.

Ionization: Process in which either an electron is added to a molecule or an atom or removed from them thereby producing ions in their ground state.^[17]
Ionizing radiation: These are electromagnetic radiations having energy in their waves that is sufficient to overwhelm binding energy of the electrons in molecules or atoms thereby creating ions.^[18]

Hazard: Hazard means any mechanical, biological, physical or an environmental agent that can cause damage or harm to the human beings, other organisms or their environment if not controlled.^[19]

RESULTS

100 questionnaires were filled by 100 participants, out of which 43 were male and 57 were female. 80% of the participants were students while 20% were the staff members of radiology department, Public Hospital Lahore. The study revealed that 58% of the participants were confident about their knowledge related to hazards of ionizing radiation.

Variables	Frequency	Percentage (%)
X-rays dangerous radiations for health		
Yes	32	32
No	68	68
C.T dangerous source of radiations for health		
Yes	43	43
No	57	57
Radiological treatment dangerous for health		
Yes	41	41
No	59	59

PET scan dangerous for health	9	9
Yes	91	91
No		
Cancer most common health risk of rad.	83	83
Yes	17	17
No		
Genetic disorders most common health risk	65	65
Yes	35	35
No		
Skin disorder commonest health risk of rad.	62	62
Yes	38	38
No		
Nuclear waste dangerous source of radiation	94	94
Yes	6	6
No		
After X-ray exam. Rays stay in our body	39	39
Yes	61	61
No		
X-ray dose varies with age and body size	85	85
Yes	15	15
No		
Workers X-ray dept. >10 yrs. at high risk	89	89
Yes	11	11
No		
Staff members safe	24	24
Yes	76	76
No		
Stay away from patients under radiations	53	53
Yes	47	47
No		
Diff. parameters for chest X-ray In children	72	72
Yes	28	28
No		
Diff. parameter for chest X-ray in adults	72	72
Yes	28	28
No		
Diff. parameters for chest X-ray in pregnant	76	76
Yes	24	24
No		
Diff. method for chest X-ray in lactating mothers	67	67
Yes	33	33
No		
UV exposure enhanced now-a-days	89	89
Yes	11	11
No		
Inventions in tech cause more rad. Exposure	64	64
Yes	36	36
No		
Any training of rad. exposure and its risks	24	24
Yes	76	76
No		
Any awareness procedure about avoiding rad. exposure around you	48	48
Yes	52	52
No		
Need to enhance awareness among staff	87	87
Yes	13	13
No		
Need of awareness among K.E students	96	96

Yes	4	4
No		
Media helpful in spreading awareness	65	65
Yes	25	25
No		
Regular lectures helpful in I.R awareness	79	79
Yes	21	21
No		
Seminars are helpful in I.R awareness	86	86
Yes	14	14
No		

VARIABLES	MEDICAL STUDENTS	STAFF OF RADIOLOGY DEPARTMENT	CHI.SQUARE VALUE	P-VALUE
X-rays dangerous radiations for health Yes No	23 57	9 11	1.942	0.163
C.T dangerous source of radiations for health Yes No	27 53	16 4	13.964	0
Radiological treatment dangerous for health Yes No	34 46	7 13	.372	.542
PET scan dangerous for health Yes No	2 78	7 13	20.635	0
Cancer most common health risk of rad. Yes No	71 9	12 8	9.373	0.002
Genetic disorders most common health risk Yes No	51 29	14 6	.275	.600
Skin disorder commonest health risk of rad. Yes No	52 28	10 10	1.528	.216
Nuclear waste dangerous source of radiation Yes No	75 5	19 1	.044	.833
After X-ray exam. Rays stay in our body Yes No	30 50	9 11	.378	.539
X-ray dose varies with age and body size Yes No	65 15	20 0	4.412	.036
Workers X-ray dept. >10 yrs. at high risk Yes No	75 5	19 1	9.219	.002

Staff members safe				
Yes	22	2		
No	58	18	2.686	.101
Stay away from patients under radiations				
Yes	35	18		
No	45	2	13.739	0
Diff. parameters for chest X-ray in children				
Yes	54	18		
No	26	2	4.018	.045
Diff. parameter for chest X-ray in adults				
Yes	54	18		
No	26	2	4.018	.045
Diff. parameters for chest X-ray in pregnant				
Yes	65	11		
No	15	9	6.044	.014
Diff. method for chest X-ray in lactating mothers				
Yes	56	11		
No	24	9	1.628	.202
UV exposure enhanced now-a-days				
Yes	72	17		
No	8	3	.409	.523
Inventions in tech cause more rad. Exposure				
Yes	55	9		
No	25	11	3.917	.048
Diagnostic therapy more dangerous than disease				
Yes	21	10		
No	59	10	4.219	.040
Radiation badges are helpful in preventing exposure				
Yes	69	20		
No	11	0	3.090	.079
All rad. harmful for health				
Yes	28	17		
No	52	3	16.162	0
Patients receiving repeated rad. are at high cancer risk				
Yes	74	19		
No	6	1	.154	.965
Are radio and TV antennae rays safe				
Yes	44	13		
No	36	7	.653	.419
Huge rad. exposure always leads to cancer development				
Yes	43	11		
No	37	9	.10	.920
Ionizing rad. are used in MRI				
Yes	28	2		
No	52	18	4.762	.029
Ionizing rad. are used in ultrasound				

Yes	26	2	4.018	.045
No	54	18		
Rad. absorber shields provide protection to radiology staff				
Yes	72	20	2.174	.140
No	8	0		
Major rad. protection measures				
Yes	41	15	3.663	.056
No	39	5		
Any training about rad. exposure and its risks				
Yes	14	10	9.625	.002
No	66	10		
Any awareness procedure about avoiding rad. exposure around you				
Yes	34	14	4.848	.028
No	46	6		
Need to enhance awareness among staff of dept.				
Yes	67	20	3.736	.053
No	13	0		
Need of awareness among medical students				
Yes	76	20	1.042	.307
No	4	0		
Media helpful in spreading awareness				
Yes	55	10	2.473	.116
No	25	10		
Regular lectures helpful in I.R awareness				
Yes	60	19	3.858	.050
No	20	1		
Seminars are helpful in I.R awareness				
Yes	66	20	4.070	.044
No	14	0		

DISCUSSION

Radiation exposure is enhanced now-a-days and man-made sources account for about 18% exposure of ionizing radiations. Although radiations are widely used for diagnostic and therapeutic purposes but on the other hand their use also causes adverse effects depending upon their dose, duration and intensity. Several researches are conducted in different parts of the world to know about the awareness of ionizing radiations among the people.

Our study included 100 participants. Majority of the participants were medical students (80%) and 20% were staff members of radiology department public hospital.

Cancer was considered to be the most common risk to health due to radiations by 83% of the participants (*p-value 0.002*) and it was believed to be the most frequent single risk for health due to exposure to the radiations in a research done in 2014.^[11]

CT scan is a dangerous source of radiations depending upon its dose, duration, intensity along with the age and body part of the recipient. The single CT scan exposure is equal to almost 100-200 chest X-rays. 43 participants called CT scan a dangerous source of radiation while 57 participants out of which 53 were medical students did not mark it as dangerous for health which showed that the awareness of participants especially medical students in this aspect is deficient.

People working in X-ray department for more than 10 years are at high risk according to 89 participants ($p < 0.05$) in comparison with the study conducted in one of the private medical colleges of Karachi, Pakistan in 2008 which showed that expected lifespan of radiologists is shorter than the other medical specialists according to 13% of fourth year MBBS students ($p < 0.0005$).^[16]

Skin disorders were found to be the most common health risk by 62% of our participants but at the same time 38% of people did not consider skin disorders the most common health risk by radiations and 35% participants were unaware of the fact that genetic disorders are commonly caused by these radiations.

26% medical students and 2% staff members were of the view that ionizing radiations are used in ultrasound ($p < 0.05$) in contrast with the study conducted in 2015 in Nigeria which showed that out of 312 students 49% believed that ionizing radiation are emitted during ultrasonography.^[4] In another research done in February 2010 about awareness among internees and the students regarding ionizing radiations from the commonly used imaging procedures of diagnosis, the results showed that (11.3% and 25.5%) respondents had an incorrect belief that ultrasonography and magnetic resonance imaging procedures emit ionizing radiations respectively.^[15]

With the advancement in technology, new inventions are a source of increased radiation exposure according to 64% of the participants, out of which 55 were medical students and 9 participants were staff members ($p < 0.05$). Radiation badges were found helpful in preventing radiation exposure by 89% of the respondents.

30% of the participants of this study had an opinion that ionizing radiations are used in MRI while 70% did not consider that ionizing radiations are used in MRI ($p < 0.05$), as compared to the previous research which indicated that 23% of the medical students of 4th year and 15% of the final year medical students believed MRI to be non-ionizing. It means majority of the participants in our study were aware of the fact that ionizing radiations are not used in MRI.^[16]

65% of the medical students and 20% of the staff members knew that X-ray examination dose varies with age and size of body ($p < 0.036$). Different parameters are used for chest X-ray examination in children (72%) with p value 0.045 and in pregnant ladies (76%) with p value 0.014. 54% of the medical students and 18% of the staff members were of the view that different parameters are used for chest x-ray examination in adults ($p < 0.045$).

Results of study showed that 52 respondents were of view that they do not observe any awareness procedure for avoiding radiation exposure around them ($p 0.028$) and 86% of the participants had a view that seminars are helpful in awareness about ionizing radiation ($p 0.044$).

The medical students as future doctors have to answer questions regarding radiations. They can achieve this ability by getting information during their rotation in the department of radiology. Their knowledge should be reliable, adequate and up-to-date. This need is also highlighted in a research done in 2010 Feb.^[15] We have to overcome the lack of awareness. The results of this research showed that although being medical students,

there are students and staff members who are unaware of hazards of ionizing radiations. In our society people go on for these diagnostic radiological tools even for minor illnesses as a result of which we see that the ratio of cancer patients is increased and infertility is very common now-a-days. So, there is a need that people must know that these imaging techniques must only be used when necessary and protective measures must be used by the staff of radiology department during these procedures. In this way we can reduce these life threatening risks that are becoming prevalent. It can be done by delivering specific objectives regarding radiations in curriculum for medical students. Lectures, tutorials and workshops can play an important role in this regard.

CONCLUSION

Majority of the participants included in this study were aware of the fact that ionizing radiation when used in excess are harmful for health but there is a proportion of medical students and staff who are unaware of harmful effects of radiations and the protective measures that must be used in radiological procedures. Major portion of people and staff although know about protective measures but still they observe negligence in adopting those measures during radiological procedures. So, there is a need to enhance awareness among the people regarding life threatening hazards of radiations so that they may adopt protective measures. For this purpose students must be educated during their ward rotation in the radiology department and mass media can also play a vital role in this aspect to spread awareness among people on a larger scale.

REFERENCES

1. WHO[INTERNET]. Ionizing Radiation, health effects and Protective Measures. GENEVA. Nov 2012[cited 2016]. Available from: www.WHO.int/mediacentre/factsheets/fs371/en/
2. Stein J. The Carcinogenic Hazards of Ionizing Radiation in Diagnostic and Therapeutic Radiology. CA., 1967; 17(17): 278-87.
3. Syed M, Qamar A, Nighat N. Knowledge about ionizing and non-ionizing radiations among medical students. JAMC., 2008; 20(1): 118-21.
4. Geofery L, Basirat M, Eze CU, Nwobi I, Chigozie NI, Auwal A, Kalu O, Bobulin NF, Abubakar G. Evaluation of the knowledge and awareness of non-ionizing radiations among final year students of college of medical science university of Maiduguri. IRJPAP., 2015 Dec; 3(3): 8-14.
5. Lee CL, Haims AH, Monico EP, Brink JA, Forman HP. Diagnostic CT scans: assessment of patient, physicians and radiologist awareness of radiation dose and possible risks. Radiology, 2004; 231: 393-8.
6. Salih S, Zeidan ZA, Alzalabani A, Albadrani MS, Yousef M. Awareness and knowledge towards ionizing radiation hazards among medical students, Interns and Residents in Al-Madinah Al-Munawarah, KSA. Life Sci J., 2014; 11(3): 6-10.

7. Zhou GZ, Wong DD, Nguyen LK, Mendelson RM. Students and Intern awareness of Ionizing Radiation exposure from common diagnostic imaging procedures. *J Med Imaging Radiat Oncol.*, 2010; 54(1): 17-23.
8. Shiralkar S, Rennie A, Snow M, Gulland RR, Lewis MH, Thomas KG. Doctors' knowledge of radiation exposure: Questionnaire study, 2003 Aug; 327(7411): 371-2.
9. Thomas KJ, Lewis MH, Shiralkar S, Snow M, Gallband RB, Rennie A. Doctors' knowledge of radiation exposure of radiosensitive in different organs is deficient. *BMJ.*, 2002 April 13; 324(7342): 919.
10. Quinn AD, Taylor CG, Sabharwal T, Sikdar T. Radiation protection awareness in non. radiologists. *BJR.*, 1997; 70: 102-106.
11. Yurt A, Cavusoglu B. Gunay T. Evaluation of awareness on radiation protection and knowledge about radiological examinations in health care professionals who use ionizing radiation at work. *MIRT.*, 2014; 23(2): 48-53.
12. Dellie ST, Admassie D, Ewnetu Y. An assessment of final year medical students and interns awareness of Radiation exposure to common diagnostic imaging procedures. *Advances in Radiology*, 2014.
13. Rassin M, Granat P, Berger M, Silner D. Attitude and knowledge of physicians and nurses about ionizing radiation. *JRADNV.*, 2005 June; 24(2): 26-30.
14. Krille L, Hammer P, Merzenich H, Zeeb H. Systemic review on physicians knowledge about radiation dose and radiation risks about CT. *EJRAD.*, 2010 Oct; 67(1): 36-41.
15. Zhou GZ, Wong DD, Nguyen LK, Mendelson RM. Student and intern awareness of ionizing radiation exposure from common diagnostic imaging procedures. *J Med Imaging Radiat Oncol.*, 2010 Feb; 54(1): 17-23.
16. Mubeen SM, Abbas Q, Nisar N. Knowledge about ionizing and non-ionizing radiation among medical students. *J Ayub Med Coll Abbottabad*, 2008; 20(1): 119.
17. Mc Naught AD, Wilkinson A. Adiabatic lapse rate in atmospheric chemistry. In: Nic M, Jirat J, Kosata B. *Compendium of chemical terminology; IUPAC Recommendations*. 2nd ed. Oxford: Science B, 1997; 1547.
18. Thing L. WhatIs.com[Internet]. [place unknown]: [publisher unknown]; 1999. Available from: <https://www.google.com.pk/url?sa=t&source=web&rct=j&url=http://whatis.techtarget.com/definition/ionizing-radiation&ved=0ahUKEwiVr-qJnYnLAhXF2hoKHRNxDO0QFgg7MAU&usg=AFQjCNG0YxD1DTOFnpbCEwuDR5TkEzrRQg>
19. Wikipedia, the free encyclopedia. William H: Hazard Identification: from a quantitative to a qualitative approach, 2001; 12(4): 223-8.