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ASSESSING RADIATION PROTECTION AWARENESS AMONG HEALTHCARE PROFESSIONALS IN KHYBER PAKHTUNKHWA: A CROSS-HOSPITAL STUDY

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ABSTRACT

Background: *Modern diagnostic methods often utilize ionizing radiation and it helps to identify many illnesses. Several current modalities operating on ionizing radiation comprise X-ray. Despite the fact that ionizing radiation has been used in diagnosis and therapy of various disorders it has also been linked with different avoidable risks for healthcare professional, technician and the patient. However, to minimize the risks associated with ionizing radiation, patient and personnel can be protected. This survey was conducted to establish the level of awareness of radiology staff over radiation protection.****Objective:*** *The aim of the study was to determine the awareness level of radiation protection in health care professionals practicing in diverse hospitals of KPK Pakistan.Materials and Method: Data for this cross-sectional study was collected in the various teaching hospitals in KPK Pakistan. A criteria was created in order to engage the 240 participants. The teaching hospitals that comprised were Hayatabad Medical Complex Peshawar, Lady Reading Hospital Peshawar, Timergara Teaching Hospital, and Khyber Teaching Hospital Peshawar. Questionnaire was arranged the usefulness of which is examined by carrying out a pilot study by choosing radiologic staffs from the mentioned hospitals. The data was collected simultaneously by completing the questionnaire and the data was analyzed with aid of the SPSS software.****Results****: The educational background of 240 participants differed from SSC (matric) to graduation/ 'F' level. The professional practice durations of the participants in medical radiology mean ± SD was 15 ± 8 years; The duration of practice ranged between 1-32 years. Finally the data are considered to assess that the participants' knowledge level about radiation awareness was different from each other the range was 35 % to 95% and the median score of the participants was 75 % of total marks. It emerged that the awareness level difference depends on the educational background and duration of experience in the specialty of medical radiation science profession.****Conclusion:*** *The survey finding revealed the existence of a very strong need to implement personnel training programme in MRS both at provincial and national level. In addition, one needs the right educational qualifications in science and practice of*

administering personal qualities assessment (PQA) tests on the radiology personal when recruiting them.
Keywords: *Protection, shield, awareness, radiology, radiation*

INTRODUCTION

The United Nations reports that 3,700 million radiology tests and treatments are performed globally, with ionizing radiation playing a significant role in diagnosing and treating diseases. However, many patients and healthcare professionals are exposed to unwanted radiation due to lack of radiation protection awareness. Advances in technology and laws have reduced these risks, but there is still a need for increased awareness and strategies to protect patients[1]. A study conducted in KPK found that 93% of radiologic personnel had low knowledge about ionizing radiation risks, and 93% had less scores in all modalities and therapeutic procedures associated with radiation risks. The study aims to improve awareness and understanding among radiologic personnel in KPK [2].

Diagnostic modalities like X-rays, CT, MRI, ultrasound, PET scans, and nuclear medicine are widely available worldwide in hospitals for treating, diagnosing, and monitoring certain diseases. These modalities work on radiation, affecting patients and healthcare personnel. Advanced orthotic and urologic procedures often require intraoperative fluoroscopic procedures. The radiation exposure dose depends on the type of procedure and the area of the body being diagnosed. Some procedures have higher exposures, such as lower GI series, computed tomography, and PET scans. MRI and ultrasound are non-invasive, sensitive, and specific, making them important for acute and chronic disease patients and planning spine surgery. Ultrasound is considered safe in pregnancy and has no known radiation hazards to operators[3,4].

The study aims to evaluate the knowledge and practices of radiation precaution among healthcare professionals in a tertiary hospital. It identifies areas of insufficiency in knowledge and availability of personal safety equipment. The study emphasizes the need for appropriate education and enhanced protection of radiation equipment to decrease exposure for both medical personnel and patients. Incorrect operation of equipment risks both patients and operators, indirectly exposing staff members to unwanted radiation doses.

Radiation safety is crucial for healthcare providers, patients, and various departments in hospitals. Fluoroscopy examinations emit the highest ionizing radiation, causing potential risks to patients and healthcare personnel. Formal training on radiation safety helps reduce unnecessary exposure. Three basic guidelines are optimization, justification, and dose limitation. Radiologic professionals play a crucial role in educating patients and departments about potential side effects of radiation exposure. The ALARA rule ensures precautions are taken to decrease radiation exposure. Radiologic workers must have sufficient information about dosimeters and radiation protection equipment, such as aprons, gonadal shields, pelvis protectors, lead goggles, and console room shielding[5,6].

Understanding the science of radiation and technical protection strategies is crucial for healthcare professionals and patients. X-rays, high-energy rays within the electromagnetic spectrum, have a high capability to break molecules and ionize atoms, leading to the production of active ions that can damage DNA and cause mutations. Direct x-ray beams and scattered background x-rays are responsible for healthcare personnel and patients' exposure. There are three types of radiation dose measurements: absorbed dose, equivalent dose, and effective dose. Continuous exposure exceeding this threshold can contribute to a 1 in 1000 life spine risk of lethal malignancy. Other types of radiation, such as Alpha, Beta, and Gamma rays, can also be harmful and damaging[7].

Radiation dose can cause biological effects, either deterministic or stochastic. Deterministic effects result when a defined exposure limit is exceeded, while stochastic effects are dose-dependent and can lead to malignancy after years of exposure. Deterministic effects are influenced by the total amount of radiation exposure over time, while stochastic effects are likely if a specific x-ray damage genetic materials, leading to malignancy. Research on the effects of ionizing radiation from short-term to long-term exposure is crucial, as there are high fluctuations in radiation exposure and healthcare protection[8].

To reduce radiation exposure, three key guidelines are: minimizing exposure time, ensuring source to personnel distance, and using protective shielding. To avoid unwanted radiation, personnel should preplan

examination procedures and obtain only required radiographs. Magnification can enhance individual exposure, so use it carefully. Real-time fluoroscopy can be used to evaluate anatomy better, but pulsed fluoroscopy can capture more radiographs in a second. Maximizing distance from the x-ray beam and examination area is crucial. Maintaining proper spatial and contrast resolution is essential to minimize radiation exposure to healthcare professionals[9].

Physical radiation shielding is crucial in radiology, and various types of personal protective equipment (PPE) can be used to protect personnel. Lead acrylic aprons can decrease radiation by factor 10 of head and neck, while movable shields can help avoid 90% of radiation dose exposure. Leaded aprons are preferred for personal safety, with diameters ranging from 0.20 mm to 0.5 mm. Thyroid shielding and aprons should be used together. Patients should wear protective gowns for body parts not being radiographed. Leaded goggles should have a diameter of 0.26 mm, and the cover must stop radiation to protect eye lenses. Regular testing, shortage, and storage of PPE are essential. Dosimeters are also necessary for measuring radiation exposure, but many personnel do not wear them or wear them incorrectly[10].

Nuclear medicine (NM) has been used for diagnostic and therapeutic purposes since the 1940s, with drugs prepared from radioactive isotopes and molecular vehicles. Positron emission tomography (PET) is a diagnostic modality, while brachytherapy is a type of radiation therapy used to treat cancer. However, NM drugs can cause adverse effects like thrombopenia, vomiting, nausea, fatigue, neutropenia, and diarrhea. To manage radiation exposure, healthcare providers should follow standard precautions, flush spoiled radioactive drugs in secure areas, store NM drugs in shielded sections, and dispose of radioactive substances properly. As radiological imaging advances, healthcare society is focusing on ionizing radiation safety, improving safety training, and enforcing protective policies. Dose optimization is crucial in interventional radiology, and ensuring the ALARA (as low as reasonably achievable) regulation helps reduce radiation exposure[11,12].

MATERIALS AND METHODS

This cross-sectional and observative study survey was carried out in various teaching hospitals in KPK Pakistan. A criteria was built to involve the participants consist of house officers and teaching medical officers. The teaching hospitals comprised were the Hayatabad Medical Complex Peshawar (HMC), Leady Reading Hospital Peshawar (LRH), Timergara Teaching Hospital KPK and Khyber Teaching Hospital Peshawar (KTH). Questionnaire was arranged the usefulness of which is examined by carrying out a pilot study by choosing radiologic under graduate internees, technologists and technologists, radiologists from the mentioned hospitals. Data was taken together by filling the questionnaire from the involved house officers and training medical officer, radiologists and technologists.

Study Design: Cross sectional and observative survey

- Hayatabad Medical Complex Peshawar (HMC)
- Leady Reading Hospital Peshawar (LRH)
- Timergara Teaching Hospital KPK
- Khyber Teaching Hospital Peshawar (KTH).

Study Duration: February to June 2022.
Sampling Technique: Probability convenient sampling technique

Sample selection:

The sample size of our study is 240 Health Care Professional. We have visited to the mentioned hospitals and met the (HOD) of Radiology department, we ask about the Health Care Professional and he respond us about 636 Health Care Professional are working in the mentioned hospitals so we will be meet them for radiation awareness in four Months. Then according to Raosoft calculator.

- Sample size: **240**
- Population size: **636**
- Population proportion: **50%**

- Confidence level: **95%**
- Margin of error: **5%**

S. No	Time Span	No Health Care Professionals
1	1st Month	60
2	2nd Month	60
3	3rd Month	60
4	4th Month	60

Inclusion Criteria:
Assessment of awareness of radiation protection, dose levels and associated complications of radiation exposure in imaging procedures among undergraduate internees, radiology residents, radiologists, technologists and technicians of any ages.

- Diagnostic or Therapeutic radiation

Exclusion Criteria:
Our study excluded:

- Health care provider other than radiology
- Patients
- Patient attendant
- Public
- Natural and other man-made radiation except diagnostic or therapeutic radiation

Ethical issues
Ethical permission to carried out the study was got from Hayatabad Medical Complex hospital Peshawar ethical committee. Consent to carry out the survey at HMC Radiologic department was attained from HMC authorized committee. demographic consent was used to study personnel. Recorded information in the questionnaire and clinical data were used only for the study and not any purpose.

2. Data Collection Procedure
The information was collected through closed ended questionnaire.
A semi-structured questionnaire was designed and filled by the selected house officers, radiographic staffs post-graduate trainees of the respective MTI's. The questionnaire was self-explanatory and the participation of respondents was voluntary.
Besides, a pilot testing was performed before distributing the questionnaire among the actual participants to ensure the viability of the study.

3. Statistical Analysis
For constant data, mean and standard deviation were calculated. While categorical variables like demographic values were obtainable in terms of frequencies and percentages. Results were drawn by applying an appropriate statistical analysis. The data was analyzed by using SPSS (Statistical Package for Social Science), version 25 to determine, Prevalence of radiation risks and hazards and level of awareness among radiographer in MTI's of KPK.

RESULTS AND ANALYSIS

Figure 1: Percentage distribution of level of awareness with key wards

This figure evaluate the percentage distribution of the level of awareness among radiologic personnel using questionnaire Terminology, the highest percent were radiation (90%) term to which majority of participant were aware at high extant, the 2nd highest percent of the participant awareness is protection 65%, the next term is shielding 35%s which was low among personnel as expected, they are aware of patient safety (55%) at some level while the radiation risk, and radiation hazard ratio were low among them 25% and 12% were not applicable.

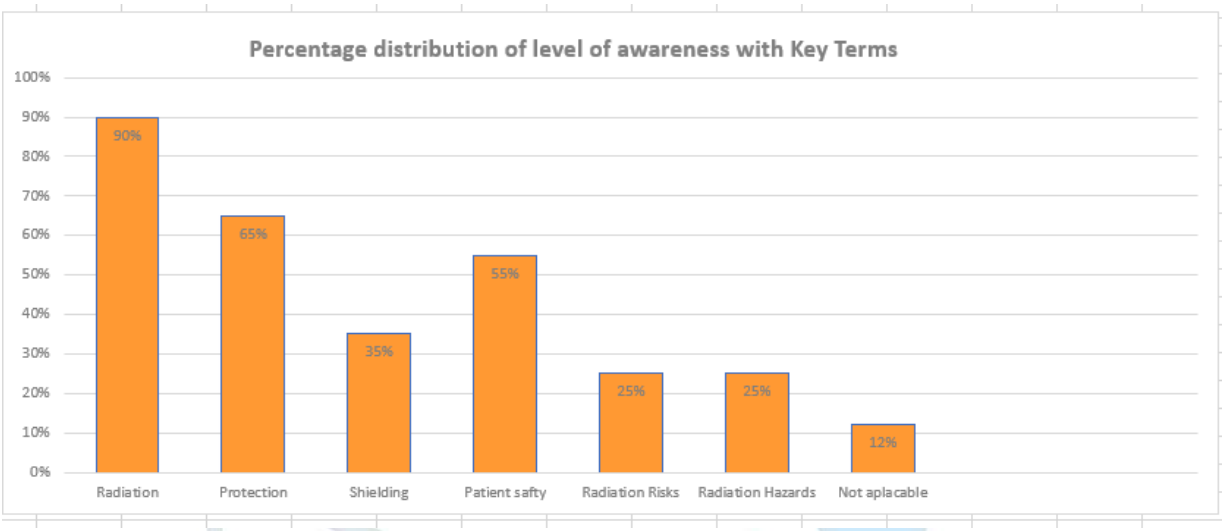


Figure 2: Percentage distribution with age wise of participants

The below table and figure 3.1 show that the frequency of the age wise distribution of radiation awareness. There was a total of 240 participants in the current study. Among them 25 to 40 years old were 113(47.0%) individuals, 41 to 60 years old were 127(53.0%) individuals.

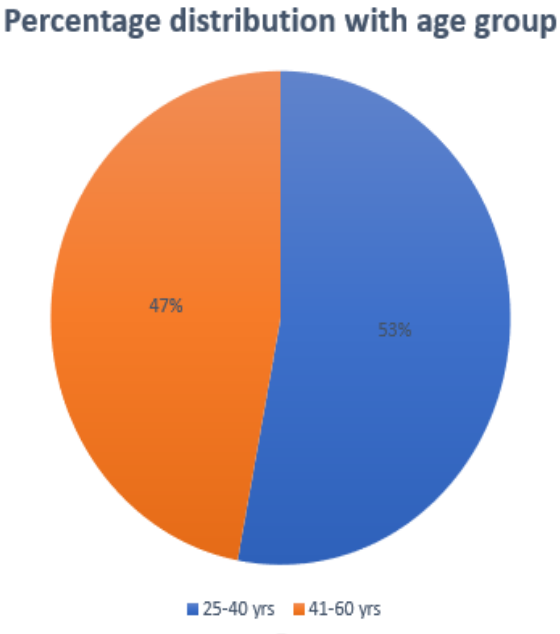


Table 1 :Frequency of the age wise distribution for the radiation awareness of contributors

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	25-40	113	47	38.1	47.0
	41-60	127	53	31.0	53.0
	Total	240	100.0	100.0	

Table 2: Distribution frequency based on academic qualification of participants with mean score (%)

The academic education of the radiology technician were ranging from matric (SSC) to graduation level (table-2).The distribution frequency based on qualification of participants with mean score as participant frequency 70 (29.3%) and mean score were 70 in an SSC qualified group, Frequency of participant were 35(14.6%) and mean value 74 in group of SSC with radiology diploma certificate from medical faculty board, HSSC qualified participant frequency were 47(19.5%) with mean score of 76, HSSC with radiology diploma from KPMF, BS. Radiology, MS. Radiology and Radiologists frequency were 97 (12.2), 41(7.1), 13(5.3%) and 7(3%) respectively while mean score 78, 80, 83, and 92 respectively.

Academic Qualification	**Frequency (n=240)**	**Mean Score (%)**
SSC	70(29.3%)	70
SSC with Radiology diploma (KPMF)	35(14.6%)	74
HSSC	47(19.5%)	76
HSSC with Radiology diploma (KPMF)	97(12.2%)	78
BS. Radiology	41(17.1)	80
MS in Radiology	13(5.3%)	83
Radiologists (FCPS)	7(3%)	92

Table 3: Experience VS percent score

It was experienced that a participant having a background of medical science had best levels of awareness about radiation safety as compare the science illiterate, representing that related informative science of awareness had play vital role of knowing ionizing radiation induced practices and accompanying awareness. Our study revealed that the higher frequency of experience duration was 88% between 16 to 20 years, frequency of this experience group was higher as compare to the rest of groups. The remaining 5 groups percentage frequency were ranging between 65% to 74% (Table-3). The possible reasons for the drop in percentage frequency in a group of more experience intervals were seems to be because of the false familiarity and the absence of interest with time, slowness and aging complications.

Experience Duration (years)	**Frequency (n=240)**	**% Score**
1-5	18(7.3%)	65
6-10	35(14.6)	74
11-15	70(29.3)	68
16-20	35(14.6%)	88
21-25	41(17.1)	73
26-32	41(17.1%)	70

Table 4 : Regularity Compliance

In framework the regularity appliance necessities, the outcomes of this study specify that entire MTI hospitals and private medical centers required PNRA registration and license to use ionizing radiation and

radiopharmaceutical legally under PNRA guideline. Likewise, the survey outcomes reported that only one hospital is holding a license and registration of Pakistan nuclear regulation authority and without this hospital there were no quality assurance control program and HCPs dose inspection for exposure duration of radiation (Table-4).

Hospital	PNRA Licensee	Quality Control Activities	Personal Monitoring
A	Yes	Yes	Yes
B	No	No	No
C	No	No	No
D	No	No	No

Table 5: Awareness of radiation hazard or risks frequency and percent.

A high frequency of the personnel (70%) believed that ionizing radiation has not very harmful to humanoid population, while 33.6% considered that radiation is very harmful for human being and a minor frequency believed that it was not hazardous to human being (Table 5).

Variable	n (%)
Enthusiastic to join the training about radiation hazard Yes	50 (20.9)
Not sure	172 (71.8)
No	21 (9.1)
Medical radiation hazard Very hazardous	80 (33.6)
Not much hazard	175 (70)
No hazard	29 (120

Figure 4: Distribution of participants according to habitual personal protection equipment (PPE) with lead apron, eye goggles, and thyroid shield while practicing in an atmosphere with radiation.

This figure determined that PPE wore relatively, 60.8% and 15.5% of them revealed that they regularly wear a leaded apron and a thyroid shield when working in atmospheres that involved radiation exposure, correspondingly. Though, Leaded goggles are frequently reported as the less wearing equipment of personnel protective equipment in various reports, the usage score ranges between 3% to 6% while the gonadal shielding is about 18% uses among participants in KPK Pakistan.

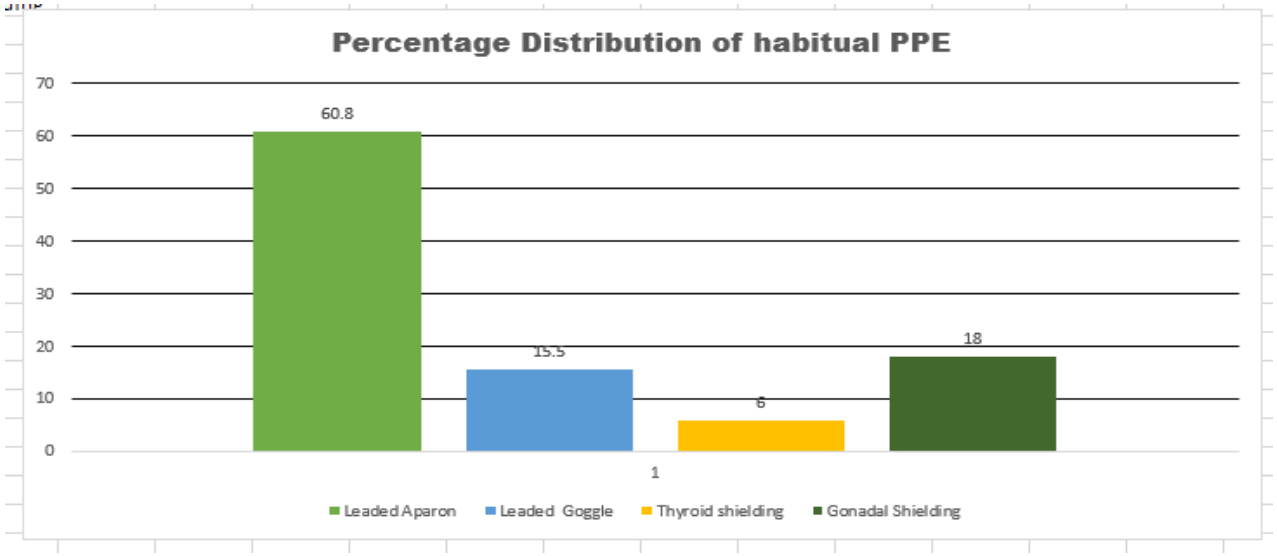
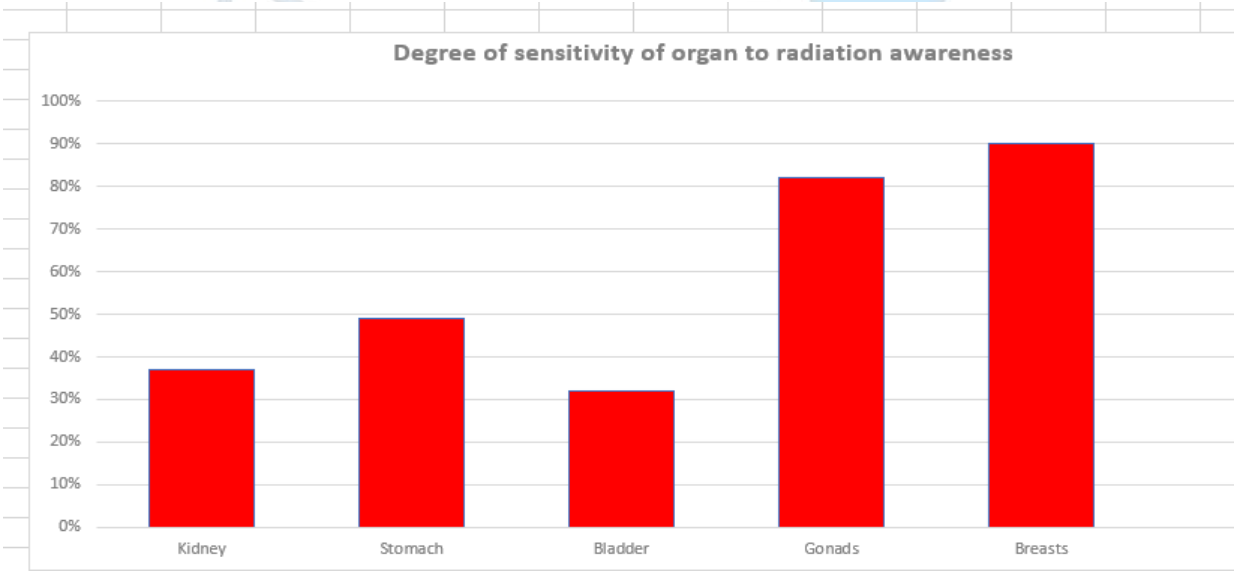


Figure 5: Information regard the percentage distribution of radiation sensitivity of various organs.

Using questioners by questioning contributors to assemble the several organ sensitivity data to radiation, The frequency was 50 (44.7%) they accurately arranged the organs, regarding each organ sensitivity to radiation, there were 37.5%, 49.2%, 32.5%, 82.5% and 90% who accurately arranged the kidney, stomach, gonads and breasts, respectively (Figure 5), for example urinary bladder was less sensitive as compare to the breasts and gonads which are the more sensitive.



DISCUSSION

This survey revealed that high frequency of HCPs was aware of the word radiation (90%), protection (65%), and patient safety (55%) terms while the least awareness terminologies were shielding (35%), radiation risk (25%) and radiation hazard (25%) (Figure .1). The age wise distribution is caried out among two groups 25-40 and 41-60 years the frequency was high of 41-60 years old contributors (53%) (Table.1, and Figure. 2). The outcomes of this survey direct that the educational qualifications and training in the respective subjects of medical radiation Science (MRS) of technologists is important for reliable diagnostic and therapeutic outcome from ionizing radiations practice in medical. On job training of irrelevant educational background technologists is often inconvenient. In radiation therapy and nuclear medicine all the MRS technologists had

on job training as currently there is no particular national training course in the country for the technologists in these two specialties for radiation awareness. The repetition or retakes of the procedures because of the staff in-competencies, absence of quality assurance activities or standard equipment performance can lead in needless exposure not only to the patients but personnel as well and at the same time loss of valuable resources. The PNRA regulations necessitate awareness of the MRS personnel about radiation safety practices, standards and management levels. The continuing professional development (CPD) relates to radiation protection practices is needed to create awareness amongst the MRS technologists as the consciousness of radiation is the first step before implementation, amenability and devotion to national regularity context. The CPD of the MRS technologists here in Pakistan also needs mandatory changes following the introduction of new diagnostic and therapeutic modalities in medical usage of ionizing radiations. In advanced countries CPD program for the radiographers and radiation technologists also comprise clinical audit, risk management and research areas [13]. The data analysis of academic qualifications versus percent mean score revealed that the sample group with radiographic certificates, SSC, HSSC with certificate from Khyber Pakhtunkhwa medical faculty (KPMF) and radiographic bachelors had a higher score as compared to the other educational groups (Table1). It was observed that sample group with science background had better radiation safety awareness levels than the others, representing that related educational background has a positive role in the understanding of ionizing radiation-oriented practices and associated awareness. It was further revealed that the score of 16-20 years' experience duration group was 88% which was higher than the all-other groups. In the rest of five groups percent score ranged from 65 - 74% (Table-3). The possible causes for the decrease in percent score in the higher experience groups seems to be due to the absence of interest with passing years, unpunctuality and other age-associated factors. In framework of regularity necessities, the outcomes of this study indicate that all the public sector hospitals and clinics using ionizing radiation equipment and radioactive substance required to registered and licensed under the PNRA registration and licensing context. Wearing the personal protective equipment (PPE) ratio were relatively low among HCP in this survey as required, the highest percentage of the wearing shielding was leaded aprons and the least wearing percentage was leaded goggle, the hospital radiation monitoring and safety regulation department required to ensure the wearing PPE shielding which minimize the radiation up to 90% (Figure .3).

In contradistinction to the recent findings, a study that was caried out among 92 Turkish health personnel including doctors, nurses, and technicians found that 42.4% and 21.7% of them were not aware about radiation hazards and considered common radiologic studies to be moderately safe, relatively[13].On the other hand, 77.3% of the radiology, radiotherapy, and dental personal of a teaching hospital in Nigeria[12] highly conscious and to be aware about radiation hazards. Similarly, 82% of anesthesia staffs in the United States were found to follow strictly radiation safety precaution and very high level of safety from radiation hazards. [13] With regard to the Asia-Pacific area, Fan et al. [14] found that 78.2% of orthopedical surgeons in China concern radiation exposure to be a problem of great concern.

Another survey was performed by Chaowanan Khamtuikrua that found about 78.5% of the participants were wore a thyroid shield, but only 31.3% of them wore lead goggles [15]. Another study that was caried out among orthopedic surgeons found that 35%, 3%, and 6% of them preferred to use a portable lead shield than wear protective apparel, wore lead goggles, and worked without a personal protective device, correspondingly. Similarly, another study that was performed in Nigeria in 2013 [16] found that only 12%, 5%, and 3% of radiographers consistently wore a lead apron, lead goggles, and a thyroid shield in their work environments, respectively.

5.1 Limitations

This study was carried out in a limited area with limited resources which did not conclude well the knowledge, behavior and attitude of radiology health care personnel. Knowledge and awareness are required towards the radiation risks and hazards as it is an essential chunk of daily clinical procedures, which will, no doubt, protect patients, radiologic personnel and co-department staffs from an incessant source of suffering.

Conclusions

The study finding report that there is a higher necessity for radiologic personnel awareness training sessions in entire medical radiation sections both at provincial and state level. The additional characteristic is the requirement for appropriate educational background in science introduction of post qualification admission test for medical radiologic personnel during recruitments.

Awareness and knowledge about radiation hazards of HCP may varies based on the occupational roles, level of training, and even nationality of healthcare professionals. The present findings observed that, in general, there was a low level of awareness about radiation hazards among the current sample. Most of the participants reported that they use were uses proper personnel protective equipment (except leaded apron) when they work in environments that contain radiation exposure. However, an extremely high number of health care personnel of radiology and other departments demonstrated inadequate knowledge about radiation hazards. These findings underscore the need to increase awareness and knowledge about radiation risks and hazards among health care personnel of radiology departments and co-staff members.

Recommendation

Further studies are recommended which will also enhance the dedication of the concern individuals towards radiation protection awareness. Radiation protection awareness training are required both national and provincial level to increase proper use of shielding by technicians to avoid potentially hazardous ionizing radiation risks.

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