



CODEN [USA]: IAJPBB

ISSN: 2349-7750

**INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES**

SJIF Impact Factor: 7.187

<https://zenodo.org/records/10526816>Available online at: <http://www.iajps.com>

Research Article

**AWARENESS OF INTERVENTIONAL RADIOLOGY AMONG
MEDICAL STUDENTS ENROLLED IN DIFFERENT
CURRICULA AT WESTERN REGION MEDICAL SCHOOLS IN
SAUDI ARABIA****Yahea Alzahrani¹, Abdullah S. Basfar², Mohammed A. Al Thomali², Haneen Rahbini³,
Saja A. Alotaibi², Mohammad Ahmed⁴, Mansour N. Alotaibi².**¹ Associated professor of Radiology, Internal Medicine Department, Faculty of Medicine, Taif University, Taif, SAU.² Faculty of Medicine, Taif University - College of Medicine, Taif, SAU.³ Faculty of Medicine, King Abdulaziz University Faculty of Medicine, Jeddah, SAU.⁴ Gastroenterology, King Abdulaziz University Faculty of Medicine, Jeddah, SAU.**Abstract:**

Background: Modern medicine depends heavily on interventional radiology (IR), yet there needs to be more skilled interventional radiologists to meet the demand. However, many undergraduate medical students are unfamiliar with IR's principles, techniques, and strategies. Medical students must be exposed to IR to become future physicians and interventional radiologists.

Objectives: To compare different curriculums regarding awareness and knowledge about IR among undergraduate medical students in Western region medical schools in Saudi Arabia.

Subjects and methods: A multi-site descriptive, cross-sectional study was conducted among fifth- and sixth-year medical students. A valid and reliable questionnaire was used to collect the data.

Results: The study included 803 medical students. Males represented 54.5% of them. Their age ranged between 22 and 26 years, with an arithmetic mean of 23.3 and a standard deviation of 0.8 years. The history of completing or planning to complete an elective in radiology was reported by 15.9% of the participants. In comparison, a history of considering a career in diagnostic or interventional radiology was reported by 15.7% and 16.1% of the participants, respectively. Concerning reasons for not being sure about considering a career in interventional radiology among the participants, the most commonly reported was needing more knowledge about IR (44.3%), followed by finding it not interesting (31.3%). 46.8% of students expressed good knowledge about IR, whereas 35.1% expressed excellent knowledge. Male ($p=0.018$), older ($p<0.001$), sixth academic level students ($p=0.001$), those with a higher GPA ($p<0.001$), students of King Abdulaziz University in Jeddah ($p<0.001$), those who reported completing or planning to complete an elective in radiology ($p=0.008$) and students who had history of ever seeing patients treated by an interventional radiologist ($p=0.034$) were more knowledgeable about IR compared to their counterparts. According to students, the most preferred method to gain more exposure to interventional radiology was lectures from interventional radiologists, followed by a radiology module.

Conclusion: Most clinical year students in Western Saudi Arabian universities expressed good to excellent knowledge about IR. However, it is recommended that knowledge of IR be reinforced and the level of interest among medical students improved through lectures from interventional radiologists and training modules.

Keywords: interventional radiology, Radiology modules, Knowledge, Medical students

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Please cite this article in press Yahea Alzahrani et al., Awareness Of Interventional Radiology Among Medical Students Enrolled In Different Curricula At Western Region Medical Schools In Saudi Arabia , Indo Am. J. P. Sci, 2023; 10 (12).

INTRODUCTION

Interventional radiology (IR) is a fast-expanding field of medicine that makes use of image-guided; the frequency of minimally invasive image-guided operations has surged recently, driven by technological advancements [1-2], from limb-saving angioplasties in 1964 to more than 50 therapeutic procedures today, the field has advanced [3].

Due to their vital involvement in many aspects of practice and the rising demand for IR procedures, there is now a shortage of interventional radiologists [4]. Since 2010, IR has been recognized as a subspecialty [5] in several countries throughout the world, and independent IR residency programs are now being granted. For instance, the Accreditation Council for Graduate Medical Education approved the combined IR and diagnostic radiology (DR) residency in the United States in 2014 [6].

Over the last decade, there has been considerable growth in the number of students applying for training in the field of IR. However, medical students' exposure to IR and knowledge of it remains poor. Early exposure to IR via introductory lectures has been demonstrated to strengthen medical students' understanding of IR and their desire to pursue the specialty as a profession [7].

Determining medical students' level of understanding and preferred strategies for learning more about IR has drawn greater attention recently [1], This study investigates how medical students at King Abdulaziz University (with a dedicated radiology module) and Um AlQura and Taif Universities (without a dedicated radiology module) perceive and understand Interventional Radiology (IR). Its aim is to encourage early interest in IR among future radiologists and advocate for integrating IR earlier into medical school curricula.

This study aimed to compare awareness, knowledge, and perceptions of IR among medical students at

different curricula in Western region medical schools in Saudi Arabia

SUBJECTS AND METHODS:

A multi-site descriptive, cross-sectional study was conducted among medical students in their fifth and sixth year in three medical schools in the Western Region of Saudi Arabia with different curriculums: King Abdulaziz University in Jeddah, Um AlQura University in Makkah, and Taif University in Taif. The data were collected using an online questionnaire administered by Google Forms.

Using the sample size calculator from the University of California, San Francisco, with a 5% margin of error and 95% confidence interval, we estimated the appropriate sample size to be 446 students in the fifth and sixth years. However, due to the nature of the study and to increase the statistical power of the study, we included all answered questionnaires.

The questionnaire was originally developed from a study conducted among two medical schools [1]. We substituted one question regarding IR procedures with a question from a study that had been conducted among undergraduate medical students in 2016 [8]. After that, we adapted all the questions to fit our different curricula. A pilot study was conducted on 10% of our sample size to make sure that all questions were understandable; the results of this pilot study were not included in the final data analysis.

Ethical approval was obtained from the ethics committee at Taif University on 2023-02-20, with approval number 44-242. After obtaining consent from the target institution, we sent the questionnaire to all medical students in the fifth and sixth years. The questionnaire took about 5 minutes to be completed. The participants were guaranteed that any details they provided would be kept private and used

solely for research purposes. Participants were informed that they could refuse to answer any questions with which they were uncomfortable.

Regarding responses to knowledge questions, a score of "1" was assigned to correct answers, whereas a score of "0" was assigned to incorrect or Don't know/missing answers. The total score and its percentage for each participant were computed. Then, the percentage of the overall knowledge score was categorized as poor (<50%), good (50-69%) and excellent ($\geq 70\%$).

Data entry and statistical analysis were conducted using the Statistical Package for the Social Sciences (SPSS) software version 28 for Windows. Frequency, percentage, range, arithmetic mean, and standard deviation were used to describe the data, depending on the variable type. Chi-square test and one-way analysis of variance (ANOVA) tests were applied to analyze the differences and/or associations. A p-value of <0.05 was considered statistically significant.

RESULTS:

The study included 803 medical students. Table 1 summarizes their demographic characteristics. Males represented 54.5% of the participants. Their ages ranged between 22 and 26 years, with an arithmetic mean of 23.3 and a standard deviation of 0.8 years. More than half of the students (54%) were enrolled in the sixth academic year and had a grade average point (GPA) of 3.5-4 out of 4 or 4.3-5 out of 5 (53.8%). The majority of them were recruited from King Abdulaziz University in Jeddah (42.1%).

Most of the participating medical students rated their knowledge of interventional radiology, compared with other medical specialties, as fair (33.7%) or good (32.4%), as shown in Figure 1. A history of completing or planning to complete an elective in radiology was reported by 15.9% of the participants, as seen in Figure 2. Additionally, 15.7% (Figure 3) and 16.1% (Figure 4) of the participants reported considering a career in diagnostic or interventional radiology, respectively.

Regarding the reasons for not considering or being unsure about a career in interventional radiology among the participants, the most commonly reported reason was a lack of sufficient knowledge about IR (44.3%), followed by a lack of interest (31.3%), as shown in Figure 5. 40.8% of the participants reported a history of encountering patients who were treated by an interventional radiologist, as demonstrated in Figure 6.

The majority of the students correctly recognized various procedures performed in interventional radiology. Specifically, embolization of gastrointestinal bleeding was correctly recognized by 80.4% of the students, uterine artery embolization for fibroids by 79%, lower limb angioplasty by 77.2%, and trans-arterial chemoembolization by 75.2%. However, only 44.3% of them were aware that interventional radiologists can admit patients to the hospital, as shown in Table 2.

Overall, 46.8% of students expressed a good level of knowledge about interventional radiology, while 35.1% expressed an excellent level of knowledge, as shown in Figure 7. The main sources of information for the participants about interventional radiology were the mandatory radiology module (30.4%), lectures from interventional radiologists (15.6%), and self-directed learning (11.7%). While 20% of students reported having no specified source of information, as depicted in Figure 8.

Male students were more likely to have excellent knowledge about interventional radiology compared to female students (36.5% vs. 33.4%, $p=0.018$). The age of students who expressed excellent knowledge about interventional radiology was significantly higher than that of those who expressed poor knowledge (23.5 ± 0.8 vs. 23.2 ± 0.8 , $p<0.001$). Students in the sixth year were more likely to have excellent knowledge about interventional radiology compared to fifth-year students (40.3% vs. 29%, $p=0.001$). Students from King Abdulaziz University in Jeddah were more likely to express excellent knowledge about interventional radiology compared to those from Um Al Qura University in Makkah and Taif University (43.5% vs. 28.7% and 29.3%, respectively, $p<0.001$). Students with the highest GPA had the highest rate of excellent knowledge (39.6%, $p<0.001$). Students who reported completing or planning to complete an elective in radiology were more likely to have an excellent knowledge of interventional radiology than others ($p=0.008$). Additionally, students who had a history of ever seeing patients treated by an interventional radiologist expressed the highest level of excellent knowledge compared to their peers ($p=0.034$), as shown in Table 3.

The majority of medical students (77.1%) believed that interventional radiology would be beneficial, as indicated in Figure 9. Additionally, 40.3% of students recommended a duration of 4 weeks for the radiology module, as shown in Figure 10. According to the students, the most preferred method to gain more exposure to interventional radiology was lectures

from interventional radiologists Mean±SD (4.24 ± 0.82), followed by the radiology module (4.09 ± 1.01), as shown in Table 4.

DISCUSSION:

Despite the importance of interventional radiology (IR) in various healthcare services, including trauma, cardiovascular diseases, urology, and oncology [9], there is an international, as well as national, shortage of skilled interventional radiologists [10,11]. The limited number of qualified professionals in this field is a significant concern. Furthermore, the lack of knowledge among medical students during their clinical years about IR could potentially hinder their consideration of it as a future career option.

This study revealed that only 15.9% of the students completed or planned to complete an elective in radiology, while 15.7% and 16.1% of them considered a career in diagnostic or interventional radiology, respectively. A similar observation was made in another recent Saudi study, where 16.1% of the students expressed an interest in a career in radiology [10]. However, in India, the majority (91.5%) of undergraduate students expressed interest in receiving IR-based instruction as part of their undergraduate teaching degree [3]. In the USA (2013), a nationwide survey study found that although 58% of medical students claimed to be interested in the IR profession, only 5.5% of students reported participating in an IR rotation, while 12.7% of students indicated interest in IR [12]. The low consideration of this career is puzzling and provides the rationale for conducting the present study.

The present study revealed that the majority of medical students (81.9%) expressed either a good or excellent level of knowledge about interventional radiology (IR). This figure is higher than those reported in other Saudi studies conducted among undergraduate medical students in Jeddah [10] and the Southwestern region [13]. In those studies, 36.7% and 52% of the students, respectively, had inadequate knowledge about IR. Additionally, in the Jeddah study [10], 15.7% reported having no knowledge about it. In Ireland, England, and Canada, poor knowledge of IR was observed in 62%, 55.5%, and 52% of medical students, respectively [4,14,15]. Furthermore, a recent systematic review indicated that more than half of the included studies reported low knowledge among students about IR [16]. In India, 60% of undergraduate medical students had a very poor or poor understanding of IR [3]. Therefore, the figure reported in this study is encouraging, as it signifies an improvement in the awareness of IR

among medical students in Saudi Arabia over the past few years.

The main reasons for medical students in this study to not consider or be unsure about a career in interventional radiology were insufficient knowledge about IR (44.3%) and lack of interest (31.3%). In another study conducted in Saudi Arabia, the most common reason for not considering IR (42.9%) was a lack of information [10]. Similarly, in India (2021), the most frequently mentioned reason for not pursuing a career in IR was a lack of awareness (61.6%) [6].

The most prevalent misconception among medical students about radiology as a specialty is that the only task of a radiologist is to read films and write reports, with no relationship with patients. This misconception greatly affects their consideration of a career in radiology or interventional radiology [10]. In another US study, the most commonly reported reasons for not choosing radiology or interventional radiology as a specialty were the lack of direct contact with patients and concerns about the work environment [17].

According to the Strategy Development Framework for Interventional Radiology, it has been recommended that simple interventions, such as introductory lectures and simulation sessions, can effectively capture students' attention and enhance their understanding, as demonstrated in the case of interventional radiology [16].

In the current study, it was found that male students had a higher level of knowledge about interventional radiology (IR) compared to female students. This could be attributed to more males pursuing a career in IR than females [2,6]. Additionally, older students and those in the sixth academic level demonstrated greater knowledge about IR compared to younger students and those in the fifth academic year level. Similar findings were observed in another Saudi study [10] and in the USA [1].

Interestingly, students from King Abdulaziz University in Jeddah exhibited higher levels of knowledge about interventional radiology (IR) compared to those from Um Al Qura University in Makkah and Taif University. This difference could be attributed to the fact that students at King Abdulaziz University are exposed to a mandatory Radiology module as part of their curriculum, unlike Um Al Qura University and Taif University, where such a module is not in their curriculum.

It is quite expected to find that students with the highest GPA, those who reported completing or planning to complete an elective in radiology, and those who had a history of ever seeing patients treated by an interventional radiologist were more knowledgeable about IR compared to their peers. A recent systematic review revealed that most of studies have concluded that early contact with IR and seeing patients treated with an interventional radiologist can increase interest, knowledge, and motivation in such specialties [16]. In the USA (2013), greater understanding and knowledge of IR was found among the students who had participated in an IR rotation [12]. In Saudi Arabia, students who were interested in radiology and IR, specifically those who had an elective in radiology and students who had already undertaken or were planning to undertake an elective in IR, were more knowledgeable about IR compared to those who were not interested in the specialty [10].

In this study, the most preferred method for gaining more exposure to interventional radiology, according to the students, was lectures by interventional radiologists, followed by a radiology module. This finding is supported by previous observations that students' knowledge improves after attending ten hours of lectures on interventional radiology [8].

Study limitations

The study has two important limitations that should be addressed. First, the students were recruited from only three universities in Western Saudi Arabia. Second, the design of the study was a cross-sectional online one, which may have a response bias, including only students who were interested in the subject.

CONCLUSION:

The participant's medical students demonstrate good to excellent IR knowledge. Interestingly, being male, older, in the sixth year of studies, having a higher GPA, having completed, or planned a radiology elective, and observing prior IR patient treatments were all associated with significantly higher IR knowledge. Moreover, students from King Abdulaziz University in Jeddah were more likely to express excellent knowledge about interventional radiology than those from Um Al Qura University in Makkah and Taif University, suggesting the effectiveness of their curriculum.

Lectures by interventional radiologists and comprehensive radiology modules are preferred learning methods. Integrating these elements and

mandatory rotations, especially early on, is recommended to enhance student interest and knowledge, while a national study is needed for a broader perspective.

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Table 1: Demographic characteristics of the participants (n=803)

| Demographic characteristics | Frequency | Percentage |
|--|-----------|------------|
| Gender | | |
| Male | 438 | 54.5 |
| Female | 365 | 45.5 |
| Age (years) | | |
| Range | 22-26 | |
| Mean±standard deviation | 23.3±0.8 | |
| Academic level | | |
| Fifth year | 369 | 46.0 |
| Sixth year | 434 | 54.0 |
| University | | |
| King Abdulaziz, Jeddah | 338 | 42.1 |
| Umm Al-Qura, Makkah | 195 | 24.3 |
| Taif | 270 | 33.6 |
| Last GPA | | |
| (3.5-4) out of 4 Or (4.3-5) out of 5 | 432 | 53.8 |
| (3-3.49) out of 4 Or (3.75- 4.29) out of 5 | 252 | 31.4 |
| (2.5-2.99) out of 4 Or (3.12-3.74) out of 5 | 85 | 10.6 |
| Less than 2.50 out of 4 Or less than 3.11 out of 5 | 34 | 4.2 |

GPA: Grade point average

Table 2: Responses of the medical students to knowledge questions concerning interventional radiology

| Knowledge questions | Correct answers | | |
|---|-----------------|--------|------------|
| | Response | Number | Percentage |
| Does an Interventional Radiologist perform the following procedures? | | | |
| Cardiac angioplasty | No | 174 | 21.7% |
| Femoropopliteal arterial bypass graft. | No | 289 | 36.0% |
| Venous access procedures | Yes | 562 | 70.0% |
| Arteriovenous fistulas formation for hemodialysis | Yes | 496 | 61.8% |
| Uterine artery embolization for fibroids | Yes | 634 | 79.0% |
| Lower limb angioplasty | Yes | 620 | 77.2% |
| Embolization of gastrointestinal bleeding | Yes | 646 | 80.4% |
| Ablation of small kidney tumors | Yes | 517 | 64.4% |
| Embolization of trauma patients to control bleeding | Yes | 592 | 73.7% |
| Laparoscopic surgery | No | 513 | 63.9% |
| Trans-arterial chemoembolization | Yes | 604 | 75.2% |
| Can interventional radiologists admit patients to the hospital? | Yes | 356 | 44.3% |

Table 3: Factors associated with knowledge of the medical students about interventional radiology.

| | Knowledge about interventional radiology | | | p-value |
|---|--|------------------------|-----------------------------|---------------------|
| | Poor N=145 N (%) | Good N=376 N (%) | Excellent N=282 N (%) | |
| Gender | | | | |
| Male (n=438) | 91 (20.8) | 187 (42.7) | 160 (36.5) | 0.018* |
| Female (n=365) | 54 (14.8) | 189 (51.8) | 122 (33.4) | |
| Age (years) | | | | |
| Mean±SD | 23.2±0.8 | 23.3±0.8 | 23.5±0.8 | <0.001 [†] |
| Academic level | | | | |
| Fifth year (n=369) | 80 (21.7) | 182 (49.3) | 107 (29.0) | 0.001* |
| Sixth year (n=434) | 65 (15.0) | 194 (44.7) | 175 (40.3) | |
| University | | | | |
| King Abdulaziz, Jeddah (n=338) | 39 (11.5) | 152 (45.0) | 147 (43.5) | <0.001* |
| Taif (n=270) | 58 (21.5) | 133 (49.3) | 79 (29.3) | |
| Um AlQura, Makkah (n=195) | 48 (24.6) | 91 (46.7) | 56 (28.7) | |
| Last GPA | | | | |
| (3.5-4)/4 Or (4.3-5)/5 (n=432) | 56 (13.0) | 205 (47.4) | 171 (39.6) | <0.001* |
| (3-3.49)/44 Or (3.75- 4.29)/5 (n=252) | 55 (21.8) | 115 (45.7) | 82 (32.5) | |
| (2.5-2.99)/4 Or (3.12-3.74)/5 (n=85) | 22 (25.9) | 43 (50.6) | 20 (23.5) | |
| < 2.50/4 Or < 3.11/5 (n=34) | 12 (35.3) | 13 (38.2) | 9 (26.5) | |
| History of completing or planning to complete an elective in radiology | | | | |
| No (n=459) | 83 (18.1) | 207 (45.1) | 169 (36.8) | 0.008* |
| Yes (n=128) | 19 (14.8) | 52 (40.6) | 57 (44.6) | |
| Not sure (n=216) | 43 (19.9) | 117 (54.2) | 56 (25.9) | |
| History of ever seeing patients treated by an interventional radiologist | | | | |
| No (n=391) | 71 (18.2) | 195 (49.8) | 125 (32.0) | 0.034* |
| Yes (n=328) | 55 (16.8) | 138 (42.0) | 135 (41.2) | |
| Not sure (n=84) | 19 (22.6) | 43 (51.2) | 22 (26.2) | |
| Source of information | | | | |
| Mandatory radiology modules (n=244) | 36 (14.8) | 113 (46.3) | 95 (38.9) | 0.081* |
| No Source (n=161) | 38 (23.6) | 81 (50.3) | 42 (26.1) | |
| Lectures from radiologists (n=125) | 21 (16.8) | 70 (56.0) | 34 (27.2) | |
| Self-directed learning (n=94) | 21 (22.3) | 39 (41.5) | 34 (36.2) | |
| Social media (n=68) | 9 (13.2) | 28 (41.2) | 31 (45.6) | |
| Radiology elective (n=52) | 9 (17.3) | 19 (36.5) | 24 (46.2) | |
| Radiology interest group (n=24) | 4 (16.7) | 10 (41.7) | 10 (41.7) | |
| Research projects (n=15) | 4 (26.7) | 8 (53.3) | 3 (20.0) | |
| Multidisciplinary meetings (n=15) | 2 (13.3) | 5 (33.3) | 8 (53.3) | |
| Others (n=5) | 1 (20.0) | 3 (60.0) | 1 (20.0) | |

SD: Standard deviation *Chi-square test †One-way analysis of variance (ANOVA) test

Table 4: Perception of Intervention Radiology among the participants

| | Strongly avoid | Avoid | Indifferent | Prefer | Strongly prefer | Mean±SD |
|---|----------------|---------------|---------------|---------------|-----------------|-----------|
| How would you prefer to gain more exposure to interventional radiology? | | | | | | |
| Radiology module | 24 (3.0) | 32 (4.0) | 136 (16.9) | 267 (33.3) | 344 (42.8) | 4.09±1.01 |
| Lectures form interventional radiologist | 11 (1.4) | 11 (1.4) | 96 (12.0) | 343 (42.7) | 342 (42.6) | 4.24±0.82 |
| Research project | 77 (9.6) | 129 (16.1) | 296 (36.9) | 189 (23.5) | 112 (13.9) | 3.16±1.15 |
| Interventional radiology interest group | 47 (5.9) | 70 (8.7) | 221 (27.5) | 269 (33.5) | 196 (24.4) | 3.62±1.12 |
| Multidisciplinary meetings. | 38 (4.7) | 59 (7.3) | 236 (29.4) | 280 (34.9) | 190 (23.7) | 3.65±1.06 |
| Self-directed learning | 40 (5.0) | 79 (9.8) | 191 (23.8) | 293 (36.5) | 200 (24.9) | 3.67±1.10 |

SD: Standard deviation

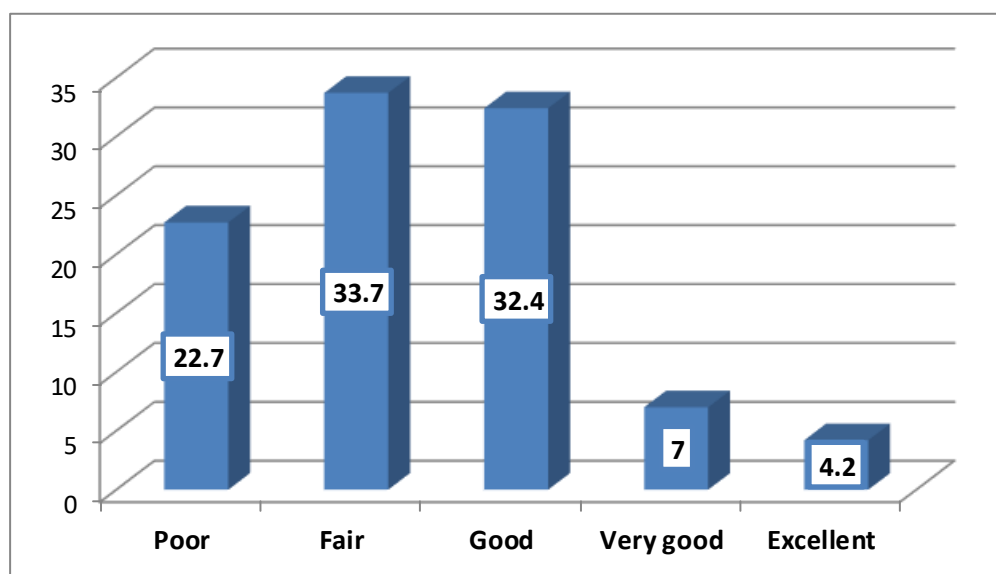


Figure 1: Self-rating of knowledge of interventional radiology among medical students, compared with other medical specialties.

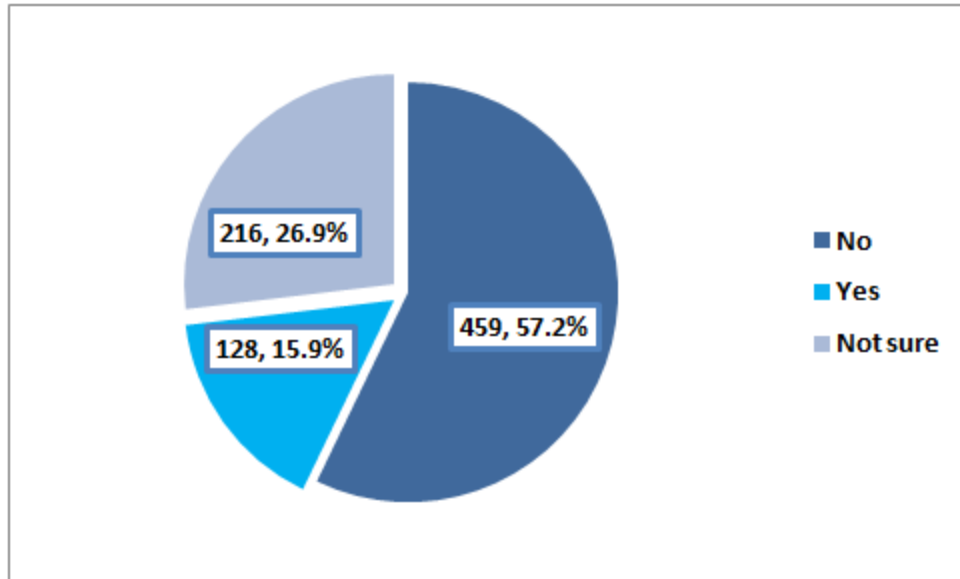


Figure 2: History of completing or planning to complete an elective in radiology among the participants.

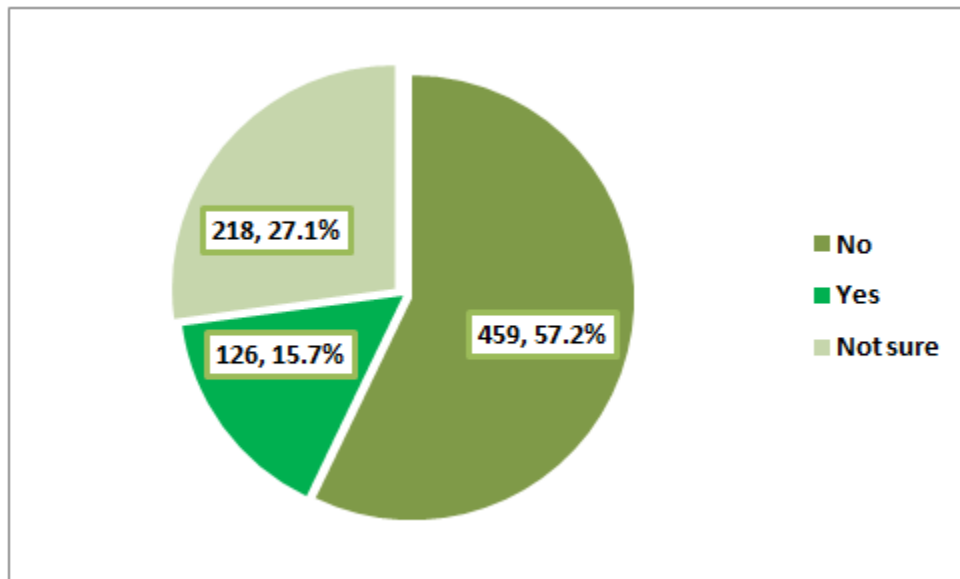


Figure 3: History of considering a career in diagnostic radiology among the participants.

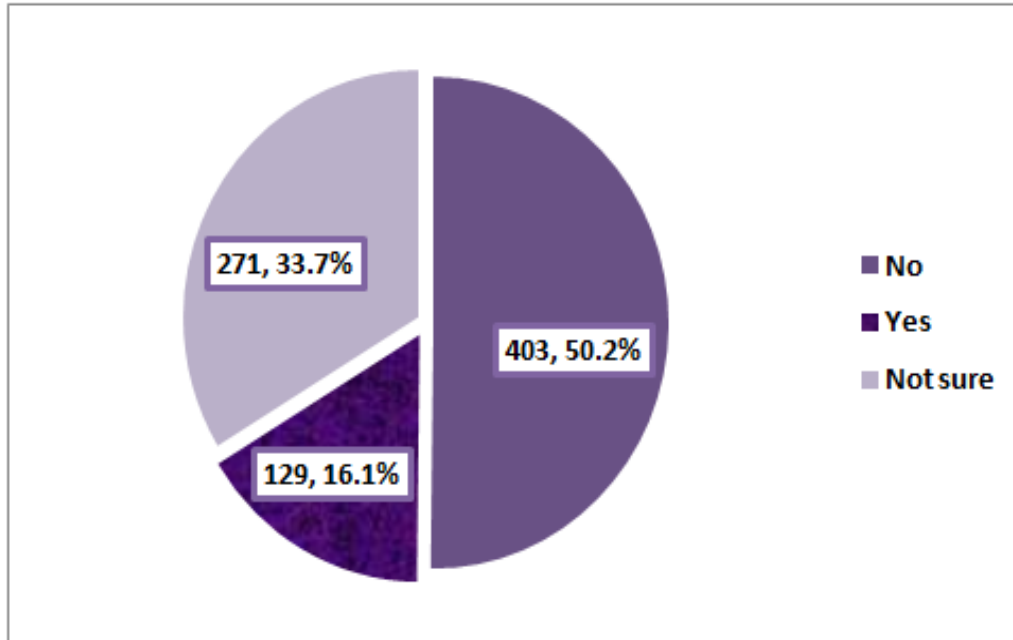


Figure 4: History of considering a career in interventional radiology among the participants.

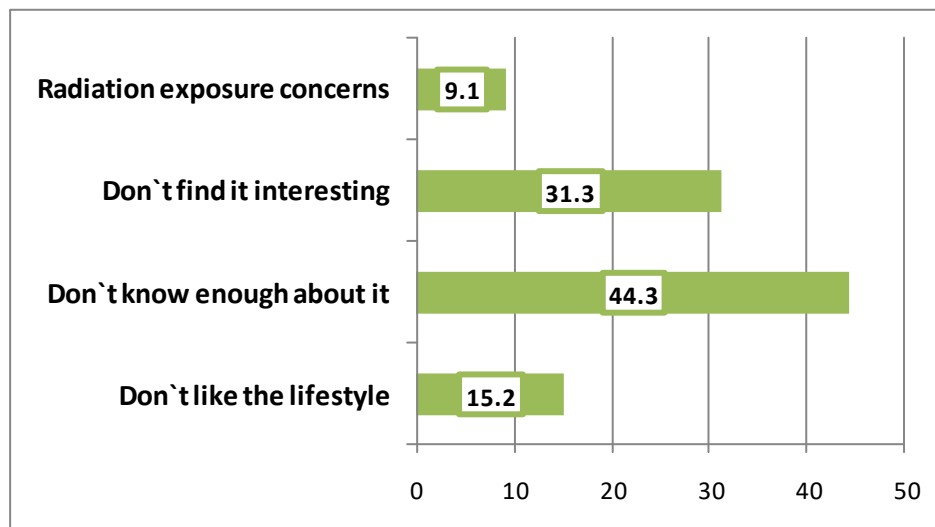


Figure 5: Reasons of being not or unsure to consider a career in interventional radiology among the participants (n=764)

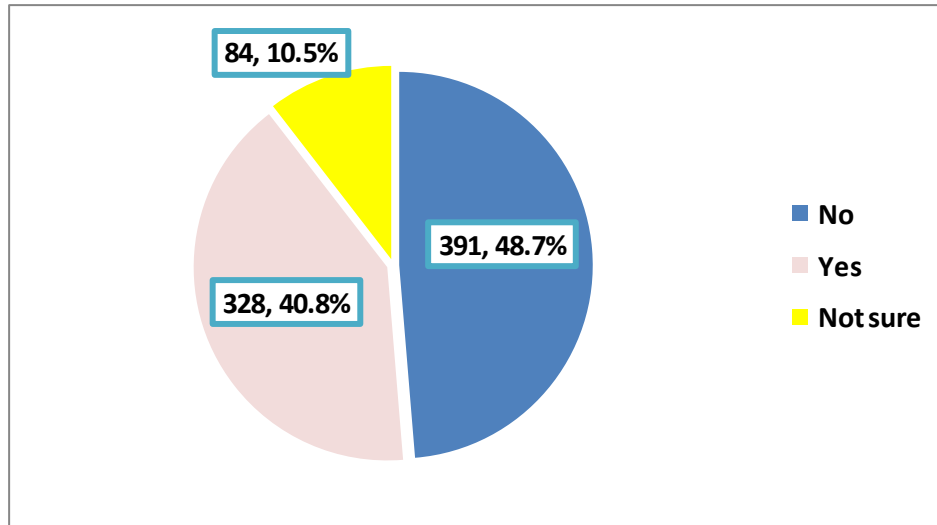


Figure 6: History of ever seeing patients who were treated by an interventional radiologist among the participants.

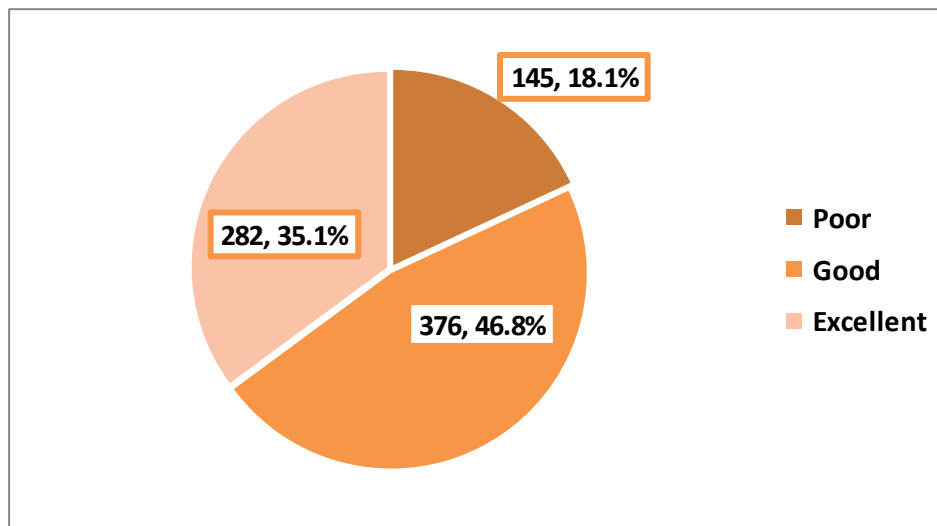


Figure 7: Overall level of knowledge of the medical students about interventional radiology.

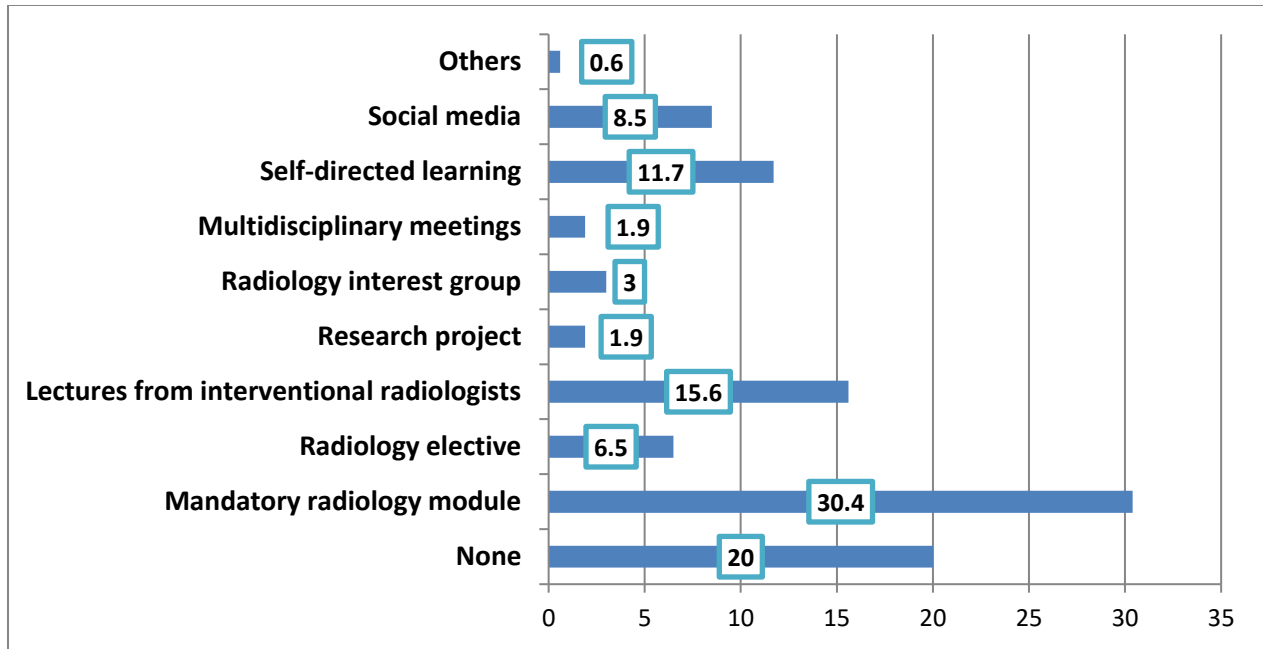


Figure 8: Source of information about interventional radiology among the participants.

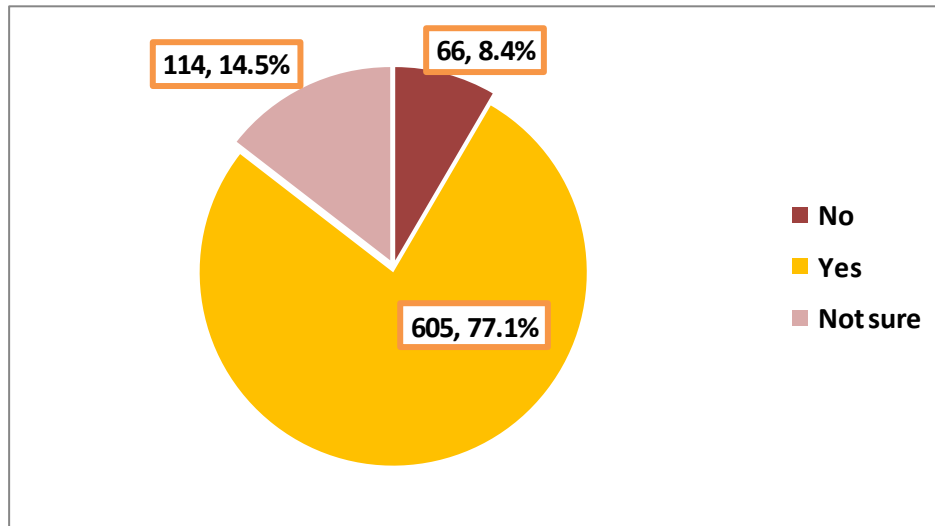


Figure 9: Participants` thinking about the fact that intervention radiology would be beneficial.

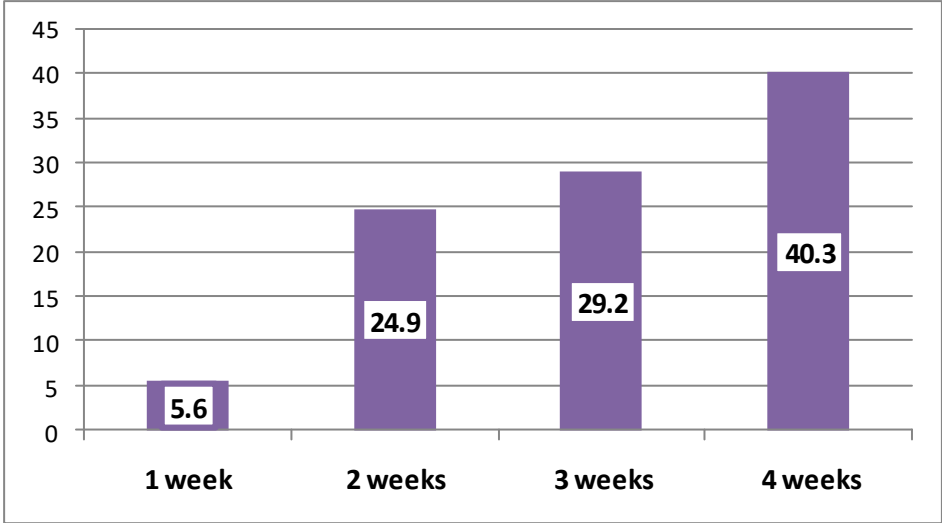


Figure 10: Suggested duration by the participants for the radiology module (n=719)