

Work and Training Conditions of German Residents in Radiology – Results from a Nationwide Survey Conducted by the Young Radiology Forum in the German Roentgen Society

Arbeits- und Weiterbildungsbedingungen in der Facharztweiterbildung Radiologie – Ergebnisse einer bundesweiten Weiterbildungsumfrage durch das Forum Junge Radiologie in der Deutschen Röntgengesellschaft

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Key words

ER-ratio, working conditions, psychosocial workload, continuing education, resident, radiology

received 01.07.2019

accepted 09.10.2019

Bibliography

DOI <https://doi.org/10.1055/a-1047-1075>

Published online: 9.1.2020

Fortschr Röntgenstr 2020; 192: 458–469

© Georg Thieme Verlag KG, Stuttgart · New York

ISSN 1438-9029

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ABSTRACT

Purpose Good training is the basis for high job satisfaction and high-quality patient care in radiology. The aim of this survey was to record the current state of working conditions for residents in radiology training in Germany and to focus on the aspects of training and psychosocial workload. The description of the actual state should help to identify possible problem areas and to develop improvement approaches.

Materials and Methods At the beginning of 2018, we sent an electronic questionnaire to the German Roentgen Society

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(DRG), the German Association of Chairmen in Academic Radiology (KLR), the Chief Physician Forum of the DRG (CAFRAD) and the Forum of Registered Radiologists (FUNRAD) with the request to forward it to radiology residents. With 63 questions, the questionnaire covered seven essential areas of medical working and training conditions. In order to ensure interdisciplinary comparability, most questions were identical to previous surveys among residents of other disciplines.

Results 643 residents started the survey. 501 (78 %) questionnaires were fully processed and included in the final analysis. 65 % of respondents were satisfied with their current job situation. At the same time, shortcomings, especially with regard to the reconciliation of family and work as well as scientific and clinical work, became clear. Only 36 % of participants with children were satisfied with the compatibility of family and work at their workplace. Only 31 % of the researchers were satisfied with their research conditions. In addition, residents experienced a high psychosocial workload.

Conclusion Job satisfaction is high among radiology residents in direct comparison to other disciplines. However, based on this survey, adjustments to working conditions and training in radiology seem necessary to maintain the health of the physicians concerned, to encourage motivation for scientific work and to enhance development opportunities, especially for women, through a better compatibility of work and family life. The present survey identifies strategies and leadership tools that can help to achieve this.

Key Points:

Residents in radiology training ...

- have a relatively high job satisfaction.
- experience a high psychosocial workload.
- evaluate the compatibility of family and work as in need of improvement.
- are interested in research, but evaluate research conditions as insufficient

Citation Format

- Oechtering TH, Panagiotopoulos N, Völker M et al. Work and Training Conditions of German Residents in Radiology – Results from a Nationwide Survey Conducted by the Young Radiology Forum in the German Roentgen Society. *Fortschr Röntgenstr* 2020; 192: 458–469

ZUSAMMENFASSUNG

Ziel Eine qualitativ hochwertige Weiterbildung ist Grundlage für eine hohe Arbeitszufriedenheit und eine exzellente Patientenversorgung in der Radiologie. Ziel dieser Umfrage war es, den aktuellen Stand der Arbeitsbedingungen von Ärzten in der Weiterbildung Radiologie in Deutschland zu erfassen und einen Fokus auf die Teilaspekte Weiterbildung sowie psychosoziale Arbeitsbelastung zu legen. Die Beschreibung des Ist-Zustandes soll helfen, mögliche Problemfelder zu identifizieren und Verbesserungsansätze zu entwickeln.

Material und Methoden Anfang 2018 wurde ein elektronischer Fragebogen über die Deutsche Röntgengesellschaft (DRG) e. V., die Konferenz der Lehrstuhlinhaber für Radiologie (KLR), das Chefarztforum der DRG (CAFRAD) und das Forum Niedergelassener Radiologen (FUNRAD) an radiologische Weiterbildungsassistenten verschickt. Der Fragebogen deckte mit 63 Fragen 7 wesentliche Themenfelder ärztlicher Arbeits- und Weiterbildungsbedingungen ab. Um eine fächerübergreifende Vergleichbarkeit zu sichern, wurden Fragen von bisherigen Erhebungen unter Ärzten in Weiterbildung anderer Fachrichtungen übernommen.

Ergebnisse 643 Ärzte haben die Umfrage begonnen. 501 (78 %) Fragebögen wurden vollständig bearbeitet und in die endgültige Analyse einbezogen. 65 % der Befragten waren mit ihrer derzeitigen beruflichen Situation zufrieden. Gleichzeitig wurden Defizite besonders in Bezug auf die Vereinbarkeit von Familie und Beruf sowie die Möglichkeit zu wissenschaftlichem Arbeiten deutlich. Nur 36 % der Teilnehmer mit Kindern waren zufrieden mit der Vereinbarkeit von Familie und Beruf an ihrem Arbeitsplatz. Nur 31 % der wissenschaftlich Tätigen waren zufrieden mit ihren Forschungsbedingungen. Zudem war die psychosoziale Arbeitsbelastung unter den befragten Ärzten stark ausgeprägt.

Schlussfolgerung Die Arbeitszufriedenheit ist unter radiologischen Assistenzärzten im Vergleich zu anderen Fachrichtungen hoch. Dennoch scheinen auf Basis dieser Erhebung Anpassungen der Arbeits- und Weiterbildungsbedingungen in der Radiologie erforderlich, um die Gesundheit der betroffenen Ärzte zu erhalten, die Motivation für wissenschaftliches Arbeiten zu fördern und die Entwicklungsmöglichkeiten insbesondere von Frauen durch eine bessere Vereinbarkeit von Familie und Beruf aufzuwerten. Die vorliegende Umfrage zeigt Strategien und Führungsinstrumente auf, mit denen dies erreicht werden kann.

Introduction

As in every resident training program in Germany, radiology training is faced with increasing demands regarding cost-effectiveness and efficiency in patient care [1–3]. As a result of the growing number of examinations, the workload has been increasing for years – among residents in training as well as among specialists and senior physicians and those authorized to provide training [4]. Medical advances, increasing specialization, and technical

developments require greater detailed knowledge and high quality of medical reports. A growing number of physicians no longer want to work 100 % in the clinical routine: Many begin working part time already during their training, young mothers and fathers go on parental leave [5], and residents performing research want official research rotations [6]. In addition, artificial intelligence will dramatically change the daily routine for radiologists. Radiology is changing and faces major challenges.

An overview of the actual training situation in Germany and how it is perceived by residents is not yet available. At present, we can only speculate about the reasons for dissatisfaction at work with all the associated risks ranging from high number of sick days to burnout [7], high error rate, inefficiency and poor patient care [8–10]. However, they must be clearly identified in order to be able to improve training and thus prevent dedicated young physicians from emigrating, selecting alternative occupational fields, or reducing their working hours [11]. It is therefore essential to include the next generation of radiologists in the shaping of working and training conditions and of the future direction of radiology.

The goal of the survey was therefore to assess the opinions of residents in radiology in Germany and to compare them with the results of other national [12, 13] and international professional radiology societies [14]. Therefore, problems can be detected and improvement potential can be realized in a targeted manner.

Materials and Methods

Survey

The target population was residents in radiology training. Invitations to participate in the anonymous survey were sent either directly to participants or to the following distributors with the request for forwarding: the German Roentgen Society (DRG), the Conference of Professors of Radiology (KLR), the Chief Physician Forum of the DRG (CAFRAD) and the Forum of Registered Radiologists (FUNRAD). The survey could be completed in the 6-week period between January 15 and March 3, 2018. Participation reminders were sent after two and four weeks. The online questionnaire provider SurveyMonkey® (Survey Monkey Inc., San Mateo, CA, USA) was used for the survey. The sample was randomly taken from the above-named target population. Due to the anonymous nature of the survey, it was not necessary to consult an ethics committee.

The questionnaire included 63 questions in 7 subject areas (► **Table 1**). To ensure cross-discipline comparability, the questionnaire was based in large parts on surveys among residents in training for internal medicine [12, 13] and contained non-validated items except for the model of effort-reward imbalance and the questions regarding work and family [15].

Model of effort-reward imbalance

Questions regarding the psychosocial workload were based on the short version of the branch-independent effort-reward imbalance (ERI) questionnaire [16, 17]. The work-stress model was based on the assumption that employees receive a defined social reward for their efforts (social reciprocity). Based on the effort scale and the reward scale (with the subscales of recognition, salary/career mobility and job security), an effort-reward ratio was created. An effort-reward imbalance as an expression of an elevated psychosocial workload is defined as an effort-reward ratio (ER ratio) greater than 1. A third scale measures overcommitment. A high level of overcommitment is an intrinsic tendency toward excessive commitment that can increase an effort-reward imbalance.

► **Table 1** Topics and number of questions,

topic	number of questions
work conditions in daily professional life	4
continuing medical education and training	9
compatibility of work and family	12
compatibility of work and research	6
model of effort-reward imbalance (short version)	16
specific questions regarding radiology	4
demographics	12
total: 63 questions	

Statistics

As parametric methods for statistical hypothesis testing, the t-test for independent samples (95% confidence interval [95% CI]) was used to compare two groups while ANOVA with the Tukey post-hoc test was used for multiple groups. The Mann-Whitney U-test (MWU) and Kruskal-Wallis test (with MWU tests for post-hoc analysis) were used as the non-parametric methods. Expected and observed distribution patterns were compared using contingency tables and checked for statistical significance using the Chi² test. A p-value < 0.05 was considered statistically significant.

For the tests mentioned above, the following key figures for effect size were used: t-test Cohen's d (magnitude of effect for the mean differences): < 0.5 small, 0.5–0.8 medium, > 0.8 large effect. ANOVA: Eta² (percentage of explained variance): < 0.06 small, 0.06–0.14 medium, > 0.14 large effect. MWU test: r (magnitude of effect for median differences): < 0.3 small, 0.3–0.5 medium, > 0.5 large effect. Chi²: Cramér's V (Chi²-based measure of association): 0.1 small, 0.3 medium, 0.5 large effect. An adjustment for multiple tests was performed in accordance with Bonferroni-Holm (based on significance level $\alpha = 0.05$; 14 statistical hypothesis tests over the entire sample; new level of significance as α_x where appropriate). In all tests, the parametric and non-parametric methods yielded a consistent result. For the sake of clarity, only the primarily used test method is specified in the result section. All statistical analyses were performed with SPSS Statistics Version 25 (IBM, New York, USA).

Results

Of a total of 643 initiated questionnaires, 501 were completed. Thus the percentage of completed questionnaires that were used in the final analysis was 78% (501/643). ► **Table 2** provides an overview of the demographics of survey participants.

Working conditions in daily professional life

65% (326/501) of participants were very or mostly satisfied with their general professional situation, 22% (108/501) were undecided, and 13% (67/501) were mostly or very dissatisfied. The

undecided and dissatisfied participants were surveyed regarding the reasons for their dissatisfaction (175 participants, 15 options, multiple answers possible, average 2.9 responses/participant). high temporal workload (40%), insufficient training quality (35%), lack of instruction and supervision (34%), and work intensification (31%) were selected as the four most common factors. With regard to job satisfaction, there was no statistically significant association with the hospital ownership ($p = 0.1$), the place of employment (basic care or maximum care hospital, university, private practice; $p = 0.8$) and the presence of children ($p = 0.7$). Participants were asked how they felt the quality of patient care had changed in general and in radiology over the last few years (scale between -5 /very negative to $+5$ /very positive). The rating of the participants was -0.7 ± 1.9 (mean \pm standard deviation) in general and $+0.5 \pm 1.8$ for radiology. Finally the participants were asked whether they have considered or already implemented one of the following options due to dissatisfaction with their working conditions: 15% (75/501) have reduced and 42% (212/501) have considered reducing their working hours, 31% (154/501) have changed and 37% (184/501) have considered changing their place of work, 3% (14/501) have given up and 27% (134/501) have considered giving up clinical practice, 6% (28/501) have moved abroad and 33% (165/501) have considered moving abroad.

Model of effort-reward imbalance

► **Fig 1** shows the responses to the 16 questions regarding the short version of the model of effort-reward imbalance. The psychosocial workload was high among participants with an ER (effort-reward) ratio of 1.7 ± 1.6 (effort scale 76 ± 19 , reward scale 55 ± 16). The ER ratio was >1 for 79% of participants and >2 for 23% (► **Fig. 2**).

The level of overcommitment ($47 + 20$) was moderate among participants. There were no statistically significant associations between psychosocial workload and the hospital ownership ($p = 0.5$) and the place of employment ($p = 0.6$).

Continuing medical education and training

When hired, 38% (183/501) of those surveyed received an employment contract for the entire training period. This was the case significantly more often at non-university hospitals (Chi^2 , $p < 0.001$). In contrast, only 16% at university hospitals received such a contract compared to 42% at maximum care hospitals.

The use of a structured training curriculum was confirmed by 37% (186/501) of those surveyed and was most common at university hospitals. 52% of those surveyed from university hospitals had a structured curriculum in contrast to 29% of participants from maximum care hospitals (Chi^2 , $p = 0.001$).

62% of participants (311/501) expected to complete training in the defined regular training period. 51% of those surveyed (253/501) assumed that they will have learned the training content required by the logbook by the end of the training period.

When asked about the occurrence and quality of the mandatory yearly interview with the training supervisor, 40% (197/501) of participants stated that interviews are held but primarily to fulfill the documentation requirement. 37% (187/501) reported

► **Table 2** Demographics of survey participants.

participants	total		501
gender	female/male in %		51/49
age in years	MV \pm SD		32 \pm 3.8
	%	≤ 30	35
		31–34	45
≥ 35		20	
year of training	MV \pm SD		4.3 \pm 1.7
	%	1 st –3 rd	31
		4 th –5 th	52
$\geq 6^{\text{th}}$		17	
working hours	full time/part time in %		83/17
	full time female : male in %		72:94
	part time female : male in %		28:6
children	no/yes in %		65/35
nationality	german/other in %		92/8
state	%, most common	Bavaria	18
		North Rhine-Westphalia	17
		Baden-Württemberg	15
hospital ownership	%	public	72
		non-profit	11
		private	17
place of employment	%	hospital providing specialized/general care	22
		maximum care hospital	25
		university	46
		private practice	7

MV \pm SD: mean value \pm standard deviation.

structured and constructive yearly interviews with the training supervisor, while 23% (117/501) reported a lack of interviews. There was no statistically significant correlation between the mode of the yearly interview with the training supervisor and the place of employment ($p = 0.024$, $\alpha_6 = 0.008$). The existence of a structured training curriculum and regular constructive yearly interviews with the training supervisor was statistically significantly associated with a higher job satisfaction (MWU, $p < 0.001$, $r = 0.22$ or Kruskal-Wallis, $p < 0.001$) and a lower psychosocial workload (t-test, $p = 0.003$, $\alpha_7 = 0.007$, 95% KI -0.68 – (-0.11) , Cohen's $d = 0.25$ or ANOVA/Tukey, $p < 0.001$, $\text{Eta}^2 = 0.04$) (► **Fig. 3**).

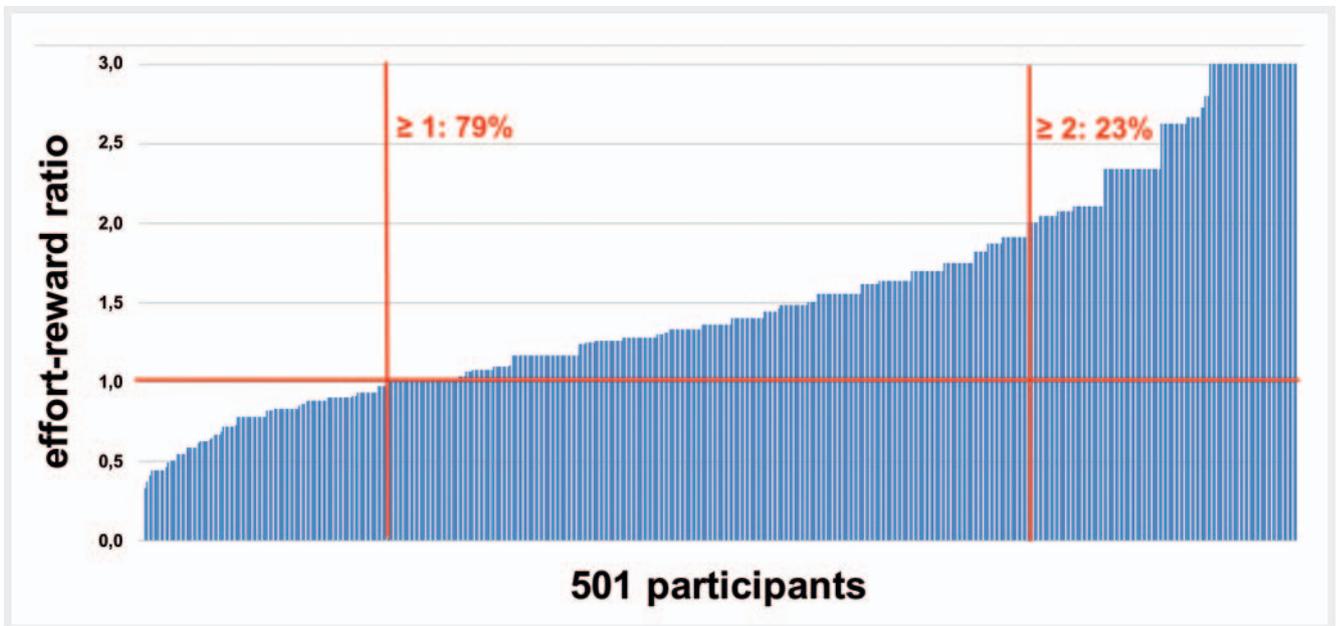
42% (211/501) of those surveyed rated participation in external continuing education as indispensable, 51% (2554/501) as helpful and 7% (36/501) as not necessary. The participants were then asked to assess which basic conditions or training instruments would be particularly helpful (10 options, multiple selections possible, average 2.9 responses per participant, ► **Table 3**).

With respect to career, participants were asked questions about their ideal future position and place of work (► **Table 4**). With respect to gender (Chi^2 , $p < 0.001$, Cramér's $V = 0.32$) and

Short version of the model of effort-reward imbalance with 16 questions (E: Effort, R: Reward, O: Overcommitment)	Responses (frequency/percent, n=501)				
	Strongly disagree	Disagree	Agree	Strongly agree	
1/E. Due to the high workload, there is often significant time pressure.	7 1%	55 11%	224 45%	215 43%	
2/E. I am often interrupted at work.	3 1%	35 7%	190 38%	273 55%	
3/E. My work has steadily increased over the last few years.	9 2%	97 19%	236 47%	159 32%	
4/R. I receive the recognition I deserve from my supervisor or another relevant person.	52 10%	162 32%	238 48%	49 10%	
5/R. The opportunities for advancement in my field are poor.	73 15%	257 51%	145 29%	26 5%	
6/R. I am experiencing - or expect - a worsening of my work situation.	66 13%	229 46%	159 32%	47 9%	
7/R. My own job is at risk.	218 44%	225 45%	50 10%	8 2%	
8/R. Based on the services I have rendered and the amount of effort I have invested, I consider the level of recognition appropriate.	55 11%	218 44%	201 40%	27 5%	
9/R. Based on the services I have rendered and the amount of effort I have invested, I consider my personal chances for professional advancement appropriate.	28 6%	154 31%	283 57%	36 7%	
10/R. Based on the services I have rendered, I consider my salary appropriate.	101 20%	190 38%	180 36%	30 6%	
11/O. At work, I easily get into time pressure.	19 4%	171 34%	232 46%	79 16%	
12/O. I often think about problems at work as soon as I wake up.	108 22%	197 39%	138 28%	58 12%	
13/O. I have no trouble disconnecting from work when I get home.	62 12%	190 38%	180 36%	69 14%	
14/O. Those closest to me say that I sacrifice too much for my work.	61 12%	203 41%	181 36%	56 11%	
15/O. I have a hard time disconnecting from work and continue to think about it in my free time.	78 16%	206 41%	154 31%	63 13%	
16/O. If I put off something that I should have done today, I cannot sleep at night.	122 24%	238 48%	115 23%	26 5.2%	

► **Fig. 1** Responses of the 501 survey participants to the 16 questions regarding the model of effort-reward imbalance. Questions are marked with E: Effort; R: Reward; and O: overcommitment.

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► **Fig. 2** ER ratio of all participants. An ER (effort/reward) ratio > 1 means that effort factors surpass reward factors. This implies an effort-reward imbalance and an increased psychosocial workload.

full-time/part-time work (χ^2 , $p < 0.001$, Cramér's V 0.28), there were statistically significant associations with the ideal future position ("other" option (6% (31/501)) excluded from the analysis). Male gender and full-time work tended to be associated with the aspiration for leadership positions in hospitals or self-employment. 37% (185/501) specified private practice as their ideal future place of work, 26% (130/501) specified a maximum care hospital or university hospital without an academic career, 18% (89/501) specified a university hospital with an academic career, 12% (62/501) specified a primary care hospital and 7% (35/501) specified industry/other. The most common desired fields of work were as follows [446 participants answered this optional question, 11 options (including 6 options from general diagnostic radiology), multiple selections were possible, on average 2.3 options were selected per participant]: At least one area of general diagnostic radiology 70%, interventional radiology 35%, diagnostic neuroradiology 29%, interventional neuroradiology 16%, and pediatric radiology 12%.

Specific questions regarding radiology

Participants were asked to specify what they find attractive about radiology (12 options, multiple responses possible, on average 2.7 options selected per participant). Exciting clinical work was named as the main reason in 74% of cases, the mix of diagnostic and interventional work in 51% of cases, and new technical developments and good compatibility of family and work in 35% of cases, respectively. 20% (100/501) of respondents switched to radiology after starting training in a different area of specialization.

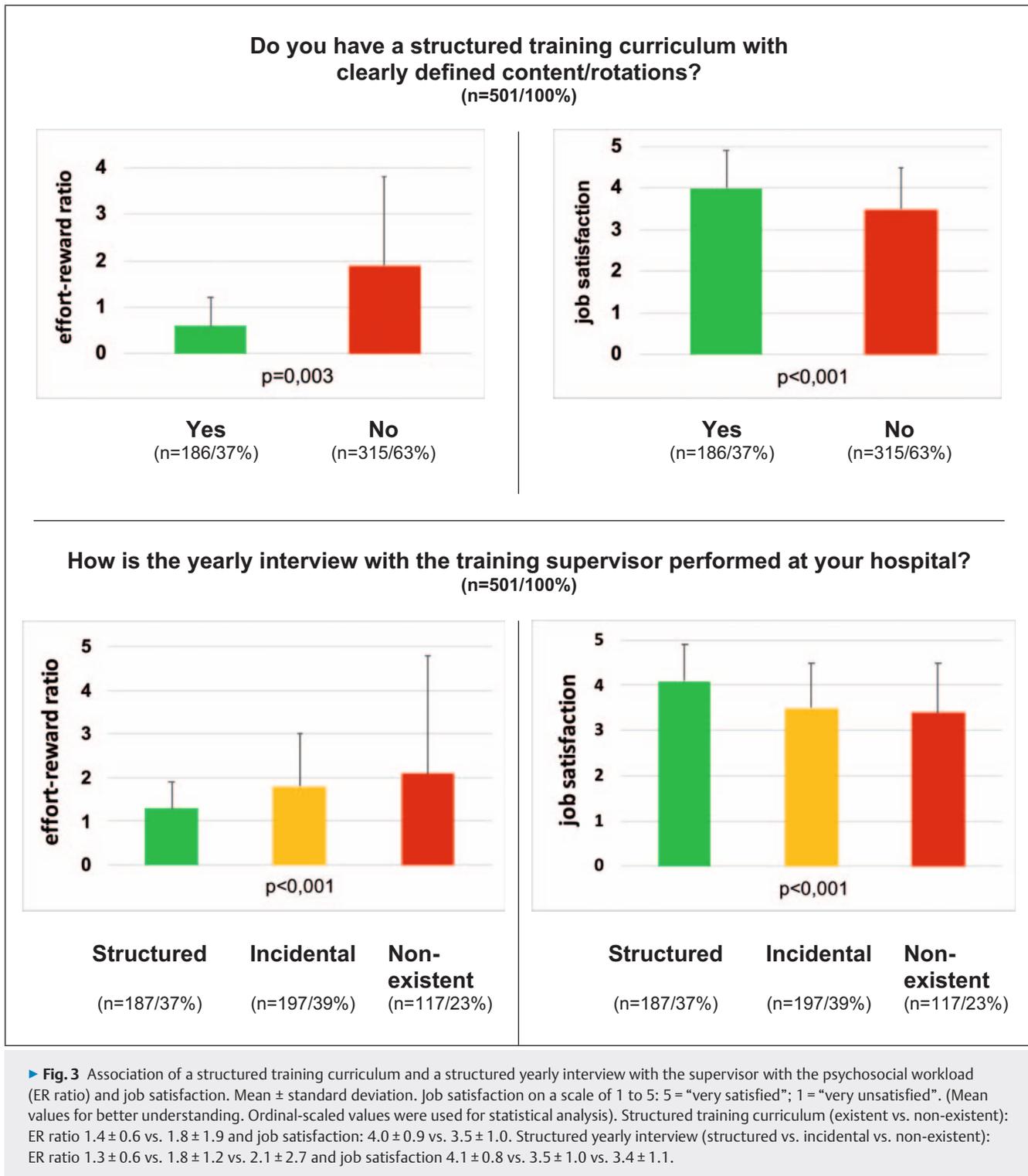
In response to a question regarding the increase in specialization in radiology, 44% (222/501) of those surveyed stated that a radiologist should be a generalist for all modalities and areas. 45%

(227/501) were of the opinion that a radiologist should specialize in one clinical area, while 10% (52/501) felt that a radiologist should specialize in a specific modality. With respect to teleradiology (6 options, 1 option per participant), 55% of participants who provide teleradiology services to other hospitals stated that problems occur more frequently in teleradiology examinations than in examinations performed inhouse (e.g., technical problems, miscommunication). 75% of participants whose hospital receives teleradiology services indicated that teleradiology usually functions smoothly. 87% of participants without own experience with teleradiology have a positive opinion of the process. 64% viewed the increasing use of technology to analyze radiology images (e.g. with big data, artificial intelligence, and radiomics) as an opportunity, while 23% (114/501) saw it as a risk [14% (68/501) did not respond].

Compatibility of work and family

83% (416/501) of participants worked full-time and 17% (85/501) worked part-time. 46% (39/85) of those working part-time felt that they are at a disadvantage with regard to advancing in their training. 35% (173/501) of participants had children and answered the questions regarding the compatibility of family and work (► **Table 5**).

66% of the mothers and 12% of the fathers worked part-time. The participants with children were asked about factors that would facilitate a good balance between work and family life (13 options, multiple selections possible, on average 2.7 options selected per participant, ► **Table 3**). 82% (141/173) of the participants with children went on parental leave including 89% (89/100) of the mothers and 71% (52/73) of the fathers. The median duration of parental leave was 12 months. On average, women took 14 + 5 months parental leave, while men took 3 + 3 months.



Compatibility of clinical work and research

59% (293/501) of participants had received a doctorate. An additional 31% (154/501) aspired to receive a doctorate. 51% (254/501) of participants were performing scientific work or were planning to do so. Those performing scientific work were asked questions with respect to the existing or expected conditions for their research. 31% (80/254) of participants were very or mostly satis-

fied, 25% (63/254) were undecided, and 44% (111/254) were mostly or very dissatisfied. The following were named as the three main reasons for (partial) dissatisfaction (6 options, multiple selections possible, on average 2.4 options selected per participants): 87% said that the majority of their research must be performed in their spare time, 54% stated that there is insufficient material and/or personnel support from the hospital, and 52% said that they receive insufficient instruction/support from

► **Table 3** Measures to improve training, compatibility of family and work as well as scientific and clinical work.

Which basic conditions/training instruments are particularly effective for you? ¹	
supervision by specialist or senior physician with regular case discussion	92 %
structured curriculum with fixed, transparent rotation plan	47 %
online reference works and books	43 %
congress visits and external training courses	38 %
Which of the following factors would provide a good balance between work and family life for you? ²	
more flexible working hours, e. g. by having more say in determining the working time	59 %
completion of some work at home (teleradiology)	42 %
less overtime	35 %
more predictable or regular working hours	33 %
Which of the following points would make research more attractive for you? ³	
more time for research during clinical training	85 %
structured education and training in scientific skills	50 %
support during topic selection	27 %

Participants could choose from ¹10, ²13, and ³10 measures per question. The most frequent answers are given.

► **Table 4** Career goals of survey participants dependent on gender and working hours. The career goals of survey participants varied significantly according to gender and full-time or part-time work (Chi2-Test: $p < 0.001$). 6 % (31/501) chose “other” and were not included in the statistical analysis.

career goal		total	men	women	full time	part time
salaried specialist	n	79	16	63	48	31
	%	17 %	7 %	26 %	12 %	39 %
senior physician at hospital	n	199	95	104	169	30
	%	42 %	42 %	43 %	43 %	38 %
head physician at hospital	n	48	39	9	46	2
	%	10 %	17 %	4 %	12 %	3 %
independent radiologist	n	144	78	66	128	16
	%	31 %	34 %	27 %	33 %	20 %
total	n	470	228	242	391	79
	%	100 %	100 %	100 %	100 %	100 %
			$p < 0.001$		$p < 0.001$	

their supervisors. Finally, the researchers were asked to specify which measures would improve conditions for scientific work (10 options, multiple selections possible, on average 2.6 options selected per participant, ► **Table 3**). Participants not performing scientific work were asked to specify the main reason for their lack of research (6 options). The most common responses were: 26 % of participants said “insufficient time/other priorities” and “no time in addition to clinical work” and 17 % said “research is not important for my planned career path”.

Discussion

For the first time, this study systematically recorded the opinion of doctors in radiology training in Germany regarding work and training conditions, compatibility of work and family, research, and radiology. This study enables the identification of conflict areas across locations and thus creates a basis for improvement approaches and future strategies.

Working conditions and workload

65 % of the radiology residents were satisfied with their work situation during specialist training – significantly more than in other disciplines like internal medicine (38 %) [13], urology (44 %) [18], and ophthalmology (40 %) [19] or a cumulative evaluation of five

► **Table 5** Questions regarding compatibility of family and work. 173 participants with children answered these questions. Number/percentage.

strongly agree	tend to agree	undecided	tend to disagree	strongly disagree
I am satisfied with the compatibility of family and work at my place of employment.				
22/13 %	40/23 %	52/30 %	36/21 %	23/13 %
36 %			34 %	
I regularly have to neglect family obligations for work or vice versa.				
44/25 %	64/37 %	40/23 %	15/9 %	10/6 %
62 %			15 %	
I feel that my employer supports me in balancing work and family (e. g. with flexible hours).				
26/15 %	49/28 %	42/24 %	31/18 %	25/15 %
43 %			33 %	
I feel that my colleagues support me in balancing work and family (e. g. with flexible hours).				
20/12 %	46/27 %	62/36 %	26/15 %	19/11 %
39 %			26 %	
Family-friendly policies are discussed at my place of employment, for example, in continuing education programs, newsletters, and support programs and they are thus part of the corporate culture.				
12/7 %	32/19 %	41/24 %	57/33 %	31/18 %
26 %			51 %	
So far, I have decided against more family responsibility because it is not compatible with my career path.				
15/9 %	29/17 %	30/17 %	42/24 %	57/33 %
26 %			57 %	
Employees without family obligations often have to fill in for employees with family obligations.				
29/17 %	62/36 %	45/26 %	29/17 %	8/5 %
53 %			22 %	

different disciplines (46 %, including radiology) [11]. In the pooled analysis 26 % were dissatisfied compared to only 13 % among radiologists. This high degree of satisfaction conflicts with the high psychosocial workload among those surveyed. With an ER ratio of 1.7, radiologists scored only minimally better or even worse than internists (1.8) [13], anesthesiologists (1.6) [20] and urologists (1.4) [18]. Thus, residents in training had a significantly higher psychosocial workload than other people working full-time in Germany, who had an average ER ratio of 0.6 [21]. One possible explanation for this seeming discrepancy could be the extremely positive identification with the profession as a radiologist.

The high psychosocial workload of residents can have negative effects ranging from health problems to an increasing lack of physicians and reduced quality of patient care [8, 22]. The quality of patient care was assessed by residents as declining both in the present study and in other studies [11].

Not only prospective radiologists but also internists [13] and urologists [18] cited the high time requirement, high workload, and deficits in training as the main reasons for dissatisfaction with current working conditions. The high percentage of physicians considering reducing their hours and changing jobs due to dissatisfaction with their working conditions shows that there is a risk of or there have already been consequences. Almost one third of survey participants already changed jobs because of dis-

satisfaction. Despite better job satisfaction, this percentage was higher than in the pooled analysis including multiple disciplines (22 %) [11]. One possible reason could be that residents in radiology training are less willing to accept poor working conditions. It is not clear whether this comparatively high rate can be explained by the relatively high migration rate from other disciplines to radiology.

Continuing medical education and training

Compared to other disciplines, fewer radiology residents received an employment contract for the entire training period (38 % vs. 45 %). Particularly at university hospitals, the rate was significantly lower (16 %). Short-term employment contracts and the associated uncertainty that prevents long-term planning can also result in an increased psychosocial workload. Especially given the increasing lack of physicians, it would make sense to provide long-term employment contracts and systematic development and support of employees during their professional careers.

Interestingly, a structured yearly interview with the training supervisor and a structured training curriculum correlated across disciplines in a statistically significant manner with higher job satisfaction and a lower risk of effort-reward imbalance. Although the yearly interview with the training supervisor seems to be a relatively simple means of improving job satisfaction, it is

performed in a structured and constructive manner in only 37 % of cases. A structured training curriculum is also promising but more difficult to implement. Most participants viewed supervision with case discussion to be the most effective training instrument. However, it requires significant time and personnel making it significantly more cost-intensive than books and medical congresses. Given the increase in workload and the lack of financing for specialist training in Germany, special importance should be placed on ensuring that this valuable direct transfer of knowledge is not further reduced. It would be desirable to institutionalize case discussions so that they are considered as important as mandatory radiological demonstrations and rounds in disciplines with wards. Regular case discussions ensure a steeper learning curve with higher quality findings that can then reduce the time needed for validation by a specialist. One study regarding the extension of student training from 1.8 to 6.5 hours per day at a university hospital did not have a negative effect on report turnaround times [23]. Hopefully, an expansion of internal training also wouldn't have a significant negative effect on the daily routine. Measures to improve training are summarized in ► **Table 6**.

One fifth of all participants indicated an inability to complete training within the regular training period due to a lack of rotations, a lack of report numbers, or a lack of personnel. In addition, the wait times for examination dates can be very long. Depending on the German state, it can take a few months up to one year. The negative consequences affect residents in training as well as employers who are faced with greater scheduling uncertainty and a shortage of specialists.

Specific questions regarding radiology

Exciting clinical work and the mix of diagnostic and interventional work were stated to be the main reasons for the high attractiveness of radiology. In tumor boards and clinical conferences, radiologists are increasingly included in essential clinical decision processes and are thus part of the clinical routine. This coincides with survey results among students completing their practical year [24]. The results showed that young radiologists would like to actively participate in patient care.

Teleradiology received a generally positive rating but was viewed more critically by participants personally using teleradiology since they were directly confronted by problems more frequently. New technical developments were also rated highly. Residents had a positive view of the future: The majority of participants viewed big data, artificial intelligence, and radiomics as an opportunity.

Compatibility of work and family

35 % of participants considered the good compatibility of family and work to be one of the advantages of radiology. Although this was confirmed in a direct comparison with other disciplines, the absolute numbers show clear improvement potential.

Only 15 % of residents in internal medicine were satisfied with the compatibility of family and work [13]. In comparison, residents in radiology were significantly more satisfied (36 %). Nonetheless, every third participant in this study was dissatisfied with the compatibility of family and work.

► **Table 6** Measures to improve training conditions.

primary time-intensive measures

- structured and constructive yearly interview with training supervisor
- supervision with case discussion
- structured training curriculum with fixed, transparent rotation plan and internal continuing education

primary money-intensive measures

- online reference works and books
- congress visits, external continuing education

Residents in internal medicine felt significantly less supported by their employer (16 %) and colleagues (27 %) with respect to the compatibility of family and work [13] than residents in radiology (43 % and 39 %, respectively). Interestingly, radiologists did not indicate any major difference between support from the employer and support from colleagues, while internists found their colleagues to be significantly more helpful. One possible explanation is the standardized workflow in radiology that is not as dependent on colleagues as work on a ward.

Family-friendly policies, e. g. as a result of regular continuing education and support programs, were already part of the corporate culture at one of four radiology training centers, while this was the case at only one of six internal medicine training centers [13]. Part-time models seem to be slightly easier to integrate into radiology training. Although almost half of those working part time in radiology felt disadvantaged with regard to advancing in their training, this number was significantly higher among internists (almost two thirds) [13].

Despite the better compatibility of family and work among radiologists compared to internists, these results do not yet fully coincide with the reputation of radiology as a family-friendly discipline. In this study more flexible working hours and a home office are the key factors that could improve satisfaction. Particularly in radiology it is possible for planned routine examinations to be assessed on a flexible time schedule in home office or while working part-time. The radiology home office has already been studied with promising results [25]. These models should be established soon and comprehensively. Corresponding recommendations are already available [26]. This would not only make work easier for residents with children but would also free up currently unused resources. In the face of all of the (justified) excitement about the potential of the home office, possible disadvantages should also be taken into consideration in the practical implementation. The right of radiology to exist as a clinical discipline as well as continuing education and training must not be jeopardized by the lack of clinical work, such as patient consultations and direct contact with colleagues in one's own discipline and in other disciplines, as often occurs in the case of a home office [26]. Avoiding such errors when introducing this work model is essential particularly in light of the rapid development of artificial intelligence and automated image analysis.

The majority of those who stay home with their children are still women: They went on parental leave almost 5 times longer than men and were 5 times more likely to work part time. However, the number of fathers taking time off or working part

time to be with their children has increased significantly in recent years [27]. The reduction of working hours among women also seems to affect their career planning: 17% of men but only 4% of women aspired to a position as head physician. We can only speculate about the reason for this difference. However, it can be assumed that women find the compatibility of work and family to be more problematic and therefore plan a different career path.

Since the number of women in medicine continues to increase, it is essential for medicine to become more flexible and for the working and training conditions to be adapted to the changing reality. Particularly in radiology, it would be comparatively easy to implement structures that promote the compatibility of family and work in a targeted manner.

Compatibility of clinical work and research

Half of the residents who participated in the survey were performing or wanted to perform scientific work. That number was significantly higher than in internal medicine or anesthesiology where only 19% and 27%, respectively, were interested in research [13, 28]. The high rate shows both interest in research as well as a desire to perform research. However, this was not supported by basic conditions with which not even one third of participants were satisfied. The main criticisms were the shifting of research to personal time and the lack of support from supervisors and the hospital. In contrast, 59% of American residents were satisfied with the research opportunities at their institution [14]. However, this data coincides with the criticism of the German Research Society [29] and the German Council of Science and Humanities [30] regarding research in university medicine in Germany.

To be able to keep up with rapid technical advancement and perform well in the national as well as international comparison, conditions must be favorable for productive scientific work and research in radiology. For this purpose, most residents wanted more dedicated research time during their clinical education. Clinician Scientist Programs, for example, are suitable for this purpose. They could also provide the necessary structured education regarding scientific skills. Only in this way can we guide radiology, which has been at the center of the digital disruption because of its extensive use of technology, toward a successful future. Residents have the necessary potential and interest.

Limitations

The following limitations must be taken into consideration in the interpretation of the survey results: The percentage of unvalidated and possibly suggestive questions can distort the results. Since the participants were invited to participate in the survey via different organizations, the basic characteristics (such as age, gender, and place of residence) of the target population could not be recorded. Therefore, the representativeness of the study population compared to the target population unfortunately cannot be examined. There could be a selection bias since the satisfaction of the participants could have affected the participation rate.

Conclusion

The working and training conditions in radiology are rated better by residents in training compared to other disciplines. However, consequences of the increase in workload are also seen in radiology. The current working and training conditions and the high psychosocial workload of residents can affect the health of employees and ultimately result in a lower quality of patient care. By improving the compatibility of family and work, development possibilities, particularly for women, can be strengthened.

CLINICAL RELEVANCE OF THE STUDY

1. The high satisfaction of residents in radiology with their professional situation compared to other disciplines makes it attractive for prospective doctors.
2. The high psychosocial workload can jeopardize the health of residents and thus also affect radiological care in the long term.
3. This study shows relatively simple measures that can result in an improvement of the working and training conditions of residents in radiology.

Conflict of Interest

The authors declare that they have no conflict of interest.

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