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Hanan Hassan Mohamed Soliman

Department of public health,
Community, Environment and
Occupational Medicine,
Faculty of Medicine, Suez
Canal University, Egypt

Lamiaa ELSayed Fiala

a) Department of public
health, Community,
Environment and
Occupational Medicine,
Faculty of Medicine, Suez
Canal University, Egypt.

b) Department of Health
Sciences, Faculty of Health &
Rehabilitation Sciences,
Princess Noura Bint
Abdulrahman University,
Riyadh, Saudi Arabia

Azza Abdelhamid Gad

Department of Radiology,
Faculty of Medicine, Suez
Canal University, Egypt

Ehab Hasanin

Department of Clinical
Oncology and Nuclear
Medicine, Faculty of Medicine,
Suez Canal University, Egypt

Ayman Ekram Fahim

Department of public health,
Community, Environment and
Occupational Medicine,
Faculty of Medicine, Suez
Canal University, Egypt

Amaal A. Tawfik

Radiation Physics, Egyptian
Nuclear and Radiological
Regulatory Authority, Egypt

Correspondence

Hanan Hassan Mohamed Soliman

Department of public health,
Community, Environment and
Occupational Medicine,
Faculty of Medicine, Suez
Canal University, Egypt

Knowledge and practices of radiation safety among healthcare workers in Ismailia city hospitals, Egypt

Hanan Hassan Mohamed Soliman, Lamiaa ELSayed Fiala, Azza Abdelhamid Gad, Ehab Hasanin, Ayman Ekram Fahim and Amaal A. Tawfik

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Abstract

Best medical practices needs health care workers to have an awareness of the possible threats from radiological imaging practices to allow for effective risk/benefit assessments and assurance that ionizing radiation is used skillfully. The aim of this study was to describe the knowledge and practices of health care workers regarding ionizing radiation safety and exposure. A cross sectional study was conducted at four hospitals in Ismailia city, and all health care workers (292) with potential exposure to radiation at the different hospital departments/units were included in the study. A structured self-administered questionnaire was used. The mean scores of correct answers regarding knowledge and practice were as low as 20.6 ± 5.7 and 3.6 ± 4.1 respectively. There is a significant positive correlation between knowledge score and practice score ($P < 0.0001$). The linear regression analysis showed that age, gender and specialty of participants are significant predictors of knowledge while age and working load of participants are predictors of practice. The majority of healthcare workers in this study lacked any specific training or education about radiation protection. We concluded that radiation safety knowledge and practice of participants were poor.

Keywords: radiation, protection, safety, knowledge, practice

Introduction

Radiological techniques play an essential role in the management of many diseases and they are used either for diagnostic and therapeutic purposes [1]. It was estimated that about 10 million and more diagnostic radiological techniques and 100000 nuclear medicine checks are being done daily. The national commission on radiological protection and measurements (NCRP) - report 160 entails that medical X-ray represents nearly 95% of all radiological investigations that account for 74% of the collective dose to the United States population [2]. Irrespective of the beneficial effect of the use of ionizing radiation, many risks such as somatic and genetic damages are estimated [3]. The risk of cancer due to diagnostic radiology is estimated to be about 0.5% to 3%. About 7500 and 5700 cases of radiation induced cancer among Japanese and United States population, respectively are attributed to the radiation dose from diagnostic X-ray processes each year [2]. Radiation safety and protection is thus necessary in order to reduce the levels of that exposure [4]. Education is the significant and the key measure of managing radiation safety and each individual using radiation needs to know what radiation is and how to handle it, as there is a growing number of diagnostic radiology procedures performed yearly which increases the concern for practicing radiation safety [5]. Studies have constantly revealed a deficiency of satisfactory awareness among physicians of necessary conceptions related to radiation exposure from medical imaging. In addition, many previous studies have shown that physicians tend to undervalue the hazards of radiation exposure to patients and health care workers [6]. In one study, it was stated that most healthcare workers did not receive any radiation safety-related training (88.8%) and 80.0% of them did not use to read about radiation safety [7]. In another study by Sushant and Sapana (2017), 72 % of the sample knows the meaning of justification, 84% knows the meaning of optimization and 76% of them have a good knowledge about ALARA [8]. The study of Awosan *et al.*, (2016) showed that less than a third (30.0%) of study population knew the limit on effective dose of ionizing radiation for a radiation worker and in another study,

it was shown that only 52.7% know the dose limit for radiation workers while 48.3% know the dose limit for general public [9, 10].

Subjects and Methods

This cross-sectional study was conducted in Ismailia city hospitals, Egypt between May 2015 to august 2017 to assess the knowledge and self-reported practices of health care workers regarding radiation Safety and protection. Confidentiality and anonymity were maintained according to the regulations mandated by Research Ethics Committee of Faculty of Medicine Suez Canal University. This study was conducted at four hospitals in Ismailia city and three hospitals refused to participate in the study. All health care workers with potential exposure to radiation at the different hospital departments/units (physicians, technicians, nurses and physicists) were included in our study and the number of eligible health care workers was (496) of these hospitals, only "292" healthcare workers agreed to participate with overall response rate of 59%.

A structured self-administered questionnaire that was developed by the researcher based on literature review. This questionnaire was then reviewed by four content experts and pilot tested for appropriateness of the content, wording, level of language, type, form, sequence of questions. The questionnaire was formed of the following parts: a. General characteristics data including socio-demographic data; occupational data including questions about qualification and duration of practice and work practice data as number of working hours per day and average number of patients seen daily. b. Data about radiation safety awareness, compliance and measures including questions about knowledge of radiation exposure risks and the radiation safety principles. C. Data about radiation safety practices of healthcare workers. D. Data about having previous training and the presence of radiation safety protocols.

Data were first cleaned, filtered then coded and entered into Microsoft Excel 201. Statistical analyzes were performed by IBM SPSS Statistics Version 22.0 (The Statistical Package for Social Science). Descriptive statistics of the data were presented. Graphs and tables were used as appropriate and according to the type of variables. Each statement of knowledge was measured on a two points, as right answer was scored (1), and wrong answer was scored (0). For the part of the questionnaire that assess practice, each statement was measured on a three points Likert scale ranging from zero (Bad) to three (Adequate). The percent score will classify knowledge and practice into poor, moderate and good according to the study of Salih *et al.*, (2014) and the study of Alavi *et al.*, (2017) in which scores less than 50% were considered as poor, between 50% and 75% medium as

and greater than 75% were considered as good [11, 12]. Alavi *et al.*, (2017) established a score for estimating knowledge, practice and attitude according to the Iranian academic grading (0–20) using the university's common 20-point grade scale. Therefore, the minimum and maximum scores were 0 and 20, respectively, for each set of RP-KAP questions. Scores <10 were categorized as poor; 10–15 as medium, and ≥ 16 were defined as good scores [12]. Statistical significance was determined at 95% level of confidence (i.e. differences will be considered significant if $P < 0.05$).

Results

The participants in this study were distributed as following; nine technicians at Hospital A, 92 health care workers at Hospital B, 167 health care workers at Hospital C and 24 at Hospital D. 34% of the participants were female and 66% of them were male. The mean age of them was 32 years of age. The majority of the participants were obtained from Hospital C (57.2%), then from Hospital B (31.5%). Regarding the distribution of participants in different departments, the majority of them (32.5%) were obtained from radiology department. As regard to the job characteristics of the study participants, the majority of the participants were physicians (151/292) and mostly young (68 residents and 48 specialists) (Table 1). The median workload of participants was 7 hours/day - 5 days a week. The average number of patients seen per day was 10-20 for 97 participants and was > 20 for 136 participants. 80% of participants have 5-10 years of work experience (table 2). The majority of study participants lacked any specific training or education about radiation (Figure 1). All mean scores of correct answers regarding knowledge are poor except the knowledge regarding investigations using ionizing radiation that reveals moderate knowledge. The mean score of correct answers regarding knowledge was 20.6 ± 5.7 representing 40.4 % of the total score (table 3). There was an overall inadequacy of radiation safety self-reported practices regarding patients among all participants (Figure 2). In addition, There were otherwise overall inadequacies of radiation safety self-reported practices among all participants (Figure 3). As regard to the different causes of inadequate radiation safety practices, unavailability being the most frequent cause. Second to the unavailability, the insufficient number of safety equipment plays a role (Figure 4). There is a significant positive correlation between knowledge score and practice score ($P < 0.0001$) (Figure 5). The linear regression analysis shows that age, gender and specialty of participants are significant predictors of knowledge while age and working load of participants are predictors of practice (table, 4).

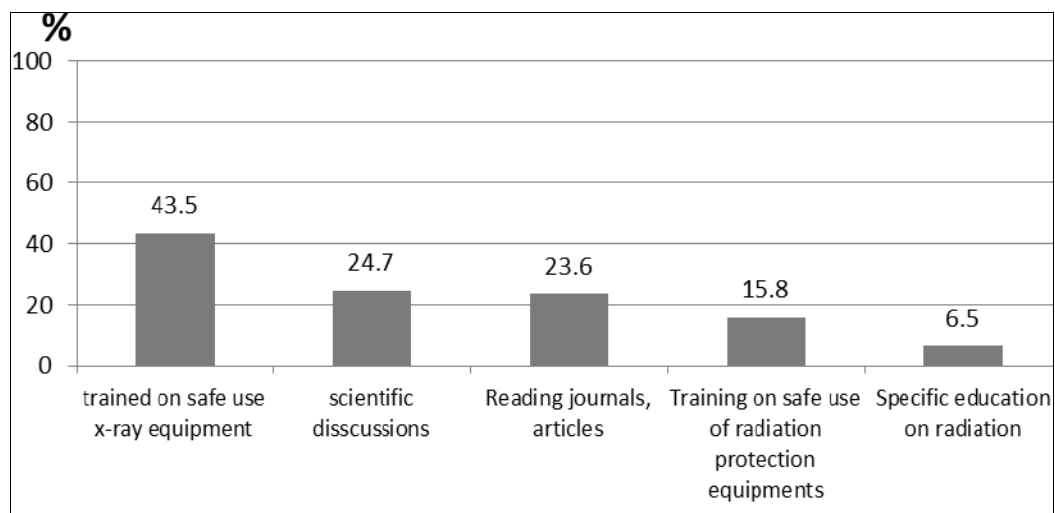
Table 1: Demographic and job characteristics of study participants (n=292)

Characteristics	Mean \pm SD	Median (range)
Age (years)	32.7 \pm 7.7	31 (27-38)
Gender	N	%
Male	194	66.4
Female	98	33.6
Hospital		
Hospital A	9	3.1
Hospital B	92	31.5
Hospital C	167	57.2
Hospital D	24	8.2
Job Category		

Resident	68	23.3
Specialist	48	16.4
Consultant	35	12.0
Nurse	73	25.0
Technician	66	22.6
Physicist	2	0.7
Specialty		
Radiologist	38	13.0
Cardiologist	29	9.9
Gastroenterologist	8	2.7
Oncologist	9	3.1
Anesthesiologist	34	11.6
Orthopedic	33	11.3
Technician	66	22.6
Nurse	73	25.0
Physicist	2	0.7
Level of education		
Bachelor degree	70	24.0
Master degree	48	16.4
PhD degree	35	12.0
Nursing school	49	16.8
Nursing technician institute	77	26.4
Faculty of nursing	13	4.5

Table 2: Occupational characteristics of study participants (n= 292)

Characteristics	Mean \pm SD	Median (range)
Working hours/day	8.4 \pm 3.1	7 (6-12)
Working days/week	4.9 \pm 1.2	5 (2-7)
Years of experience	N	%
Less than 5 years	90	30.8
5-10 years	80	27.4
More than 10years	122	41.8
Number of patients/day seen/day		
Less than 10	59	20.2
10-20	97	33.2
> 20	136	46.6

**Fig 1:** Sources of information about radiation protection (n=292)**Table 3:** The scores of correct answers regarding knowledge

Knowledge scores	Maximum score	Mean \pm SD	%
Knowledge of ionizing radiation exposure	14	2.8 \pm 2.4	20
Knowledge of ionizing radiation hazards	8	4.1 \pm 1.6	51.25
Knowledge of procedures using ionizing radiation	13	7.6 \pm 2.2	58.5
Knowledge of effective doses	8	0.3 \pm 1.3	3.75
knowledge score of correct answers	51	20.6 \pm 5.7	40.4

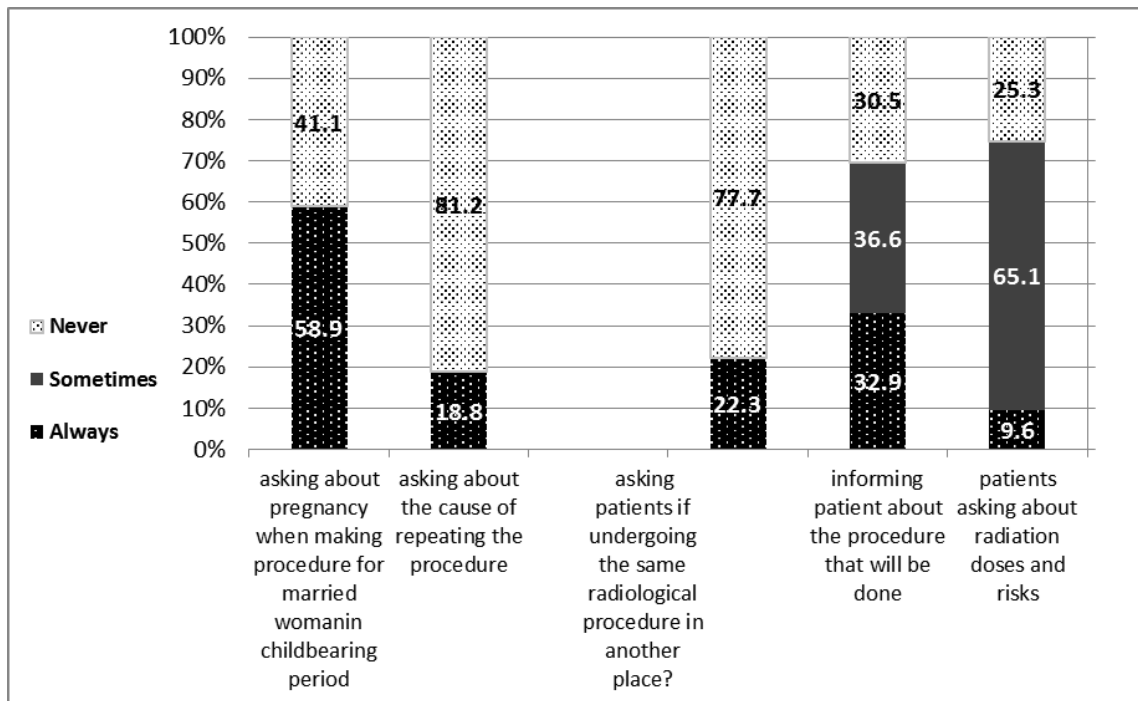


Fig 2: Radiation safety practices regarding patients

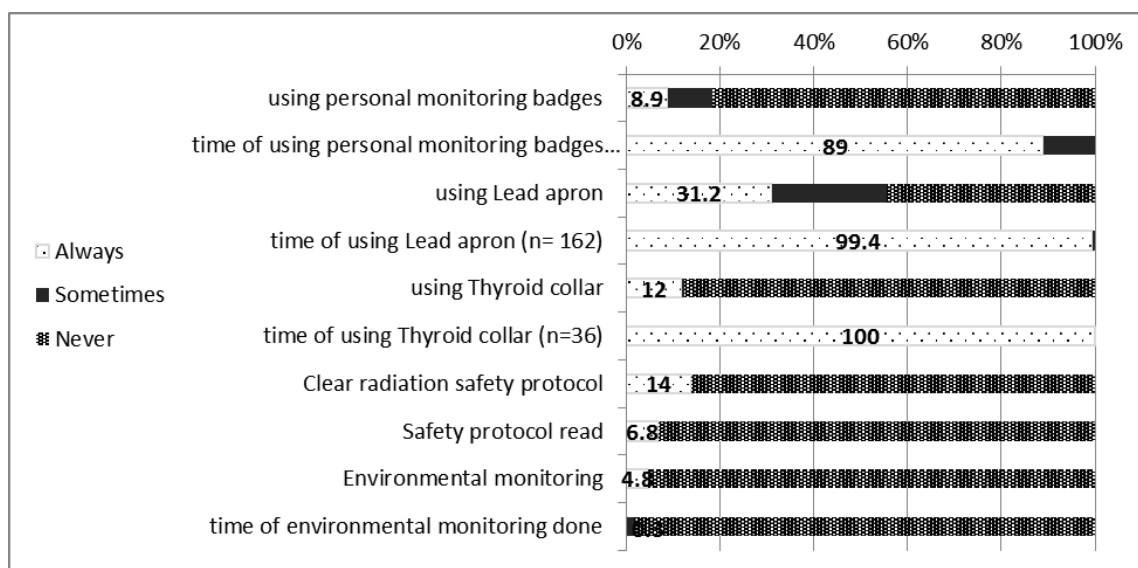


Fig 3: Radiation safety practices of healthcare workers

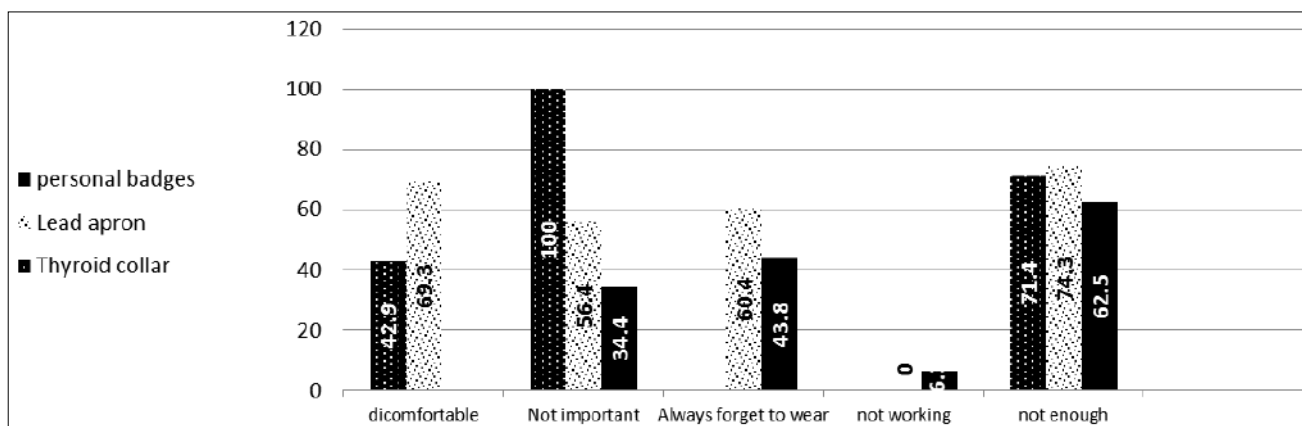


Fig 4: Causes of inadequate and poor practices

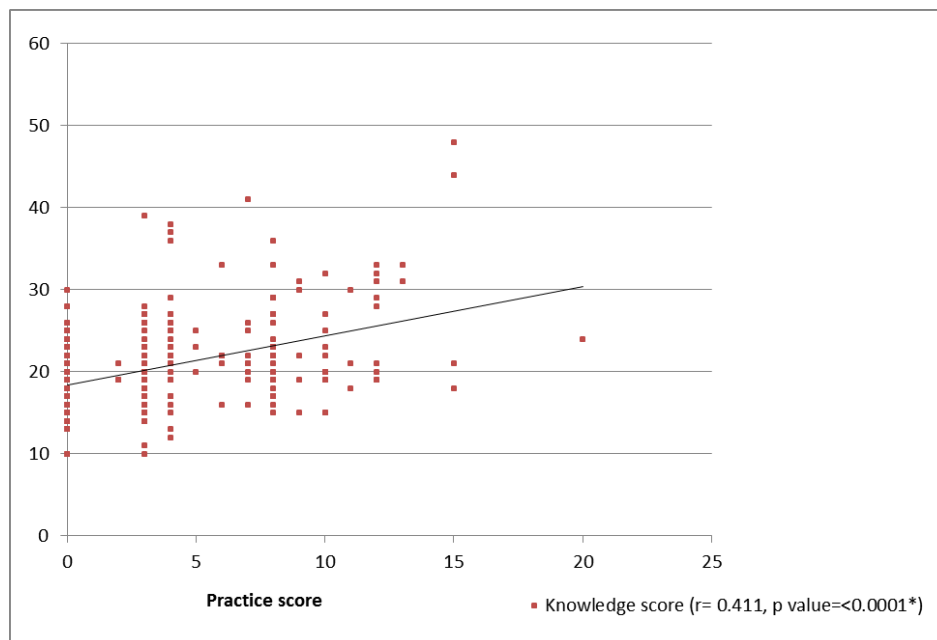


Fig 5: Correlation between radiation safety knowledge scores with practice score.

Table 4: Multiple linear regression analysis of independent risk factors affecting knowledge and practice

Variable	Knowledge			Practice		
	B	T	P-value	B	t	P-value
Age	0.113	2.481	0.014	0.076	2.381	0.018
Gender	-2.586	-3.830	<0.0001	0.099	0.207	0.836
Specialty	-0.707	-5.750	<0.0001	0.064	0.713	0.476
Work hours/day	-0.085	-0.823	0.411	-0.192	-2.688	0.008
Work days/week	-0.097	-0.347	0.729	0.889	64.483	<0.0001

Discussion

A total of 292 healthcare workers agreed to participate in the study with a response rate of 59%. A nearly similar response rate of health care workers (50.2%) was described in the study of Furmaniak *et al.*, (2016) who assessed radiation awareness among dentists, radiographers and students [13]. On the other hand, the response rate in our study was lower than the 76% rate found in the study of Abdellah *et al.*, (2015) that was carried out at Suez Canal university hospital on 2015 to assess the physicians' knowledge, attitude and practices of radiation safety [7]. This difference may be attributed to that in our study we surveyed four hospitals and our sample included different job positions (physicians, technicians, nurses and physicists) while on the other study only physicians in one hospital were included. On another occasion, the response rate in our study was higher than the study of Sadigh *et al.*, (2014) where response rate was 32.5% (173/532 residents) [14]. This difference may be due to the single sample type (residents) chosen from one large academic teaching system in the study of Sadigh *et al.*, (2014) [14]. The majority of healthcare workers in this study lacked any specific training or education about radiation. As shown in our study, only 15.8% of healthcare workers had training on radiation safety, 6.5% of them had specific education on radiation and 76.4% of them did not use to read about radiation safety. Likewise, the study of Abdellah *et al.*, (2015) stated that most participants (88.8%) did not receive any radiation safety-related training and 80.0% of them did not use to read about radiation safety [7]. On another study, all participants had a formal course on radiology during their undergraduate study in the medical school that is inconsistent with our

study and only 8% (16 out of 190) had specialized module on radiation hazard that is in agreement with the present study [11]. In the present study, the mean score of correct answers regarding knowledge was 20.6 ± 5.7 from the maximum score (50) representing 41.2 % of the total score. Similar to our study findings, the study of Abdellah *et al.*, (2015) at Suez Canal university hospital, it was mentioned that the mean knowledge percent score was 56.5 ± 15.2 and ranged from 40% - 60% [7]. This score of knowledge is considered poor as well as the study of Salih *et al.*, (2014) where it was stated that knowledge scores less than 50% were considered as poor, between 50% and 75% medium and greater than 75% were considered good [11]. The poor level of knowledge in our study may be due to absence of suitable university courses at the undergraduate and postgraduate levels and poor training for staff. This study shows an overall inadequacy of radiation safety practices regarding patients among all participants. This is in line with the study of Ricketts *et al.*, (2013) in which most of patients (92%) were not informed about the radiation dangers related to tests that they were planned to receive and 50% of the doctors indicated that between 0% to 25% of their patients asked about radiation risk, whereas the remainder of the doctors stated that no patients asked [15]. Regarding the radiation safety practices by healthcare workers, there were an overall inadequacy of radiation safety practices among all participants regarding the use of personal monitoring badges, lead aprons and thyroid collar (lead aprons are the mostly used). Similar to these findings, Abdellah *et al.*, (2015) stated that physicians used lead aprons more than they use other PPE [7]. As presented in this study, unavailability of radiation safety measures was the

most frequent cause of poor practices. Likewise, Abdellah *et al.*, (2015), reported insufficient availability of radiation safety equipment as radiation dose badges ^[7]. In another study by Rahman *et al.*, (2008), it was mentioned that less than half of the cardiologists used protective measures such as thyroid collars and lead shields and the lack of its usage is due to the unavailability ^[16]. In this study, the mean total score of correct answers regarding practice was 3.6 ± 4.1 representing 12% of the maximum score of 30. In the study of Alavi *et al.*, (2017), it was mentioned that the mean practice score was 13.1 ± 3.3 accounting for 65.5% of the maximum score of 20. The difference between the two studies may be because the later study was performed in Saudi Arabia where there are available resources to afford the required radiation safety equipment ^[12]. On the other hand in Abdellah *et al.*, (2015), the percentages of mean practice scores ranged from 35% - 67% ^[7]. As presented in our study, there is a significant positive correlation between knowledge score and practice score ($P < 0.0001$). These findings go in agreement with Jeong and Jang, (2015) that stated that knowledge of radiation protection showed a statistically significant positive correlation with performance of radiation protection behavior ($r = .229$, $p < .01$) ^[17]. As shown in this study, the linear regression analysis shows that age, gender and specialty of participants are significant predictors of knowledge while age and working load of participants are significant predictors of practice. The study of Alavi *et al.*, (2017) mentioned that the result of the linear regression analysis established that the area of study, marital status, and levels of education were the significant predictors of knowledge. In addition, a significant association was noted between in-service training and attitude. Gender and experience period with radiation significantly predicted radiation protection practice ^[12].

Conclusion

The majority of healthcare workers in this study lacked any specific training or education about radiation. Radiation safety knowledge and practices of participants were poor.

“The authors declare that they have no conflict of interest”.

Participants' information were kept confidential for the research purpose only. An informed consent was taken where the participants were informed that responding is voluntary and that they can refuse responding without stating any reason.

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