

Development of a Questionnaire to Evaluate the Knowledge and Attitudes of Medical Students Regarding Radiation Protection

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Abstract

Introduction: The aim of this study was to design a standard questionnaire facilitating the evaluation of the knowledge and attitude of medical students regarding radiation protection. **Methods:** At first, a 30-item questionnaire was prepared. The scale construction procedure was performed using content validity assessment. Considering objectives, some items were designed based on textbooks and the ideas of oral radiologists, medical physicists, and occupational medicine specialists as the expert panel. Content validity of the draft was determined by the panel. **Results:** Test-retest procedure was used to determine the reliability of the questionnaire by kappa statistic and Cronbach's alpha coefficient. Experts evaluated the content validity as desirable. Kappa coefficient was more than 0.75 for almost all knowledge and attitude items. Cronbach's alpha coefficients for basic knowledge, practical knowledge, and attitude domains were 0.793, 0.823, and 0.822, respectively. **Conclusion:** The designed questionnaire was confirmed as reliable considering Iranian cultural concepts.

Keyword: Questionnaire, Radiation protection, Knowledge, Attitude, Medical students.

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Introduction

Dentists use radiographs more often than any other health professionals. For this reason, compliance to as low as reasonably achievable (ALARA) principles becomes important in their practice in order to reduce patient exposure to ionizing radiation (1). The ALARA principles in dental radiology are mainly aimed at selection criteria, equipment, and quality assurance (1, 2). Continuous advances in dental radiography equipment have resulted in dose reduction without quality impairment (3-5). Studies have shown that dentists do not appreciate this technology advancement and still overexpose their patients (7, 8).

Nowadays, radiographic examination is of great importance in diagnosis and treatment (9-10). Since the ionizing radiation is proved to be potentially harmful, passing radiation protection courses is necessary for the students of medical sciences. Medical professionals have a crucial role in social effective dose reduction by rational prescription and reasonable practice (11).

According to a study performed by Aravind et al. (12) in India, dentists have a poor performance in dose reduction. Shahab et al. (13), evaluating the radiation protection knowledge of 1,000 dentists about patient dose protection in Iran, concluded that the majority of dentists in the study group did not select the proper method, material, and equipment in order to minimize patient exposure to unnecessary radiation in dental radiography. Based on

Jacob et al. (6), dentists' knowledge and attitudes regarding radiographic procedures need to be improved. Therefore, the continuous monitoring of knowledge and attitudes in the professional population seems to be necessary. Regarding this, the students of medical sciences were selected as the target group in this study.

Questionnaire is an appropriate scale for knowledge and attitude assessment. Most of the research projects addressing this issue were based on self-designed and single-dimensional questionnaires and currently, no standard instrument is available. The aim of this study was to design a standard questionnaire to assess the knowledge and attitudes of medical students regarding radiation protection.

Materials and Methods

To design a standard questionnaire, reliability and validity assessment is an inevitable procedure. Accordingly, the authors utilized content validity evaluation as a powerful technique in designing. First of all, some categories were defined based on the objectives of the study. Textbooks, databases, and expert panel were considered as the references to design the items. The expert panel included dentomaxillofacial radiologists, occupational medicine specialists, and medical physicists. The questionnaire draft contains four sections, covering the respondent's demographic information, resources of knowledge, knowledge (n=17), and attitude (n=13; Fig. 1)

To determine the face and content validities, the expert panel evaluated the draft in terms of simplicity, perceptibility, grammatical soundness, and relevance of the items, and then put their comments. Furthermore, they suggested adding new items or deleting some. Total

experts' agreement about clarity and relevancy was evaluated by two approaches, namely conservative and less conservative. In the conservative approach, the number of favorable items was divided by the total number of the items. In the less conservative approach, the number of favorable items based on 80% of the observers was divided by the total number of the items.

To assess content validity, quantification procedures were applied. Item content validity index (I-CVI) and scale content validity index (S-CVI) were determined by the content validation of the expert panel, including maxillofacial radiologists, occupational medicine specialists, and medical physicists. Each observer rated the items in terms of relevancy, rationality, and clarity on a four-point Likert scale (1: undesirable, unclear, or irrelevant statement, 2: relatively desirable, clear, or relevant statement which needs major revision, 3: desirable, clear, and relevant statement which needs minor revision, and 4: totally desirable, clear, and relevant statement).

To determine the S-CVI, the number of the items accepted as level 3 or 4 was divided by the total number of the items. Furthermore, the total number of experts who had rated an item as level 3 or 4 was divided by the total number of experts to show each item content validity (i.e., I-CVI). After the implantation of some modifications based on the ideas of the expert panel and data analysis results, the draft was given to five medical students as laypeople to mark the undesirable items. Consequently, the interrater agreement index was determined to evaluate their ratings. The test-retest procedure was used to evaluate the scale reliability when 30 dental students responded to the questionnaire twice in a two-week interval. Kappa statistics and Cronbach's alpha coefficient were applied to show the reliability of the scale.

Evaluation of Radiation Protection Knowledge and Attitudes in Medical Students

Date:

Dear respondent,

This structured questionnaire is prepared to assess your knowledge and attitude regarding radiation biology and protection anonymously. The results will be utilized to improve educational program and are not valid for any other purposes.

Age:

Gender:

Educational status (Major and grade):

Institution:

1-1 How much do you know about radiation protection procedures?

- 1- Nothing 2- A little 3- Moderately 4- Much 5- Too much

1-2 How much did you get from mass media about radiation protection?

- 1- Nothing 2- A little 3- Moderately 4- Much 5- Too much

1-3 How much did you get from academic courses about radiation protection?

- 1- Nothing 2- A little 3- Moderately 4- Much 5- Too much

2-1 Considering the biologic effects, which one is the target molecule in X- and Gamma-ray exposure in organisms?

- 1- Water 2- DNA 3- Protein 4- Carbohydrate 6- No idea

2-2 The most sensitive intracellular organelle to ionizing radiation is:

- 1- Mitochondria 2- Endoplasmic reticulum 3- Chromosome 4- Ribosome 5- No idea

2-3 Which one has no effects on cell sensitivity to radiation?

- 1- Differentiation 2- Metabolism 3- Proliferation activity 4- Physical dimensions 5- No idea

2-4 Which cells are more sensitive to ionizing radiation?

- 1- Neurons 2- Bone marrow stem cells 3- Fibroblasts 4- Spermatozooids 5- No idea

2-5 High tissue pressure of which gas increases cell radiosensitivity?

- 1- Carbon dioxide 2- Carbon monoxide 3- Nitrogen 4- Oxygen 5- No idea

2-6 Which one has fewer effects on radiation-induced damages?

- 1- Tissue volume 2- Dose 3- Dose rate and fractionation 3- Vertical angulation of exposure 5- No idea

2-7 In equal doses, which one induces more damage in tissues?

- 1- X-ray 2- Gamma-ray 3- Alpha particles 4- Beta particles 5- No idea

2-8 Which radiation effect shows a non-threshold dose-response relationship?

- 1- Cancer induction 2- Epilation 3- Skin erythema 4- Anemia 5- No idea

2-9 Which factor(s) determine(s) the number and type of prescribed radiographs?

- 1- Dose limits 2- Justification and clinical judgment 3- Patient's radiosensitivity
4- Geographic location and background radiation 5- No idea

2-10 When the probability of exposure by the primary X-ray beam (imaging useful beam) for all the walls of a room is equal, which wall must be reinforced by leaded protective barriers? The wall next to:

- 1- Waiting room or staff room 2- Patio 3- Pavement 4- Restroom or dressing room 5- No idea

2-11 Secondary X-ray beam consists of photons which are scattered after interaction with matter (i.e., patient) in any direction. The intensity of the secondary beam in one meter to the machine is:

- 1- Equal to useful (primary) beam 2- Much lesser than the primary beam
3- Two to three times more than useful beam 4- No idea

2-12 If the distance to X-ray source is doubled, the X-ray intensity will be:

- 1- Double 2- A half 3- The same 4- A quarter 5- No idea

2-13 To monitor radiology staff absorbed dose, which device is applied routinely?

- 1- Geiger-Muller counter 2- Film badge 3- Thermo-luminescence dosimeter 4- Pen dosimeter 5- No idea

2-14 In diagnostic radiology, filtering reduces the patient dose by removing:

- 1- Secondary beam 2- Leakage beam 3- Low-energy photons 4- Short wavelength photons
5- No idea

2-15 Which one may reduce patient exposure to X-ray?

- 1- Applying high-speed instead of low-speed films
2- Radiation room ventilation

- 3- Obtaining optimum film density by increasing exposure time rather than kilovoltage peak
- 4- Adding antioxidant agents to patient's diet
- 5- No idea

How much do you agree?

- 3-1 Considering probable hazards to an embryo, engaging pregnant employees in radiology services is unjustified.
1- Strongly disagree 2- Disagree 3- Neutral 4- Agree 5- Strongly agree
 - 3-2 Radiography is more hazardous to an embryo than smoking and alcohol.
1- Strongly disagree 2- Disagree 3- Neutral 4- Agree 5- Strongly agree
 - 3-3 Radiography will cause sterility and depilation in long-term.
1- Strongly disagree 2- Disagree 3- Neutral 4- Agree 5- Strongly agree
 - 3-4 It would be better to take calcium-rich diet like milk to reduce radiation hazards.
1- Strongly disagree 2- Disagree 3- Neutral 4- Agree 5- Strongly agree
 - 3-5 Living next to radiology services is unsafe.
1- Strongly disagree 2- Disagree 3- Neutral 4- Agree 5- Strongly agree
 - 3-6 Staying in radiology services' waiting rooms is unsafe.
1- Strongly disagree 2- Disagree 3- Neutral 4- Agree 5- Strongly agree
 - 3-7 Retaking a radiograph because of technical errors is not justified.
1-Strongly disagree 2- Disagree 3- Neutral 4- Agree 5- Strongly agree
 - 3-8 Risks of radiographic procedures are more than benefits in children.
1-Strongly disagree 2- Disagree 3- Neutral 4- Agree 5- Strongly agree
 - 3-9 If the number of prescribed radiographs is more than one, it would be better to take them in different sessions for recovery.
1- Strongly disagree 2- Disagree 3- Neutral 4- Agree 5- Strongly agree
 - 3-10 Practitioners who put their treatment plan without radiographs are more eligible than those who prescribe radiographs.
1- Strongly disagree 2- Disagree 3- Neutral 4- Agree 5- Strongly agree
 - 3-11 Despite considering all protective issues, X-ray is harmful and it would be better to have medical and dental practices done without X-ray imaging.
1- Strongly disagree 2- Disagree 3- Neutral 4- Agree 5- Strongly agree
 - 3-12 If I/my wife am/is pregnant and the physician prescribes an X-ray, considering the risks, we will not take it.
1- Strongly disagree 2- Disagree 3- Neutral 4- Agree 5- Strongly agree
 - 3-13 The risk of thyroid cancer after dental X-rays is more than that of head and neck computed tomography.
1- Strongly disagree 2- Disagree 3- Neutral 4- Agree 5- Strongly agree
- Thanks for your support

Results

In this study, a questionnaire was developed to evaluate the knowledge and attitudes of medical students regarding radiation protection. The face and content validities, as well as reliability, of the questionnaire were measured. Based on the expert panel, the total reliability was calculated as 83.3% and 96.6% using the conservative and less conservative approaches, respectively. Furthermore, according to the students, the reliability was estimated at 100% using the conservative approach.

In the face validity assessment procedure, experts recommended some grammatical points which were

considered in the final version. One item about the main source of radiation in daily life was omitted because in the target group, no respondent could answer it correctly. To assess the S-CVI, the sum of the I-CVI (Table. I) was divided by the total number of the items. The S-CVI was calculated as 98.33%. Due to the pilot study, kappa statistic was calculated for each item (Table. II). Cronbach's alpha coefficient was calculated for each domain of the questionnaire. In basic knowledge, practical knowledge, and attitude domains, the Cronbach's alpha coefficients were calculated at 79.3%, 82.3%, and 82.2%, respectively.

Table I. Content validity index for clarity and relevancy of some items (I-CVI). I-CVI was 100% for the most of items except those that are mentioned in the table

Item	I-CVI (%)
How much do you agree: Retaking a radiograph because of technical errors is not justified.	91.67
Risks of radiographic procedures are more than their benefits in children.	91.67
If the number of prescribed radiographs is more than one, it would be better to take them in different sessions for recovery.	91.67
Despite considering all protective issues, X-ray is harmful, and it would be better to have medical and dental practice done without - ray imaging.	83.3
If I/my wife am/is pregnant and the physician prescribes an X-ray, considering the risks, we will not take it.	91.67

Table II. Kappa coefficient for each item in different domains

Basic knowledge items		Practical knowledge items		Attitude items	
No.	Kappa (%)	No.	Kappa (%)	No.	Kappa (%)
1	80	10	80	1	80
2	96.6	11	93.3	2	83.2
3	90	12	100	3	96.7
4	96.6	13	100	4	90
5	96.6	14	100	5	100
6	86.7	15	100	6	100
7	100	16	86.6	7	86.6
8	83.3	17	90	8	93.4
9	63.3			9	86.6
				10	90
				11	96.7
				12	83.3
				13	100

Discussion

This study was conducted to design a standard questionnaire to assess the knowledge and attitudes of medical students regarding radiation protection. Garg et al. (14) performed a study on the awareness level of dental students about health physics which was based on a questionnaire. They assessed the effects of membership in associations and attending in continuous educational programs on knowledge and attitude. However, in the current study, both basic and practical domains of knowledge were covered; therefore, our questionnaire seems to be more comprehensive and relevant. Furthermore, in many questionnaire-based studies similar to that of Garg et al. (14), only the practical domain has been considered. However, authors

believe that the evaluation of a practice should be observation-based instead of questionnaire-based.

On the other hand, in the current study, it seems that content validity assessment increased the validity and reliability of the final product. This procedure not only decreases the number of faulty items but also reduces the necessity for multiple peer-reviews and reference checking. To evaluate reliability, acceptable kappa and alpha Cronbach's coefficients were considered as 0.75 in this study. Nonetheless, in other similar studies, these indices were no more than 0.65 (15).

The 30-item questionnaire with five-point Likert scale was found to be clear and relatively relevant in the attitude section and have reliable items in all sections. Regarding this, it can be concluded that this instrument

can properly assess the knowledge and attitude of medical students regarding radiation protection and render valuable information in different research projects. Although the scale can be accepted as a comprehensive and practical one in Iranian students, more evaluation may be necessary for a perfect adjustment.

Conclusion

The questionnaire designed in the current study is reliable and valid considering cultural issues and can be utilized to assess the knowledge and attitudes of medical students regarding radiation protection and health physics with minor revisions in different cultures.

Conflicts of Interest

None declared.

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