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Research Article

Awareness of medical staff towards radiation protection and dose for radiological procedures in Taif, Saudi Arabia

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Abstract:
Aim: This study was carried out to evaluate basic knowledge on radiation protection and dose for radiological procedures among medical staff in Taif City.
Method: Questionnaires were administered among the 220 participants of this study to include nurses, technologist, medical students, residents, registrar and consultant within Taif City.
Results: among the 220 participants, 57.73% (127) were females while 42.27% (93) were males. Medical students comprised more than half of the total respondents, followed by nurses 16.8% and resident 11.4. 47.3% claimed they have average knowledge, 26.8% said they have good knowledge and 15.9% and 1.4% admitted they have poor and no knowledge respectively. Only 8.6% were sure that they have excellent knowledge on radiation. Meanwhile, 46.3%said they received lecture or tutorials in radiology, and 18.2% were not certain if they received such. It is remarkable to note that 46.4% of the respondents did not received education in radiation protection and 21.4% could not account if they had this information.
In general, knowledge of the participants on radiation is low considering they are in the medical profession. Scores were not consistent in each group of participants as they display either high or low scores in the different items, however, higher scores were obtained by medical students, residents, and consultants . Lowest score obtained by the participants was on more than one week in the natural background equal to one chest x-ray where only 11.4% got the correct answer. Highest score was obtained on children as the most sensitive to radiation where nearly 66.8% of the participants got the answer right.
Conclusion: It is concluded that knowledge on radiation hazard, dose, and protection of the participants is not adequate. Integrating the basics of radiation in the medical curriculum and supporting it with exposure, experience, and training would certainly improve level of knowledge of the participants.

Keywords: radiation, medical staff, knowledge

INTRODUCTION

Radiation therapy treats many types of diseases particularly cancer effectively. But like other treatments, it often causes side effects. These are different for individual person. They depend on the type of cancer, its location, the radiation therapy dose, and your general health.High doses of radiation therapy are used to destroy cancer cells. Side effects occur because radiation therapy can also damage healthy cells and tissues near the treatment area. Today, major advances in radiation technology have made it more precise, leading to fewer side effects. For some people, radiation therapy causes few or no side effects. For others, the side effects are more severe. Reactions often start during the second or third week of treatment. They may last for several weeks after the final treatment.The use of ionizing radiation for diagnostic purposes in the operating room has steadily increased the past 2 decades (1).and unintended radiation exposure for patients is increasing at a rate of 5% per year.(3) Although several authors have examined the amount of harmful radiation to the primary surgeon during various intraoperative procedures,(4) little attention has focused on the knowledge of exposure to the risks of residents in training. As a result, there has been a considerable increase in the amount of radiation to which trainees are exposed compared with past generations. The long- term sequelae of this radiation exposure by neurosurgery residents are unknown.

Radiation can be classified into ionizing and non- ionizing. Non-ionizing radiation does not have enough energy to produce ions (5), whereas ionizing radiation has the ability to knock electrons off atoms, thereby changing its chemical properties (5, 6). Likewise, there are four types of ionizing radiation: alpha radiation (α), beta radiation (β), photon radiation (gamma [γ] and X- ray) and neutron radiation (n) (6).Ionizing radiation comes from both natural and man-made materials (5, 6). From a total of 18% man-made radiations, around 15% exposures are due to the medical x-rays and nuclear medicine imaging (7, 8). The ionizing radiation that comes from man-made sources can be controlled and prevented, but there is little we can do for radiations that comes from natural sources (2, 3). Currently, there are different preventive measures recommended by the international commission on radiological protection (ICRP) (9) to reduce or prevent radiation side effects. It was recommended that all patient exposures must be justified and kept as low as possible. Doses should also be limited. Clients in governmental health institutions can push health professionals to take radiation imaging (10), and due to this and other factors, nearly 30% (10) of all radiologic examinations prescribed by physicians are not clinically significant. Hence, knowledge of clients about the health hazards of radiation imaging as well as protective measures would play a key role in reducing unnecessary imaging and its impacts as well as in utilizing protective measures persistently (11).Despite the presence of adequate evidence about knowledge of ionizing and non-ionizing radiation imaging among health professionals and radiologists, information about knowledge of radiation related health hazards and protective measures among clients has been limited. Therefore, This study was carried out to evaluate basic knowledge on radiation protection and dose for radiological procedures among medical staff in Taif City.

Results

Demographic characteristics of the participants

Table 1 presents that from among the 220 participants, 57.73% (127) were females while 42.27% (93) were males. Medical students comprised more than half of the total respondents, followed by nurses 16.8% and medical consultants 6.36%.

It is also evident from the table that as to their perceived level of knowledge on radiation, 47.3% claimed they have average knowledge, 26.8% said they have good knowledge and 15.9% and 1.4% admitted they have poor and no knowledge respectively. Only 8.6% were sure that they have excellent knowledge on radiation.Meanwhile, 46.3%said they received lecture or tutorials in radiology, and 18.2% were not certain if they received such. It is remarkable to note that 46.4% of the respondents did not received education in radiation protection and 21.4% could not account if they had this information.

Table 1. Demographic characteristics of the study participants (n=220)

	Gender			
Occupation	**Male**	**Female**	**Total**	**Percentage (%)**
Nurse	4	33	37	16.8
Technician	10	7	17	7.73
Medical student	41	73	114	51.8
Resident	18	7	25	11.4
Registrar	10	3	13	5.91
consultant	10	4	14	6.36
TOTAL	**93 (42.27)**	**127 (57.73)**	**220**	**100**
Knowledge on radiology				
Excellent	11	8	19	8.6
Good	26	33	59	26.8
Average	42	62	104	47.3
Poor	13	22	35	15.9
No Knowledge	1	2	3	1.4
Lectures/Tuto				
rials in	46	56	102	46.3
Radiology	32	46	78	35.4
Yes	15	25	40	18.2
No				
Maybe				
Education in Radiation Protection				
Yes	28	43	71	32.3
No	40	62	102	46.4
Maybe	25	22	47	21.4

The 220 respondents took a 10-item quick quiz to assess the level of their knowledge on radiation. The figures below summarizes the knowledge of the participants to the quick quiz. The bar colored green represents the correct response for each item.

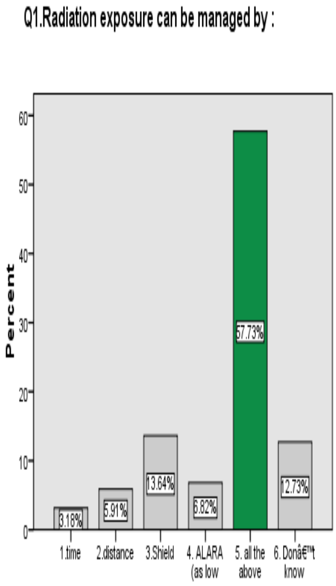

Figure 1a. Distribution of responses for question 1 (n=220)

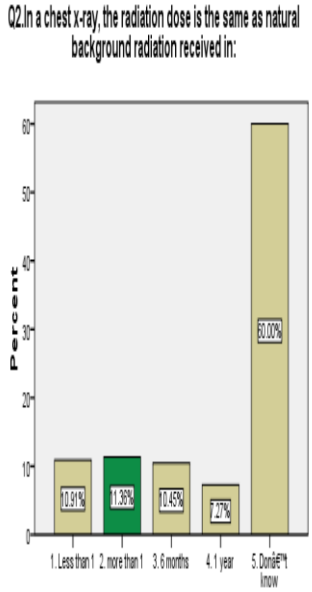

Figure 1b. Distribution of responses for question 2 (n=220)

Figure 1a shows that more than 50% of the participants are aware of managing radiation exposure through time, distance, shield, and ALARA. Meanwhile, Figure 1b depicts a low level of knowledge where only 11.36% of the participants knew that the radiation dose is the same as natural background radiation received in 1week time.

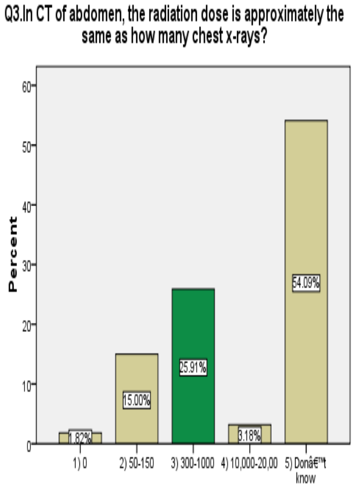

Figure 1c. Distribution of responses for question c (n=220)

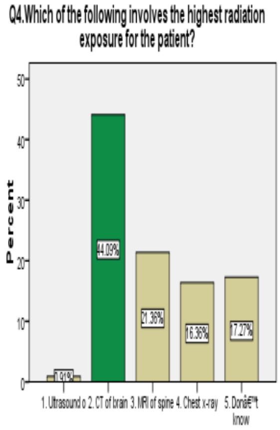

Figure 1d. Distribution of responses for question 4 (n=220)

From Figures 1c and 1d, it is evident that the participants have low level of knowledge as to the equivalent radiation dose of abdominal CT scan to chest x-ray with only 25.91% getting the correct answer. However, it is remarkable to note that 44.09% of the participants know that among the sites of radiation exposure, CT scan of the brain has the highest radiation exposure.

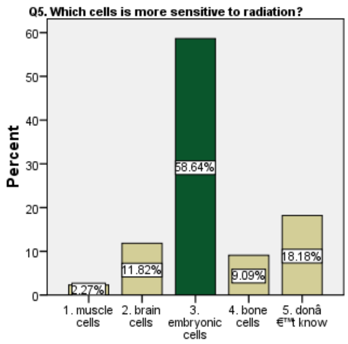

Figure 1e. Distribution of responses for question 5 (n=220)

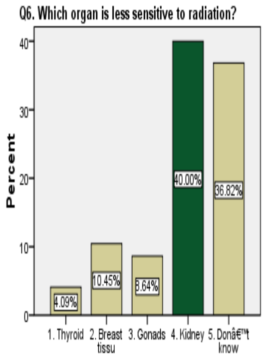

Figure 1f. Distribution of responses for question 6 (n=220)

It can be observed from Figure 1e that nearly 60% of the participants know that embryonic cells are more sensitive to radiation and 40% have knowledge that kidney is the organ that is least sensitive to radiation.

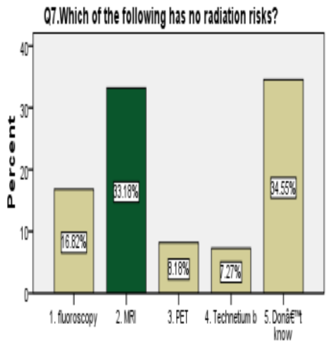

Figure 1g. Distribution of responses for question 7 (n=220)

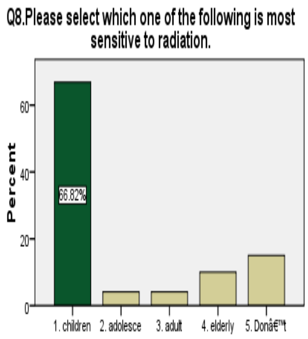

Figure 1h. Distribution of responses for question 8 (n=220)

Figure 1g presents that only 33% of the participants know that MRI has no radiation risks and an almost equal proportion doesn't know which among the methods has no radiation exposure. It is noteworthy that nearly 70% of the participants know that children are the most sensitive to radiation.

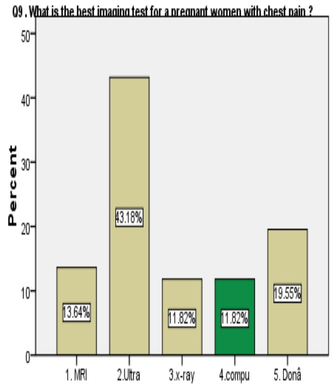

Figure 1i. Distribution of responses for question 9 (n=220)

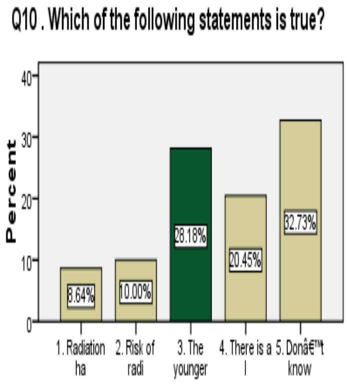

Figure 1j. Distribution of responses for question 10 (n=220)

Figure 1i presents a low level of knowledge of the participants as to the the best imaging technique for pregnant women here only 11.82% got computed tomography correct. Meanwhile, only 28.28% knows that the younger a patient's age is, the greater is the risk of radiation inducing cancer.

Summary of Responses

The 220 respondents took a 10-item quick quiz to assess the level of their knowledge on radiation. From Table 2, it can be gleaned that in general, the level of knowledge of the respondents maybe regarded low or inadequate. This may mean that despite the claim of the majority of the respondents that they have an average knowledge on radiation (Table 1), it may not be sufficient as revealed in their test scores.

From among the 10-item questions, highest knowledge was in item 8 where nearly 70% got the correct answer that children are most sensitive to radiation. On the other hand, almost 90% of the respondents didn't know that CTA (computed tomographic angiography) is the most prescribed radiologic procedure for pregnant women with chest pain. Low level of knowledge was also seen in item 2 on the dose of radiation where only 11.4% got the question right.

Table 2. Summary of Radiation Knowledge through quick quiz across occupation as associated to occupation (n=220)

Knowledge Item	**Occupation**						**TOTAL**
	Nurse	**Technician**	**Medical Student**	**Resident**	**Registrar**	**Consultant**	
1. Management of radiation exposure.							
Correct	16 (43.2)	10 (58.8)	61 (51.75)	18 (72)	11 (44)	11 (84.62)	**127 (57.7)**
Incorrect	21 (56.8)	7 (41.2)	53 (48.25)	7 (28)	2 (8)	3 (23.08))	**93 (42.3)**
2. Radiation dose received more than 1 week.							
Correct	7 (18.9)	3 (17.6)	7 (6.14)	3 (12)	2 (15.4)	3(21.4)	**25 (11.4)**
Incorrect	30 (81.1)	14 (82.4)	107(93.9)	22 (88)	11(84.6)	11 (78.4)	**195 (88.6)**
3. Radiation dose approximately 300-1000 chest x-rays in CT abdomen.							
Correct	14 (19)	5(29)	16 (14)	11 (44)	5 (38)	6 (43)	**57 (25.9)**
Incorrect	23 (81)	12 (71)	98 (86)	14 (56)	8 (62)	8 (57)	**163(74.1)**
4. Plain film has the highest radiation exposure for the patient.							
Correct	13 (35)	16 (94)	38 (33)	12 (48)	6 (46)	12 (86)	**97 (44.09)**
Incorrect	24 (65)	1 (6)	76 (6)	13 (52)	7 (54)	2 (14)	**123 (55.91)**
5. Embryonic cells are more sensitive radiation.							
Correct	22 (59)	12 (71)	54 (47)	18 (72)	9 (69)	14 (100)	**129 (58.6)**
Incorrect	15 (41)	5 (29)	60 (53)	7 (28)	4 (31)	0 (0)	**91 (41.4)**
6. Kidney is less sensitive to radiation.							
Correct	16 (43)	8 (47)	30 (26)	15 (60)	9 (69)	10 (71)	**88 (40)**
Incorrect	21 (57)	9 (53)	84 (74)	10 (40)	4 (31)	4 (29)	**132 (60)**
7. MRI has no radiation risks.							
Correct	10 (27)	12 (71)	30 (26)	10 (40)	5 (38)	6 (43)	**73 (33.2)**
Incorrect	27 (73)	5 (29)	84 (74)	15 (60)	8 (62)	8 (57)	**147(66.8)**
8. Children is most sensitive to radiation.							
Correct	25 (68)	13 (76)	72 (63)	19 (76)	8 (62)	10 (71)	**147(66.8)**
Incorrect	12 (32)	4 (24)	42 (37)	6 (24)	5 (38)	4 (29)	**73 (33.2)**
9. Computed tomographic angiography (CTA) as the best imaging test for a							

pregnant women with chest pain.							
Correct	4 (11)	5 (29)	12 (11)	2 (8)	2 (15)	1 (7.1)	**26 (11.8)**
Incorrect	33 (89)	12 (71)	102 (89)	23 (92)	11 (85)	13 (93)	**194(88.2)**
10. The younger a patient's age, the greater the risk of radiation inducing a cancer.	10 (27)	10 (59)	21 (18)	8 (32)	6 (46)	7 (50)	**62 (28.2)**
Correct	27 (73)	7 (41)	93 (82)	17 (68)	7 (54)	7 (50)	**158 (71.8)**
Incorrect							

Discussion

The spectacular and dynamic changes in technology brought important breakthroughs in clinical diagnosis, one of these is radiation technology. No one in this world today is left untouched to ionizing radiations. A study reported that in fact 18% of exposure is due to man-made source (20). A report of the US National Council and Measurements revealed that X-rays and nuclear medicine accounts 15% of all exposures to radiation (21). In United Kingdom, a study reported 100-250 deaths each year from cancers directly related to radiation exposure (22). While ionizing radiation offers improvement in diagnosis and treatment of diseases, its health risks should be a primary concern.

This present investigation was carried out to determine the extent of knowledge of the health care workers (nurses, doctors, hospital staff) and medical students on radiation. This study reports low level or inadequate knowledge among the participants on radiation considering that they are healthcare workers. This finding corroborates the finding of various studies which documented deficiencies of knowledge among medical students, doctors, paramedics and dentists about their understanding of ionizing radiation or the use of the equipment involved (23, 24, 25). Similarly, a study in Al-Madinah found overall knowledge and awareness on radiation hazards among medical students, interns and residents to be inadequate, 98% had low scores on all items regarding all aspects of radiation hazards (26). Despite the importance of radiation and its consequent hazards, only 32.3% obtained informal education course which may explain why participants have very low mean score of correct answer, 37.8%

The result of this study revealed higher scores obtained by medical students, consultants, and residents when scores were ranked, however, their scores were still low citing the fact that they are in the medical field. This result supports the finding in Al-Madinah which reported strong evidence of association between awareness on radiation hazards (having exposed to previous course on radiation hazards) and knowledge on radiology and medical physics ($p \leq 0.0010$). In addition, weak evidence was found between awareness on radiation hazards and gender in all aspects of radiation hazards with higher mean rank among females ($p \leq 0.05$). The study also found no evidence of association between awareness on radiation hazards among medical students, interns and residents across gender (p value was 0.08 for medical students, 0.58 for interns and 0.48 for residents) (7).Reflecting on the result of this study, researchers find it alarming that future medical practitioners and current medical practitioners displayed low level of knowledge on radiation which is important in arriving at appropriate clinical decisions. Unless they are taught which imaging methods use radiation and the approximate quantity of radiation involved, these medical practitioners may compromise the health of their patients and consequently public health in general. It is evident that the participants' knowledge on important aspects of radiation protection has a lot of shortcomings which we believe should be considered in designing the undergraduate medical curriculum to address the challenges of the future. Another important aspect of this investigation is the response "don't know" which was not classified by the researchers as wrong answer, but a choice of the participants not to answer. Categorically assessing this response, it would mean that they really have no idea or no knowledge on the matter being asked, which if collated with the wrong answers would contribute to the very low scores of the participants such as knowledge on radiation dose where nearly 55% answered they don't know. Although it would be unfair to expect them to quantify exact doses of radiation, we believe it is not unreasonable to expect them to know when is the radiation dose the same as a natural background as well as the hierarchy of radiation exposure. Overall, the quite disappointing scores on participants' knowledge of the many basic principles of radiation protection may be attributed to the lack of formal focused teaching/instruction in radiation.

A cohort study between 2009-2010 among medical students of King Abdulaziz University in Jeddah reported a significant improvement on the level of knowledge of the participants after lectures on radiation were integrated in their course (27). This may suggest that looking into the content of how radiation is taught in the curriculum would affect the level of knowledge and understanding of students which we suggests be considered in designing the medicine curriculum.

Conclusion

Based on the findings of this study, it is concluded that knowledge on radiation hazard, dose, and protection of the participants is not adequate. Integrating the basics of radiation in the medical curriculum and supporting it with exposure, experience, and training would certainly improve level of knowledge of the participants.

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