

Autopsy-Based Learning is Essential But Underutilized in Medical Education: A Questionnaire Study

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To this day, autopsies and dissections have been essential in medical education, but declining autopsy numbers have endangered this long-standing tradition. Students' perceptions of these teaching methods should be constantly updated to help educators understand how to achieve their teaching goals. The purpose of this study was to explore the state of autopsy- and dissection-based teaching in two Finnish universities based on the experiences of the students, survey their perceptions of such teaching, and to compare the Finnish situation with students' perceptions in other countries as it emerges from medical literature. A questionnaire went to 859 second-, fourth-, and sixth-year medical students. The questions concerned dissection and autopsy classes these students had attended, the views of the students in regard to the number of classes, and the benefits of and attitudes towards autopsy teaching. An open question of how to improve autopsy teaching was included. The response rate was 19.4%. Most respondents requested more autopsy and dissection classes, especially practical education. They found autopsies most beneficial in learning anatomy and dealing with one's own emotions related to death. Their experiences proved least beneficial for interaction with the relatives of a deceased patient and for people skills. Integrational methods and focusing on the main learning outcomes were suggested as improvements. Overall, students found dissection and autopsy teaching important, but felt concerned about the diminishing autopsy numbers. Focusing on main learning objectives and better integration of autopsies in the teaching of different specialties could help to utilize autopsies to a greater extent. *Anat Sci Educ* 0: 1–11. © 2021 The Authors. *Anatomical Sciences Education* published by Wiley Periodicals LLC on behalf of American Association for Anatomy.

Key words: anatomical dissection; medical education; undergraduate education; clinical autopsy; forensic medicine; medicolegal autopsy; pathology

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Additional supporting information can be viewed in the online version of this article.

Received 19 June 2020; Revised 13 March 2021; Accepted 14 March 2021.

Published online ## ## ## in Wiley Online Library (wileyonlinelibrary.com). DOI 10.1002/ase.2073

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INTRODUCTION

Autopsies and dissections have been an invaluable tool for learning since the dawn of medicine. To this day, medical students participate in dissections and autopsies to learn anatomical structures and pathological processes of the human body. However, the numbers of teaching autopsies and dissections are constantly and disconcertingly declining (O'Grady, 2003), along with the declining number of autopsies worldwide (Turnbull et al., 2015; Hamza, 2017; WHO, 2020).

The reasons behind this decline are complex. According to the review articles of van den Tweel and Wittekind (2016) as well as of Burton and Underwood (2007), the low autopsy rates arise from multitudinous causes including ones that are

economic, social, cultural, and technological. Intriguingly, the aversion of pathologists to performing autopsies has long been one underlying factor (Charlton, 1994; Hamza, 2018). Hence, much concern has risen in many countries, with worry arising as to whether learning the basics of medicine could be endangered (Kalra and Macpherson, 2015).

Numerous studies have assessed the true utility of autopsy teaching in the modern era, identifying students' perceptions, including the benefits of learning different specialties and professional skills of medicine and attitudes towards autopsies as well as their social and psychological perspectives all over the world. Medical students generally find autopsies a necessary and useful part of their studies, whether they are doing their degree in the United States (US) (Kemp et al., 2019), the United Kingdom (UK) (Bamber et al., 2014), Europe (Anders et al., 2014; Ioan et al., 2014), Asia (Khoo, 2014; Qasim et al., 2015; Rao and Prasad, 2016), the Middle East (Madadin, 2013), or Africa (McNamee et al., 2009). Similar findings have emerged in the education of other medical professionals (Mc Garvey et al., 2015; Keiser and Murray-Wright, 2020).

Studies involving medical teaching staff in the United States (Talmon, 2010) and the United Kingdom (Burton, 2003; Bamber and Quince, 2015) have shown that, although there is a large variation in the method of organizing autopsy teaching, the autopsies are seen as multifactorial tools of transmitting knowledge and attitudes. Among other things, students gain insight into clinicopathological correlations (Tandon et al., 2019) and practical issues such as medicolegal external examination (Anders et al., 2011). Furthermore, autopsies raise awareness of risks in the practice of medicine (Ioan et al., 2014) and enable the students to contemplate their own views on the end of life (McNamee et al., 2009). The most often reported disadvantage is unpleasantness during the first autopsy experiences (Qasim et al., 2015; Rao and Prasad, 2016).

The Finnish autopsy rate has long been exceptionally high (Lunetta et al., 2007), but a drop in Finland's autopsy statistics, especially for clinical autopsies, has recently taken place (Statistics Finland, 2019). This negative trend has already been reflected in the amount of autopsy teaching available to medical students (Ahlblad, 2015), though no exact data exist.

Dissection- and autopsy-based teaching is provided in five medical faculties in Finland (Universities of Helsinki, Turku, Tampere, Eastern Finland in Kuopio, and Oulu), each having its own curriculum. In the 6-year medical degree programs, gross anatomy courses including compulsory or optional dissection courses are scheduled in the first and second years. Pathology teaching is organized either as a single module or as separate general and systemic modules in the early years, and the modules include 4–10 hours of clinical autopsies. Forensic medicine modules are given in the fourth or sixth year. In Tampere and Helsinki, all the study modules are integrated into larger course complexes. Detailed data are available in the respective study guides (Tampere University, 2020; University of Eastern Finland, 2020; University of Helsinki, 2020; University of Oulu, 2020; University of Turku, 2020).

Anatomy, pathology, and forensic medicine form the basis of medicine in many respects, which is why students' attitudes towards learning these subjects need to be constantly updated in order to help the teachers better understand how to achieve their teaching goals. Based on this, the study questions were (1) how many dissection and autopsy classes the students attend in two Finnish medical faculties—Oulu and Turku—, and do differences emerge in them; (2) how did students perceive the

usefulness of these teaching methods to learning certain professional skills and medical specialties; and (3) how would students develop dissection- and autopsy-based teaching. It was hypothesized that some differences would emerge in the amount of teaching, but that the Finnish students' views would be alike in the two faculties and parallel those presented in the literature. The aims of the study were to gain insight into the potential of the studied teaching methods and to improve teaching.

MATERIALS AND METHODS

The outlines of medical curricula of the Universities of Oulu and Turku including the modules featuring dissection- and autopsy-based teaching are presented in Figure 1. The numbers of teaching hours and the contents of the modules in each university are not identical, and the curricula undergo module updates and reforms each year. According to the study guides of 2017–2018, the anatomy module in Oulu consisted of 140 hours of lectures and 75 hours of laboratory work, and the module included embryology and cell biology. A separate, optional course in anatomical dissection included 18 hours of dissections. In Turku, anatomy was taught as part of several study modules which include elements of physiology with a total of approximately 200 hours of lectures and 43 hours of laboratory work. Participating in anatomical dissection was mandatory and included 3–15 hours of dissections.

Pathology was taught in two separate modules (general and systematic parts) in Oulu, including a total of 50 hours of lectures and 69 hours of laboratory work, of which 18 hours were scheduled for autopsies (Fig. 1). Turku arranged one pathology module, which included 70 hours of lectures, 20 hours of laboratory work (microscopy), and 10 hours of autopsies. Forensic medicine modules included approximately 30 hours of lectures and 1–1.5 hours of autopsy teaching (external examination) in both universities. However, participation in an external examination of a cadaver was optional in Turku. Learning-results of the students were assessed with written examinations in all modules in both universities. Some modules included smaller examinations throughout the course based on, for example, the laboratory work done. Essays on specific subjects were also an option in assessing the progress.

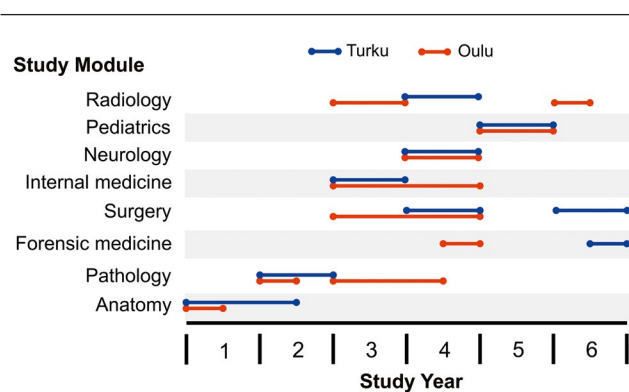


Figure 1.

Curricular map with time line of dissection (in anatomy) and autopsy classes (in pathology and forensic medicine) at Universities of Oulu and Turku. Other selected study modules were included to give the context of the curricula surrounding these classes throughout study years 1–6. The length of colored bar represents the duration of the module.

Study Design

This study was a cross-sectional survey in two of the five Finnish medical faculties: the University of Oulu and the University of Turku. Second-, fourth-, and sixth-year medical students of each university, totaling 859, received invitations to participate in the study by answering a questionnaire anonymously. The invitations went out via e-mail sent to each year's student mailing list in spring semester 2018 after the relevant courses had ended each year. The questionnaire was open for four weeks. A reminder invitation went out after two weeks, and another reminder two days before closing of the questionnaire link. Study participation was voluntary. The work complies with the Declaration of Helsinki, and the study protocol was approved by the University of Oulu Ethics Committee of Human Sciences.

Questionnaire

The survey was carried out with Webropol 2.0 (Webropol Inc., Helsinki, Finland), an online tool for creating surveys and collecting answers. The questionnaire included 19 separate sections (English translation of the questionnaire appears as Supplemental material File 1). Background questions included age, gender, university, and year the student was attending, and the highest degree before medical studies. The survey instrument was developed to address the following topics: the number of times attending a dissection or autopsy, group sizes, and the total number of cadavers examined in courses of anatomical dissections, pathology, and forensic medicine either by observation or by participating in the examination (question-set 1); the students' views on the amount of autopsy teaching (set 2); the students' views on the benefit of this teaching method to their learning different medical specialties and professional skills (set 3); and their attitudes towards autopsy teaching (set 4). Finally, the participants responded to an invitation to share their ideas via an open question on how they would improve autopsy teaching methods.

The questionnaire consisted mainly of multiple-choice questions. Opinions on the benefit of autopsy education were recorded on a usefulness score of 0–5 (0 = no use at all; 5 = extremely useful). Attitude questions were recorded on a five-point Likert scale, and the answers were subsequently treated as numeric with value 1 for “totally disagree,” 2 for “disagree,” 3 for “neither disagree nor agree,” 4 for “agree,” and 5 for “totally agree.”

Testing and Validating the Survey

The questionnaire was tested by the research group to establish face validity. Additionally, a few outsider research personnel helped in testing the question construction. So as to maximize the total number of participants, no students were involved in the testing. Validity was assessed with Kendall's tau-b calculated for questions measuring similar topics. Reliability of the question sets was tested with Cronbach's alpha.

Data Analysis

The responses were analyzed statistically with IBM SPSS Statistics, version 25 (IBM Corp., Armonk, NY). To identify differences between the universities and between study years,

as well as concerning the background variables, the Chi-squared test served for categorical variables and Student's *t*-test for continuous variables. “No opinion/no answer” choices were excluded from statistical calculations. Probability values below 0.05 were considered statistically significant. Effect sizes were measured with Cohen's *d* when using Student's *t*-test and Cramer's *V* when using chi-squared test.

The open question was analyzed with a qualitative content analysis using the inductive approach (Elo and Kyngäs, 2008). The answers were organized, and emerging themes and subthemes were identified. Frequencies of theme-/subtheme-related answers were gathered to formulate a general description of the topic.

RESULTS

Demographic Data

Of 859 students, 167 participated in the survey (response rate 19.4%). For their demographic data see Table 1. No statistically significant differences existed in background variables between the universities or study years, and 55.7% of the respondents reported that during medical studies they saw a cadaver for the first time in their life.

Validity and Reliability of the Questionnaire Instrument

Correlation coefficients for questions surveying students' views on the amount of teaching were 0.44 (anatomy), 0.57–0.78 (pathology), and 0.35–0.72 (forensic medicine). Correlation coefficients for questions surveying general medical skills (anatomy, physical examination of patients,

Table 1.

Demographic Data of Students Participating in the Survey

Characteristics	University of Oulu	University of Turku	Total
Total <i>n</i> (%)	98 (58.7)	69 (41.3)	167 (100.0)
Mean age, years (±SD)	26.0 (±5.0)	25.0 (±4.0)	25.0 (±4.0)
Study year, <i>n</i> (%)			
Second	45 (45.9)	25 (36.2)	70 (41.9)
Fourth	22 (22.4)	25 (36.2)	47 (28.1)
Sixth	31 (31.6)	19 (27.5)	50 (29.9)
Gender, <i>n</i> (%)			
Male	42 (42.9)	25 (36.2)	67 (40.1)
Female	55 (56.1)	42 (60.9)	97 (58.1)
No answer	1 (1.0)	2 (2.9)	3 (1.8)
Highest degree, <i>n</i> (%)			
High school graduate	82 (83.7)	62 (89.9)	144 (86.2)
University degree	16 (16.3)	7 (10.1)	23 (13.8)

procedures performed by general practitioner, cause-effect relationships of diseases and traumas, and interpretation of symptoms and findings) were 0.32–0.54; questions surveying medicolegal skills (writing out death certificates, diagnosis of death, examination of assault injuries, and differences between clinical and medicolegal death investigation) were 0.35–0.60; and questions surveying emotional aspects (capacity for empathy, people skills, adopting physician's occupational identity, and dealing with one's own emotions related to death) were 0.39–0.56. Correlation coefficients for questions measuring usefulness scores of operational specialties (anesthesiology, surgery, ear, nose and throat diseases, ophthalmology, and gynecology and obstetrics) were 0.36–0.60; non-operational specialties (acute medicine, physical medicine and rehabilitation, dermatology, respiratory diseases, pediatrics, neurology, oncology, internal medicine, occupational medicine, and general medicine) were 0.35–0.64; and diagnostic specialties (forensic medicine, pathology, and radiology) were 0.32–0.67. Cronbach's alpha values were 0.83 (question set 1), 0.87 (set 2), 0.95 (set 3), and 0.63 (set 4).

Participation in Dissection and Autopsy Classes and Group Sizes

Some differences emerged in the numbers of participation in dissection and autopsy classes between the universities (Supplemental material File 2). A greater proportion of students in Oulu reported having attended in a smaller (1–10) than in a larger (>10) group for their participation in clinical autopsies than did those in Turku (79.5% vs. 40.9%, $P < 0.001$, $V = 0.38$), with no significant differences between those universities regarding medicolegal autopsies or anatomical dissections (data not shown).

The numbers of cadavers seen by the students in anatomical dissections, clinical, and medicolegal autopsies differed significantly between the universities ($P < 0.001$ in all comparisons; $V = 0.60$ for anatomy, $V = 0.37$ for pathology and $V = 0.52$ for forensic medicine; Supplemental material File 3).

Perceptions of the Number of Dissection and of Autopsy Classes

Respondents generally opted for more classes regarding all the dissection- and autopsy-based education with some differences between the universities (Table 2). Students in Oulu were more frequently happy with demonstrations of medicolegal external examination than were those in Turku (42.3% vs. 7.1%, $P = 0.005$, $V = 0.35$). In Oulu, most of the students wanted more classes involving participation (74.1% vs. 34.8%, $P < 0.001$, $V = 0.41$) and observation (66.3% vs. 27.3%, $P < 0.001$, $V = 0.40$) in anatomical dissections compared with Turku.

Opinions on Usefulness of Autopsy Education

Overall, dissection and autopsy teaching was found most beneficial in learning anatomy (4.18 ± 1.1 ; mean usefulness score \pm standard deviation), dealing with one's own emotions related to death (3.50 ± 1.4), learning cause-effect relationships of diseases and traumas (3.43 ± 1.5), and learning about differences between clinical and medicolegal death investigation (3.41 ± 1.5). The least benefit from autopsy teaching

was connected with people skills (0.82 ± 1.1) and interaction with the next of kin of a deceased patient (1.76 ± 1.7) (Fig. 2). Regarding different specialties, autopsies were assessed to be most relevant in learning pathology (4.43 ± 1.0), forensic medicine (4.31 ± 1.2), and surgery (3.94 ± 1.2), and least relevant concerning psychiatry (0.56 ± 0.9) with some differences in the students' views between the universities (Fig. 3).

Attitudes Toward Dissection and Autopsy Education

The statement questions regarding negative aspects of dissection and autopsy teaching received low scores in both universities with only minor differences (Fig. 4). The students in Turku had more often taken part in classes about death-related topics (4.87 ± 0.4 vs. 4.19 ± 1.3 , $P < 0.001$, $d = 0.69$; mean Likert scores \pm standard deviation). Respondents in Oulu wanted more such classes (3.23 ± 1.2 vs. 2.58 ± 1.0 , $P < 0.001$, $d = 0.60$). A few differences arose between men and women: Women estimated autopsy teaching as being slightly more stressful emotionally than did men (2.68 ± 1.3 vs. 2.22 ± 1.2 , $P = 0.025$, $d = 0.36$). In addition, women reported more often having nightmares (1.53 ± 1.2 vs. 1.18 ± 0.6 , $P = 0.013$, $d = 0.36$). Also, somewhat more physical symptoms occurred among those that witnessed a cadaver for the first time during autopsy teaching than among those that had seen one earlier (3.04 ± 1.5 vs. 2.45 ± 1.4 , $P = 0.010$, $d = 0.41$).

How Would Students Improve Dissection and Autopsy Teaching?

Two main themes emerged in the analysis of the open question, "Providing learning opportunities" and "Improving the content of classes." Six subthemes in each theme were identifiable (Table 3).

The most frequent comments regarded providing more autopsy classes and smaller group sizes. Many students were also concerned that they were not provided with equal opportunities to attend dissection and autopsy classes. Regarding the second theme, opportunities for hands-on training and better guidance were topics stressed. Integration of autopsy teaching into other specialties or study modules was also suggested, as well as shifting the emphasis to better support the content of each study module. Quotations were freely translated from Finnish.

"More autopsies, especially with self-participating and not just as an observant in a large group". (subthemes "More classes" and "Hands-on training"; Oulu)

"Smaller groups. When about twenty people cram into a small room, you won't see or learn anything, and some faint just because of the crowd." (subtheme "Smaller groups"; Oulu)

"Everyone should get a chance to attend [dissection- and autopsy-based classes] ... All my autopsy classes were canceled, and only some students got to attend dissections." (subthemes "Equal learning opportunities"; Oulu)

"... every medical student should get at least one mandatory autopsy class with participation in the examination. Also more opportunities should be provided for the enthusiastic students". (subthemes "More classes," "Equal learning opportunities," "Optionality," and "Hands-on training"; Turku)

Table 2.

Students' Perceptions of the Amount of Dissection and Autopsy Classes at the University of Oulu and the University of Turku

Dissection- and autopsy classes in study modules	University of Oulu					University of Turku						
	More classes n (%)	Satisfactory amount n (%)	Less classes n (%)	No opinion/no answer n (%)	More classes n (%)	Satisfactory amount n (%)	Less classes n (%)	No opinion/no answer n (%)	More classes n (%)	Satisfactory amount n (%)	Less classes n (%)	No opinion/no answer n (%)
Anatomical dissections												
Participating	63 (64.3)	21 (21.4)	1 (1.0)	13 (13.3)	24 (34.8)	45 (65.2)	0 (0.0)	0 (0.0)	0 (0.0)	43 (62.3)	1 (1.4)	0 (0.0)
Observing	53 (54.1)	26 (26.5)	1 (1.0)	18 (18.4)	15 (21.7)	40 (58.0)	0 (0.0)	0 (0.0)	14 (20.3)			
Clinical autopsies												
Participating	56 (57.1)	35 (35.7)	0 (0.0)	7 (7.1)	25 (36.2)	43 (62.3)	1 (1.4)	0 (0.0)				
Demonstration of full autopsy	48 (49.0)	44 (44.9)	3 (3.1)	3 (3.1)	16 (23.2)	42 (60.9)	1 (1.4)	10 (14.5)				
Demonstration of findings	41 (41.8)	44 (44.9)	3 (3.1)	10 (10.2)	21 (30.4)	37 (53.6)	1 (1.4)	10 (14.5)				
Medicolegal autopsies												
Participating in autopsy	33 (33.7)	35 (35.7)	1 (1.0)	29 (29.6)	16 (23.2)	10 (14.5)	0 (0.0)	43 (62.3)				
Demonstration of full autopsy	36 (36.7)	35 (35.7)	1 (1.0)	26 (26.5)	21 (30.4)	6 (8.7)	0 (0.0)	42 (60.9)				
Demonstration of findings	30 (30.6)	31 (31.6)	5 (5.1)	32 (32.7)	18 (26.1)	8 (11.6)	0 (0.0)	43 (62.3)				
Participating in external examination	59 (60.2)	10 (10.2)	2 (2.0)	27 (27.6)	22 (31.9)	5 (7.2)	0 (0.0)	42 (60.9)				
Demonstration of external examination	40 (40.8)	30 (30.6)	1 (1.0)	27 (27.6)	26 (37.7)	2 (2.9)	0 (0.0)	41 (59.4)				

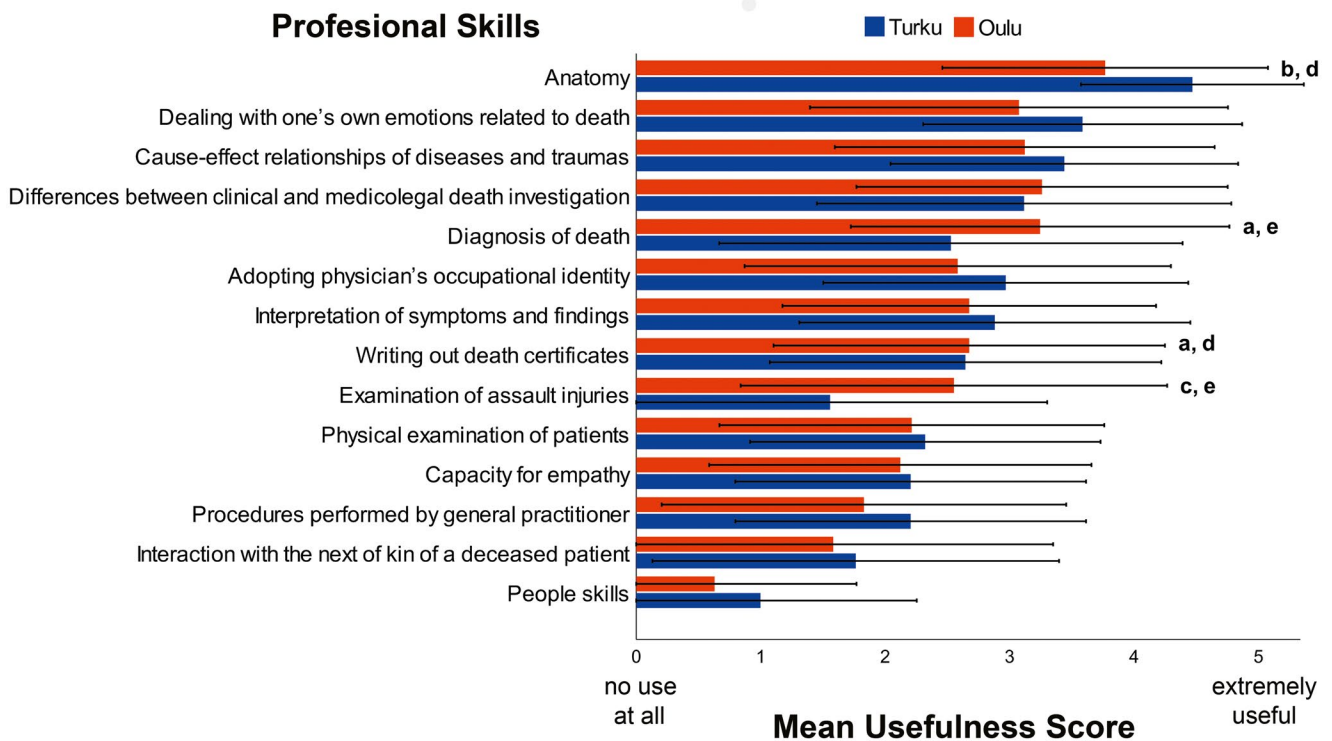


Figure 2.

Mean usefulness scores in learning different professional skills in medicine at the University of Oulu ($n = 98$) and the University of Turku ($n = 69$). Data were collected on the scale from 0 = no use at all through 5 = extremely useful. Error bars represent \pm standard deviations. Statistically significant differences between universities: ^a $P < 0.05$; ^b $P < 0.01$; ^c $P < 0.001$; effect sizes: ^d $d > 0.20$; ^e $d > 0.50$.

“Training in essential clinical emergency skills, such as coniotomy, on cadavers would be important.” (sub-themes “Integration into other classes” and “Hands-on training”; Turku)

“Rather little guidance was offered in the actual autopsy. A scalpel was just put in one’s hand and we were told to begin.” (subtheme “Better guidance”; Turku)

“... Diagnosis of death and doing external examination should be stressed more in the medicolegal education ...” (subtheme “Better emphasis”; Oulu)

DISCUSSION

This study reaffirmed the essential role that both autopsies and dissections play in medical studies, as viewed by the students. The results showed clearly the large demand for better learning opportunities, and the students joined with the teaching staff in their worry about the declining number of autopsy classes (O’Grady, 2003; Kosma, 2009). There is constant pressure to improve teaching—a fact more apparent now than ever due to the current pandemic and its impact on medical students (Ferrel and Ryan, 2020). Involving students in curricular planning has many advantages in the implementation and evaluation of the modules (Geraghty et al., 2020), which is why the students’ opinions should be under continuous examination.

Many students emphasized the need for more education in practice such as doing the external examination of a cadaver. In Finland, as in many other European countries (Anders et al., 2011) general practitioners play a crucial role in performing the examination of a cadaver at police request. Two of the main

learning outcomes of the forensic medicine module, diagnosis of death and writing out death certificates, received, however, overall usefulness scores of less than 3. Somewhat higher scores were given by the Oulu students, but there is definitely room for improvement in this respect, highlighted also by the comments on the open question. Incorporating a practical viewpoint is supported by the study of Anders et al. (2011), where the majority of students felt able to perform a post mortem examination and to write out a death certificate after a course including hands-on training. Moreover, Schröder et al. (2017) reported that only one-third of general practitioners had received practical training during their undergraduate studies in Germany, with resultant repercussions for their performance of external examinations.

One of the specialties benefiting from dissection and autopsy teaching is obviously surgery (3.92), although the overall usefulness score for performing procedures was low (2.08). Furthermore, many open-question comments brought up the potential of integrating procedural training into dissection and autopsy classes. Indeed, cadaver specimens have proven useful for practicing basic procedures (Kim et al., 2016). A number of studies have addressed the use of cadavers in experimenting with novel techniques in postgraduate training (Mantica et al., 2020), ones that could help minimize the risk of complications in such procedures (Hampp et al., 2019; Park et al., 2019). Moreover, dissections offer an irreplaceable approach to discovering specific anatomical details such as the nasal bone structure (Roussel et al., 2020). To meet these demands, The Tampere Surgical Education Centre at Tampere University Hospital, Finland, has introduced the use of unembalmed cadavers in a realistic operating theater

Medical Specialties

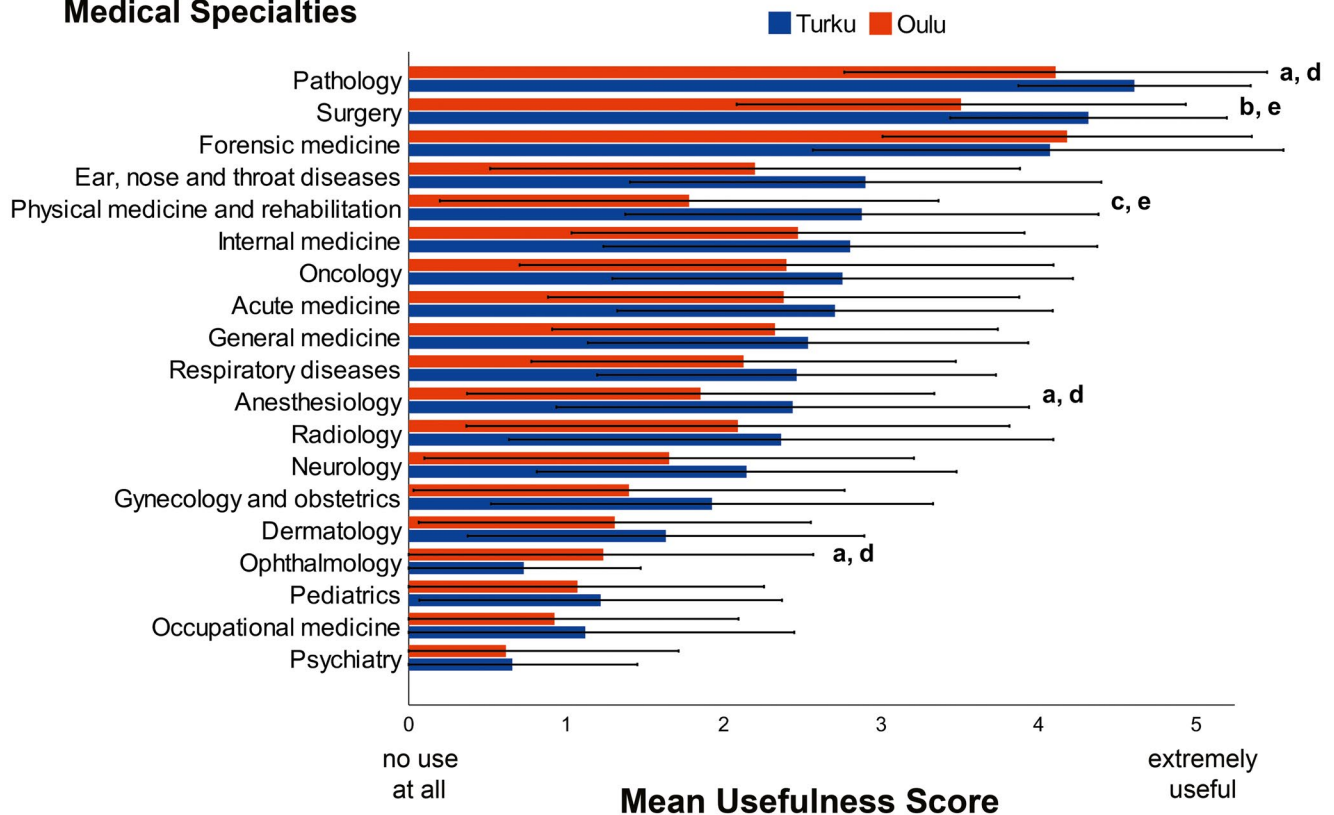


Figure 3.

Mean usefulness scores in learning different medical specialties at the University of Oulu ($n = 98$) and the University of Turku ($n = 69$). Data were collected on the scale from 0 = no use at all through 5 = extremely useful. Error bars represent \pm standard deviations. Statistically significant differences between universities: ^a $P < 0.05$; ^b $P < 0.01$; ^c $P < 0.001$; effect sizes: ^d $d > 0.20$; ^e $d > 0.50$.

setting to provide authentic learning opportunities (Tampere University Hospital, 2020). These cadavers are selected from among those undergoing a medicolegal autopsy. For a few years, cadavers for anatomical dissection have had a similar origin at the University of Oulu, involving also small-scale postgraduate training for surgeons (personal communication).

Attending autopsies can greatly enhance the understanding of pathophysiological mechanisms of common disease processes such as heart failure and pulmonary embolism (Anders et al., 2014). In addition, autopsy offers a unique opportunity to gain invaluable information on more uncommon entities (Aiello, 2016). However, the current autopsy classes seem to fail in conveying these aspects to the students, as surprisingly low usefulness scores were given to internal medicine (2.79) and other non-operative specialties. Neither was autopsy teaching seen as very beneficial for the learning of cause-effect relationships (3.43) and of the interpretation of symptoms and findings (2.85). In the study of Tandon et al. (2019), however, more than 60% of students reported improved understanding of clinicopathological correlations. The same theme also emerged in the studies of McNamee et al. (2009) and Khoo (2014).

What then can be done to increase the student's appreciation in this regard? In the United States, anatomy and pathology education is integrated into clinical studies, for instance, by including brain dissection as part of neurology and discussion of clinicopathological correlations of autopsy findings during

internal medicine classes (Margret and Cambor, 2012). A few of the respondents suggested implementing supplementary or alternative teaching methods such as virtual autopsy. Autopsy videos allow students to learn at their own pace and enable the teaching of large groups (Burton et al., 2004). Diaz-Perez et al. (2014) asserted that linking virtual techniques to clinical studies enhanced learning of pathology. Talmon et al. (2014) created a virtual teaching tool which they evaluated to be as effective as an authentic autopsy in many respects. In the work of Lalli (2020), a medical student at the University of Turku, autopsy videos were combined with slideshows presenting the history and histological findings related to the autopsy. This approach allowed the comprehension of how conclusions as to the causes of death are based on the history and autopsy findings. In the related survey, most students found this approach useful (Lalli, 2020).

The downside of virtual autopsy techniques is their absence of emotional attachment (Talmon et al., 2014). Authentic autopsies offer a unique opportunity to reflect on one's own emotions regarding death, an aspect which the students found somewhat important (3.50). A similar view was expressed by medical educators, with more than half responding that allowing students to evaluate their own views on death was somewhat or very important (Talmon, 2010).

In contrast, quite a low score went to "interaction with the next of kin of a deceased patient" (1.77). This is somewhat surprising, as traditional autopsies with authentic cadavers provide a safe study environment before facing death and meeting

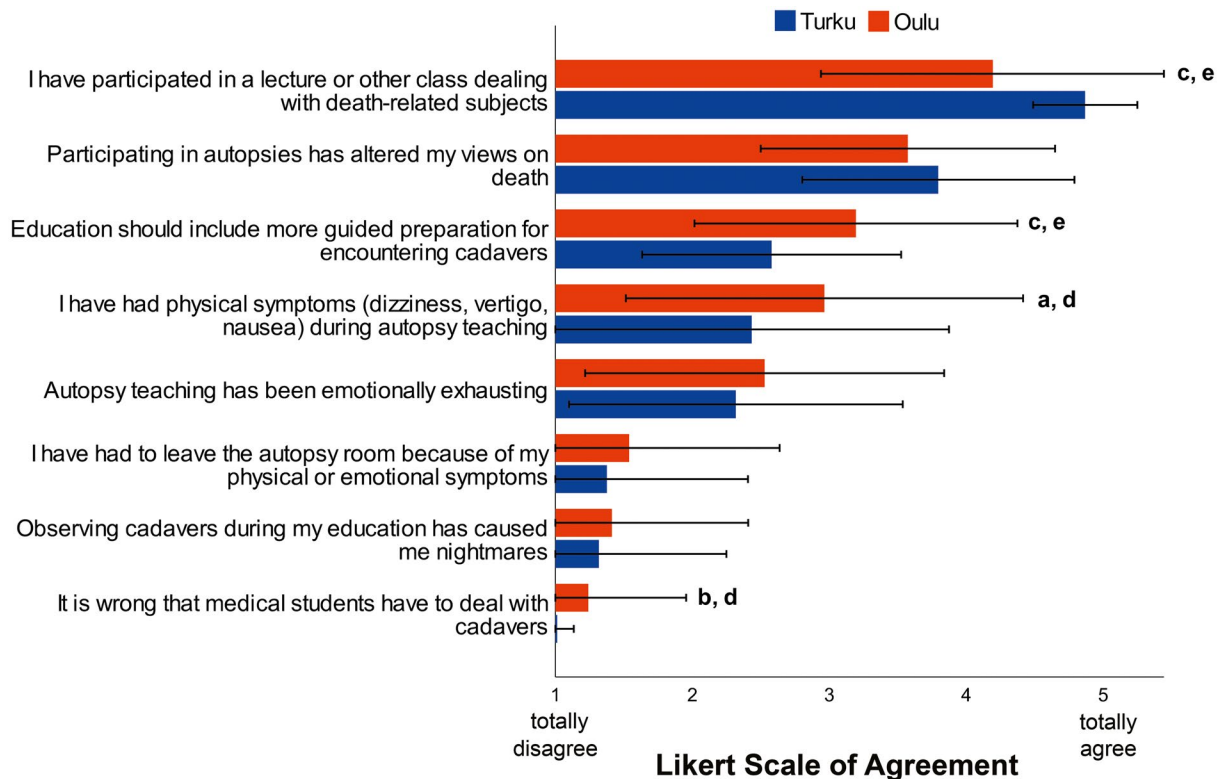


Figure 4.

Responses to the survey on attitudes towards dissection and autopsy education at the University of Oulu ($n = 98$) and the University of Turku ($n = 69$). Data were collected on a five-point Likert scale where 1 = totally disagree and 5 = totally agree. Error bars represent standard deviation. Statistically significant differences between universities: ^a $P < 0.05$; ^b $P < 0.01$; ^c $P < 0.001$; effect sizes: ^d $d > 0.20$; ^e $d > 0.50$.

with the relatives of the deceased in practice (Mc Garvey et al., 2015). The issue is important especially regarding situations when a clinical autopsy is considered, because, in addition to Finland, many countries require the relatives' consent (Henry and Nicholas, 2012; Eka et al., 2014). A fact pointed out is that physicians are more likely to promote conducting autopsies when they have attended autopsies during their own education (Khoo, 2014; Bagga et al., 2016). The more profound knowledge the clinicians have as to the purpose and possibilities of the autopsy, the better they can discuss these topics with relatives, making more likely their consent to the autopsy. Interestingly, however, none of the studies reviewed by Bamber and Quince (2015) showed that attending autopsies leads to an increase in students' consent to permitting their own autopsy. One-fourth of the students in Pakistan (Qasim et al., 2015) and one-half of the students in India (Rao and Prasad, 2016) were willing to consent to the autopsy of their own or their relative's body after autopsy classes. In contrast, Ioan et al. (2014) found that Romanian students very often agreed with a similar statement. The researchers stated this finding to correlate with the recognition of autopsies' important societal and medical status (Ioan et al., 2014).

As expected, those statements regarding negative effects from attending autopsies received low scores on a Likert scale. The students in Oulu reported slightly more physical symptoms than did those in Turku. This could be linked with the finding that Oulu students had less frequent attendance of classes dealing with death-related topics. Many studies have discussed the negative effects of attending autopsies (Bamber and Quince,

2015). Anders et al. (2011) reported that almost one student in five had experienced some personal disturbance after doing a medicolegal external examination. In another study, only a few had reported physical symptoms like nausea or fainting after an autopsy, but many found the odors unpleasant (Anders et al., 2014). Similar findings were related to anatomical dissections performed on unembalmed cadavers (Goyal et al., 2016).

Gender-related differences arose as to suffering negative experiences. That women reported more emotional distress and nightmares is not notably true in the literature. Ioan et al. (2014) reported greater discomfort by woman participants, whereas the opposite was true in the study by Qasim et al. (2015). Rao and Prasad (2016) found no significant differences between gender reactions to autopsy experience.

The number and degree of physical symptoms were somewhat correlated with the student's observing a dead person for the first time. Attending the first autopsy is stressful, and the students' energy may mostly be concentrated on coping with the actual situation rather than learning from it (McNamee et al., 2009). The experience can even be traumatizing (Wong and Trollope-Kumar, 2014). Weurlander et al. (2012) assessed that the students' coping correlates with how they view the experience: as an unnatural situation, as a practical exercise, or as a chance to learn a pathologist's work. It is widely reported that the negative psychological aspects are ameliorated during repeated autopsy classes (Bamber and Quince, 2015). The same has been shown with nursing students attending anatomical dissections (Mc Garvey et al., 2015), suggesting that attending more than one autopsy class would be advisable.

Table 3.

Themes and Subthemes Emerged from the Open Question “How Would You Develop Autopsy Teaching?”

Theme/Subtheme	University of Oulu <i>n</i> (%)	University of Turku <i>n</i> (%)	Total <i>n</i> (%)
Providing learning opportunities	61 (58.1)	44 (41.9)	105 (100.0)
More classes	20 (60.6)	13 (39.4)	33 (100.0)
Smaller groups	18 (56.3)	14 (43.8)	32 (100.0)
Equal learning opportunities	17 (85.0)	3 (15.0)	20 (100.0)
Less classes/Satisfactory number of classes	3 (30.0)	7 (70.0)	10 (100.0)
Optionality	3 (37.5)	5 (62.5)	8 (100.0)
Timing in curriculum	0 (0.0)	2 (100.0)	2 (100.0)
Improving the content of classes	33 (42.9)	44 (57.1)	77 (100.0)
Hands-on training	10 (43.5)	13 (56.5)	23 (100.0)
Integration into other classes	8 (47.1)	9 (52.9)	17 (100.0)
Better emphasis	11 (68.8)	5 (31.3)	16 (100.0)
Better guidance	1 (9.1)	10 (90.9)	11 (100.0)
Better preparation/debriefing	2 (40.0)	3 (60.0)	5 (100.0)
Supplementary/alternative methods	1 (20.0)	4 (80.0)	5 (100.0)
No answer	47 (64.4)	26 (35.6)	73 (100.0)

Despite the few negative elements, almost all respondents in this study agreed that examining cadavers should be a part of their medical studies. Both the students (Ioan et al., 2014; Qasim et al., 2015; Rao and Prasad, 2016) and the medical educators (Burton, 2003; Talmon, 2010) generally agree with this. To minimize any negative effects, an integral part of medical education should include discussion of the emotional aspects both before and after the autopsy or dissection, as some have suggested previously (Bamber et al., 2014). Open comments noted that even practical considerations such as group sizes can help in making the experience easier.

Many students expressed their concern over the lack of equivalence in learning opportunities. The reason for this was mainly the cancellation of classes because of the lack of suitable cadavers (clinical autopsies), but also the limited number of attendees in optional anatomical dissections (in Oulu). Similar inequalities have been reported between medical schools in the United Kingdom (Bamber and Quince, 2015) and the United States (Talmon, 2010). Improving the harmonization of autopsy teaching in the Finnish medical faculties requires discussion. Careful consideration should also be applied to the necessary degree of obligation for autopsy classes.

Limitations of the Study

The low questionnaire response rate (167, 19.4%) resulted partly in small study groups, which is why the comparisons were made between universities rather than between study years. Based on gender distribution, the data represent the

whole student population quite well; in 2017, slightly more than half the students beginning their medical studies in Finland were women (Ahlblad, 2017).

Comparing the amount of teaching between universities is not straightforward because of the large dissimilarities in the curricula. Obvious differences were apparent in the allocated teaching hours, and, most importantly, in the distribution of optional and compulsory studies, which may at least partly explain the discrepancy between the numbers of cadavers examined. It is a recognized fact that attendees of optional and compulsory courses may differ in their opinions based on, for example, pre-existing interest in or an opinion as to the importance of the topic. Moreover, this kind of questionnaire study may encourage chiefly the most conscientious students to respond. Despite these factors, however, the main findings (usefulness scores and Likert scores) were quite similar between the universities.

The retrospective nature of this inquiry provides its own drawbacks. The time between completing the study module and responding to the questionnaire varied among students and among study modules, which may cause numerical inaccuracy. The opinions and attitudes naturally reflect the situation at the time of responding.

CONCLUSIONS

This study supported the hypothesis that the Finnish students' views were in line with those expressed in other countries, reaffirming the importance of autopsy teaching in medical education. The limiting aspect and concern, however, seems to be the

diminishing number of autopsies, especially clinical autopsies. It is clear that dissection and autopsy teaching needs improvement in order to achieve educational goals. Focusing on the main learning objectives and integrating autopsy classes into the teaching of different specialties and skills could help to utilize the existing autopsies to a greater extent. In this digital era, autopsy teaching should not be allowed to become extinct.

ACKNOWLEDGMENTS

The authors declare that they have no conflict of interest.

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LITERATURE CITED

Ahlblad J. 2015. Makers of diagnosis. *Suom Lääkäril* 44:2920–2923.

Ahlblad J. 2017. Every tenth got accepted. *Suom Lääkäril* 72:1763.

Aiello VD. 2016. The autopsy as the cornerstone for education and research in cardiology. *Autops Case Rep* 6:1–3.

Anders S, Fischer-Bruegge D, Fabian M, Raupach T, Petersen-Ewert C, Harendza S. 2011. Teaching post-mortem external examination in undergraduate medical education—The formal and the informal curriculum. *Forensic Sci Int* 210:87–90.

Anders S, Mueller M, Spherhake J-P, Petersen-Ewert C, Schiekirka S, Raupach T. 2014. Autopsy in undergraduate medical education—What do students really learn? *Int J Leg Med* 128:1031–1038.

Bagga IS, Goyal V, Singh A, Chawla H, Goel S, Sharma S. 2016. Knowledge towards post-mortem examination and reasons for not specialising in morbid anatomy: Study among medical undergraduate students. *Int J Res Med Sci* 4:2792–2795.

Bamber AR, Quince TA. 2015. The value of postmortem experience in undergraduate medical education: Current perspectives. *Adv Med Educ Pract* 6:159–170.

Bamber AR, Quince TA, Barclay SI, Clark JDA, Siklos PW, Wood DF. 2014. Medical student attitudes to the autopsy and its utility in medical education: A brief qualitative study at one UK medical school. *Anat Sci Educ* 7:87–96.

Burton JL. 2003. The autopsy in modern undergraduate medical education: A qualitative study of uses and curriculum considerations. *Med Educ* 37:1073–1081.

Burton JL, Diercks-O'Brien G, Rutty GN. 2004. Videos have a role in postgraduate necropsy education. *J Clin Pathol* 57:877–881.

Burton JL, Underwood J. 2007. Clinical, educational, and epidemiological value of autopsy. *Lancet* 369:1471–1480.

Charlton R. 1994. Autopsy and medical education: A review. *J Roy Soc Med* 87:232–236.

Diaz-Perez JA, Raju S, Echeverri JH. 2014. Evaluation of a teaching strategy based on integration of clinical subjects, virtual autopsy, pathology museum, and digital microscopy for medical students. *J Pathol Inform* 5:25.

Eka I, Rowan C, Osborn M. 2014. Mind the gap: Are NHS trusts falling short of recommended standards for consent to autopsy? *J Clin Pathol* 67:10–13.

Elo S, Kyngäs H. 2008. The qualitative content analysis process. *J Adv Nurs* 62:107–115.

Ferrel MN, Ryan JJ. 2020. The impact of COVID-19 on medical education. *Cureus* 12:e7492.

Geraghty JR, Young AN, Berkel TDM, Wallbruch E, Mann J, Park YS, Hirshfield LE, Hyderi A. 2020. Empowering medical students as agents of curricular change: A value-added approach to student engagement in medical education. *Perspect Med Educ* 9:60–65.

Goyal PK, Gupta M, Kaur J. 2016. Autopsy as a tool for learning gross anatomy during 1st year MBBS. *Int J App Basic Med Res* 6:230–232.

Hampp EL, Sodhi N, Scholl L, Deren ME, Yenna Z, Westrich G, Mont MA. 2019. Less iatrogenic soft-tissue damage utilizing robotic-assisted total knee arthroplasty when compared with a manual approach: A blinded assessment. *Bone Joint Res* 8:495–501.

Hamza A. 2017. Declining rate of autopsies: Implications for anatomic pathology residents. *Autops Case Rep* 7:1–2.

Hamza A. 2018. Perception of pathology residents about autopsies: Results of a mini survey. *Autops Case Rep* 8:e2018016.

Henry J, Nicholas N. 2012. Dead in the water—Are we killing the hospital autopsy with poor consent practices? *J R Soc Med* 105:288–295.

Ioan BF, Neagu MF, Manolescu IF, Plăieșu TF, Damian S. 2014. Utility of autopsy in medical education—Students' opinions and attitudes. *Rev Med Chir Soc Med Nat Iasi* 118:801–807.

Kalra J, Macpherson J. 2015. The decline of the hospital autopsy: A missed opportunity for quality and education in healthcare. *Austin J Clin Pathol* 2:1024.

Keiser MM, Murray-Wright M. 2020. Autopsy observation as experiential learning for nurse practitioner students in an online advanced pathophysiology course. *Nurse Educ* 45:111–113.

Kemp WL, Koponen M, Sens MA. 2019. Forensic autopsy experience and core entrustable professional activities: A structured introduction to autopsy pathology for preclinical student. *Acad Pathol* 6:2374289519831930.

Khoo JJ. 2014. Perceptions of medical students towards autopsy as an educational tool. *J Contemp Med Educ* 2:57–62.

Kim SC, Fisher JG, Delman KA, Hinman JM, Srinivasan JK. 2016. Cadaver-based simulation increases resident confidence, initial exposure to fundamental techniques, and may augment operative autonomy. *J Surg Educ* 73:e33–e41.

Kosma VM. 2009. Autopsies teach even now. *Duodecim* 125:1242–1243.

Lalli E. 2020. The importance of autopsies in teaching pathology from the perspective of medical students. University of Turku: Turku, Finland. Undergraduate Thesis. 15 p.

Lunetta P, Lounamaa A, Sihvonen S. 2007. Surveillance of injury-related deaths: Medicolegal autopsy rates and trends in Finland. *Inj Prev* 13:282–284.

Madadin MS. 2013. Assessment of knowledge about, attitudes toward, and awareness of a forensic medicine course among medical students at the University of Dammam. *J Forensic Leg Med* 20:1108–1111.

Mantica G, Leonardi R, Pini G, Esperto F, Proietti S, van Deventer H, Giusti G, Gaboardi F, van der Merwe A, Terrone C. 2020. The current use of human cadaveric models in urology: A systematic review. *Minerva Urol Nefrol* 72:313–320.

Margret MS, Cambor CL. 2012. The integration of pathology into the clinical years of undergraduate medical education: A survey and review of the literature. *Hum Pathol* 43:567–576.

Mc Garvey A, Hickey A, Conroy R. 2015. The anatomy room: A positive learning experience for nursing students. *Nurse Educ Today* 35:245–250.

McNamee LS, O'Brien FY, Botha JH. 2009. Student perceptions of medico-legal autopsy demonstrations in a student-centred curriculum. *Med Educ* 43:66–73.

O'Grady G. 2003. Death of the teaching autopsy. *BMJ* 327:802–803.

Park JH, Park KR, Kim D, Kwon HW, Lee M, Choi YJ, Kim YB, Park S, Yang J, Cho J. 2019. The incision strategy for minimizing sural nerve injury in medial displacement calcaneal osteotomy: A cadaveric study. *J Orthop Surg Res* 14:356.

Qasim AP, Hashmi KUR, Ahmad M, Naheed K. 2015. The value of autopsy in medical education: Student's attitudes & opinion. *J Univ Med Dent Coll* 6:17–25.

Rao GV, Prasad SK. 2016. Autopsy—Perception and attitudes of undergraduate medical students in South India: A questionnaire survey. *Int Arch Integrat Med* 3:204–211.

Roussel LM, Patron V, Maubert E, Escalard C, Goux D, Beaudouin V, Lechapt E, Moreau S, Hitier M. 2020. New landmarks in endonasal surgery: From nasal bone to anterior cribriform plate including branches of anterior ethmoidal artery and nerve and terminal nerve. *Int Forum Allergy Rhinol* 10:395–404.

Schröder AS, Wilmes S, Sehner S, Ehrhardt M, Kaduszkiewicz H, Anders S. 2017. Post-mortem external examination: Competence, education and accuracy of general practitioners in a metropolitan area. *Int J Leg Med* 131:1701–1706.

Statistics Finland. 2019. Quality Description: Causes of death 2018. Statistics Finland, Helsinki, Finland. URL: http://www.stat.fi/til/kssyt/2018/kssyt_2018_2019-12-16_laa_001_en.html [accessed 6 December 2020].

Talmon G. 2010. The use of autopsy in preclinical medical education: A survey of pathology educators. *Arch Pathol Lab Med* 134:1047–1053.

Talmon GA, Czarnecki D, Bernal K. 2014. The eAutopsy: An effective virtual tool for exposing medical students to the postmortem examination. *Am J Clin Pathol* 142:594–600.

- Tampere University. 2020. Curricula guides, licentiate degree in medicine. Tampere University, Tampere, Finland. URL: <https://www10.uta.fi/opas/koulutus.htm?opsId=163&cuiLang=en&lang=en&lvv=2017&koulid=422> [accessed 6 December 2020].
- Tampere University Hospital. 2020. Tampere Surgical Education Centre (TSEC). Tampere University, Tampere, Finland. URL: <https://www.tays.fi/tamperesurgicalcentre> [accessed 6 December 2020].
- Tandon A, Kanchan T, Atreya A, Tandon A. 2019. Perceptions of medical students towards autopsy teaching and its significance. *Med Sci Law* 59:143–148.
- Turnbull A, Osborn M, Nicholas N. 2015. Hospital autopsy: Endangered or extinct? *J Clin Pathol* 68:601–604.
- University of Eastern Finland. 2020. Study guide's Medicine, 2018–19 information. University of Eastern Finland, Kuopio, Finland. URL: https://weboodi.uef.fi/weboodi/vl_kehys.jsp?MD5avain=&Org=20784102&vl_tila=1&Opas=3902&Kieli=6 [accessed 6 December 2020].
- University of Helsinki. 2020. Study guide's Degree Programme in Medicine 2017–2018, years 1–6, 2017–18 information. University of Helsinki, Helsinki, Finland. URL: https://weboodi.helsinki.fi/hy/vl_kehys.jsp?MD5avain=&Org=116719396&vl_tila=1&Opas=5365&Kieli=6 [accessed 6 December 2020].
- University of Oulu. 2020. Curriculum for the degree programme in medicine 2017–2018. University of Oulu, Oulu, Finland. URL: https://weboodi.oulu.fi/oodi/vl_kehys.jsp?MD5avain=&Kieli=6&Org=41624920&vl_tila=1&Opas=1865 [accessed 6 December 2020].
- University of Turku. 2020. Curricula guides, licentiate degree in medicine. University of Turku, Turku, Finland. URL: <https://nettiopsu.utu.fi/opas/tutkintoOhjelma.htm?rid=30512&cuiLang=en&lang=en&lvv=2017> [accessed 6 December 2020].
- van den Tweel JG, Wittekind C. 2016. The medical autopsy as quality assurance tool in clinical medicine: Dreams and realities. *Virchows Arch* 468:75–81.
- Weurlander M, Scheja M, Hult H, Wernerson A. 2012. Emotionally challenging learning situations: Medical students' experiences of autopsies. *Int J Med Educ* 3:63–70.
- WHO. 2020. World Health Organization. European Health Information Gateway. Autopsy rate (%) for all deaths. World Health Organization, Geneva, Switzerland. URL: https://gateway.euro.who.int/en/indicators/hfa_545-6410-autopsy-rate-for-all-deaths/ [accessed 2 April 2020].
- Wong A, Trollope-Kumar K. 2014. Reflections: An inquiry into medical students' professional identity formation. *Med Educ* 48:489–501.