Work and Training Conditions of German Residents and Young Radiologists in Interventional Radiology – A Nationwide Survey

Arbeits- und Ausbildungsbedingungen von deutschen Assistenzärzten und jungen Radiologen in der Interventionellen Radiologie – eine bundesweite Umfrage

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ABSTRACT

Introduction With the increasing need for minimally invasive procedures based on lower complication rates, higher patient acceptance, and technical developments, there is a growing focus on the sound interventional training of young radiologists. This survey aimed to analyze the current situation in interventional radiology (IR) training in Germany to detect shortcomings and identify areas for improvement.

Materials and Methods From November 1–30, 2020, an online questionnaire was distributed to representative radiological associations and societies with the request to forward it to radiology residents and radiologists <40 years. The 44 questions covered six distinct areas from personal working conditions to the characterization of the IR department, training conditions, role of women in IR, and attendance at congresses/external training.

Results A total of 330 participants completed the questionnaire. 77 % of participants expressed a high interest in IR, and

47 % could even imagine subspecializing in interventional radiology. Most institutions provided the necessary learning conditions and infrastructure. The rate of overall satisfaction with IR training conditions was 45 % (vs. a dissatisfaction rate of 39 %). However, females showed a lower satisfaction rate with their training environment than male participants (28 % vs. 51 %; P = 0.06). Positive correlations with work satisfaction were found for the presence and duration of the IR rotation, the number of partly independently/mentored performed interventions, and structured feedback. Moreover, the need for a structured training curriculum was expressed by 67 % of participants.

Conclusion Radiological residents and young radiologists expressed a high interest in interventional radiology, and they rate the infrastructure of German hospitals regarding IR as sufficient. However, they expressed the need for consistent IR rotations and better-structured resident and postgraduate education (curricula & interviews).

Key Points:

Interest in interventional radiology among radiological residents and young radiologists in Germany is high, but satisfaction with interventional radiology training leaves room for improvement. The most frequently mentioned aspects that can improve IR training were

- organized rotations of at least 6 months
- structured curriculums with face-to-face feedback
- structured guidance by senior interventionists during procedures

Citation Format

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ZUSAMMENFASSUNG

Einleitung Die fundierte interventionelle Ausbildung junger RadiologInnen gerät durch den zunehmenden Bedarf an minimal-invasiven Prozeduren immer mehr in den Fokus. Ziel dieser Umfrage war es, die aktuelle Situation der Ausbildung in der Interventionellen Radiologie (IR) in Deutschland zu analysieren, um Defizite aufzudecken und Verbesserungsmöglichkeiten zu identifizieren.

Materialien und Methoden Vom 1. bis 30. November 2020 wurde ein Online-Fragebogen an repräsentative radiologische Verbände und Gesellschaften versandt mit der Bitte, ihn an AssistenzärztInnen und RadiologInnen < 40 Jahre weiterzuleiten. Die 44 Fragen deckten 6 verschiedene Bereiche ab, von den persönlichen Arbeitsbedingungen bis zur Charakterisierung der IR-Abteilung, den Ausbildungsbedingungen, der Rolle der Frauen in der IR und der Teilnahme an Kongressen/externen Fortbildungen.

Ergebnisse Insgesamt haben 330 TeilnehmerInnen den Fragebogen ausgefüllt. 77 % der TeilnehmerInnen bekundeten ein hohes Interesse an der IR und 47 % konnten sich sogar eine Subspezialisierung in der interventionellen Radiologie vorstellen. Die Mehrheit der Institutionen stellten die notwendigen Rahmenbedingungen und Infrastruktur bereit. Insgesamt lag die Zufriedenheit über die interventionsradiologische Weiterbildung bei 45 % (vs. 39 % Unzufriedenheit), wobei die Zufriedenheit mit den Ausbildungsbedingungen bei Teilnehmerinnen geringer ausfiel als bei den Teilnehmern (28 % vs. 51 %; P = 0,06). Positive Korrelationen mit der Arbeitszufriedenheit wurden für das Vorhandensein und die Dauer der IR-Rotation, die Anzahl der teilweise selbstständig/supervidiert durchgeführten Eingriffe und ein institutionalisiertes, strukturiertes Feedback festgestellt. Darüber hinaus äußerten 67 % der Teilnehmer den Wunsch nach einem strukturierten Ausbildungscurriculum.

Schlussfolgerung AssistenzärztInnen und junge RadiologInnen zeigen ein hohes Interesse an der Interventionellen Radiologie und bewerten die Infrastruktur deutscher Krankenhäuser im Bereich der IR als ausreichend. Sie äußerten jedoch den Bedarf an konsistenten IR-Rotationen und einer besser strukturierten grundlegenden und weiterführenden Ausbildung (Curricula & Interviews).

Kernaussagen:

Das Interesse an der Interventionellen Radiologie ist bei Assistenzärzten und jungen Radiologen in Deutschland hoch, die Zufriedenheit mit der Ausbildung in der Interventionellen Radiologie ist geringer. Die am häufigsten genannten Aspekte, die die IR-Ausbildung verbessern können, waren

- organisierte Rotationen von mindestens 6 Monaten Dauer
- strukturierte Curricula mit persönlichem Feedback
- strukturierte Anleitung durch erfahrene Interventionisten während der Eingriffe

Introduction

Interventional radiology (IR) is a growing subspecialty of radiology based on the increasing demand for minimally invasive procedures, the associated lower complication rates, and ongoing technical developments that allow the replacement of invasive procedures [1–4].

An excellent resident and postgraduate training program is a prerequisite for well-trained colleagues providing optimal patient care with high job satisfaction. However, there are several obstacles to deal with including workload issues, on-call service, demand for part-time work, increasing desire for parental leave, economic pressure, competing interests between departments, or increasing quality control demands, just to name a few. These developments affect residents, fellows, and the senior physicians who train them [5, 6].

In addition to diagnostic radiology skills, radiation protection expertise, clinical reasoning, and up-to-date knowledge of the current literature, interventional radiologists have to possess excellent manual skills. Also, many radiologists consider the work-

ing environment more stressful due to emergency situations, potential complications, and the physical strain caused by long procedure times and wearing radiation protection equipment. Therefore, developing the necessary resilience and the mentioned core competencies places unique demands on residential and postgraduate training [7, 8]. Repeated radiation exposure and the necessary work time flexibility due to participation in interventional emergency care are further demanding factors, which may influence subspecialization choice and potentially strain job satisfaction [9, 10].

To understand the individual needs of young radiologists and thus improve residential training in radiology, the Young Radiology Forum (Forum Junge Radiologie) and the German Radiological Society (Deutsche Röntgengesellschaft, DRG), supported by the German Society of Interventional Radiology and Minimally Invasive Therapy (Deutsche Gesellschaft für Interventionelle Radiologie, DeGIR), conducted a survey of radiology training conditions in Germany in 2018 [11]. While international radiological societies acknowledge the importance of dedicated analyses of interventional radiology training [8, 12–14], no such investigations exist so far in Germany.

The purpose of this survey was to investigate how residents and young radiology specialists perceive interventional radiology training in Germany. We focused on identifying shortcomings to propose specific improvement measures.

Materials and Methods

Development of the questionnaire and distribution

The survey was developed by members of the Young Radiology Forum and the German Society of Interventional Radiology and minimally invasive Therapy. A dedicated software designed to conduct online surveys (SurveyMonkey, SurveyMonkey Europe Sarl, Luxembourg) was used to publish the questionnaire online from November 1 to November 30, 2020.

The addressees of the survey were resident physicians and board-certified radiologists who were at least partially working in IR and younger than 40 years. To minimize selection bias, the survey participants were recruited via the email distributors of the German Roentgen Society (Deutsche Röntgengesellschaft, DRG), the German Association of Chairmen in Academic Radiological (Konferenz der Lehrstuhlinhaber, KLR), the Chief Physician Forum of the German Radiology Society (Chefarztforum der DRG, CAFRAD), the Heads of the Institutions of the Professional Association of German Radiologists (Berufsverband der Deutschen Radiologen e.V., BDR), and the Young Radiology Forum (Forum Junge Radiologie). An email was sent at the beginning of the survey with reminders after two weeks and three days before the survey was terminated. Duplicates were excluded by matching the given answers' IP addresses. Due to the anonymous nature of the survey, an ethics committee approval was deemed not necessary.

Structure of the questionnaire

The questionnaire included 44 non-validated questions in total, which addressed the six following topics: demographic and general working conditions (n = 11), personal career preferences (n = 4), structure of the IR department (n = 5), women in IR (n = 2), internal education and training in IR (n = 17), and congress attendance and external training (n = 6). The survey mainly consisted of multiple-choice questions. In addition, questions with multiple selections or complementary free-text options were presented.

The first set of questions included six questions focusing on demographic data (gender, age, nationality, and number of children). Then, five additional questions queried general characteristics of working conditions, including type of institution, working hours, year of training of the survey participants, number of additional hours, and satisfaction with the professional situation.

The second set focused on personal career preferences with four questions requesting that participants identify their personal career preferences in general radiology and interventional radiology in particular. In addition, reasons for a current interest or lack of interest in interventional radiology were assessed.

The third set of questions analyzed the structure of IR service with five questions regarding the number and qualifications of interventional radiology staff as well as the presence of interventional radiological consultation hours, a dedicated interventional radiological inpatient service, and interventional radiological 24-hour emergency care.

The fourth set of 20 questions was designed to obtain a comprehensive representation of the current educational situation in interventional radiology within the department. The items queries included the existence and length of a dedicated rotation in interventional radiology. A particular focus was placed on the participation of residents in interventional procedures, which were thematically divided into emergency interventions and DeGIR modules [15]. In addition, the general satisfaction with training and workload were surveyed. Four questions focused on satisfaction with training in interventional radiology as well as hurdles faced by trainees in interventional radiology.

The fifth set of questions investigated the role of women in interventional radiology with a focus on identifying possible hurdles to prevent adequate training in IR for female residents. Moreover, statistical differences regarding general job satisfaction and satisfaction with IR training between genders were investigated.

The final set of questions addressed resident training and postgraduate education with questions covering congress attendance and external training.

Statistics

Statistical analyses were performed using SPSS (v25.0, IBM Corp., United States).

Descriptive statistics with respective percentages were used. Normal distribution was investigated with the Shapiro-Wilk test. If applicable, standard deviations for normally distributed data and median with [25 %; 75 % range] for non-normally distributed data were given. Student's t-test for two groups and ANOVA test for multiple groups were employed to test for significant differen-

▶ **Table 1** Demographic characteristics of survey participants.

Participants		total	330
Gender	[%]	male/female	56/44
Age	[years]	mean ± SD	35 ± 7
Nationality	[%]	German	88
		Austrian	2
		other	10
Children	[%]	yes/no	36/64
Year of training	[years]	mean ± SD	3.6 ± 1.5
	[%]	1st–3rd	40
		4th–5th	43
		> 6th	16
Working hours	[%]	full time/part time	88/12
Type of hospital	[%]	university hospital	42
		maximum care hospital	34
		standard care hospital	20
		private practice	3
General job	[%]	very satisfied	20
satisfaction		somewhat satisfied	52
		undecided	17
		somewhat unsatisfied	7
		very unsatisfied	4

ces in parametric data. The Mann-Whitney U-test (MWU) and Kruskal-Wallis test (with MWU tests for post-hoc analysis) were used for non-parametric data. $P < 0.05$ was deemed statistically significant.

Correlation was investigated using the Spearman's rank correlation coefficient. Results are given with 95 % confidence intervals. A correlation of > 0.7 was considered strong, > 0.5 moderate, and > 0.3 weak.

Results

Demographics, personal life, and general working conditions

A total of 330 participants completed the questionnaire with demographic characteristics summarized in ▶ **Table 1**. There was no significant difference in job satisfaction between different institutional types ($P = 0.52$), participants with or without children ($P = 0.68$), marital status, and families with children.

Personal career preferences

The majority of participants expressed a high interest in IR (47 % very interested, 30 % interested) regardless of the training year ($P = 0.92$). Overall, 47 % of the respondents were able to imagine subspecializing in interventional radiology, which was second only to diagnostic radiology (60 %). Neuroradiology, no specific specialization, and pediatric radiology were favored by 27 %, 27 %, and 6 %, respectively.

The three main reasons for an increased interest in interventional radiology were professional interest (82 %), manual work (80 %), and therapeutic focus (61 %). Additional free-text answers included the promising future and broadness of the profession, scientific interests, as well as the possibility of interdisciplinary interactions. The reasons for a lack of interest were primarily a predominant interest in diagnostic radiology (55 %), radiation exposure during interventions (43 %), and a potentially higher workload (36 %). Free-text answers mentioned the long duration of training, high stress level, elevated level of responsibility, lack of high-quality training opportunities, uncertain future perspective, and the lack of autonomous work in residency (▶ **Fig. 1**).

Characterization of the IR service

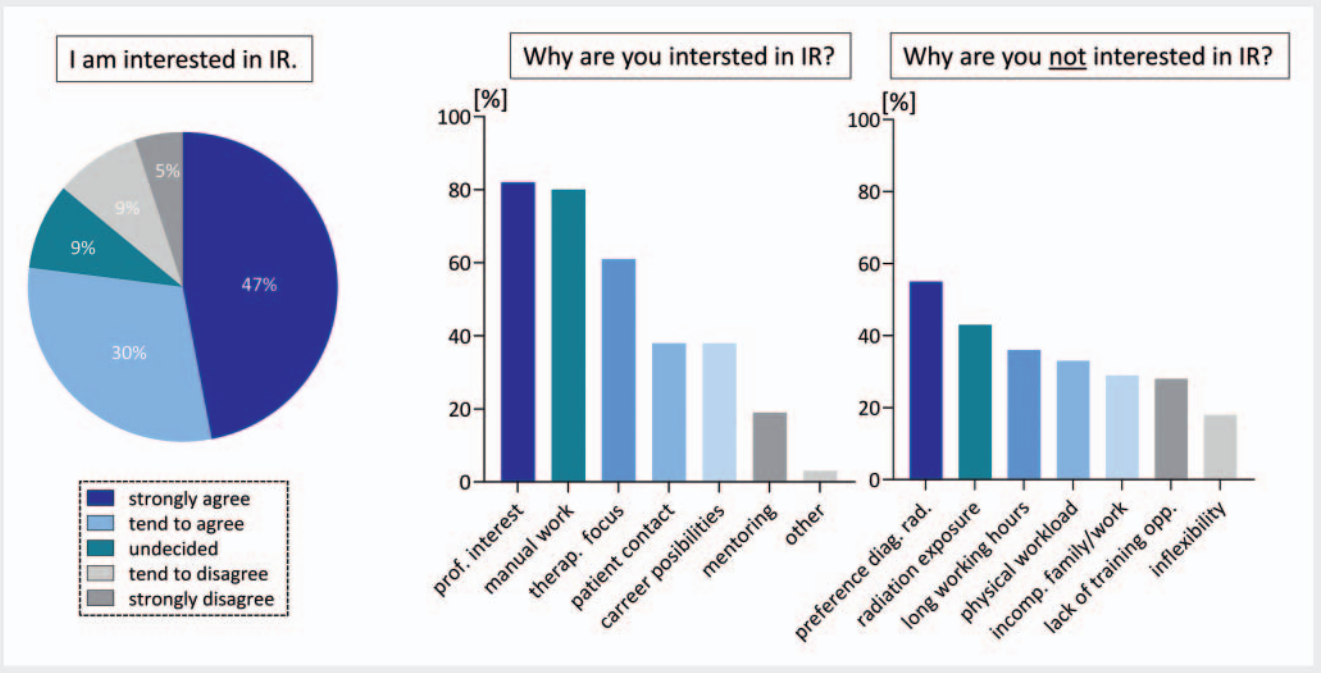
Dedicated interventional radiology patient care existed at most of the respondents' institutions (95 %) and interventional 24 h radiology emergency care was provided in 84 % of the institutions. Outpatient interventional radiology consultation was established in 32 % of cases, and a dedicated interventional radiology ward was available in 13 % (▶ **Fig. 2**). On average, interventional radiology service was provided by one (0.8 ± 0.6) chief radiologist, three (2.9 ± 1.7) senior radiologists, and two (1.9 ± 2.5) residents in training for radiology.

Education and training in interventional radiology

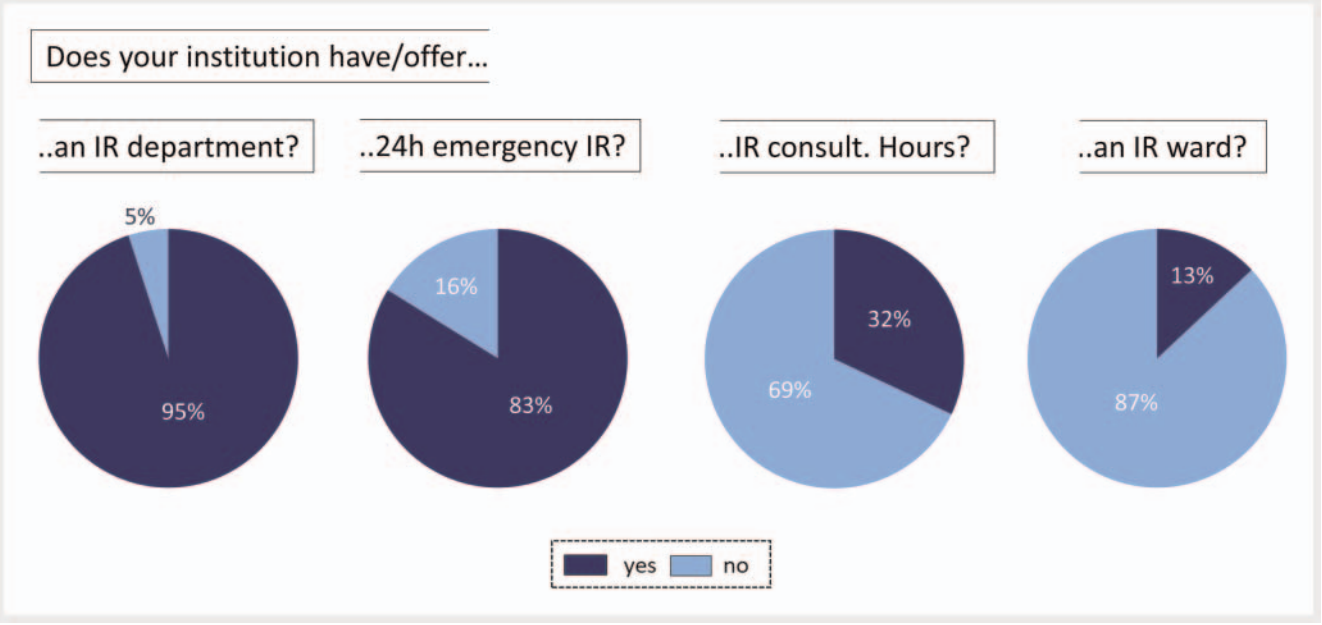
More participants were satisfied than dissatisfied with their IR training situation (very satisfied (16 %) and somewhat satisfied (29 %) vs. very dissatisfied (20 %) and somewhat dissatisfied (19 %)). There was no significant difference in satisfaction between different institutional types ($P = 0.15$) or participants with or without children ($P = 0.99$).

63 % of the participants had a dedicated rotation in interventional radiology at their institution, with a median duration of 6 [3, 6] months. The definition of a dedicated rotation was a fixed, contiguous period of work in interventional radiology lasting at least one month during which the participant is actively involved in interventional work. The currently practiced length of IR rotations in participants' institutions was considered appropriate by 57 % of participants (▶ **Fig. 3**). In the group with rotation durations of at least 12 months, more than 90 % of all respondents were satisfied with their IR training. Appropriate periods of 2–18 months were mentioned in free-text responses, with 6–12 months being favored (n = 25 vs. n = 21). Few participants wished for an interest-based length of the training period (n = 4) or emphasized the importance of the continuity of the training period (n = 3). Most residents received feedback during their rotation, which was institutionalized in 18 %, took place regularly but was not institutionalized in 25 %, or happened irregularly in 33 % of cases. The number of extra hours per week in IR was not significantly different from diagnostic radiology (both 3 [1, 5] hours; $P = 0.15$).

Based on the DeGIR/DGNR modules, residents participated in most of the interventions themselves. In Module A (vascular opening and reconstructive procedures) and Module C (diagnos-



▶ **Fig. 1** Personal career preferences and interest in interventional radiology. IR = interventional radiology, prof. interest = professional interest, therap. focus = therapeutic focus, incomp. family/work = incompatibility of family and work, lack of training opp. = lack of training opportunities.

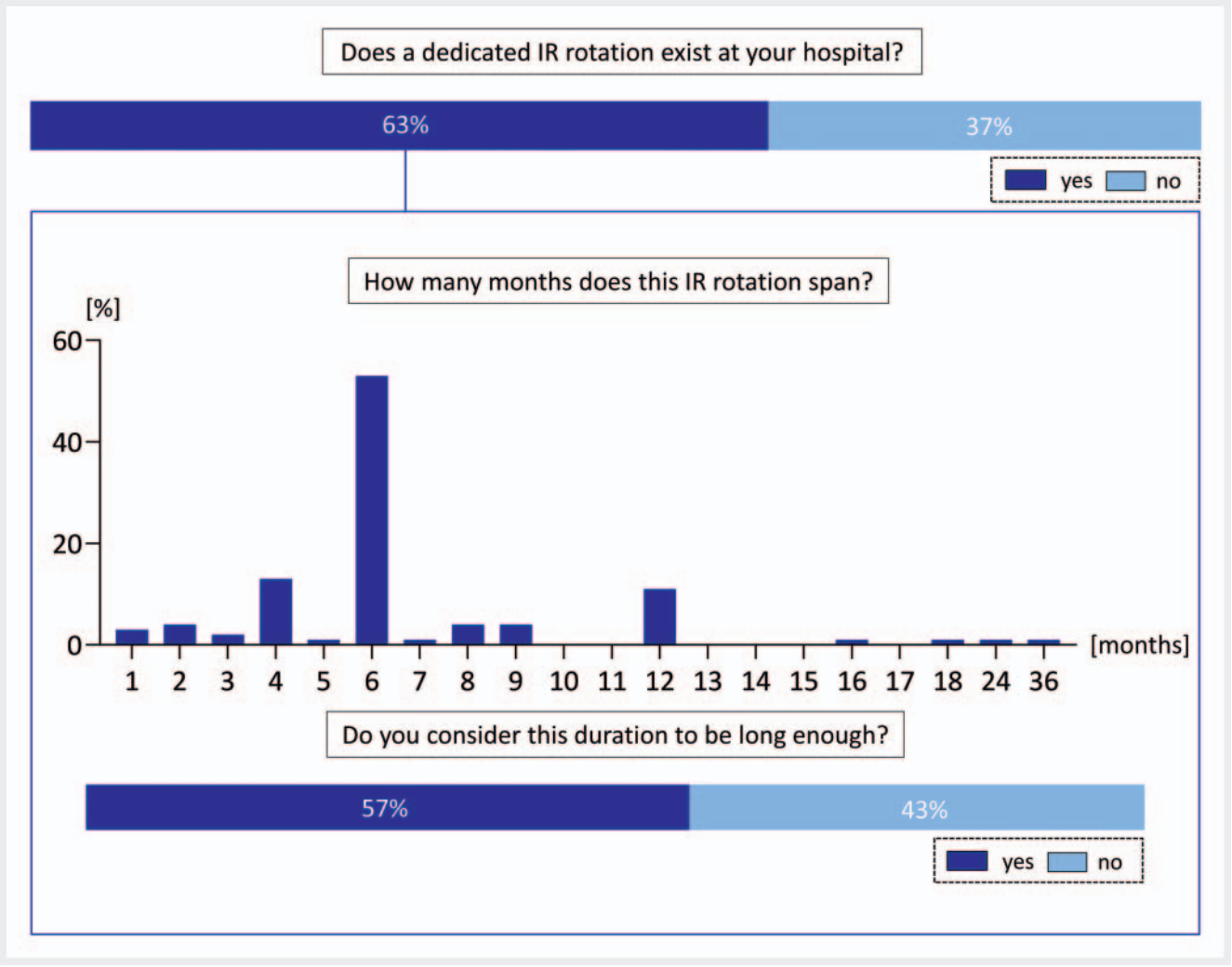


▶ **Fig. 2** Spectrum and infrastructure of the interventional radiology department. IR = interventional radiology.

tic punctures, and drainages), the proportion of interventions performed partially independently to completely independently was higher than the proportion of interventions in which only assistance was provided (▶ **Fig. 4** for a detailed overview).

Moderate correlations with IR education satisfaction were found for an institutionalized structured feedback interview and the duration of the IR rotation (both $p < 0.001$). Weak but significant correlations for education satisfaction were obtained with respect to performing interventions independently or partially independently (Modules A–D; all $p < 0.001$; ▶ **Table 3**).

Most participants identified room for improvement particularly in the form of a structured training curriculum (67 %) and in the form of the ability of residents to more actively perform interventions (55 %; ▶ **Fig. 5**). Free-text answers included earlier exposure to interventional radiology rotations, interest-based or longer rotations, the guarantee of a rotation during general radiological train-



▶ **Fig. 3** Presence and duration of dedicated rotations in interventional radiology. IR = interventional radiology.

ing, an increased number of trainees, improvement of infrastructure-based strain (increased staffing ratios, reduction of time pressure, decrease of overtime hours, broader case ranges), an increase in training quality (better supervision, structured training, elaborated feedback techniques, case reviews), a longer supervised learning period, as well as stricter control mechanisms of official national bodies to ensure training quality.

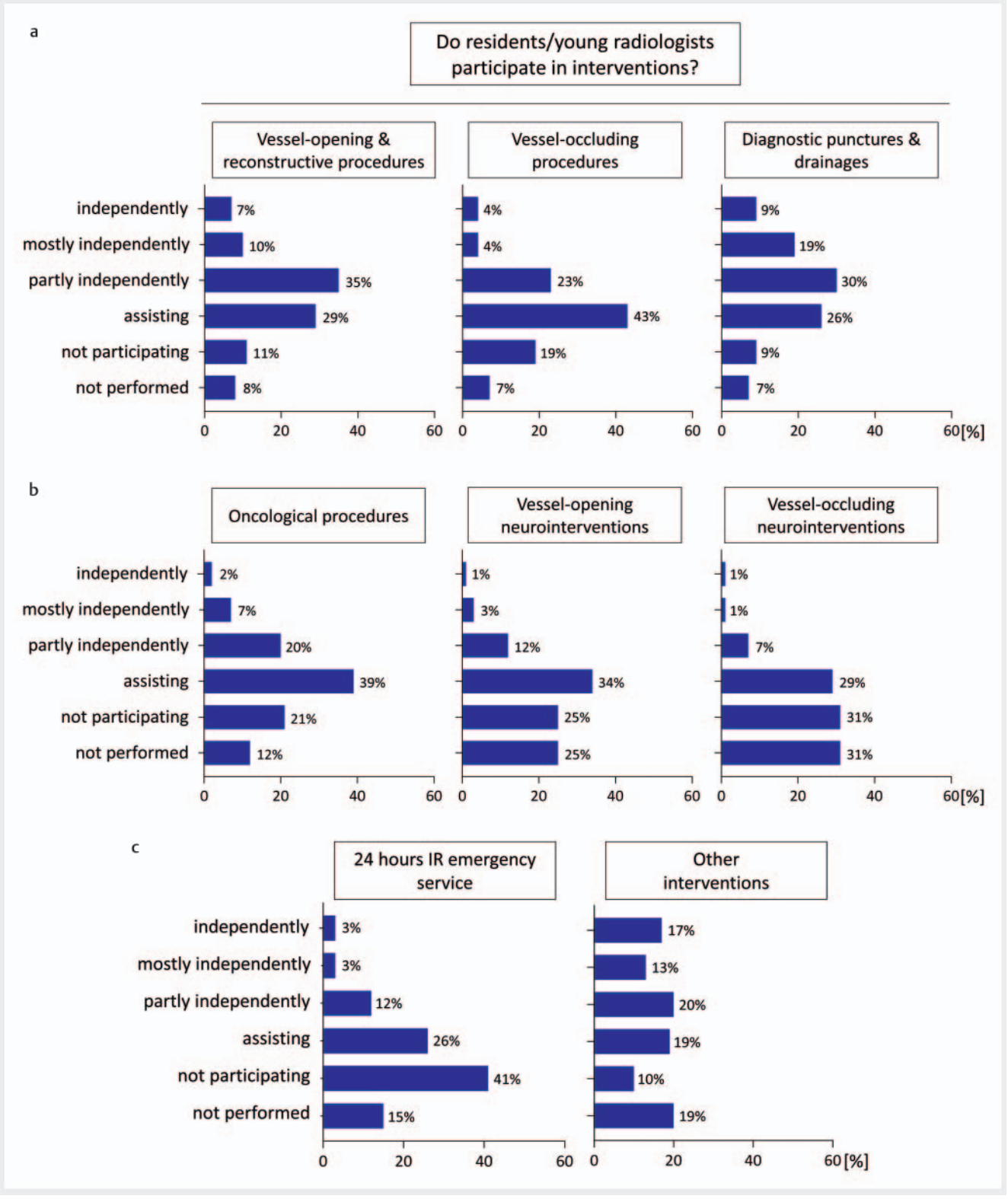
Free-text responses to the question "What hurdles prevent adequate training in IR?" included the lack of a guaranteed rotation (n = 29), an inadequate amount of training opportunities (n = 13), and the lack of reasonable selection criteria to receive mentoring in IR during residency (n = 5). Furthermore, a general shortage of staff in radiology departments leads to a transfer of trainees from training positions in IR to other radiological modalities according to the participants (n = 22). The complete lack or insufficient amount of (independent) practical work, the small number of completed training cases, and the absence of an IR training curriculum during their rotation were each mentioned by twelve participants.

Women in interventional radiology

The general job satisfaction of women was comparable to that of male colleagues (P = 0.39). However, women's satisfaction with IR training was lower than that of male participants, albeit without reaching statistical significance (P = 0.06; ▶ **Table 2**). Free-text answers to the question "What hurdles prevent adequate training in IR for female residents?" included the lack of encouragement for female residents (n = 12) due to the possible risk of pregnancy, interest in starting a family, and physical constitution. In addition, reasons concerning work-life balance, such as part-time employment (n = 8), parental leave (n = 4), being a parent (n = 2), and incompatibility of family and working place obligations (n = 4) were also considered.

Congress attendance and external training + postgraduate training/courses

Many respondents attended congresses more often than once a year (32 %) or at least once a year (48 %). The three most frequently attended congresses were the German Roentgen Congress (Deutscher Röntgenkongress; 80 %), the European Congress of Radiology



▶ **Fig. 4** Involvement of residents and young radiologists in interventional procedures. The procedures are grouped according to the DeGIR modules. [15]. IR = interventional radiology.

▶ **Table 2** Satisfaction with IR training and general job satisfaction in relation to gender p < 0.05 was considered statistically significant.

	Satisfaction with IR training [%]		P	General job satisfaction [%]		P
	Female	Male		Female	Male	
Very satisfied	16	16	0.06	17	23	0.39
Somewhat satisfied	22	35		54	50	
Undecided	18	16		19	15	
Somewhat unsatisfied	19	18		4	10	
Very unsatisfied	25	16		6	2	

IR = interventional radiology.

▶ **Table 3** Correlation of different parameters with interventional radiological education satisfaction. Significant values are marked with *; p < 0.05 was considered statistically significant.

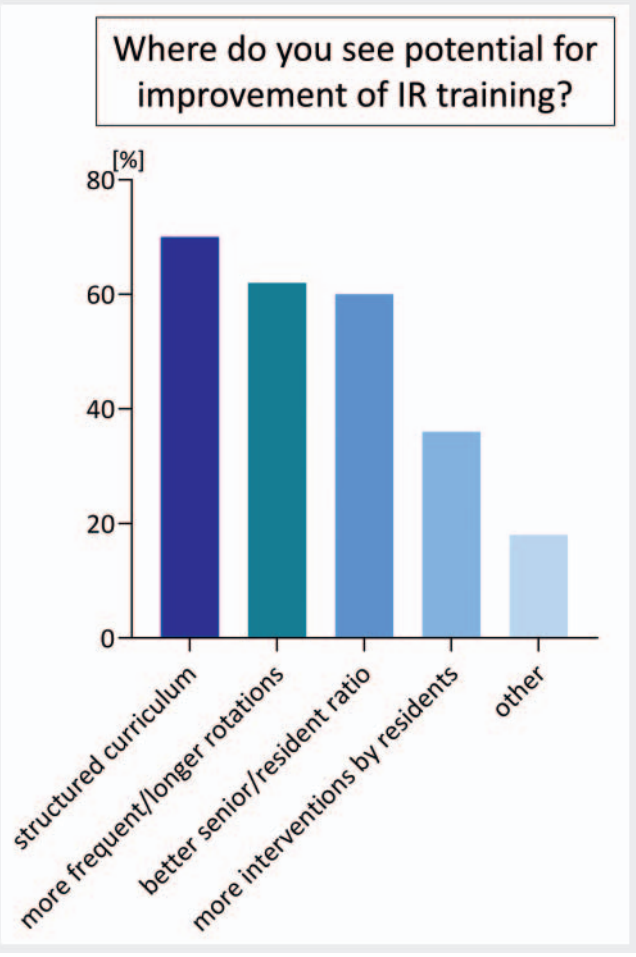
	Correlation: satisfaction with IR training		
	r	95 % CI	P
Institutionalized IR rotation	0.38*	0.26–0.49	< 0.001
Duration of the IR rotation	0.51*	0.40–0.60	< 0.001
Institutionalized structured feedback	0.54*	0.44–0.63	< 0.001
Senior/resident ratio	0.07	-0.07–0.20	0.29
Autonomous work			
Module A	0.37*	0.25–0.48	< 0.001
Module B	0.41*	0.30–0.52	< 0.001
Module C	0.31*	0.19–0.43	< 0.001
Module D	0.38*	0.26–0.48	< 0.001
Module E	0.13*	0.00–0.25	0.05
Module F	0.07	-0.06–0.20	0.25
Other	0.14*	-0.01–0.28	0.05
Congress visits	0.14*	0.01–0.27	0.03
Workshop visits outside of congresses	0.07	-0.06–0.20	0.26

IR = interventional radiology, 95 % CI = 95 % confidence interval.

(ECR, 25 %), and the Congress of the Cardiovascular and Interventional Radiological Society of Europe (CIRSE; 17 %). The main reasons for congress participation included interest in scientific education (62 %), professional education in congress sessions (70 %), and workshops (60 %; ▶ **Fig. 6**). Apart from congresses, the majority of respondents have not attended workshops yet (60 %), compared to 34 % who attend these workshops on average one time per year, and 6 % who do so more often. Possible incentives for increased congress participation included hospital coverage of registration costs (51 %) and the availability of different kinds of workshops, e. g., tailored to different levels of expertise (29–51 %; ▶ **Fig. 6**).

Discussion

Interventional radiology (IR) is a growing subspecialty of radiology [1–4]. The presented survey investigated the training situation and general opinion of residents and young radiologists in interventional radiology in Germany for the first time. Furthermore, we aimed to identify potential issues to improve training in interventional radiology to prepare the subspecialty for the future. We consider the discussion crucial since care will be provided by those who are skilled and organized – regardless of the discipline. If radiologists want to continue to offer minimally invasive interventional procedures in this competitive healthcare system, we must



▶ **Fig. 5** Areas of potential improvement in IR training. IR = interventional radiology.

ensure solid training. Furthermore, we should draw the correct conclusions from criticism and be open to innovation.

Personal career preferences

The key message from this survey is that interest in interventional radiology among young radiologists in Germany is very high regardless of their level of training. We assume a keen interest when 77 % of respondents are interested in interventional radiology and 47 % can even envision a dedicated specialization in this field. These figures are markedly higher than those previously reported by various international studies ranging from 30 % among residents already working in IR to 20 %-35 % among residents working in general radiology [8, 9, 11, 12, 16]. The reasons for interest or non-interest in interventional radiology are comparable to the results of previous inquiries [8, 9, 11, 12, 16]. While diagnostic radiology faces its own uncertainties, e. g., implementation of artificial intelligence, interventional procedures are undoubtedly an expanding field in health care with a chance for radiology to be a part of that development. The aspect of manual work and the chance to provide therapy are key arguments in favor of IR in our study. Concerns that were mentioned are mainly radiation exposure and workload issues. In line with those concerns, radiation protection during interventions is constantly being improved and innovative software solutions can significantly reduce the radiation dose by up to 35 % [17, 18]. Furthermore, our survey shows that overall overtime hours in interventional radiology were not higher than in diagnostic radiology. The reasons for the perception of a higher workload are speculative, but could, for example, be due to individual, very time-intensive interventions, so that the workload is markedly increased on certain days and is less predictable.

Characterization of IR service

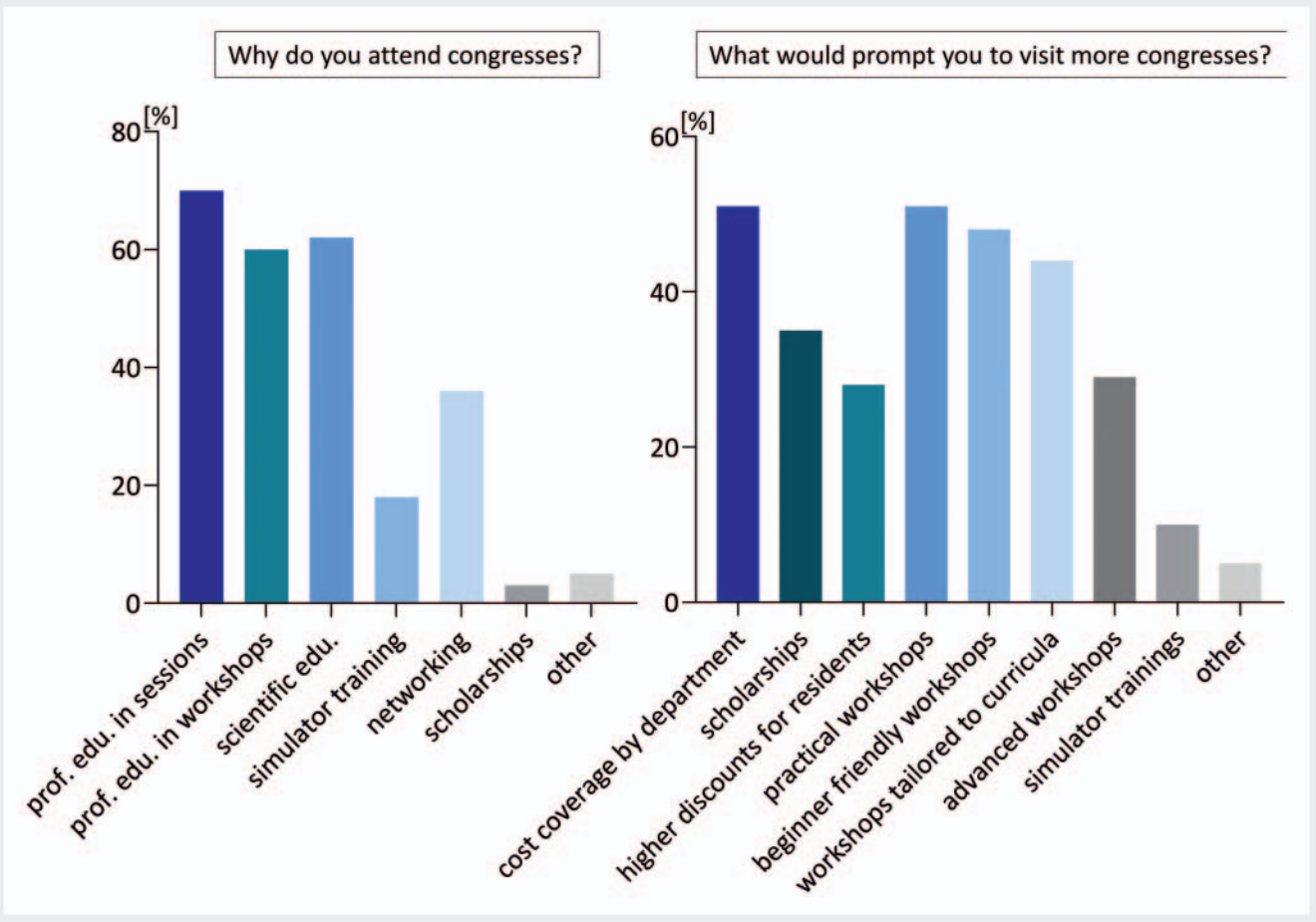
A prerequisite for successful training in interventional radiology is undoubtedly the infrastructure provided by the institution. Most of the surveyed workplaces have an interventional radiology department with a broad treatment spectrum and 24 h emergency care available. Some even have dedicated radiology wards and consultation hours. There appears to be a discrepancy between this data and the 37 % of residents who do not receive an organized rotation in IR in their perception. One possible cause could be that staffing of IR units is insufficient or that training in other modalities is prioritized over IR. This coincides with the fact that several participants report being regularly withdrawn from IR to compensate for staff shortages in other areas. As the infrastructure to provide high-quality education in interventional radiology seems readily available, organizational adjustments and an improvement in the staff situation appear mandatory to ensure the basis for successful IR training. The survey demonstrated keen interest in IR training on the part of the current generation of residents based on their request for longer rotations in IR of up to 12 months. Such a change would ensure the development of skills towards the independent execution of procedures and full integration into IR service.

Education and training in interventional radiology

General job satisfaction (72 % satisfied) and satisfaction with IR training (45 % satisfied) were higher compared to other disciplines like internal medicine (38 %), urology (44 %), and ophthalmology (40 %) [19–21]. Nevertheless, satisfaction with IR training is lower than with training in general radiology, which is similarly high (65 %) in a previous published survey by Oechtering et al. in 2018 [11]. There is certainly room for improvement considering that 39 % of participants were not satisfied with their IR training conditions.

The data from our survey suggest that the following areas are particularly relevant to the quality and satisfaction of IR training: 1) the length of rotation in IR, and 2) the existence of a structured training curriculum with appropriate feedback from trainers.

When participants were asked directly about areas of improvement, longer rotations and more autonomy when performing interventions were frequently mentioned, which were also confirmed by the significant correlations with training satisfaction. At most institutions, the rotation time was six months, which was considered too short by 43 % of the respondents. On the one hand, in the group with rotation durations of at least 12 months, more than 90 % of all respondents were satisfied, and none of the respondents were dissatisfied with the IR training. On the other



▶ **Fig. 6** Congress participation and field of interests regarding congresses. Prof. edu. = professional education.

hand, a rotation time of 6 months was mentioned as adequate by several participants. One possible conclusion is that the appropriate rotation time depends on individual interest. This could be asked for in the context of a structured training interview during further training. Several free-text statements of the respondents indicated a possible reason for short rotation times. The relatively low mandatory amount of conducted interventional radiological procedures in official German training regulations, compared to cross-sectional imaging examinations, is one reason why residents cannot spend more time in interventional radiology. Otherwise, they run the risk of extending their training period until they become a certified radiologist. Especially against the background of the high interest among young radiologists and the growing clinical importance of interventional radiology, this should be a reason to reconsider the weighting of interventional radiology in training regulations. We recommend a rotation time of at least 6 months based on this data since less time leads to low satisfaction among trainees.

The most frequently stated suggestion for improvement was the implementation of a structured training curriculum. This was also a commonly mentioned aspect in the study by Oechtering and colleagues and has just recently been developed by the Young Radiology Forum, the DeGIR, the DGNR, and the DRG. It will be interesting to see whether the introduction of the curriculum impacts the structure of education within the departments and leads to increased satisfaction in the future as anticipated by both study participants and the literature [8, 11, 22, 23]. The curriculum can also be used to promote the (partly) independent execution of interventions by residents, which also correlated with satisfaction. While feedback is provided in most institutions, it is rarely institutionalized. The authors strongly advise structured and institutionalized feedback especially since it is relatively easy to establish and the relationship with increased job satisfaction is supported by the data of both this and a previous publication [11].

Women in interventional radiology

Although the data did not reach the significance level, female residents tended towards lower satisfaction with the training conditions in interventional radiology. Systematic investigation of the reasons for this was beyond the scope of this study and therefore any conclusions remain speculative. However, free-text answers regarding specific hurdles for young female radiologists indicate that it is difficult to reconcile family obligations and the perception of a higher workload in interventional compared to diagnostic radiology. As mentioned above, the number of extra hours in IR was not significantly different from diagnostic radiology in our study. Although time-intensive emergency interventions can occur in IR, this problem can certainly be partly mitigated by suit-

able staffing and the obligatory establishment of 24-hour emergency service in radiology departments. This would have two advantages: firstly, it would enable highly qualified female radiologists to work in IR. Secondly, the radiologist would also be perceived as a therapist in the clinical environment – strengthening the position of radiology in relation to other disciplines. Moreover, preference for male residents in male-dominated departments is also mentioned, although other respondents also indicated no gender-specific hurdles. Overall, answers given by the study participants closely coincide with concerns compiled in international publications on this topic [24–26]. The authors recommend a change in structure and support in the IR working environment to attract more women to the subspecialty and encourage them to take on leadership positions. However, further investigation focusing on female residents in IR seems warranted.

Congress attendance and external training + postgraduate training/courses

In addition to training in the clinical environment, there is a very high level of willingness to embrace education outside the daily training program. Educational activities at congresses are one of the main drivers for young radiologists to attend such events. A large proportion of participants would welcome a broader range of workshops, especially at the most frequently attended congress, the German Roentgen Congress. Although this congress is not explicitly focused on interventional radiology, more interventional workshops could inspire many young radiologists to pursue interventional radiology further. Interestingly, when asked, “What would prompt you to visit more congresses?”, more than 35 % of participants mentioned more scholarships. Scholarships, however, were the most negligible response when asked, “Why do you visit congresses?”. A possible reason for this could be the insufficient quantity of scholarships or the lack of awareness of the programs offered. A wide range of workshops targeting different levels of expertise and scholarship programs, e. g., the “Flinke Finger” program for medical students [27], are offered by different institutions and societies. An expansion of programs or better advertisement could be helpful here.

Limitations

This survey has several limitations. Since the items were not validated in a standardized manner, this may have distorted the results. The limited cohort size of 330 participants possibly influenced the results. The representativeness of the study population for the target population cannot be validated because essential demographics and other characteristics such as place of residence were not collected for the target population due to the anonymous nature of the study. Due to the focus on interventional radiology, a particular preselection bias cannot be excluded. Furthermore, no differentiation was made between neuroradiology and radiology departments, which introduces a possible selection bias, especially considering complex neurointerventions and resident participation in these interventions.

Conclusion

There is a high interest in interventional radiology among radiological residents and young radiologists. The majority of German radiology departments provide the required infrastructure with semi-structured interventional training. However, trainees in interventional radiology describe only medium satisfaction with their training. This discrepancy represents the potential for further improvement of IR training, e. g., including the presence and duration of an organized rotation in interventional radiology and a structured curriculum with face-to-face feedback. Participants placed particular emphasis on structured guidance by senior interventionists during procedures. Satisfaction among women was somewhat lower than among male study participants. Further research into the causes of this gender discrepancy and efforts to address these issues are therefore desirable. We consider the improvement in IR training crucial and a chance for radiology in general since there will be a demand for more minimally invasive procedures provided by those who are skilled and organized in competitive health care systems.

Conflict of Interest

The authors declare that they have no conflict of interest.

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