Self-reported anatomy skills among Norwegian physicians - Need for improved postgraduate teaching provision

Camilla S. Mehlum[1], Hanan Mahmood[2], Kristoffer Ellingsen[3], Ole Øyen[4], Trygve B. Leergaard[4], Anne Spurkland[4]

[1] Innlandet Hospital Trust, Gjøvik Hospital, Dep. of child- and adolescent psychiatry, Bassengparkvegen 2, N-2821 Gjøvik, Norway

[2] University Hospital of North Norway, Harstad Site, Dep. of orthopedic surgery, St. Olavs gate 70, N-9406 Harstad, Norway

[3] Akershus University Hospital, Division Kongsvinger, Dep. of internal medicine, Parkveien 35, N-2212 Kongsvinger, Norway

[4] Division of Anatomy, Department of Molecular Medicine, Institute of Basic Medical Sciences, University of Oslo, P.O.B. 1105, Blindern, N-0317 Oslo, Norway

SUMMARY

Anatomy skills are considered essential in all aspects of medical practice, and more so now than before with increasing use of diagnostic imaging techniques and advanced surgery. In conjunction with the revision of the medical study curriculum at the University of Oslo in 2014, we investigated Norwegian physicians' assessment of their own anatomy knowledge and the educational provision of anatomical skills during and after specialization. A total of 902 Norwegian physicians divided into the specialties of general medicine, internal medicine, surgery, neurology and radiology responded to an anonymous survey.

As many as 73% of the physicians had at some time point experienced insufficient anatomy knowledge in their own practice, most commonly among surgeons and neurologists. The respondents expressed a need for supplementary educational provision in anatomy during and after specialization, and 36% were unfamiliar with such offers. Notably, dissection courses seemed unavailable during specialization.

Our findings demonstrate a requirement for an improved supply of anatomy education during and after specialization. Anatomy courses that combine dissection, radiological images and clinical application would seem desirable.

Key words: Anatomy – Anatomy education – Anatomy and medical education – Clinical anatomy – Anatomy teaching

INTRODUCTION

Anatomy skills are fundamental in most areas of medical clinical practice. Academic communities have expressed concerns about the reduction of the extent and quality of anatomy teaching in many medical curricula (Gogalniceanu et al., 2008; Drake et al., 2009, Craig; Tait et al., 2010; Drake et al., 2014; Sbayeh et al., 2016). Gogalniceanu et al.

Corresponding author:
Ole Øyen, Anatomy division, Institute of Basic Medical Sciences, University of Oslo, P.O.B. 1105, Blindern, N-0317 Oslo, Norway. E-mail: oleoy@medisin.uio.no

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(2008) claims that accumulated evidence indicates a worldwide decline in the absolute resources and time allocated to anatomy teaching, attributed to the high costs of maintaining dissection facilities, curricular overcrowding by non-science-based lectures, and a general disenchantment of university faculties with anatomy as a subject.

Furthermore, the significant increase in medical knowledge and technological advances already entails greater demands for detailed anatomy knowledge and technical skills during specialist education. Technological developments may also have a positive impact on acquiring anatomy skills, especially with regard to improved learning and guiding methods (audiovisual/3D programs/presentations, guiding apps). However, the development of new imaging methods and minimally invasive surgical techniques has changed the way in which anatomy needs to be viewed and abstracted. Future doctors will need to conceptualize anatomy from the perspective of angiography, ultrasound imaging, computed tomography, laparoscopy, and endoscopy. These are currently not directly addressed in many undergraduate curricula, giving rise to a discrepancy between the requirements of clinical practice and the delivery of medical school and postgraduate education.

Several institutions internationally have recently established clinically oriented anatomy courses, mainly based on macro-anatomy training on cadavers (D'Antoni et al., 2019; Meredith et al., 2019; Clifton et al., 2020). Currently, there are few clinically oriented anatomy courses for specialist training available in Norway.

With improved imaging/computational technologies and possibilities for diagnostic imaging allowing more advanced and complicated surgical procedures, we hypothesize that doctors in specialization perceive insufficient anatomical knowledge, and experience need for improved access to anatomical training also after their basic medical training.

To explore this in a Norwegian context, we surveyed physicians' assessment of their own anatomy knowledge and the demand for clinically oriented anatomy teaching among a representative sample of Norwegian physicians, being either clinical specialists or in clinical specialization.

Medical training in Norway is provided by four major universities in collaboration with the local state-owned hospitals. These four universities educate around 600 Norwegian physicians yearly. Traditionally, however, a relatively large proportion of Norwegian medical students receive their medical education abroad. Currently nearly half of these students are trained abroad (Grimstad, 2019). This is far more than the average for OECD countries. The preferred campuses have in recent years been located in Poland, Hungary, Slovakia, Denmark, Czech Republic, Latvia and Germany (accounting for more than 90% of students).

A representative sample of 902 Norwegian physicians were asked to assess their own anatomy knowledge and the perceived demand for clinically oriented anatomy teaching. The high proportion of foreign students made it possible to compare the individual outcome of anatomy teaching in Norway with that of international universities.

Our survey revealed that the majority of physicians have experienced insufficient anatomy knowledge in their own practice, most commonly among surgeons and neurologists. Physicians trained outside Norway rated their anatomy skills better than physicians trained in Norway. Our findings thus confirm a demand for improved anatomy skills among clinicians, and indicate that an offer of postgraduate clinical anatomy courses is warranted in Norway.

MATERIAL AND METHODS

Pilot study

Six physicians representing the specialties of orthopedics, gynecology and obstetrics, neurology, gastroenterological surgery, radiology and ear-nose-throat were interviewed on issues related to clinical anatomy. The information that emerged was used as the starting point for an online survey on a random sample of Norwegian physicians.

Survey

The survey was conducted in December 2015 and contained 25 questions about Norwegian physicians' assessment of their own anatomy skills and of the anatomy teaching they received during medical school and specialization (Ellingsen et al., 2016). A six-point scale of the ordinal level and nominal level was used to provide graded answers. A link to the questionnaire was sent out via email to a random sample of members of five professional specialist associations in the Norwegian Medical Association: Norwegian Internal Medicine Association, Norwegian Surgical Association, Norwegian Neurological Association, Norwegian Radiological Association and Norwegian Association for General Medicine. In each of these associations, 500 members were drawn at random (with the exception of the Norwegian Neurological Association, where all 492 members with registered email addresses were selected). A total of 2491 members were contacted (one E-mail address out of 2492 was rejected).

Ethical considerations

The survey was fully anonymous, with no registration of personal data, not requiring ethics committee approval in Norway (https://rekportalen.no/).

Statistics

Statistical analyses were performed using IBM SPSS Statistics (SPSS). Continuous variables were analyzed with T-test for comparison of means. Categorical variables were analyzed by Chi Square test. Tables and figures were created using Microsoft Office Excel.

RESULTS

Respondents

Responses were received from 902 (36.2%) physicians. Without an established relationship with the recipient, it is claimed that a response rate of >20% must be considered acceptable (Noel and Huang, 2019). Demographic data on the respondents are presented in Table 1; regarding gender, medical school (including Norway vs abroad), year of graduation and specialization status/time.

Table 1. Demographic data on the 902 respondents regarding gender, medical school (including Norway vs abroad), year of graduation and specialization status/time.

Respondent demographics n=902	
Gender n=902	Female: 452 (50,1%) Male: 450 (49,9%)
Medical school n=902	Abroad: 330 (36,6%) Oslo (UiO): 242 (26,7%) Bergen (UiB): 157 (17,4%) Trondheim (NTNU): 98 (10,9%) Tromsø (UiT): 75 (8,3%)
Year of graduation from medical school n=902	1970-79: 1 (0,1%) 1980-89: 45 (5,0%) 1990-99: 240 (26,6%) 2000-09: 436 (48,3%) 2010-15: 180 (20,0%)
Speciality status / Time in speciality n=901	In specialization: 413 (45,8%) Specialist < 5 years: 181 (20,1%) Specialist 5-10 years: 174 (19,3%) Specialist 11-20 years: 117 (13,0%) Specialist > 20 years: 16 (1,8%)
Distribution among specialities n=892	General medicine: 158 (17,7%) Internal medicine: 174 (19,5%) Surgery 210 (23,5%) Neurology 141 (15,8%) Radiology 209 (23,4%)

In our sample population, 37% of physicians had been educated abroad, which provides opportunities for comparing the individual outcome of anatomy teaching in Norway with that of international universities. The respondents were not asked about their nationality, but we know (Grimstad, 2019) that more than 95% of students, including those educated abroad, are Norwegian citizens.

Ten participants who could not be categorized into any of the specialties were excluded from analyses that dealt with distribution among specialties. Most of the respondents (95%) had completed their education after 1990.

Physicians' assessment of their own anatomy knowledge

The respondents were asked to give an assessment of their own anatomy knowledge at different times in their careers, on a graded scale from 1 to 6 (Fig. 1; 1: Too poor for good clinical practice; 6: More than sufficient for good clinical practice). The median value was 4 for 'Post medical school' and 'In specialization; current',

while increasing to 5 for 'Post specialization' and 'Specialists; current'. These stages have been defined in the legend. (Grade-partitioned data not shown).

The average self-assessment of anatomy knowledge after completing specialization (4.58) and current among specialists (4.64) was significantly higher than retrospectively assessed after completing medical studies (4.30; p <0.001) (Fig. 1). Among the specialists who reported inferior (1-3) anatomy knowledge after medical school, the anatomy knowledge after completion of specialization was assessed as significantly better (2.82 vs 4.12; p <0.001). The specialists who assessed that they had superior anatomy knowledge (4-6) after medical school reported no change after completing the specialization. Stratification of the groups according to place of study showed that physicians who had studied abroad scored their own anatomy knowledge after medical school significantly higher than physicians who had studied in Norway (4.47 vs 4.20; p <0.001), and twice as high a percentage indicated a value of 6; that is, more than adequate for good clinical practice (23.1% vs 11.6%; data not shown). When comparing the four universities in Norway, there were no significant differences (data not shown).

Surgeons and radiologists reported improved anatomy skills over time

There was no difference between the specialties regarding anatomy knowledge at graduation from university (Fig. 1).

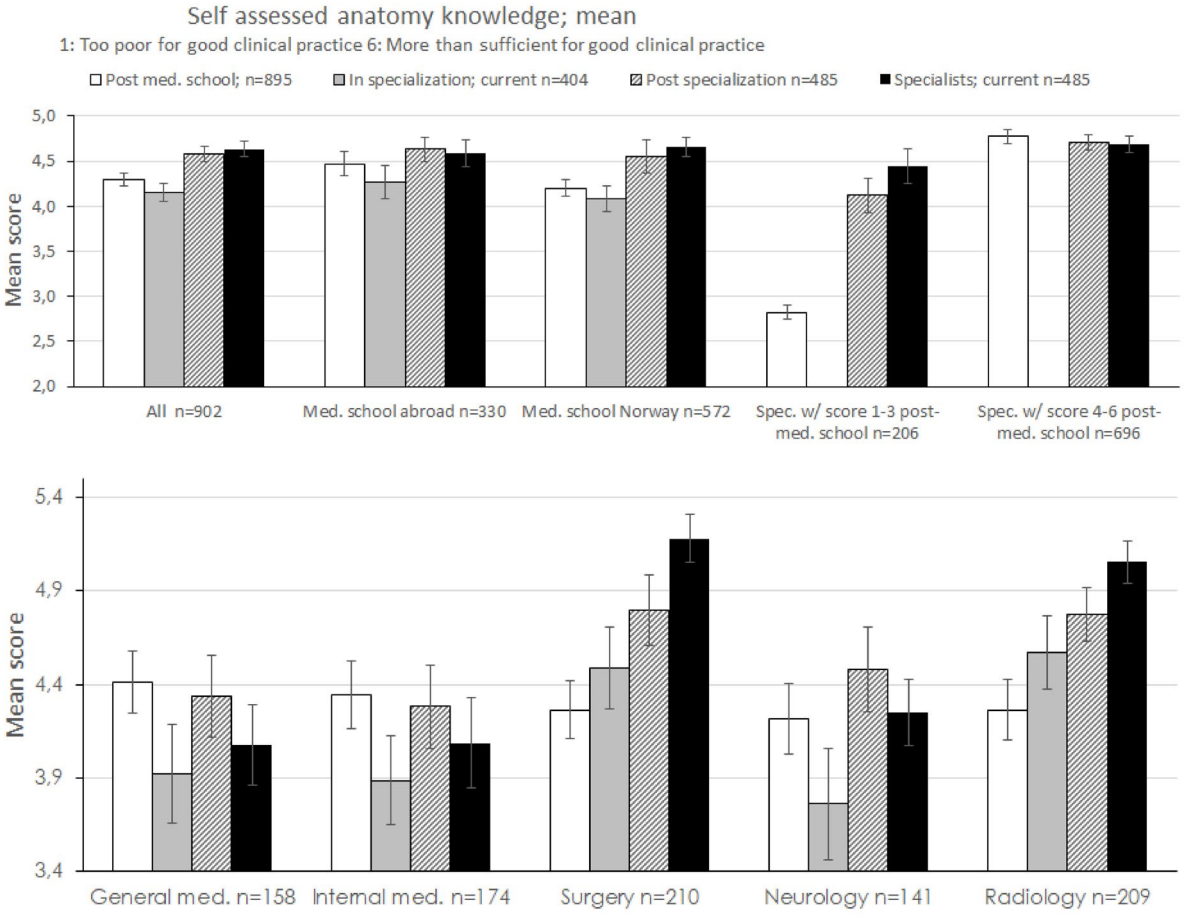

Fig. 1.- Physicians' self-assessment of anatomy knowledge at different times in their careers; average scores (grades 1-6), with 95% confidence intervals. The above panel shows the overall results and stratification according to study site (abroad vs Norway) and score at graduation (1-3 vs 4-6). In the below panel the results are broken down by specialty.

Post medical school: Retrospective assessment of anatomy knowledge at graduation from medical school. In specialization; current: Current assessment of anatomy knowledge among those currently in specialization. Post specialization: Retrospective assessment of anatomy knowledge at completion of specialization. Specialists; current: Current assessment of anatomy knowledge among current specialists.

At a later stage in their careers, surgeons and radiologists considered their anatomy skills to be significantly better than general practitioners, internal medics and neurologists (p <0.001). Surgeons and radiologists assessed their anatomy knowledge progressively better over time, while a similar trend was not present among the other specialties.

High proportion of physicians with experience of inadequate anatomy skills

As much as 73.1% of physicians reported having experienced inadequate anatomy skills in their occupational practice (Fig. 2), with the highest proportion among radiologists and neurologists and the lowest proportion among internists.

When asked about the importance of anatomy skills in the specialty, there were significantly higher scores among surgeons, neurologists and radiologists (p < 0.001). The physicians who assessed the importance of good anatomy skills in their specialty as high (value 5-6) were more likely to have experienced inadequate anatomy skills than physicians who rated anatomy skills in their specialty as less important (75.1% vs. 62.1%; p = 0.002).

The experience of inadequate anatomy skills also depended on time in the specialty. A large majority of physicians under specialization (79.0%) responded that they had experienced inadequate anatomy skills in their practice, while this proportion was lower among physicians who

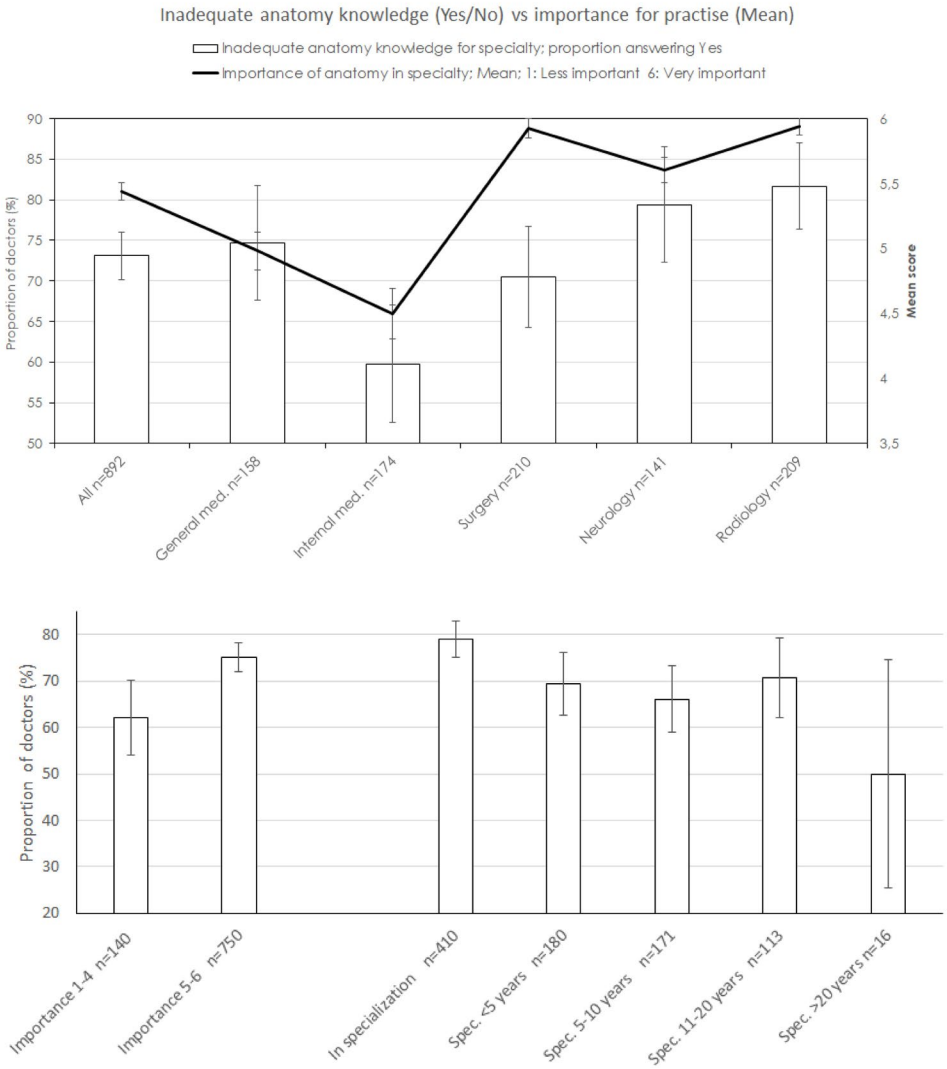

Fig. 2.- Proportion of doctors who had experienced inadequate anatomy knowledge in their practice (Yes/No), broken down by specialty (upper panel), degree of importance of anatomy in specialty and time in specialization (lower panel). The upper diagram also shows average values (solid line) for assessing the importance of anatomy in one's own specialty (1: Less important; 6: Very important). 95% confidence intervals are plotted in all graphs.

had practiced as specialists for less than 5 years (69.4%), 5-10 years (66.1%), 11-20 years (70.8%) and over 20 years (50.0%) (Fig. 2).

Among physicians who had studied abroad, a lower proportion (69%) reported inadequate anatomy skills, compared with physicians that had studied in Norway, almost reaching significance (69.2% vs 75.2%; p = 0.055; data not shown).

Anatomy teaching in medical school seemed sufficient and more relevant for clinical examinations than clinical procedures

The amount of anatomy teaching during medical school was consistently assessed as sufficient, as 77.8% entered the values 3 or 4, on a scale of 1 to 6, where 1 is too little and 6 is too much (data not shown).

Physicians educated abroad experienced the amount of anatomy teaching in medical school as significantly greater than physicians trained in Norway (4.00 vs. 3.36; p <.001) (Fig. 3; upper panel), and a higher proportion entered the values 5 or 6 (30.5% vs. 6.7%). Among physicians educated in Norway, the amount of anatomy teaching during medical school was considered significantly less at the University of Tromsø compared to the University of Oslo (UiO) (3.11 vs. 3.38; p = 0.008) and the University of Bergen (UiB) (3.11 vs 3.46; p = 0.003), but not significant compared to the Norwegian University of Science and Technology (NTNU) (3.11 vs. 3.31).

The evaluation of the relevance of anatomy teaching at university for clinical examinations and clinical procedures is shown in Fig. 3 (lower panel).

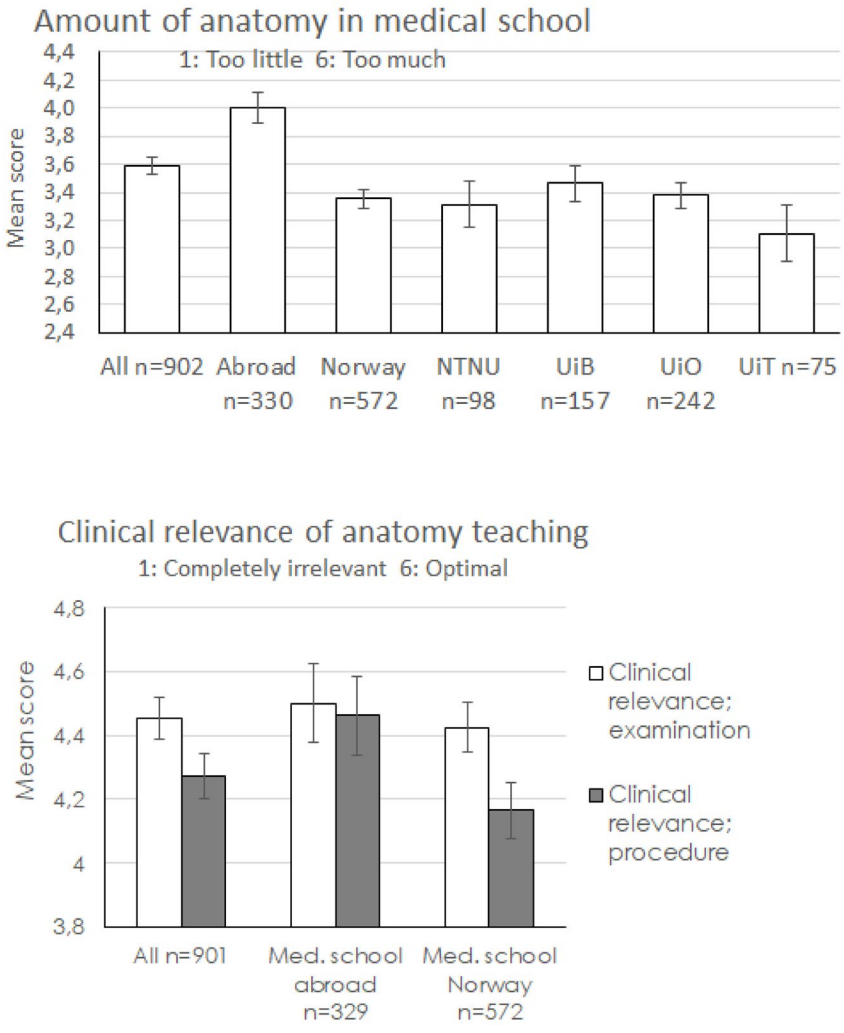

Fig. 3.- Physicians' assessment of the amount of anatomy teaching in medical school (upper panel) and the relevance of anatomy teaching for clinical examination and clinical procedures (lower panel), broken down by study site; average scores (grades 1-6), with 95% confidence intervals.

The experience of relevance to clinical procedures was indicated as significantly lower than relevance to examinations (mean value 4.27 vs. 4.45; p < 0.001). Physicians educated abroad rated the teaching's relevance for clinical procedures significantly higher than physicians educated in Norway (4.46 vs 4.16; p <0.001), and almost as high as the relevance for clinical examination (4.50).

Anatomy teaching during and after specialization was indicated as insufficient

The provision of anatomy during specialization was reported as insufficient by a predominant proportion of Norwegian physicians (Fig. 4; upper panel).

The average value for the amount of anatomy teaching during specialization was however decent (3.04), but significantly lower than that stated for the medical study (3.04 vs 3.59; p <0.001).

Radiologists (3.43; p <0.001) and internists (3.19; p = 0.033) were significantly more satisfied with the amount of anatomy teaching than the average for the other specialties.

The offer for learning and maintaining anatomy skills after medical school was considered inadequate. As much as 36.1% of physicians reported that they were not familiar with existing anatomy teaching offered to clinicians, and among the remaining 73.9% perceived the teaching provision as inadequate (value 1-3; data not shown). The neurologists were most satisfied with their anatomy training possibilities, but there was little difference between the specialties.

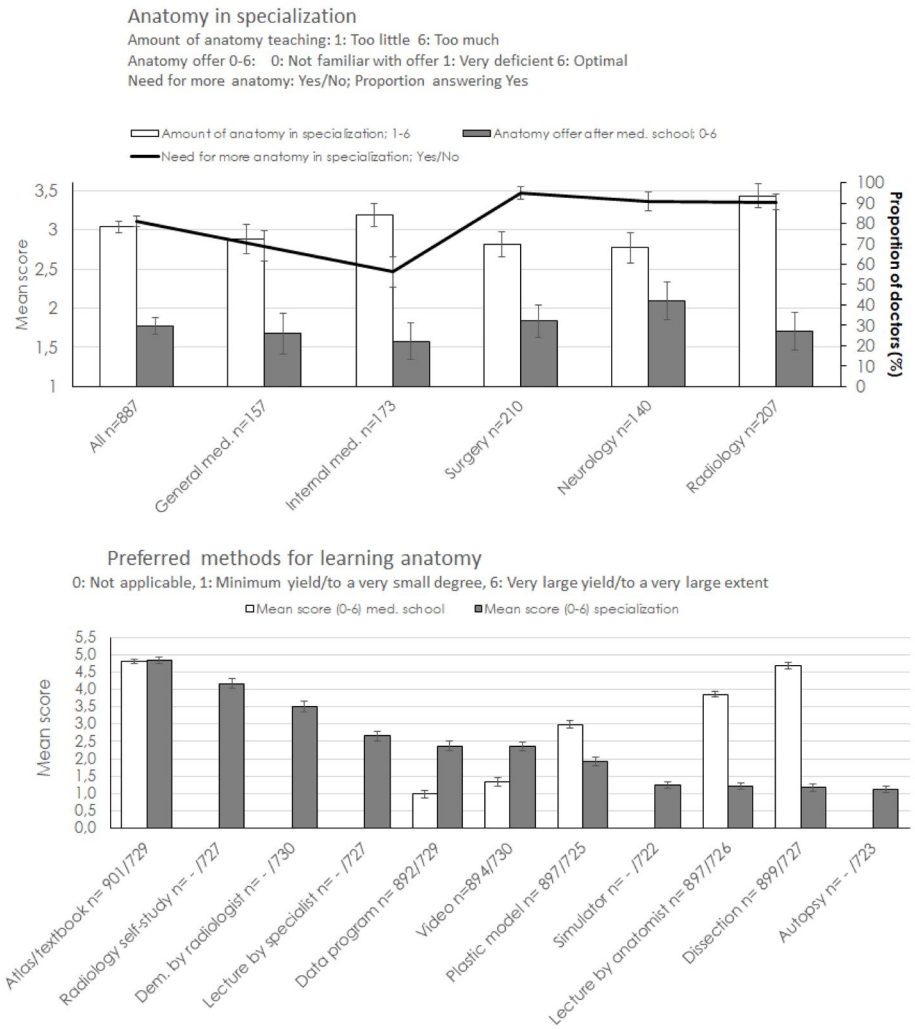

Fig. 4.- Assessment of the amount of anatomy and the availability of anatomy teaching in specialization (grades 1-6/0-6), as well as evaluation of the need for more anatomy (Yes/No) (upper panel); average scores and proportion 'Yes', with 95% confidence intervals. Average assessment of methods for learning anatomy during medical school (grades 0-6) (lower panel), with 95% confidence intervals.

Online survey/questionnaire for Norwegian physicians

A. BASIC DATA

Are you?:
Man
Woman

At which university did you study medicine?
Universitety of Oslo (UiO)
Norwegian University of Science and Technology (NTNU)
University of Bergen (UiB)
University of Tromsø (UiT)
Abroad

When did you finish medical school?
After 2010
2000-2009
1990-1999
1980-1989
1970-1979
1960-1969
Prior to 1959

What specialties do you have or are you specializing in?
[List of specialities]

Hvor lenge har du praktisert som spesialist innenfor din nåværende spesialitet?
Er under spesialisering
Under 5 år
5-10 år
11-20 år
Over 20 år

How long have you been practicing as a specialist in your current specialty?
Is under specialization
Less than 5 years
5-10 years
11-20 years
More than 20 years

B. ANATOMY IN MEDICAL SCHOOL

On a scale of 1 to 6, what do you think about the amount of anatomy teaching in medical school?
1: Too little, 2, 3, 4, 5, 6: Too much

What learning methods did you use to learn anatomy in your medical studies, and how much benefit do you think you received?
0: Not applicable, 1: Minimum yield, 2, 3, 4, 5, 6: Very large yield
- Lectures
- Selfstudy of atlas/textbook
- Dissection (The students dissect themselves)
- Self-study of ready-made preparations
- Demonstration of pre-prepared preparations by anatomy teacher or more experienced students
- Self-study of plastic models
- Videos
- Data programs, including apps

What did you think about your anatomy knowledge after graduating from medical school?
1: Too poor for god clinical practice, 2, 3, 4 , 5, 6: More than sufficient for good clinical practice

How clinically relevant do you think the anatomy teaching at the medical school was to be able to do a clinical examination?
1: Completely irrelevant, 2, 3, 4, 5, 6: Optimal

How clinically relevant do you think the anatomy teaching at the medical school was to be able to perform medical procedures?
1: Completely irrelevant, 2, 3, 4, 5, 6: Optimal

C. ANATOMY DURING SPECIALIZATION

Do you think that good anatomy knowledge is important in your specialty?
1: Less important, 2, 3, 4, 5, 6: Very important

What do you think about your anatomy knowledge right after completing your specialization?
1: Too poor for god clinical practice, 2, 3, 4 , 5, 6: More than sufficient for good clinical practice

What do you think about your anatomy knowledge now?
1: Too poor for good clinical practice, 2, 3, 4 , 5, 6: More than sufficient for good clinical practice

Have you experienced having deficient anatomy knowledge in your practice?
Yes, No

Did you need to learn more anatomy during the specialization?
Yes, No

If yes to the previous question: To what extent did you use any of these methods to learn more anatomy during the specialization?
1: To a very small degree, 2, 3, 4, 5, 6: To a very large extent
- Self-study of atlas/textbook
- Self-study of plastic models
- Dissection (of preprepared bodies)
- Lectures by experienced specialist
- Lectures by anatomist
- Exercise in the autopsy room at the hospital
- Self-study of radiological images
- Study of radiological images under the guidance of a radiologist
- Videos
- Simulators
- Data programs, including apps
- Other methods > Text field for additional information on other methods

To what extent did you use any of these methods during your specialization to learn clinical skills or procedures?
0: Not applicable, 1: To a very small degree, 2, 3, 4, 5, 6: To a very large extent
- Self-study of textbook/web sites
- Observing others executing the procedure
- Performing the procedure under supervision
- Exercise on plastic models/dolls
- Exercise on preprepared bodies/preparations
- Exercise in the autopsy room at the hospital
- Simulators
- Self-study of radiological images
- Videos explaining the procedure
- Data programs, including apps
- Other methods > Text field for additional information on other methods

If you have used radiology, simulators or carcasses to learn anatomy or clinical skills during the specialization, where have you used this?
In Norway
Abroad
Both

Do you think the teaching in your specialization is sufficient?
1: Too little, 2, 3, 4, 5, 6: Too much

D. EDUCATIONAL PROVISION

What do you think about the teaching provision in Norway to learn or maintain anatomy knowledge and clinical skills after the basic education as a doctor?
0: Not familiar with offers, 1: Very deficient, 2, 3, 4, 5, 6: Optimal

Do you have contact with medical students in your work?
Yes, No

If Yes >

What do you think about today's medical students' anatomy knowledge?
1: Very deficient, 2, 3, 4, 5, 6: Very good

Can you elaborate on your opinions about today's medical students' anatomy knowledge? Feel free to come up with examples.
Text field

Do you have any advice or comments on how you could possibly improve the offer of clinically oriented anatomy teaching at the medical school or in the continuing education of doctors?
Text field

When asked (yes/no) about the need for more anatomy in specialization, surgeons, neurologists and radiologists answered affirmatively in as much as 90-95%, significantly higher than general practitioners and internal medics.

The discepancy between the relatively high mean value for the amount of anatomy in specialization (3.04), compared with the low ratings for supply and high for need, are dealt with in the Discussion section.

Dissection was considered particularly valuable for learning anatomy in medical school

When asked about the preferred means of learning anatomy, there were a number of significant differences in the evaluation of the benefit of different methods (Fig. 4; lower panel) in medical school compared to in specialization. During medical school, studies of atlas/textbooks (average score 4.81) and cadaveric dissection courses (4.68) were valued higher than the use of computer programs (1.00) and video (1.34). For the learning of anatomy during specialization, the use of atlases and textbooks was considered significantly more valuable than studies of radiological images, which were ranked in second place (4.84 vs. 4.17; $p < 0.001$).

During specialization, dissection courses, autopsies, the use of a simulator and lectures by anatomists were considered to be relatively insignificant, and were stated as 'not applicable' by a large proportion of the respondents.

DISCUSSION

Inspired by a several year-long revision of the University of Oslo medical study plan starting in 2014, we conducted an electronic, anonymous survey regarding anatomy skills and teaching provision in anatomy, among a random sample of Norwegian physicians during specialization and ready-made specialists.

More clinically angled anatomy teaching?

Our findings regarding clinical relevance suggest a desire for more clinically angled anatomy education among physicians. As the medical knowledge base is constantly increasing and ever larger amounts of information are to be included in the medical study plan, it may be rational to make the basic anatomy teaching more clinically oriented (Drake et al., 2009; Craig et al., 2010). Furthermore, it has been reported that anatomy teaching with a clinical context improves learning and long-term memory (Bergman et al., 2008; Fincher et al., 2009) – and thus the clinical application.

Despite the findings that the amount of anatomy teaching in medical school seemed sufficient, a high proportion of physicians had experienced a lack of anatomy skills in practice. An obvious reason is that in most specialties detailed anatomy skills are required within a fairly specific area. The goal of basic education in anatomy is to provide *general* anatomy knowledge *sufficient* for good medical practice. Much of the detailed anatomy knowledge, relevant to each specialty, must therefore be acquired during specialization - in interaction with clinical application and during courses.

Assessment of ultrasound, CT and MRI images has become an important part of clinical everyday life in most specialties (Murphy et al., 2014; Geitung and Grottum, 2016). It therefore seems natural that clinically oriented anatomy teaching, both in basic and postgraduate education, should include knowledge relevant to the evaluation of radiological images (Ganske et al., 2006; Phillips et al., 2013).

Physicians educated abroad were more satisfied with their anatomy skills

Physicians who had studied abroad rated their anatomy skills as significantly better and the teaching's relevance for clinical procedures as significantly higher than physicians educated in Norway. Furthermore, a lower proportion of physicians educated abroad reported inadequate anatomy skills in their practice. This may indicate that foreign campuses have a greater volume or a more intensive type of teaching. And it may be consistent with a more progressive attitude towards clinical anatomy abroad (Meredith et al., 2019; Clifton et al., 2020). One may also wonder whether doctors educated abroad have a greater need to assert their educational status and

background (almost all of them are Norwegian citizens).

Need for strengthening of anatomy teaching during and after specialization

None of the specialist groups involved in the survey were satisfied with the teaching provision during specialization, and there seems to be a clear need for strengthening of this field. We consider that the relatively high mean value (3.04) for the amount of anatomy in specialization, compared with the low ratings for supply and high for need, may be conditioned by an unclear question, unfortunately not specifying anatomy teaching (cfr Questionnaire in Supplement).

The importance of having clinically relevant further education programs in anatomy after primary education is emphasized in a prospective UK study (Bhangu et al., 2010) in which only 14% of last-year students felt confident in their anatomy skills with regard to clinical practice. General practitioners, internists and neurologists reported declining anatomy knowledge after specialization. Several of the physicians requested targeted "refresher courses" in anatomy. But also among surgeons and radiologists, who considered their anatomy knowledge to be steadily rising from the end of medical school, more anatomy teaching was called for during specialization. Such services exist to a very limited extent in Norway today, and we are aware that Norwegian physicians have sought services in clinical anatomy abroad.

Teaching methods for courses during and after specialization

Studies of radiological images were among the most commonly used methods for learning anatomy during specialization, second only to studies of atlases/textbooks. During medical school, dissection was one of the most popular methods for learning anatomy. However, during specialization dissection was mostly considered irrelevant, presumably because dissection courses are almost unavailable. In free text fields several physicians expressed the desire for dissection and cadaver training in specialization.

It should raise concern that clinical procedures are often practised for the first time in patients. In many countries, there has been a decrease in open surgical volume among residents (Damadi et al., 2007), accompanied by diminished self-reported operative confidence and expert ratings of the operative ability (Fonseca et al., 2014). The opportunity to practice specific procedures on cadavers in advance will potentially improve patient safety (Sharma et al., 2016). Several foreign institutions offer courses where surgeons practice practical procedures on cadavers (Cabello et al., 2015; Ruiz-Tovar et al., 2019; Desai, 2021; Flynn, 2021).

Newer methods for preserving cadavers, especially the so-called "soft preservation" developed by the anatomist Walter Thiel (University of Graz, Austria), have at many universities replaced traditional formalin fixation (Thiel, 1992; Thiel, 2002; Balta et al., 2015) and opened up completely new possibilities for surgical skills training. The benefits are described as significant, with regard to natural colors and elasticity, as well as minimal formalin toxicity (Sutherland et al., 2006; Ahmed et al., 2015). This includes the possibility to perform laparoscopic procedures (Willaert et al., 2013), which is excluded on rigid, formalin-fixed carcasses.

An optimal teaching model for courses under specialization could conceivably combine dissection courses, preferably on soft-preserved carcasses, with demonstration of radiological images and the rehearsal of clinical procedures.

Limitations

The survey achieved a response rate of 36.2%. Although the sample of physicians who responded corresponded well with the Norwegian Medical Association's membership statistics in terms of campus and gender distribution, it cannot be ruled out that the respondents are particularly concerned with the topic, making the sample less representative.

We have not checked for possible confounding factors. Therefore, one should be cautious in interpreting the relationships presented as statistically significant. The questions we have

asked are partially retrospective, which obviously carries a risk of misreporting. The survey was done at the end of 2015. The teaching provision in anatomy at medical school in Oslo has changed since then. Anatomy is now taught collectively for the first two years of the study, and the exam in anatomy is conducted as a 45 minute individual oral test. We nevertheless consider our results informative and relevant for the present day situation, particularly regarding the inadequate provision of anatomy during and after specialization.

CONCLUSIONS

A remarkably high proportion (73%) of Norwegian physicians had experienced inadequate anatomical knowledge in their professional practice. The offer for learning and maintaining anatomy knowledge and skills after specialization was considered deficient. And a predominance of physicians requested an improved continuing education offer in specialization. A desirable approach would involve more clinically relevant anatomy teaching with demonstration of radiological images and rehearsal of clinical procedures, preferably using soft-preserved carcasses.

To our knowledge, there have been no previous studies on Norwegian physicians' anatomy skills. While our study is based on self-reported knowledge, future studies acquiring more objective data through knowledge tests are warranted.

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