TITLE

Challenges and Satisfaction in Cardiothoracic Surgery Residency Programs: Insights from a Europe-wide Survey

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VISUAL ABSTRACT

Key question (max. 120 characters)

How satisfied are cardiothoracic residents with their training in Europe?

Key findings (max. 120 characters)

Mean satisfaction was 7.9/10. Feedback, research time and exposure to surgeries associate with improved satisfaction.

Take-home message (max. 140 characters)

Residents are relatively satisfied with their training, but simple changes could improve it further.

Central image

ABSTRACT

Objectives:

The increasing complexity of surgical patients and working time constraints represent challenges for training. In this study, the European Association for Cardio-Thoracic Surgery Residents' Committee aimed to evaluate satisfaction with current training programs across Europe.

Methods:

We conducted an online survey between October 2018 - April 2019, completed by a total of 219 participants from 24 countries.

Results:

The average respondent was in the 4th or 5th year of training, mostly on a cardiac surgery pathway. Most trainees follow a 5-6-year program, with a compulsory final certification exam, but no regular skills evaluation. Only a minority are expected to take the examination by the European Board of Cardiothoracic Surgery. Participants work on average 61.0±13.1 hours per week, including 27.1±20.2 on-call. In total, only 19.7% confirmed the implementation of the European Working Time Directive, with 42.0% being unaware that European regulations existed. Having designated time for research was reported by 13.0%, despite 47.0% having a postgraduate degree. On average respondents rated their satisfaction 7.9 out of 10, although 56.2% of participants were not satisfied with their training opportunities. We found an association between trainee satisfaction and regular skills evaluation, first operator experience, and protected research time.

Conclusion:

On average, residents are satisfied with their training, despite significant disparities in the quality and structure of cardiothoracic surgery training across Europe. Areas for potential improvement include increasing structured feedback, research time integration and better working hours compliance. The development of European guidelines on training standards may support this.

ABBREVIATIONS

ABTS . . . American Board of Thoracic Surgery

ß . . . Beta coefficient

CI. . . 95% Confidence Interval

CTS. . . Cardiothoracic Surgery

EACTS . . . European Association of Cardio-Thoracic Surgery

EBCTS . . . European Board of Cardiothoracic Surgery

EPA . . . Entrustable Professional Activities

EWTD . . . European Working Time Directive

IQR . . . Interquartile Range

OR … Operating Room

SD . . . Standard Deviation

TMS . . . Training Management System

INTRODUCTION

Over the past half century, cardiothoracic surgery has evolved from being a subspecialty within the general surgery department to a distinct medical discipline [1]. However, numerous variants exist, as residents around the world can be trained as cardiac, cardiothoracic, cardiovascular, or thoracic surgeons [2]. There is also wide variability in the structure of programs, including lack of agreement in specified standards for certification.

In pursuit of a general European training system [3], the playing field was levelled by the introduction of the European Board of Cardiothoracic Surgery (EBCTS) examination for all European residents prior to acquiring official certification [4]. However, not all European countries have made this step mandatory: given regional differences in training, a general examination may not properly address country specific required skills and knowledge.

In addition to the differences in residency programs, the total number of cases operated on during training is shrinking due to several factors. Since its implementation in the early 2000's, the European Working Time Directive (EWTD) has limited the working hours for doctors in training. However, it remains debatable whether all countries adhere to these guidelines [5], and there is conflicting evidence on the impact of EWTD on surgical exposure [6-9]. Additionally, the increase in minimally invasive procedures, technically demanding complex cases [10, 11] and trans-catheter alternatives for treatment of less complex coronary artery disease or isolated valve pathology may compromise learning opportunities [12].

In follow-up to the 2010 report by the Surgical Training and Manpower Committee of the European Association for Cardio-Thoracic Surgery (EACTS) [5], a Europe-wide survey was conducted by the EACTS Residents Committee to evaluate the changes and differences in training programs, resident satisfaction, EWTD adherence and EBCTS exam implementation across different countries.

MATERIAL AND METHODS

An online, computer-assisted, and voluntary anonymous questionnaire (Survey Monkey, SurveyMonkey Enterprise, Los Angeles, CA, USA) was launched in October 2018 during the EACTS Annual Meeting in Milan, Italy. Weblinks were included in residents-specific EACTS newsletters on two occasions and also distributed via national residents' organisations and personal communication. The survey was accessible until April 2019. The questionnaire was designed specifically for the purpose of this survey and based on the previously published report [5]. It comprised three sections (demographics, training and evaluation) and 25 questions (Table 1). Respondents scored their satisfaction with surgical exposure and research time using nominal ordinal five-point scale questions (very dissatisfied, dissatisfied, neutral, satisfied or very satisfied), and overall satisfaction using a numeric scale (one-to-ten).

Statistical analysis was performed using Stata/IC 14.2 statistical package (StataCorp LLC, USA). Mean ± standard deviation (SD) or median and interquartile range (IQR) and valid percentages described continuous and categorial variables, respectively. To evaluate potential associations between prespecified independent variables [year of training; regular skills evaluation; protected time for research; weekly Operating Room (OR) sessions (in total, performed as 1st operator or assistant), weekly working hours (in total, dedicated to administrative work or spent on call)], and overall satisfaction, we used linear mixed-effects models assuming nesting within countries. For each variable, a model was run with it and the random intercept for country included as predictors, and satisfaction as the outcome. The same approach was used to measure the association between year of training and each job characteristic. Associations were considered statistically significant if the 95% CI did not contain 0.

A total of 219 participants from 24 different European countries completed the questionnaire. For seven countries there were ≥10 respondents.

RESULTS

Demographics

Of the 219 residents completing the survey, 74 (34.3%) were female and the mean age of the total sample was 31 (with SD ±3.9) years. Although the survey was answered by residents from years 1-6 (Table 2), the average participant was in the 4th or 5th year of training. Most participants were in cardiac surgery training (54.3%), with a minority in training for thoracic, cardiovascular or cardiothoracic surgery (Table 2). Despite 47.0% having a postgraduate degree (Table 2), only 13.0% reported having designated research time integrated in the training program. Only two residents (1.0%) declared lack of interest in research. Of the respondents, 42.0% were EACTS members and 8.7% were applicants. Interestingly, 43.0% were aware of an active National Residents Association, while 20.7% claimed that despite the existence of one, it was not very active. Table 2 illustrates the participants' demographics.

Training program details

Most training programs have a pre-defined length of 5-6 years (72.3%), but with no regular skills evaluation (64.9%) (Table 3). The use of any training management system (TMS) was absent for 75.9% of respondents. Regarding number of required cases during residency, 59.1% of respondents stated that 75-150 operations were needed to be qualified as a specialist. Notably, in 15.9% of the cases the requirement number was less than 75 cases, and in another 14.6%, less than 10. Passing a final exam was imperative for certification in 75.9% of answers, although 72.1% reported that EBCTS examination was not officially recommended or expected by the institution.

Working hours and OR exposure

Survey participants reported working 61.0±13.1 hours on an average week, of those 27.1±20.2 and 13.7±12.0 are spent on call and on administrative tasks, respectively. No evidence was found for an association between training year and the total weekly working hours (ß=0.78; CI: -0.14, 1.70) or hours

spent on call (ß=1.05; CI -0.42, 2.53) or on administrative work (ß=-0.26; CI -1.12, 0.62). Interestingly, only 19.7% of residents confirmed the implementation of the EWTD and 42.0% were unaware of the specific European regulations on working hours. On average, residents reported participating in 5.4±2.9 OR sessions per week, in 4.1±3.0 of which as assistant (Figure 1). The median reported monthly cases as primary surgeons was 1 (IQR 0-4). Training year was associated with total number of OR sessions per week (ß=0.33; CI: 0.13, 0.53), and the percentage of cases performed as 1st operator (ß=0.09; CI: 0.02, 0.17). We found no statistically significant association between training year and the ratio of cases performed as assistant to total (ß=0.02; CI: -0.01, 0.06).

Satisfaction

Of all respondents, 43.8% were at least satisfied with the amount of OR exposure in their training, and 37.6% were dissatisfied or very dissatisfied (Figure 2). Only 26.0% considered research opportunities satisfactory or very satisfactory (Figure 2). The overall satisfaction with an individual's training program was 7.9±1.3 out of 10. Regular skills evaluation (ß=1.16; CI 0.81, 1.50), total number of weekly OR sessions (ß=0.12; CI 0.04, 0.20), percentage of cases performed as 1st operator (ß=0.60; CI 0.20, 1.00), and having protected time for research (ß=0.5; CI 0.01, 1.03) were associated with higher overall satisfaction. The reported number of weekly hours dedicated to administrative work was negatively associated with overall satisfaction (ß=-0.04; CI -0.05, -0.02). No statistically significant association was found between overall satisfaction and weekly number of OR sessions performed as assistant operator (ß=0.02; CI -0.05, 0.09), total number of working hours (ß=0.002; CI: -0.01, 0.02), or amount of time on call (ß=0.001; CI -0.01, 0,01)..

DISCUSSION

European cardiothoracic surgery training programs are facing a substantial challenge due to increasing complexity of referred patients and decreased surgical exposure. We performed a Europe-wide survey amongst residents to get an update on common challenges in training programs across the continent. While the previous survey from 2010 focused mainly on working hours and the results after implementation of the EWTD, the current EACTS Residents' Committee aimed to evaluate (a) the residents' satisfaction, (b) the heterogeneity among training programs and (c) the role of EBCTS examination and the use of a structured TMS across Europe a decade later [5].

One third of the participating trainees were female, similar to that reported in a recent Canadian survey [13]. In a large USA survey, only 3.4% of adult cardiac, 5.2% of congenital heart, and 7.9% of general thoracic surgeons were female [14]. Although there is a foreseeable and welcomed increase in the number of female cardiothoracic surgeons, true gender equity is still not a reality, and unlikely to be so for quite some time [15, 16].

We distinguished between the different specialties, as several combinations exist across Europe: from separate training in cardiac and thoracic surgery, to combined departments, and the additional involvement of vascular surgery. Most trainees in the sample are specifically trained in cardiac surgery (54.3%) in comparison to cardiothoracic (20.5%), thoracic (10.0%) or cardiovascular programs (8.7%). As described earlier in the USA training survey, over the last decade specialty interests have changed, with decreasing interest in mixed cardiac/thoracic surgery, and a tendency to focus on adult cardiac surgery or thoracic surgery [2]. Concrete steps towards the implementation of a European curriculum for thoracic surgery as a mono-specialty have been published recently in a position paper by the European Society of Thoracic Surgeons [17]. This phenomenon might be explained by the emergence of sub-specialization, with its additional required training time. With increasing complexity of surgical and interventional techniques, it has become more challenging to master all techniques in cardiac,

188 vascular and thoracic surgery. However, in an interesting recent report, Antonoff and collaborators
189 found an association between sub-specialisation and self-reported lack of preparedness, which
190 underscores one of the possible drawbacks of premature subspecialisation in one's training [18].
191
192 In most countries, trainees are required to perform a specific number of cases for national certification,
193 whereas 10 years ago fewer trainees required a specific case number. Some national societies reacted
194 proactively towards the trend of increasing transcatheter therapies with a reduction of the required
195 number of open cases, and introduction of interventional skills into training programs [11]. The
196 majority of the survey participants (59%) need between 75-150 cases for their specialty certificate,
197 which is still a wide range. Only 10% require more than 150 operations while 31% stay below 75 cases.
198 However, as evident from resident feedback during our study, the definition of an operation
199 performed by a trainee may also differ from one country to another: for some, it can be defined by
200 performing the most important steps of the operation and for others, performing everything skin to
201 skin. In addition, number of minimally invasive procedures required may differ. These were not
202 specified in our survey. Thus, the quality and ability of a fully trained European surgeon becomes
203 difficult to assess by only the national certificate. A standardized practical training guide with clear
204 definitions and numbers of operations including minimally invasive approaches could contribute to a
205 higher quality of surgical performance.
206
207 Given the trend for sub-specialisation and the reduction in OR time trainees face, an alternative
208 approach to case number driven accreditation could be an objective assessment of competencies. This
209 individualized approach facilitates a more accurate competency-based assessment using the
210 framework of Entrustable Professional Activities (EPA). EPAs describe key tasks of a specialty that a
211 trainee can be trusted to perform. The concept was developed in the early 2000's in the Netherlands
212 and is gradually being introduced in several undergraduate medical education systems in the USA and
213 Canada and surgical residency programs in various European countries [19]. Additionally, regular

evaluation of overall physician professionalism is becoming more important [20]. Within cardiothoracic surgery, non-technical skills should be particularly emphasized.

While 75.9% of residents must sit a final exam, only 12.6% are expected to pass the standardized EBCTS certification. A standardized American Board of Thoracic Surgery (ABTS) exam poses a clear final step before becoming an independent surgeon [21], whereas a pan-European exam (EBCTS) is still lacking universal recognition. Moreover, our survey demonstrated that 75.9% of participants do not use any training management system at all. This raises an important question: how is medical education documented, and how can standards of high-quality training be maintained in such programs? Since 2018, EACTS has made available a digital portfolio/training management system (EACTS TMS), which is freely available to EACTS members. The EBCTS has transitioned to a two-level, high-standard and reproducible examination. Expert educationalists are involved in exam development and assessment, and Quality Assurance auditing is an integral part of them. The level 1 examination, comprised of 180 multiple choice questions, is designed as a training exit examination for cardiac, thoracic or cardiothoracic surgery trainees, and several countries have adopted it as such (Switzerland, Netherlands). Both the EACTS TMS and the EBCTS exam are new resources which could make education in cardiothoracic surgery more transparent and comparable across borders. In the current era of progressive globalization, surgeons who are considering moving to different European countries might benefit from a standardized and integrated documentation system, both for training and definitive settlement.

In our sample, spending more working hours in the OR and more time as the primary surgeon contributes significantly to the satisfaction of the trainees. Interestingly, increased administrative work correlated with dissatisfaction. Mean working hours per week were 60 (±13). Of all respondents, 38% claimed that the EWTD was not implemented in their center, and 42% were not even aware of its existence. Ten years after the first debate about its influence on training, there seems to be no relevant

changes related to the EWTD [5]: trainees are working the same hours and seem to do so regardless of any regulation. Still, we feel it is imperative to adapt and adhere to these directives which are enshrined in law. Although solid data is still lacking in the literature, we speculate that with the use of individualized approaches, competency-focused training, and innovative training program designs, working hours could be limited without a compromise in surgical proficiency [22]. Other forms of hands-on education should be investigated and implemented, e.g. simulation-based training, especially with regard to minimally invasive and trans-catheter procedures [23]. Moreover, the importance of a good work-life balance, and its impact on the incidence of burnout and surgical outcomes is supported by a growing evidence base [24, 25].

Almost half of the trainees (47%) have some form of a postgraduate degree, although there is wide variety in duration, structure and intensity of such research programs across different countries [26]. Unfortunately, during training, research opportunities become increasingly rare and 40% of the respondents are either dissatisfied or very dissatisfied with their research opportunities. Only 13% have protected time integrated in the training program to perform research activities. Although the involvement in scientific projects is often encouraged and crucial for further career development, it remains challenging to combine a successful clinical and scientific career during training. Our survey underscores an opportunity to avoid wasted expertise. Physician-scientists have always been critical innovators in medicine, including many of the Nobel Prize laureates in Physiology or Medicine. There is a profound need to integrate academic pathways into cardiothoracic surgery training, as practiced for example by some centers in USA [27]. Not only the increase of scientific work in our specialty, but also the ability to interpret results, distinguish between low- and high- quality research and transport findings into daily practice are few reasons for the necessity to reserve protected time for theoretical education. [29]

This survey might suggest a slight improvement as the overall mean satisfaction was 7.9 out of 10. However, the operative exposure seems to be very heterogenous with 37.6% being very dissatisfied to dissatisfied, 18.6% neutral and 43.8% satisfied to very satisfied. This issue was not addressed in the previous survey. Our study revealed that trainees who receive a regular evaluation of their work are significantly more satisfied. This underlines the importance of structured feedback and lines up with the reports from well-structured training programs [28, 29].

LIMITATIONS

The questionnaire was in English, which is not the native language of most respondents. This may have affected responses, especially where subjective assessment was required. Although the current questionnaire generated more actual responses than prior surveys, it remains unclear what the relative response rate is, as the sample frame size is unknown. Based on resident numbers available via personal communication from national resident associations, the response rate could be estimated to vary between 7% (UK, approximately 100 residents) and 68% (Portugal, 28 residents) per country. Subsequently, this survey may have been affected by sampling biases. Furthermore, we do not possess follow-up data on participants and can therefore not relate our current findings to long term outcomes such as job-finding and surgical performance.

This questionnaire was sent to residents only, to understand perceived residents satisfaction. Thus, data on training program details is based only on information from residents; to obtain data on official curriculum and program structure, contacting also heads-of-training would be important and should be addressed in future studies. Certainly, education is not a one-way road: a certified teacher as an additional parameter for quality has not been covered by our survey, but will hopefully in future, as education itself evolves as an academic discipline in our field [30].

Overall satisfaction in education is a subjective parameter which does not depend only on established training pathways and standardized curricula but also on individual motivations and ambitions. However, giving trainees the chance to anonymously score specific fields like OR and research

exposure gives an idea where the most attention is needed to prepare European cardiothoracic units for the future.

CONCLUSION

Most European trainees are satisfied with their training, but there appear to be significant disparities in the quality and structure of cardiothoracic surgery training programs. Issues to be improved include documentation, professional feedback, poor implementation of research dedicated time and increasing administrative work. Interestingly, overall working hours seem to play a minor role regarding the satisfaction of the residents. A compulsory introduction of a standardized European accreditation exam (e.g. EBCTS) and standardized training documentation (using a TMS) might be key tools to provide uniform, high-quality education throughout Europe. In addition, the development of European guidelines for training with measurable criteria may support the improvement of training systems.

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CONFLICT OF INTEREST: none declared.

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Author contributions

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329 **TABLES**

330 **Table 1. Questions included in the survey by category.**

Demographics	Training		Evaluation
Age	How many hours do you work on an average week?	Do you use a training management system (TMS)?	Is there a regular evaluation of your skills?
Gender	How many operating room sessions (half day) do you attend on an average week?	How many years of training after Med School are required until you are certified as a specialist?	How many major surgical procedures required for certification?
Country where you are doing residency	How many cases do you assist per week?	Do you have protected time for research?	Do you have to take a final exam (excluding the European Board Exam) for certification?
Are you an EACTS member?	How many cases do you operate as principal operator per week?	Are you satisfied with the research opportunities of your program?	Are you expected by your institution to take the European Board Exam?
Which year of training are you in?	Are you satisfied with the operative exposure of your program?	How satisfied are you with the quality of your training?	
Predicted calendar year for finishing your training?	How many hours are you on call per week?	Are you aware of the existence of a National Residents association in your country?	
Speciality: cardiac, thoracic, cardio-thoracic, cardio-vascular	How much time do you spend on administration? (hours a week)		
Do you have a post-graduate degree?	Is European Working Time Directive (EWTD) implemented in your centre?		

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Table 2. Demographics and overall characteristics of surveyed residents.

N	219						
Age (y), mean (SD)	31 (3.9)						
Female gender, n(%)	74 (34)						
Country, n(%)	**De**	**Fr**	**Pt**	**It**	**Ch**	**Bg**	
	55 (25)	31 (14)	19 (8.8)	14 (6.5)	12 (5.6)	10 (4.7)	
	Se	**Dk**	**Fi**	**Gb**	**At**	**Nl**	
	10 (4.7)	7 (3.3)	7 (3.3)	7 (3.3)	6 (2.8)	6 (2.8)	
	Gr	**Ru**	**Es**	**Hr**	**Ee**	**Tr**	
	5 (2.3)	4 (1.9)	4 (1.9)	3 (1.4)	3 (1.4)	3 (1.4)	
	Ua	**By**	**Cz**	**Hu**	**Lv**	**Rs**	
	3 (1.4)	1 (0.5)	1 (0.5)	1 (0.5)	1 (0.5)	1 (0.5)	
Training year, n(%)	**1**	**2**	**3**	**4**	**5**	**6**	**> 6**
	18 (8.4)	31 (14)	31 (14)	43 (20)	37 (17)	29 (14)	26 (12)
Speciality, n(%)	**Cardiac**	**Thoracic**	**CT**	**CV**	**CTV**		
	119 (54)	22 (10)	45 (21)	19 (8.7)	14 (6.4)		
Postgraduate degree, n(%)	**No**	**MSc**	**PhD**				
	116 (53)	43 (20)	60 (27)				
EACTS membership, n(%)	**No**	**Applicant**	**Yes**				
	108 (49)	19 (9)	92 (42)				
Residents' association, n(%)	**No**	**Not active**	**Yes**				
	70 (36.3)	40 (20.7)	83 (43.0)				

Data are displayed as number (valid percentages) or mean (standard deviation), unless otherwise specified. Abbreviations: DE, Germany; FR, France; PT, Portugal; IT, Italy; CH, Switzerland; BG, Bulgaria; SE, Sweden; DK, Denmark; FI, Finland; GB, United Kingdom; AT, Austria; NL, Netherlands; GR, Greece; RU, Russia; ES, Spain; HR, Croatia; EE, Estonia; TR, Turkey; UA, Ukraine; BY, Belarus; CZ, Czech Republic; HU, Hungary; LV, Latvia; RS, Serbia; CT, Cardiothoracic; CV, Cardiovascular; CTV, Cardiothoracic & Vascular; MSc, Master of Science; PhD, Doctor of Philosophy; EACTS, European Association for Cardiothoracic Surgery.

Table 3. Training programs details.

N	219			
Regular skills evaluation, n(%)	**No**	**Yes**		
	124 (65)	67 (35)		
Training management system, n(%)	**No**	**Yes, EACTS**	**Yes, Other**	
	145 (76)	15 (7.9)	31 (16)	
Final certification exam, n(%)	**No**	**Yes**		
	46 (24)	145 (76)		
EBCTS examination, n(%)	**Not aware**	**No**	**Yes**	
	29 (15)	137 (72)	24 (13)	
Years for certification, n(%)	**<5**	**[5 - 6]**	**>6**	
	26 (14)	138 (72)	27 (14)	
Procedures for certification, n(%)	**<10**	**]10 - 75]**	**]75 - 150]**	**>150**
	24 (15)	26 (16)	97 (59)	17 (10)

Data are displayed as numbers (percentages) unless otherwise specified. Abbreviations: EACTS, European Association of Cardio-Thoracic Surgery; EBCT, European Board of Cardiothoracic Surgery; N, number.

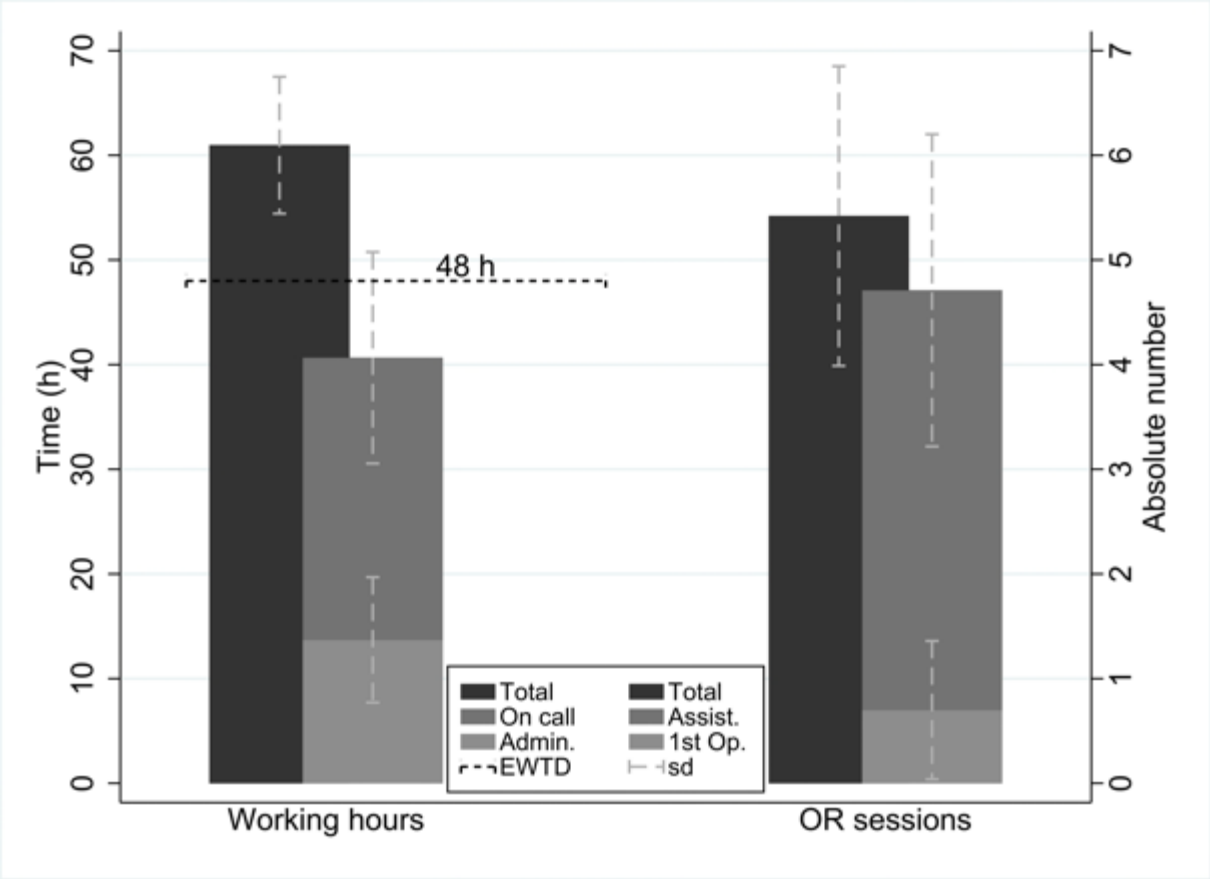
FIGURE LEGENDS

Figure 1. Working week details. Left-hand side panel summarizes average work distribution per week. Right-hand side panel OR work details. Abbreviations: EWDT, European Working Time Directive; N, number; sd, standard deviation; h, hours; Admin., Administrative work; Assist., participation in surgeries as assistant; 1st op., participation in surgeries as 1st operator*; OR, operating room. *for illustration purposes, the number of OR sessions as 1st operator per week was calculated by dividing the monthly reported number by four.

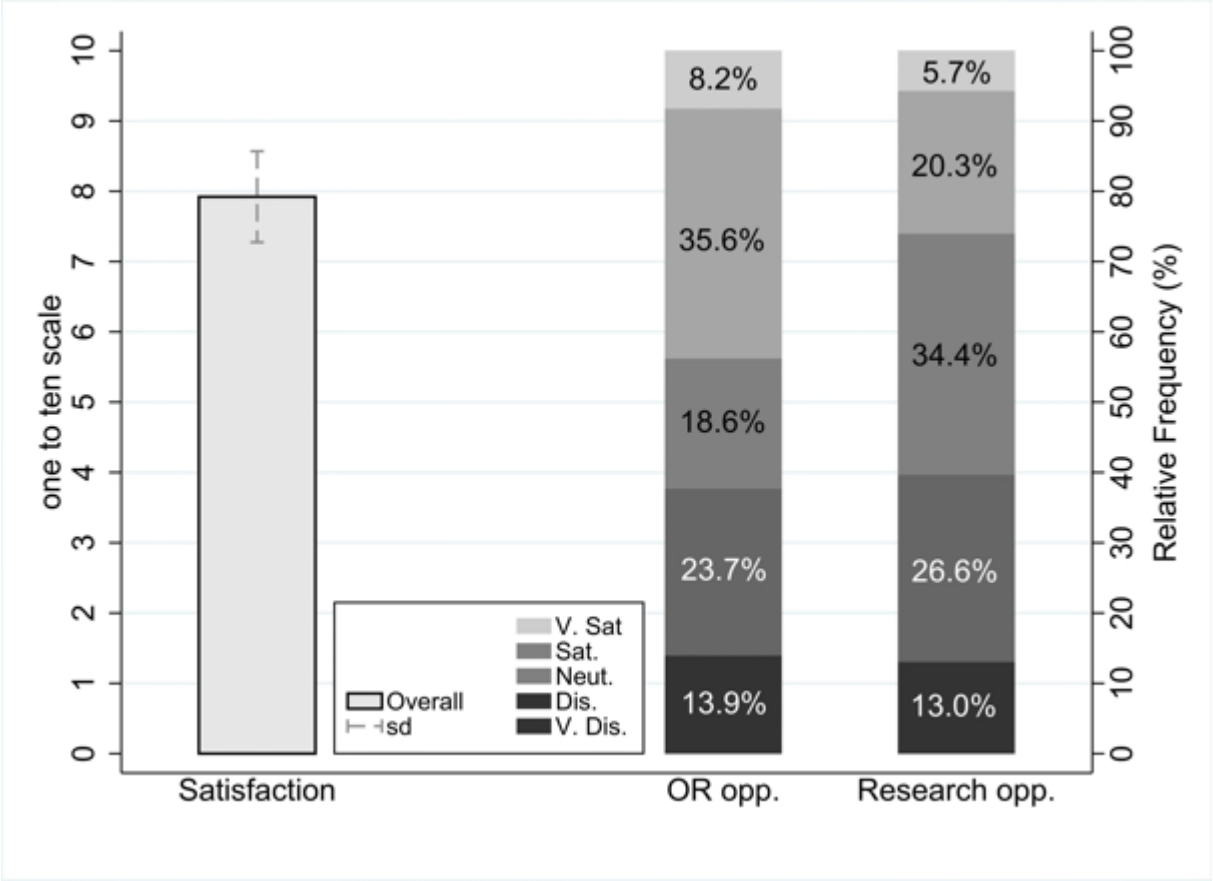
Figure 2. Satisfaction among surveyed residents. Left-hand side column shows overall satisfaction expressed on a scale of one to ten. Right-hand side columns depict stacked relative frequencies of satisfaction ranks on a five-point scale for OR exposure and research designated time. Abbreviations: sd, standard deviation; V., very; Sat., satisfied; Neut., neutral; Dis., dissatisfied; OR, operating room; opp., opportunity.

FIGURES

Figure 1



364 **Figure 2**



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