

ORIGINAL RESEARCH

Genetics in the Danish nursing education: A questionnaire study

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ABSTRACT

Objective: It is well established that genetics plays an increasing role in healthcare. This has given rise to an ongoing discussion about the genetics competencies that healthcare personnel should possess. Nurses are key players in healthcare, and several studies have found that current genetics teaching in nursing education is insufficient. Other studies have shown that many nurses have a very limited knowledge of genetics. The objective of the present study was to gain insight into the genetics content in the Danish nursing education.

Methods: We conducted a questionnaire study, involving one science lecturer from each of the 26 Danish nursing schools, asking informants about the status of genetics at their nursing school, e.g. curriculum, number of teaching lessons and exam.

Results: With a response rate of 100%, we found a large variation between schools regarding the number of genetics lessons offered, ranging from two to eleven lessons. There was also a large variation with regard to curriculum. Most schools used one of two textbooks written in Danish, and classical genetics subjects such as DNA structure, protein synthesis, single gene diseases, pedigrees, and chromosome abnormalities were part of the literature curriculum in almost all schools, with variation in the level of detail. Genetics subjects of specific relevance to nursing and healthcare, such as pharmacogenetics and cancer genetics, were only part of the literature curriculum in some schools. Genetics was only a minor exam subject (if at all), and inclusion of ethical and social aspects of genetics in healthcare varied considerably.

Conclusions: This study gives a unique insight into the situation regarding genetics in the Danish nursing education, and we argue that national recommendations regarding genetics teaching in nursing education are of importance in order to harness the full potential of genetics in healthcare.

Key Words: Genetics, Nursing education, Genetic healthcare, Nursing students, Questionnaire study

1. INTRODUCTION

The completion of the Human Genome project in 2003^[1] has led to rapid developments in genetic and genomic knowledge, diagnostic possibilities, and pharmacogenetic treatment prospects. Whereas research in genetics previously focused on rare, single-gene diseases, relevant only to a mi-

nority of patients, the focus of attention has now shifted to the whole genome and the multiple genetic factors acting together with environmental factors to cause genetically more complex diseases in larger parts of the population. This development provides new opportunities and challenges for the healthcare system and will undoubtedly require new skills

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and competencies of nurses. Thus, it is of great importance that genetics is an integral part of the curriculum in nursing education. Note that in this article we use genetics as a broad term, including genomics.

Several studies have described and discussed the insufficiency of current genetics teaching in nursing education.^[2-7] Kirk et al. stressed the importance and challenges of making the nurse community, including senior lecturers of nursing, active and conscious participants in the innovations offered by the advances in genetic healthcare.^[8] They consider the nursing community’s active involvement a necessary precondition for the integration of genetics competencies into nursing education. Furthermore, they regard the implementation of regulatory standards at the national level as a necessary means to further this goal.

In Denmark, however, there are at present no official standards, recommendations, or guidelines regarding the teaching and learning objectives of genetics in nursing education or indicating which genetic competencies graduated nurses should possess. The European Society of Human Genetics has developed a set of core competencies for health professionals^[9] to enable national societies for health professionals to use them as a basis to guide curricula and new initiatives in professional education. However, this suggested set of competencies is not legally binding; it seems to have had no impact on the Danish nursing education and to be unknown to nurse educators in Denmark. We have not found any references to these suggested core competencies in official Danish documents on nursing education. According to the ministerial order on the Bachelor’s Degree Programme in Nursing, issued in 2008^[10] (which was in effect in our reference period), Danish nursing students should be able to “explain the structure and function of the human organism, including genetic aspects”. This vague and imprecise phrase is the only learning objective in the ministerial order mentioning genetics, and it leaves room for numerous interpretations and decisions regarding the content, level, and number of lessons taught in genetics in each nursing school.

Whereas the role of genetics in nursing, including nursing education, has been subject to substantial attention internationally,^[5,11-15] this has not been the case in Denmark. A literature search performed by the authors did not reveal any particular professional, political, or social debate on the subject in Denmark. There is an ongoing debate in Denmark about the implementation and impact of novel technologies in nursing, but it seems to focus on technologies such as care technology and smart technology.

There are no previous publications assessing and discussing the content and extent of the genetics curriculum in the Dan-

ish nursing education, but as mentioned, there are reasons to believe that the content and number of lessons may vary considerably between nursing schools.

The aim of our study was therefore to inquire into the content of the genetics curriculum, the number of lessons and the exams undertaken in the Danish nursing education. We consider this study a part of the future quality assurance of the Danish nursing education, and based on our results we aim to initiate a discussion about the need for educational standards on a national level in order to meet the needs of the future healthcare system.

In Denmark, there are 26 official nursing schools (hereof four web-based) that offer the bachelor’s degree in nursing.^[16] Since 1990, the Danish Bachelor’s Degree Programme in Nursing has been part of the higher education system, currently offered at university colleges,^[17] thus creating an academic context for, and replacing, the previous apprenticeship system. Each nursing school constructs its own curriculum, based on the national ministerial order given by the Ministry of Higher Education and Science, which is setting a broad framework for Danish nursing education.^[10] In the Danish Bachelor’s Degree Programme in Nursing, the education spans three and a half years and has 210 ECTS credits,^[18] distributed between theoretical and clinical education and different scientific areas as presented in Table 1 (European Credit Transfer and Accumulation System (ECTS) credits are a standard means for comparing the volume of learning based on the defined learning outcomes and their associated workload for higher education across the European Union).

Table 1. The Danish bachelor’s degree programme in nursing

Scientific area	ECTS credits
Nursing science	120
Medical science	40
Natural science	25
Humanities	15
Social science	10
Total	210
Of which:	
Theoretical credits	120
Clinical credits	90
Bachelor thesis credits	20

With a bachelor degree, nursing students are expected to be able to work as reflective practitioners, providing total care for patients, and develop methods for assessing, reflecting on, planning, conducting, evaluating and developing nursing and assisting medical treatment.^[17]

Genetics is mentioned only twice in the 2008 ministerial order. In the description of module 3 (out of fourteen modules), it is stated in the study programme that “Anatomy and physiology including genetics” is a subject field worth 5 ECTS credits at this specific module. The same module has among its learning objectives that students should be able to “explain the structure and function of the human organism, including genetic aspects”. Thus, there are no ECTS credits allocated specifically to genetics. Rather, it is considered part of anatomy and physiology subjects.

In Denmark, a small minority of specialty nurses work in one of the six clinical genetics departments in the country, assisting medical geneticists in genetic counselling. Such genetic nurses have received special training, courses and apprenticeship at the clinical genetics departments. Their education is not the focus of this inquiry.

To the best of our knowledge, the great majority of general nurses in Denmark has so far been only little engaged in genetic aspects of healthcare. Danish nurses may therefore lack the necessary insight, skill and motivation to adapt to the rapid changes in relation to the genetic revolution in healthcare.

Several barriers to the integration of genetics into nursing practice have been identified.^[3,4,6,19] In a British context, Kirk, Lea, and Skirton found significant barriers in the lack of knowledge and awareness of genetics, and the understanding of its relevance to practice among British nurses.^[19] This may well apply to the Danish nursing context as well.

Experts within the field have described the necessity of educational changes in the nursing profession in relation to the advances in genetics science and technology, transforming healthcare systems worldwide.^[3,4,11,20,21] It is a general prediction that future health services will increasingly fo-

cus on screening and prevention, and that treatment will be much more individualized, based on genetically predicted drug responses.^[22] Therefore, for Danish nurses to provide sufficient care in this new genetic setting, they need to be educated to the level of genetic understanding required for communicating, explaining and translating genetic test results, providing reasons for prescribed treatment, and being able to deal with patients and families’ concerns in this new context.

2. METHODS

2.1 Study design

The authors developed a questionnaire comprised of open-ended questions exclusively, most of which required quantitative answers. This questionnaire was used to perform a survey.

Open-ended questions were used to obtain precise and adequate statements, based on the respondents’ own words and not limited by our prior understanding and possible bias.

The questionnaire included questions about the respondent and his/her nursing school (such as name, institution, phone number, and name of lecturer responsible for teaching genetics in the period specified) and nine questions addressing the genetics content and teaching specifically (see Table 2). Due to the relatively limited number of responding institutions (26 nursing schools) and the possibility to contact respondents again for further information, we did not pilot the survey. One question addressed a qualitative issue, inquiring into the respondent’s own opinion as to why and to what extent genetics should be part of the Danish Bachelor’s Degree Programme in Nursing. With this question we intended to inquire deeper into the respondent’s personal views on the meaning and relative importance of genetics in the nursing education now and in the future.

Table 2. The nine questionnaire items addressing the genetics content and teaching in the first half year of 2016 specifically

1) How many lessons in genetics were offered at your nursing school?
2) At what module (out of fourteen) were these lessons offered?
3) Did other teaching and learning activities besides lessons take place with regard to genetics (case work, workshop, online activities, other)? If yes: please describe these activities.
4) What was the genetics literature curriculum at your nursing school? Please describe with as many details as possible (textbook(s), pages, other material).
5) What was the primary focus of the lessons in genetics (and possible other teaching and learning activities)?
6) Did your teaching in genetics include ethical, social, economic and and/or legal aspects? If yes: please describe what aspects?
7) Was genetics part of an exam? If yes: please describe the exam (oral, written, integrated, other).
8) Do you expect that the teaching in genetics at your nursing school will continue with the same number of lessons and the same content under the new 2016 ministerial order regarding nursing education in Denmark? If no: please describe any planned or expected changes.
9) Please describe your own opinion about why and to what extent genetics should be part of the Danish nursing education programme.

2.2 Participants

One lecturer from each of the 26 Danish nursing schools was chosen as respondent, based on purposive sampling, where participants are selected specifically and intentionally (in a non-random manner) based on their merits.^[23] The inclusion criteria were that respondents had to be nurse educators and science lecturers. There were no exclusion criteria. We identified appropriate respondents of the questionnaire through an informal network of natural science lecturers from Danish nursing schools. Two of the authors have participated in network meetings on a regular basis. The respondents' educational background were identified either through LinkedIn profiles or the Danish University College Knowledge Database (UC Viden).

2.3 Sampling strategy

Each of the lecturers was contacted by email in May 2017. They were informed about the scope of the study and asked to participate. The email also contained a link to the online questionnaire, supported by Quia.^[24]

If the lecturer found that another person in their faculty would be a more competent respondent, they were permitted to pass on the questionnaire. Respondents were asked to answer the questionnaire with reference only to the period of the first semester (i.e. half-year) of 2016. All 14 modules in the Danish nursing programme were taught during the reference period, since new nursing students are enrolled in the programme every half year. In case of non-response, a reminder was sent after one week. We received questionnaire responses during May and June 2017. In cases where we needed clarification of responses, respondents were contacted again for further information.

2.4 Data analysis

Data management took place in Quia. Frequencies of quantitative data were calculated and presented in tables. Regarding respondents' answers to the questionnaire item about the genetics literature curriculum (see Table 2, question 4), we carried out a content analysis of the textbook chapters and other texts reported by the respondents. The texts were investigated with the aim of identifying the major genetics subjects covered. After this subject identification, we revisited all texts again to find out which of the themes were mentioned in the literature curriculum used in each of the 26 schools.

2.5 Ethics

Each individual singled out for this research was properly informed, prior to the investigation, about the aim, background, scope, method and ethics of the inquiry. If the person con-

tacted responded to the questionnaire, this was considered an act of consent to participate in the inquiry. Respondents were promised anonymity in the further research and publication process according to the principles of the Helsinki declaration, i.e. no respondent could be identified from our published data. All personal information such as names, emails and phone numbers will be deleted at the end of the inquiry. The study complied with the "Ethical Guidelines for nursing Research in the Nordic countries",^[25] and the "Danish Code of Conduct for Research Integrity".^[26] Ethical committee approval of this study was not necessary according to Danish law. The researchers were not administrators or similar in any of the 26 nursing schools in the study, and thus there were no conflicts of interest between researchers and respondents.

3. RESULTS

3.1 Response rate

We obtained responses from all 26 Danish nursing schools, including the four online programmes. Thus, our response rate was 100%. Nineteen of the respondents taught genetics during the reference period, seven respondents did not themselves teach genetics in the reference period.

3.2 Number of genetics lessons

The number of genetics lessons reported by respondents varied immensely between schools, ranging from two to eleven lessons (one lesson = 45 minutes of teaching). Ten of the 26 schools offered five genetics lessons or less, and only eight schools offered ten or more lessons of genetics (see Figure 1).

3.3 Other teaching and learning activities concerning genetics

Asked about other teaching and learning activities covering genetics besides lessons, respondents mentioned workshops, case work, video presentations, films, and the use of interactive online material.

3.4 Genetics literature curriculum

Most schools used chapters from one or both of two textbooks written in Danish.^[27-30] Some schools used other texts such as journal articles, typically in addition to chapters from one of the textbooks mentioned.

Content analysis of the texts used revealed which major genetics subjects were covered in each school. In Table 3, we summarize the results of this content analysis, stating how many of the schools cover each major genetics subject in their literature curriculum.

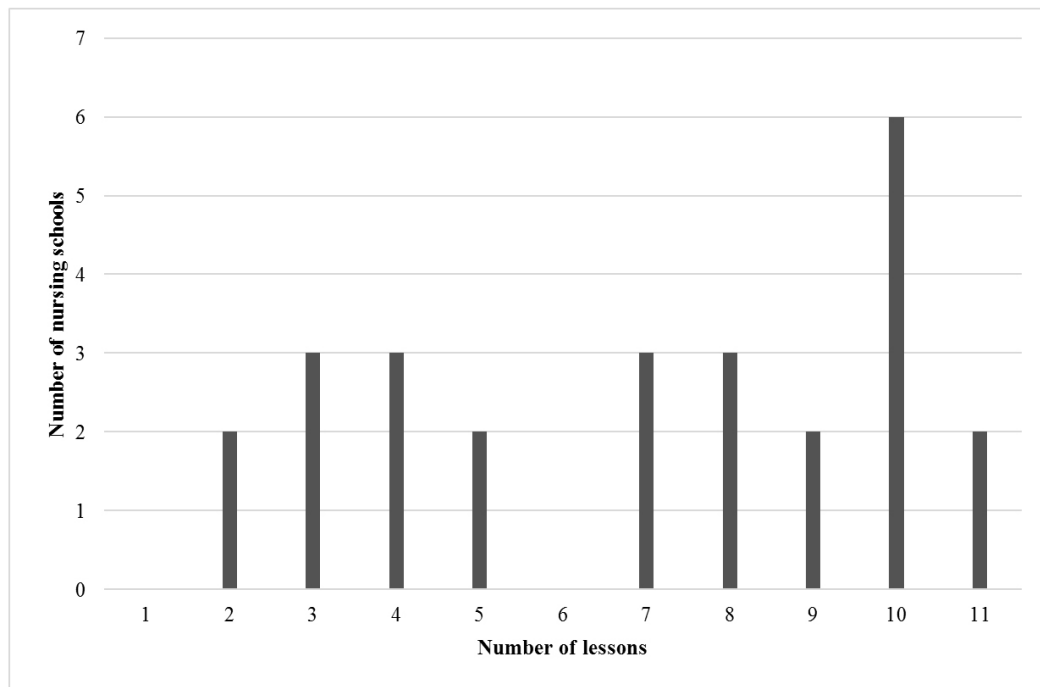


Figure 1. The number of genetics lessons in Danish nursing schools

Table 3. The number of Danish nursing schools covering each major genetics subject in their genetics literature curriculum

Genetics subject	Number of schools with subject in their literature curriculum (%)
Concepts: Genotype, phenotype	25 (96.2)
Single gene diseases	25 (96.2)
Chromosome abnormalities	
-Numerical	25 (96.2)
-Structural	20 (76.9)
Chromosomes	23 (88.5)
Biochemical genetics (DNA structure, transcription, translation)	22 (84.6)
Mutations	21 (80.8)
Pedigrees	20 (76.9)
Genetic variation	18 (69.2)
Prenatal genetic diagnosis	17 (65.4)
Concepts: penetrance, expressivity, codominance and related	14 (53.8)
Cancer genetics	13 (50.0)
Genetics of other common diseases (e.g., diabetes, hypertension, depression, atherosclerosis)	12 (46.2)
Preventive measures (carrier screening, presymptomatic genetic analysis and related)	10 (38.5)
Gene therapy	9 (34.6)
Pharmacogenetics	8 (30.8)
Epigenetics	8 (30.8)
Ethical, social economic and/or legal aspects	2 (7.7)

As shown in Table 3, traditional genetics subjects such as single gene diseases and pedigrees, chromosomes and chromosome abnormalities and DNA structure, transcription and translation were part of the literature curriculum in almost all

schools. Subjects such as genetics of common diseases, including cancer genetics, pharmacogenetics and carrier screening, i.e. health related subjects of specific relevance to nursing practice, were only present in the literature curriculum in some schools. Notably, pharmacogenetics is only part of the literature curriculum in eight schools and cancer genetics only in 13.

We also asked respondents “What was the primary focus in the lessons in genetics (and possible other teaching and learning activities)?” in order to gain insight into the genetics subjects that were prioritized. The respondents’ answers to this question were very diverse, ranging from “All of it” to very long and detailed descriptions of the content. Three representative answers, were “Firstly, something in general about genes and heredity. Thereafter, chromosome diseases, gene diseases and prenatal diagnosis”, “It was a broad introduction to genetics focusing on subjects of relevance to nursing” and “Basic understanding of chromosomes, genes, mutations, inheritance patterns. Understanding of genetic and multifactorial diseases. Screening. Epigenetics. Ethical dilemmas”.

Based on the content, the large diversity, and in some instances very general nature of answers to this questionnaire item, we found that it was not worthwhile to conduct further analyses and decided not to pursue the primary focus answers further.

3.5 Genetics in exam

Genetics was an exam subject in 17 of the 26 nursing schools. In ten schools, genetics was part of the curriculum examined in an oral exam, in seven schools it was part of a written exam. In all of these 17 schools, the exams including genetics also covered many other, larger subjects (e.g. physiology, nursing, pathology and more), and genetics was mostly a minor subject. Of these 17 respondents, seven indicated that most of their students were not asked questions about genetics even when it was an exam subject, since there were so many other subjects to cover in the exam.

Genetics was not an exam subject in seven schools. In one school, it was an exam subject only if chosen by the student. One respondent did not answer the questionnaire item on exams.

3.6 Ethical, social, economic and/or legal aspects

Eight of the 26 respondents answered that teaching in genetics did not include ethical, social, economic and/or legal aspects, or answered that they did not know, or did not answer this item in the questionnaire. The other 18 respondents submitted a variety of answers in which they mentioned primarily ethical and social aspects.

Some selected answers, exemplifying the diversity, were “Use of stem cells—ethical considerations. Ethical aspects in genetic counselling, what should the patient know?”, “Student groups were encouraged to include legal and ethical aspects in their analysis of papers (euthanasia in relation to Huntington’s disease, genetic testing in relation to BRCA genes, abortion law in relation to Down’s syndrome and ethics concerning designer babies)”, and “Aspects on ethics regarding screening and preimplantation genetic diagnosis”.

Other answers mentioned the ethics relating to the sale of genetic material, hereditary cancer, breast cancer (diagnosis and surgery), problems of interfering intentionally with natural selection, debates about chromosome diseases and hereditary cancer, and the ethics of genetic manipulation.

3.7 Expectations and plans regarding the future

The respondents were asked about their expectations or insight into plans regarding the number of genetics lessons in their school in the future under a new ministerial order on Danish Bachelor’s Degree Programme in Nursing becoming effective from September 2016. Eight respondents answered that they expected the same number of genetics lessons. Eight said that this was still not clear or that they did not know, and seven respondents expected or knew of their institution planning fewer genetics lessons.

Only three respondents expected or knew of plans regarding an increase in genetics lessons in their school.

3.8 Respondents own opinion about genetics in nursing education

All 24 respondents who answered the questionnaire item regarding their own opinion about genetics in nursing education (two respondents did not answer this item) expressed a positive view, finding it important that genetics was part of nursing education. Several of the respondents said that they thought genetics ought to be given higher priority.

4. DISCUSSION

The response rate of this questionnaire study was 100% and thus the study gives profound insight into the genetics education provided by nursing schools in Denmark as a whole.

Our study reveals notable variation in the number of lessons allocated to genetics across the different Danish nursing schools. No curriculum devoted more than 11 lessons to genetics, 10 schools had five or fewer genetics lessons, and two schools had as few as two lessons allocated to genetics. We find it a matter of concern that some Danish nursing schools devoted very few lessons to a subject that is regarded by international experts as being of great importance to future nursing.^[6, 13, 14]

The respondents' answers regarding the genetics literature curriculum revealed that classic genetics subjects, such as DNA structure, single gene diseases and pedigrees and numerical chromosome abnormalities, were part of the genetics literature curriculum in most schools. However, the two textbooks used by the majority of schools do not cover the subjects in Table 3 in the same detail. Thus, even though 25 schools have, for example, numerical chromosome abnormalities in their genetics literature curriculum, students at these schools are not necessarily taught in the same detail about this subject. As a caveat, it must be noted that some science subjects may be categorised differently by different schools. For example, DNA structure, transcription, and translation might be construed as biochemistry subjects, not genetics subjects, in some schools. Similarly, mitosis and meiosis might be seen as cell biology subjects. Therefore, the absence of specific subjects in the genetics literature curriculum in some schools that we find in our study does not exclude the possibility that these subjects might be covered under other headings, e.g. biochemistry or cell biology.

Several genetics subjects with specific relevance to health-care and nursing, such as cancer genetics, pharmacogenetics, and prenatal and carrier screening for genetic diseases were, on the other hand, only part of the literature curriculum in some schools. For example, pharmacogenetics, a subject of increasing importance in healthcare and nursing,^[31] was only part of the genetics literature curriculum in eight of the 26 Danish nursing schools.

We find this pattern concerning, since it seems to indicate that the genetics curricula in some schools are not tailored specifically to the target group – i.e. nursing students, who will encounter genetics in their future clinical contexts.

Our study does not provide information as to the cause of this apparent widespread lack of clinically relevant genetics subjects. However, factors such as the very limited time allocated to genetics in many schools might be a factor, as might the fact that many of the lecturers teaching genetics are not nurses but biologists, or other professionals with a non-clinical background.

Since there is no common national curriculum, each nursing school must put together its own genetics curriculum. Individual lecturers therefore possibly have a significant influence on the genetics content, with individual interests and preferences affecting their choices to a high degree.

Furthermore, at each of the nursing schools, several lecturers may teach genetics concurrently, and the lecturers may change from one semester to the next. Among the respondents of the present inquiry, we saw a preponderance of

lecturers with a science background (at least 17), a smaller number of lecturers with a nursing degree (at least 5), while a subset of these had a combined educational background of both nursing and natural science degrees (2 lecturers). For a few respondents the educational background is unknown.

Kirk et al. have previously emphasised the importance of lecturers with a nursing background taking an interest in genetics in order for the field to gain a substantial foothold in nursing education.^[8] Our findings may support this line of thought, as it could lead to a genetics curriculum that fits the target group better—that is, a curriculum specifically tailored to the nursing context. Thus, there is a need for cross-disciplinary cooperation and commitment to cover all aspects in future genetics education.

The limited number of genetics lessons seems to leave little room for prioritizing the ethical, legal and social implications (ELSI) of genetic healthcare. In our study, eight schools did not report any ELSI aspects included in genetics teaching at all. Perhaps surprisingly, 18 schools did, to some extent, include such aspects in their genetics teaching, even though only two schools listed such aspects in their literature curriculum.

This seems paradoxical. The Ethical Guidelines for Nursing - Denmark,^[32] established by the Ethical Council for Nursing, particularly emphasize that any relationship between patient and nurse must be based on trust and respect, and notably, that the nurse should “safeguard the patient’s life and integrity in connection with the introduction of new methods and new technologies”. The nurses are taught to navigate in nursing practice according to those ideas. Moreover, there is no doubt that well-educated and IT literate patients of the future will expect nurses to be informed about scientific advances, and minimally, to have insight into the ethical, legal and social issues emerging from genetic healthcare. They will (rightly) expect adequate and person-centred communication and care in relation to these issues.

Our study shows that genetics was formally an exam subject in the majority (17) of Danish nursing schools. However, in all these schools, genetics was part of an integrated exam covering many other subjects, notably larger subjects such as nursing, pathophysiology and anatomy and physiology. In seven of the 17 schools, the respondents' answer to the exam item in the questionnaire indicated that many nursing students are not being tested with regard to their genetics knowledge in the exam, as genetics was only a very minor topic easily overlooked in an exam covering several other major subjects.

For students in seven Danish nursing schools, genetics was

not part of any examination.

This lack of assessment could result in students deprioritising genetics, focusing their study time on other exam relevant topics. The lack of alignment between the assessment on the one hand, and learning objectives and teaching on the other, is likely to have a negative impact on the students' motivation and learning outcomes.^[33] This situation, taken together with the low number of genetics lessons, seems to us untenable in the context of the rapidly increasing relevance of genetics to clinical practice.

The 24 respondents giving their own opinion concerning genetics in nursing education stressed the importance and value of teaching genetics for nursing students, many emphasising that genetics ought to be given a higher priority.

However, there are clearly institutional challenges relating to the implementation of this goal. Several respondents pointed to the fact that they have to reach agreement with the rest of their faculty when deciding on the allocation of lessons to different subjects. In addition, for some of the respondents, cooperation and creating links with scientific areas other than natural science for the purpose of instruction in genetics was described as challenging. Respondents suggested that the complexity of the subject might be the reason for this.

Therefore, even when the specific lecturer teaching genetics finds the subject highly relevant to nurses, the attitude among the faculty as a whole, and the nurse community in general, might hinder adequate implementation of novel insights and progress within the field.

One of the factors influencing the genetics content in nursing education curricula is the readiness of nursing faculty to integrate it.^[3,21] Jenkins and Calzone investigated the readiness among American nursing faculty to integrate genetic content into their curricula.^[34] They found that more than 75% of the questioned faculty members agreed that genetics was likely to become relevant for nursing practice within the next 5 years (an answer given in 2008). Even so, 75% also claimed that they considered it highly unlikely that changes would be made to the nursing curriculum/courses in order to make room for genetics. Less than 5% of the faculty members agreed that preparing nurses to use genetics is an important role of nurse educators and that it was time to start teaching the next generation of nurses about genetics.^[34] Even though the general nursing faculty's attitude towards genetics has not yet been investigated in a Danish context, it would be interesting to examine the attitude in Denmark.

We consider it a strength of the present study that we used open-ended questions in our questionnaire. By using this type of questions, as opposed to closed questions with pre-

defined answer categories, we have been able to capture nuanced information from the respondents, best suiting the objective of our inquiry. Closed questions with predefined answer categories have been used in similar studies from other countries.^[35] One of the drawbacks is the potential for such surveys to suffer from investigator bias and limited prior understanding, as they force respondents to choose from a set of predefined answers that do not necessarily reflect the actual situation experienced by respondents.

On the other hand, answers to open-ended questions can be more difficult to categorise and analyse, as we have experienced in our study, for example, in relation to the question about primary teaching focus, and the integration of ethical, legal and social aspects of genetics. Thus, due to the nature of respondents' answers it was not possible to perform an analysis of theme clustering regarding these questionnaire items.

Furthermore, a number of respondents seem to have misunderstood one of our questions (Question 3). In this question, we explicitly ask about other teaching and learning activities besides lessons. A number of respondents answered this question by describing activities that took place in lessons, but were not traditional lecturing (e.g. case work or watching a film).

There are other limitations to the present study, indicating some risk of information bias. The respondents' insight into their institution's genetics teaching may not reflect the full picture of genetics teaching. Nineteen of the 26 respondents themselves taught genetics as a part of the course in anatomy and physiology. Seven respondents did not teach genetics in the first half year of 2016 and answered on behalf of other lecturers, e.g. external lecturers. Hence, there might be a degree of imprecision in their account. In addition, we cannot rule out the possibility that a genetics component may have been taught in other courses in nursing education, even though genetics is only mentioned in relation to anatomy and physiology in the ministerial order. These could include courses such as pathology (which potentially includes genetic topics such as the genetics of cancer and other common diseases), pharmacology (which could cover pharmacogenetics), public health and ethics.

At eight nursing schools, more than one lecturer taught genetics in the reference period. Therefore, other lecturers could have been relevant respondents, and this might have given rise to different answers to some of the questions, for example questions 8 and 9. Thus, our study has the limitation that it is based on answers from a single lecturer from each school.

In addition, our relatively close contact with respondents (due to the network) may have positively influenced the motivation to participate. This might also have resulted in some degree of social desirability bias.^[36]

Perspectives

In the summer of 2016, the new ministerial order on Danish Bachelor's Degree Programme in Nursing became effective.^[37] In all previous equivalent ministerial orders, from 1957 onwards, genetics has been mentioned as part of the natural science curriculum. In contrast, in the 2016 ministerial order, which is a broad guideline only stating learning objectives, genetics is not mentioned at all. This new omission is paradoxical considering the current revolution in precision medicine and the importance of genetic knowledge in future healthcare.

The consequences of the omission are hard to predict, since Danish nursing schools are still in the process of developing and implementing the new curricula. Some nursing schools may still consider genetics an obvious part of anatomy and physiology, and may even use the development of a new curriculum as an opportunity to prioritise this field in light of the important advances in genetics. Others, on the other hand, may interpret the omission as a sign that the field of genetics is irrelevant to the nursing profession, and may therefore disregard genetics in their future education programme. Many respondents answered that the consequences of the new ministerial order were still unknown, or that they expected minor changes in relation to genetics education. However, seven respondents expected a decrease in the number of genetics lessons, with only three expecting an increase in their school. This finding emphasises the importance of regulatory standards on a national level in providing direction and leadership for schools.^[8]

As part of the future plans for our research we therefore hope

to perform an updated survey on the integration of genetics in the Danish nursing education when the new ministerial order has been fully implemented.

Moreover, we plan to interview practicing nurses, patients and families about their experience of the role of Danish nurses with respect to genetic issues. These interviews will focus on understanding the specific need for genetic competencies in nurses in the Danish healthcare system, now and in the future. Our hope is to contribute to an increasing awareness of genetics, and to initiate discussion about the importance of integrating genetics into the education of Danish nurses.

5. CONCLUSION

Despite the increasing importance of genetics in healthcare and the nursing profession, this study reveals that the integration of genetics in the Danish nursing education is limited at present. Both the extent and the content varies between the nursing schools. Although lecturers find genetics important for nursing students, there are no national regulations ensuring that the education covers genetics to an extent that will prepare nurses adequately for future health care. Our findings support the need for initiatives to ensure that Danish nursing education meets the current and future needs for genomic competencies in nursing.

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CONFLICTS OF INTEREST DISCLOSURE

The authors declare that there is no conflict of interest.

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