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Radiation Protection Knowledge, Attitude, and Practice (KAP) in Interventional Radiology

Fatemeh Shabani[1,3], Hadi Hasanzadeh[2,3]*, Alireza Emadi[4], Majid Mirmohammadkhani[5], Ahmad Bitarafan-Rajabi[6], Ali Abedelahi[7], Mitra Bokharaeian[1,3], Hamed Masoumi[1,3], Danial Seifi[1,3], Tahereh Khani[1,3], Mohamad Sanchooli[1,3], Shima Moshfegh[1,3] and Abbas Ziari[5]

[1]Student Research Committee, Semnan University of Medical Sciences, Semnan, Iran
[2]Cancer Research Center, Semnan University of Medical Sciences, Semnan, Iran
[3]Department of Medical Physics, Semnan University of Medical Sciences, Semnan, Iran
[4]Deputy of Research and Technology, Semnan University of Medical Sciences, Semnan, Iran
[5]Social Determinants of Health Research Center, Semnan University of Medical Sciences, Semnan, Iran
[6]Echocardiography Research Center, Rajaie Cardiovascular Medical and Research Center, Tehran, Iran
[7]Department of Anatomical Sciences, Tabriz University of Medical Sciences, Tabriz, Iran

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ABSTRACT

Objectives: Due to increasing cardiac disease and its mortality rate, the frequency of cardiac imaging has grown and, as a result, interventional cardiologists potentially receive high radiation doses in cardiac examinations. This study aimed to assess the knowledge, attitude, and practice (KAP) level of radiation protection (RP) among interventional radiology staff in Iranian health care centers across the country. ***Methods***: We used a validated questionnaire survey consisting of 30 multiple-choice questions to perform a cross-sectional study. Participants were healthcare personnel working professionally with radiation at different levels (i.e., secretary, radiology technologists, nurse, and physician). The questionnaire was divided into three sections to assess KAP regarding RP. ***Results:*** Significant differences exist in RP KAP mean scores based on educational age ($p < 0.050$). There was no significant difference in RP KAP mean scores when looking at sex, practice age, and hospital type ($p > 0.050$). We found a significant difference between RP KAP mean scores and different regions ($p < 0.050$). ***Conclusions:*** Educational and practice age, sex, type of hospital, and geographical region affect he KAP of interventional radiology staff regarding RP. Since many of the subjective radiation harms for both medical team and patients, this can be easily controlled and prevented; a checkup for personnel of interventional radiology departments, considering samples from different parts of the country with different levels of education, continuous training, and practical courses may help map the status of KAP. The results of this study may also help authorized health physics officers design strategic plans to enhance the quality of such services in radiation departments.

It is more than 100 years since the first usage of X-ray. In the early days of its implementation, there was no vision about its potential harms,[1,2] including various dermatoses, cataract, hematological disorders, and cancer,[3] which necessitates considering radiation protection (RP) strategies such as the 'as low as reasonably achievable' (ALARA) principle.[4] For all medical imaging procedures, there are three basic principles: justification, optimization, and dose limits.[5] The optimization concept has been refined as a result of increasing knowledge about radiation effects.[6–8] RP has been one of the main concerns since the early days of radiography[9,10], and as the technology of medical imaging is continuously under revolution, the regulations needed for its safe usage is an important issue.[11] Assessing the knowledge of healthcare personnel working with radiation and holding RP courses might be beneficial in reducing patient and staff exposure to ionizing radiation.[12–15] Interventional cardiologists are among the top two professionals most likely to receive high radiation doses in routine examinations.[16] The Word Health Organization[1] recommends continuous training and regular refresher courses and state that specific training in interventional radiology is required

*Corresponding author: Hasanzadeh.h@semums.ac.ir

in addition to basic training.[17] The International Commission on Radiological Protection (ICRP) states that interventional procedures are complex and tend to be operator dependent. It is particularly important that individuals performing examinations are adequately trained in both RP clinical techniques and knowledge.[18]

As a good clinical practice needs good knowledge, attitude, and practice (KAP) and as they are practically interdependent, several factors such as sex, education and practice age, and hospital type and geographical region might affect good practice.

This study aimed to assess the KAP level of RP among interventional radiology staff using a validated questionnaire. The findings of this study might help to develop educational policies for radiation workers at different levels of specialty.

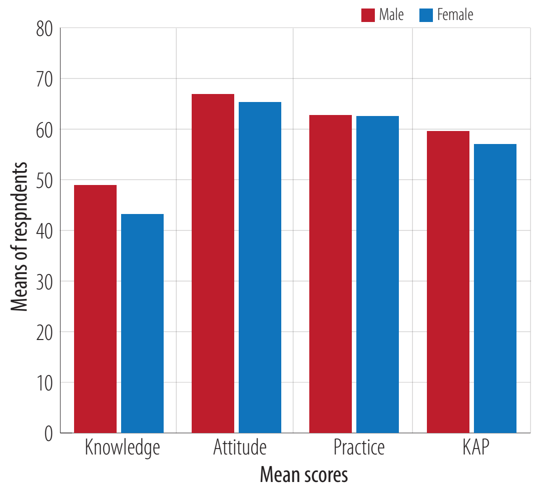

Figure 1: Mean knowledge, attitude, practice (KAP) scores, and overall KAP score regarding radiation protection between sexes.

METHODS

A simple questionnaire survey consisting 30 multiple-choice format (which was previously validated)[19] was distributed in 2014–2015 in northern (13.0%), western (10.0%), eastern (2.0%), central (16.0%) regions, and the capital of Iran (59.0%). Ten panelists including four medical physicists, one nuclear medicine specialist, one occupational health specialist, and one epidemiologist were advised and helped to calculate content validity ratio, which the acceptance level was > 0.62. The finalized questionnaire was used in a pilot study including 15 employees in interventional radiology departments using a four-week retest design to check the reliability and validity of the questionnaire. Pearson's correlation coefficient was estimated, which showed high overall reliability of final version of questionnaire ($r = 0.81$, $p < 0.001$).

The goals, methodology, and protocols of the project were clarified to the participants who were healthcare personnel working professionally with radiation as department secretaries, radiology technologists, nurses, and physicians in educational (69.0%), non-educational (8.0%), and private health clinics (23.0%). The participants were assured of the obscurity and confidentiality of the collected data. The administered questionnaire had a demographic information section including age, sex, academic degree, job title, educational age (time since graduation) as well as a general RP section about wearing lead aprons during examinations, film badges, dose limits for occupational exposure, the ALARA principle, and participation in RP training courses over recent years. This questionnaire was designed to assess KAP of RP. The collected data were analyzed using SPSS Statistics (SPSS Inc. Released 2007. SPSS for Windows, Version 16.0. Chicago, SPSS Inc.) with one-way ANOVA. A p-value < 0.050 was considered statistically significant.

RESULTS

Two-hundred and five questionnaires were collected from different geographical regions of Iran. The detailed scores of knowledge, attitude, practice, and overall KAP score regarding sex, educational and practice age, and type of hospital and geographical region of participants are given in Figures 1–5, respectively. The RP knowledge score of participants is presented in Table 1. The analysis of the relationship between sex and RP knowledge showed no significant difference between male and female protection knowledge ($p = 0.130$), as well as educational age ($p = 0.860$). There was no significant difference in the mean scores of RP knowledge and practice age ($p = 0.400$) and likewise, between RP knowledge and hospital type ($p = 0.160$). A comparison of means revealed a statistically significant difference between RP knowledge and geographical region ($p = 0.010$). Furthermore, RP knowledge score in northern Iran (mean = 58.4) was significantly higher ($p = 0.010$) than the capital (mean difference = 16.7).

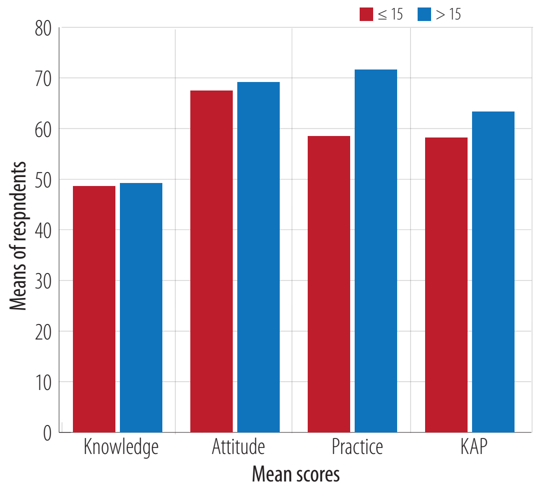

Figure 2: Mean knowledge, attitude, practice (KAP) scores, and overall KAP score regarding radiation protection and educational age (years since graduation).

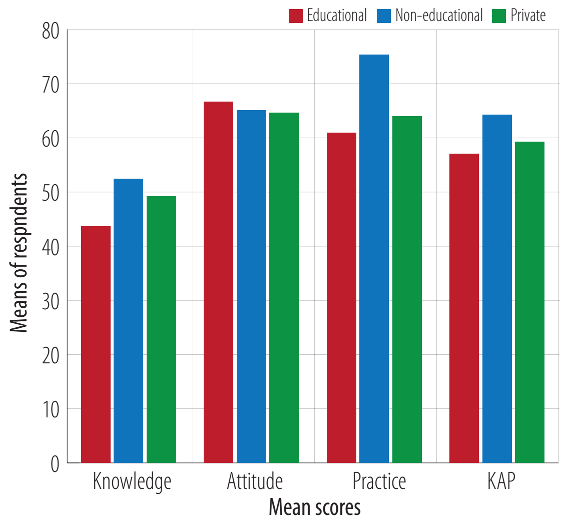

Figure 4: Mean knowledge, attitude, practice (KAP) scores, and overall KAP score regarding radiation protection between hospital types.

The mean RP attitude scores are given in Table 2. Statistical analysis showed no significant difference between RP attitude and sex ($p = 0.260$), educational age ($p = 0.570$), practice age ($p = 0.830$), hospital type ($p = 0.820$), and geographical region ($p = 0.110$). The detailed scores of the participants RP practice are listed in Table 3. There was no significant difference between RP practice and sex ($p = 0.330$) and region ($p = 0.070$). RP practice score in those with > 15 educational age was significantly higher than those with ≤ 15 educational age ($p < 0.001$). In the group with practice age (years' experience) > 15, the RP practice score was significantly higher than the group with practice age ≤ 15 ($p < 0.001$). The RP practice score in non-educational clinics was higher than educational hospitals and private clinics [Table 3].

The scores of participant RP KAP are given in Table 4. Statistical analysis showed a difference in mean scores between RP KAP and educational age ($p = 0.030$), but no significant difference between RP KAP and sex ($p = 0.470$), practice age ($p = 0.530$), and hospital type ($p = 0.200$). The mean score of RP KAP in the eastern region of Iran was significantly higher than the other geographical regions.

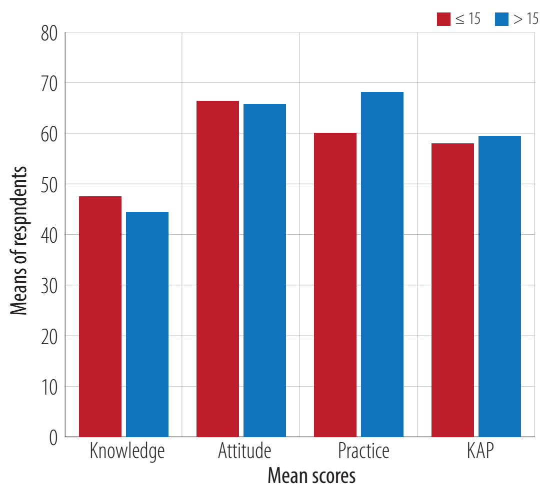

Figure 3: Mean knowledge, attitude, practice (KAP) scores, and overall KAP score regarding radiation protection and practice age.

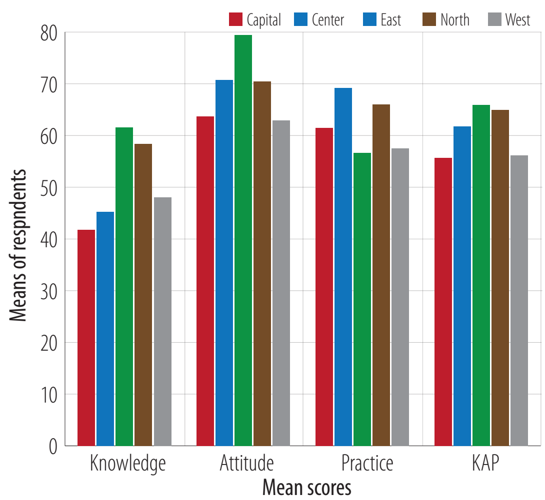

Figure 5: Mean knowledge, attitude, practice (KAP) scores, and overall KAP score regarding radiation protection between geographical regions.

Table 1: Demographic characteristics of respondents regarding radiation protection knowledge score.

Characteristic	Mean	SD	*p*-value
Sex			0.130
Male	48.9	22.4	
Female	43.2	23.1	
Educational age			0.860
≤ 15	48.5	24.2	
> 15	49.1	17.3	
Practice age			0.400
≤ 15	47.4	24.8	
> 15	44.5	18.8	
Hospital type			0.160
Educational	43.6	23.2	
Non-educational	52.4	16.9	
Private clinic	49.2	23.0	
Region			0.010
Capital	41.7	22.0	
Center	45.2	24.0	
East	61.5	22.4	
North	58.4	22.4	
West	48.0	20.5	

SD: standard deviation

Table 2: Demographic characteristics of respondents regarding radiation protection attitude score.

Characteristic	Mean	SD	*p*-value
Sex			0.260
Male	66.8	19.6	
Female	65.3	20.5	
Educational age			0.570
≤ 15	67.4	20.4	
> 15	69.1	14.4	
Practice age			0.830
≤ 15	66.4	19.9	
> 15	65.7	18.5	
Hospital type			0.820
Educational	66.6	21.2	
Non-educational	65.0	13.4	
Private clinic	66.6	18.3	
Region			0.110
Capital	63.7	21.8	
Center	70.7	15.0	
East	79.3	9.2	
North	70.4	16.9	
West	62.9	19.3	

SD: standard deviation.

Table 3: Demographic characteristics of respondents regarding radiation protection practice score.

Characteristic	Mean	SD	*p*-value
Sex			0.330
Male	62.7	17.9	
Female	62.5	17.2	
Educational age			< 0.001
≤ 15	58.4	17.8	
> 15	71.6	13.4	
Practice age			< 0.001
≤ 15	60.0	17.9	
> 15	68.1	14.2	
Hospital type			0.010
Educational	60.9	17.1	
Non-educational	75.3	12.8	
Private clinic	64.0	18.3	
Region			0.070
Capital	61.4	18.0	
Center	69.1	15.7	
East	56.6	7.2	
North	66.0	19.4	
West	57.5	12.9	

SD: standard deviation.

Table 4: Demographic characteristics of respondents regarding radiation protection knowledge attitde practice (KAP) score.

Characteristic	Mean	SD	*p*-value
Sex			0.470
Male	59.5	16.0	
Female	57.0	16.3	
Educational age			0.030
≤ 15	58.1	17.4	
> 15	63.3	9.4	
Practice age			0.530
≤ 15	57.9	16.7	
> 15	59.4	13.3	
Hospital type			0.200
Educational	57.0	16.8	
Non-educational	64.2	7.6	
Private clinic	59.2	15.3	
Region			0.030
Capital	55.6	17.1	
Center	61.7	13.4	
East	65.8	9.3	
North	64.9	14.0	
West	56.1	13.8	

SD: standard deviation.

DISCUSSION

Radiology examinations have an essential role in diagnosis. Radiation has been demonstrated to have adverse biological effects, that vary by the duration of exposure and dose,[20–22] which has shown an increased occurrence of cancer, shortening of longevity, birth defects, and cataracts.[23] The main principles for RP are time, distance, and shielding,[24] which should be carefully controlled. During an interventional cardiac catheterization procedure, an interventional cardiologist receives about 0.004–0.016 rem/case[25], nurses receive 0.8–1.6 rem/year, and technologists about 0.2 rem/year in an interventional radiology department,[26] which is mainly due to patient scatter. Modern cardiac interventional methods produce effective doses of 4–21 mSv and 9–29 mSv, respectively, and are therefore high-risk for radiation exposure,[27] which cause RP to be an occupational concern. The continuous trend towards more complex interventional examinations leads to greater exposure to staff and patients. According to the American College of Cardiology, the dose limit for occupational exposure for medical staff is 5 rem/year for the whole body, and no one should receive a cumulative exposure of more than 1 rem × age (or 50 rems).[28] Radiology technologists are expected to have more in-depth knowledge on different aspects of radiation and should play a consultant role to the physicians in choosing a proper imaging modality with minimal radiation risk.[29] Besides, one should consider the importance of good practice as well as adequate knowledge and attitude to reduce public dose due to imaging modalities. These items depend on several factors such as educational level and current policies for training personnel as well as the available accessories needed for good practice with an acceptable dose to the patient. Considering only one center to evaluate, such a multi-parametric problem might lead to a misunderstanding of several aspects of RP.

We found no significant difference between RP KAP and gender, which is in agreement with a study by Fatahi-Asl et al.[30] Arslanoglu et al,[12] showed that more female (39%) than male doctors (19%) believed that abdominal magnetic resonance imaging exposes patients to ionizing radiation.

It has previously shown that personnel with a basic science background had better RP awareness levels.[31] Staff educational age is one of the factors that influence occupational exposures. Prabhat et al,[32] confirmed the relationship between educational age and appropriate KAP level regarding RP. The KAP level was higher in interns and the least in third-year students.[32] One study found a significant difference in knowledge between young radiographers (less than three years of experience) and older radiographers, with the former having a higher score. This might be due to the freshness of younger staff.[13] However, in our study, no significant difference was observed between RP knowledge and educational age, which might be due to continuous training courses. RP practice score in those with an educational age > 15 years was significantly higher than in those ≤ 15 years. Mojiri et al,[33] explained that the radiographers with fewer years' work experience have less knowledge about the adverse effects of radiation. So, there is an actuarial relationship between awareness about dose limit and radiographers' educational level.[33] A study performed by Svenson et al,[34] among Swedish practitioners with 5–25 years experience had higher levels of KAP than those with more or fewer years experience. Su et al,[35] confirmed that with increasing age RP knowledge gets significantly worse. Rahman et al,[36] demonstrated that the number of correct answers in those with more than 10 years experience in contrast to those with less 10 years experience was 45% vs. 56%, respectively.

We found a relationship between participants practice age and their RP performance. Older staff (practice age > 15) had better radiation safety practice than younger ones (practice age ≤ 15). With increasing age and employment period, radiation safety practice also gets significantly better. The existence of a statistically significant relationship between practice age and RP performance showed that a few radiographers with low experiences have less practical information about radiation safety. Although they were recently educated, they had insufficient knowledge of radiation effects. This means that formal continuous training is necessary for younger radiological technologists.

RP practice in non-educational clinics was significantly (p = 0.010) better than educational hospitals. This might be due to the students in educational hospitals, which might violate the general discipline of the hospital and interfere with experienced staff professional work. The relationship between the geographical region of hospitals and knowledge and RP KAP was statistically significant in our study. Knowledge and RP KAP in northern

Iran was significantly better than the capital. This might be due to existing policies in the educational organization in those regions, which enforce personnel to attend these courses and limit their working shifts to have enough time to review basic items and learn new skills.

CONCLUSION

RP continues to be an important concern in the everyday practice of all medical professionals. Education and practice age, sex, and type of hospital and geographical region have their effects towards KAP of interventional radiology staff regarding RP. Based on our findings, a fundamental effort to provide more robust education and acquire greater RP KAP in interventional radiology departments is required. Many of the radiation-related harms for both interventionalists and patients can be easily prevented by having proper KAP and continuous training.

Disclosure

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