

Original Article

Experiences with pre-graduate research among Danish medical students and doctors

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ABSTRACT

INTRODUCTION. Pre-graduate research is popular among medical students. Concerns about time constraints and lack of mentorship have been raised in international studies. The extent to which these issues affect Danish medical students remains unclear. We therefore aimed to assess the conditions and outcomes of pre-graduate research among medical students from the University of Copenhagen.

METHODS. A descriptive, cross-sectional, questionnaire-based survey on experiences from pre-graduate research was distributed to medical students and recently graduated medical doctors from the University of Copenhagen who had engaged in full-time pre-graduate research. The survey covered 1) working hours and income, 2) publications and authorship and 3) work environment and well-being.

RESULTS. A total of 437 pre-graduate researchers participated in the survey. Pre-graduate research often involved a period outside of medical school (88%) and typically lasted a year (56%), with clinical research being the most common focus (68%). Almost a third worked longer hours (29%) than agreed and additional hours were commonly provided after the research period. Scholarships of 10,000 DKK a month were the primary source of income (72%). Most participants achieved their publication goals (62%) and experiences on work environment and well-being were generally positive.

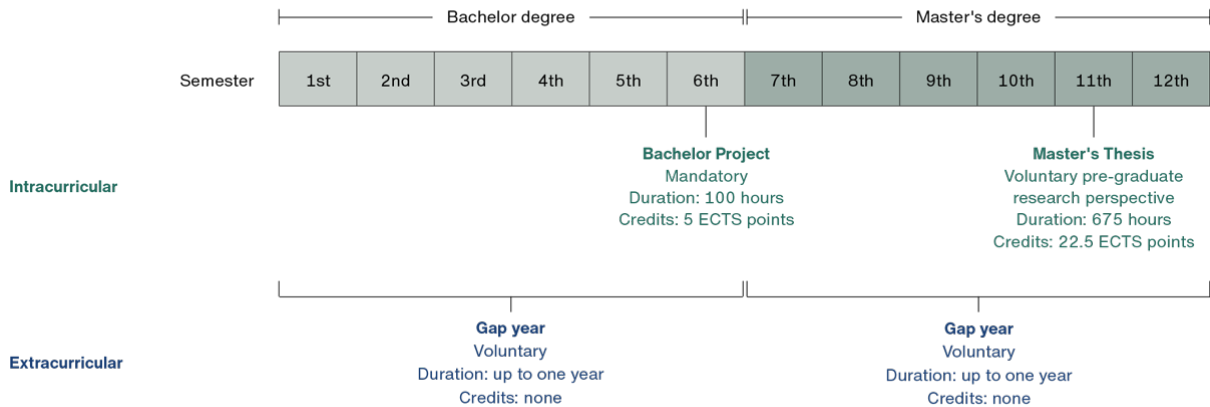
CONCLUSION. Pre-graduate research provides a conducive environment for medical students to engage in scientific research. However, engaging in pre-graduate research entails long working hours, is inadequately remunerated and often requires students to take leave from medical school.

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Studies have shown that introducing medical students to pre-graduate research may cultivate their interest in and likelihood of pursuing an academic career upon graduation [1, 2]. Danish medical schools, including the University of Copenhagen, Denmark, have integrated pre-graduate research into their curriculum (**Figure 1**) and a growing trend is seen among medical students from the university to engage in pre-graduate research (**Supplementary Material**) [3]. Research units and scientific departments share this interest and regularly recruit medical students to join research projects.

FIGURE 1 Pre-graduate research opportunities during medical school at the University of Copenhagen.



ECTS = European Credit Transfer System.

Pre-graduate research typically consists of working full-time on a research project, usually for six or 12 months. This can be done as part of the medical school curriculum and/or by engaging in intercalated employment at a research unit beyond the medical school. Medical students from various other countries have adopted similar research programmes [4, 5]. While pre-graduate research is widely acknowledged as beneficial, concerns have been raised regarding time constraints, high expectations and lack of mentorship [6, 7]. The extent to which these and other potential challenges affect Danish medical students remains unclear. The aim of our study was to evaluate the conditions and outcomes of pre-graduate research among medical students from the University of Copenhagen.

METHODS

Study design

We conducted a descriptive, cross-sectional, questionnaire-based survey on experiences from pre-graduate research. This study adheres to the Consensus-Based Checklist for Reporting of Survey Studies (CROSS) guideline [8].

Data collection methods

The questionnaire was developed based on concerns raised by medical students and conveyed to Panum's Youth Research Association (PUFF), a student-driven organisation dedicated to promoting and facilitating pre-graduate research. The questionnaire comprised 34 questions divided into 1) working hours and income, 2) publications and authorship and 3) working environment and well-being ([Supplementary Material](#)). A response to each question was required to proceed. Representatives from the Association of Danish Medical Students (FADL), PhD students, a clinical professor and an industrial and organisational psychologist reviewed the questionnaire prior to its distribution. Board members of PUFF pretested the final survey.

Sample characteristics

We included current medical students and doctors who graduated from the University of Copenhagen in 2018 or later and have been or are currently engaged in full-time pre-graduate research. The inclusion criteria were used as gatekeeper questions to avoid non-eligible responders. We used a non-probability voluntary sampling method. Sample size was not calculated a priori because of the descriptive nature of the study.

Survey administration and preparation

The survey was administered using SurveyXact [9] in relevant Facebook groups, student and research associations, the medical school paper and through posters at hospitals in Zealand and the Faculty of Health and Medical Sciences, University of Copenhagen. The survey was open for responses between March 2021 and June 2021.

Ethical considerations

Ethics committee or data protection agency approvals were not required. Access to the survey and responses was limited to the authors; DGZ, JAZ and NMH. Participation was voluntary and anonymous. Participants could provide contact information and affiliation for potential follow-up inquiries, with assurance of confidentiality. Consent was obtained before starting the survey, which complied with the General Data Protection Regulation and Danish data protection laws.

Statistical analysis

All responses, including incomplete ones, were included in the analyses. Continuous data were expressed as mean values and categorical data as numbers and/or percentages. Statistical comparisons were made using χ^2 -test statistics, with statistical significance defined as a two-tailed $p < 0.05$. Analyses were performed in SurveyXact and R Studio.

Trial registration: not relevant.

RESULTS

A total of 543 participants participated in our survey. Among these, 437 met the inclusion criteria and 377 completed the entire questionnaire. The University of Copenhagen reported that 903 medical students participated in pre-graduate research during their 11th semester between 2017 and 2021 ([Supplementary Material](#)). Considering medical students who engage in research beyond medical school, we estimated that around 1,200 students met our inclusion criteria. Our survey thus achieved a response rate of 36%.

Here, we present the key findings from our survey, while comprehensive results are available in the [Supplementary Material](#). Participant characteristics are described in [Table 1](#). Reports are based on experiences from research units in nine hospitals and institutions throughout Zealand, covering 25 medical and surgical specialties. Most participants (88%) included an extracurricular period to engage in pre-graduate research. The most popular approach was combining the 11th semester with a six-month leave from medical school (43%) or taking a gap year from medical school (33%). Only 12% conducted research solely as part of medical school curriculum. Pre-graduate research typically lasted a year (56%), or half a year (32%), and 31% of participants completed more than one research programme. The most popular type of research conducted was clinical research (68%), followed by epidemiological or registry-based research (32%), literature study (18%) and basic research (17%). Some students may have engaged in more than one type of research.

TABLE 1 Characteristics of the 437 participants.
The mean age was 27 years.

	n (%)
<i>Gender</i>	
Men	142 (32.5)
Women	294 (67.3)
Other	1 (0.2)
Total	437
<i>Students</i>	
Semester:	
1st	2
5th	2
6th	24
7th	27
8th	22
9th	17
10th	33
11th	88
12th	47
Subtotal	262
<i>Doctors</i>	
Graduation year:	
2018	28
2019	32
2020	74
2021	41
Subtotal	175

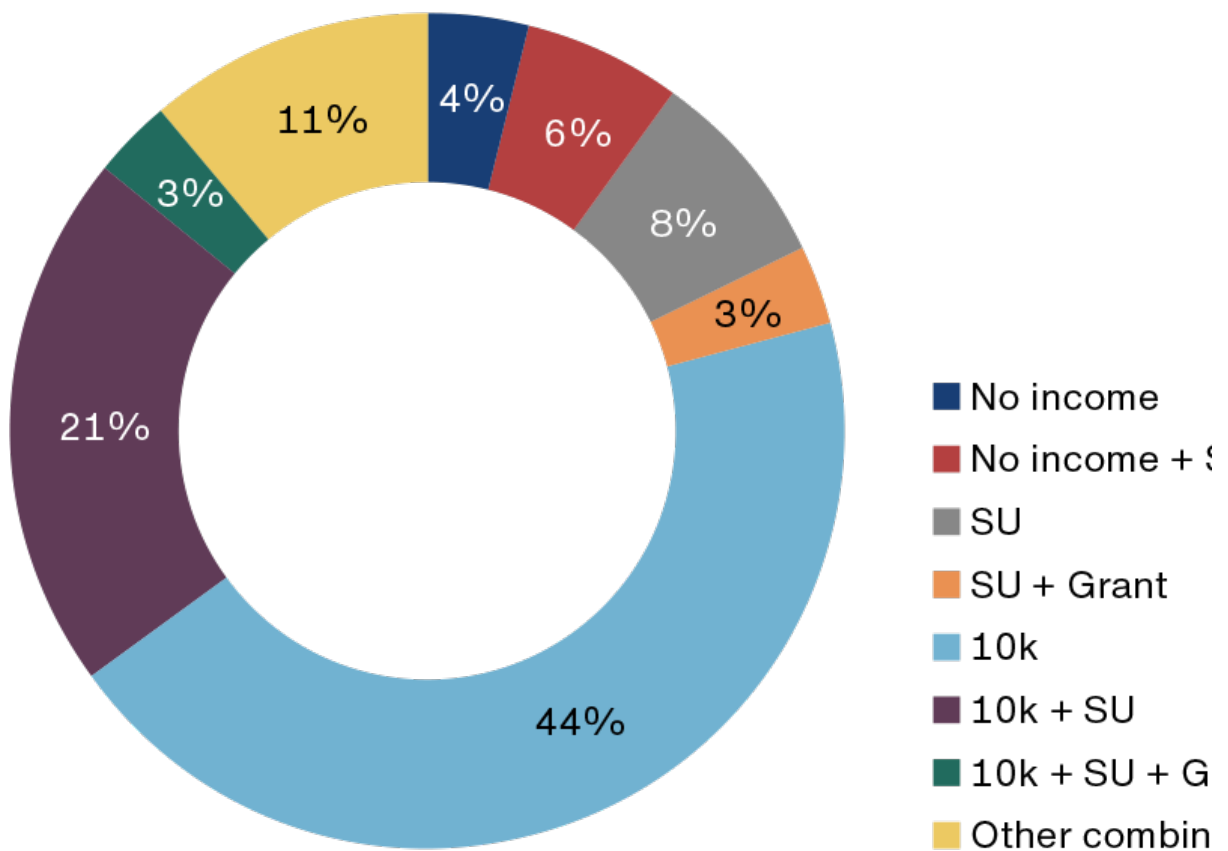
Working hours

While most participants agreed to work an average of 30-40 hours a week, only 54% actually worked within this range, whereas 30% worked more and 17% less. Furthermore, 67% provided *hours of interest*, i.e. working hours with no salary. These constituted 0-5 hours a week for 42%, 5-10 hours a week for 33% and more than ten hours a week for 24%. Among the participants who had contributed *hours of interest*, 55% indicated that this was by their own choice, whereas 33% felt obligated and 13% where required to do so. Of all participants who had completed a pre-graduate research programme, 92% continued to provide *hours of interest* after concluding their programme.

Income

The most common sources of income were scholarships of 10,000 DKK (72%) and the State Educational Grant (SU) (44%), which is a standard grant provided to all university students [10]. **Figure 2** illustrates the most common income source combinations for pre-graduate research. For 47% of the participants, the income during pre-graduate research was adequate for daily living, whereas 37% reported that their income was inadequate. One fourth (25%) found it impossible to supplement their income with other sources such as a part-time job.

FIGURE 2 Most common income source combinations during a research year.



10K = scholarship of 10,000 DKK a month; grant = monthly grant of more than 10,000 DKK; SU = State Educational Grant.

Publications and authorship

An educational plan describing the academic contents of the research programme, such as academic goals, courses and training, was provided by the research unit for 60% of participants, and 87% were able to comply with this plan. Furthermore, 95% of participants made agreements on authorship and publications, with 53% expecting a first authorship, 7% expecting a co-authorship and 34% expecting both a first- and co-authorship.

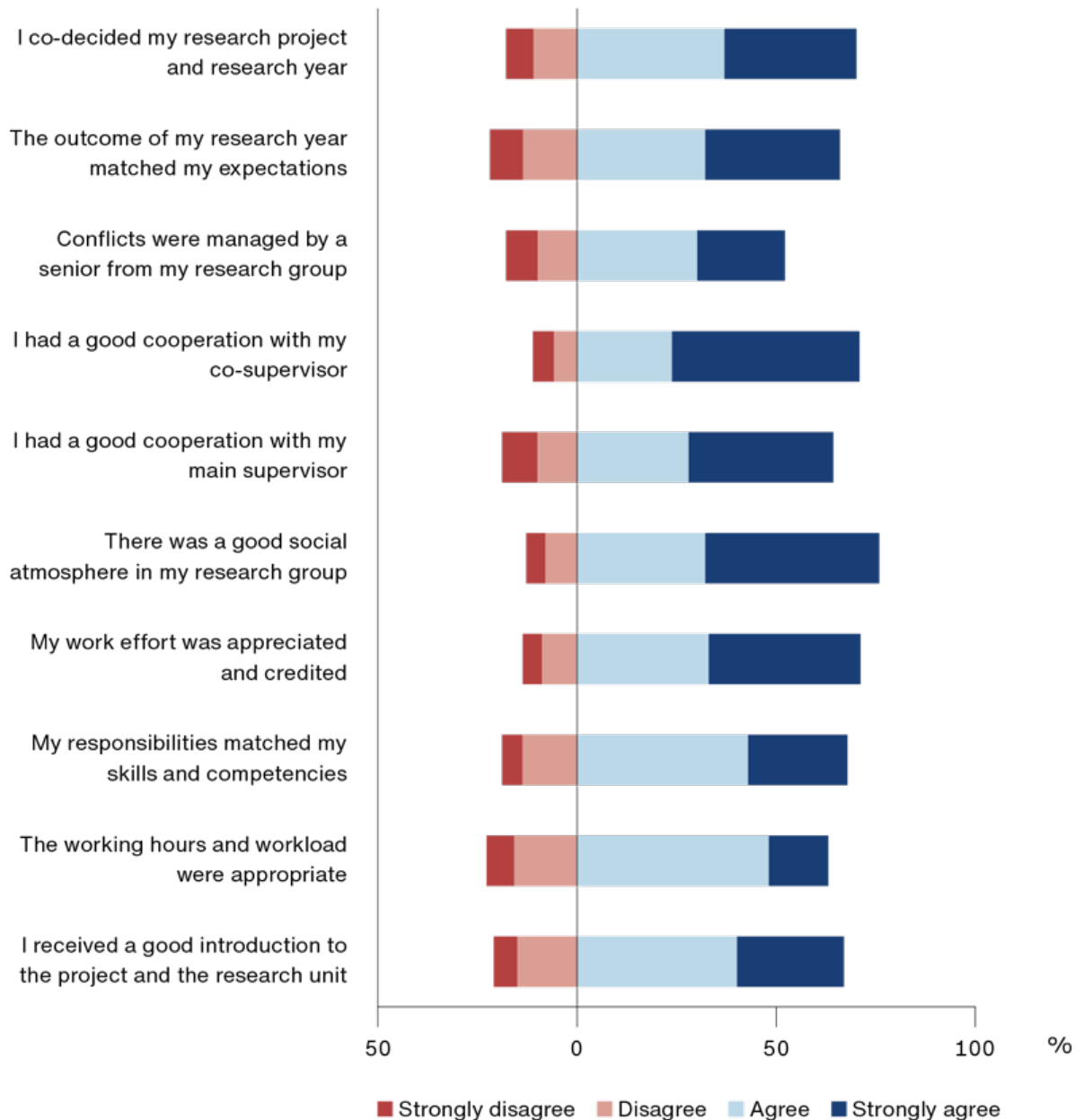
Among participants who had completed their pre-graduate research period, 45% achieved the agreed number of publications, while 33% exceeded it. However, 11% achieved fewer publications than agreed, and 11% achieved

none. Compared to participants who did research for six months, those who engaged in research for a year were more likely to exceed the agreed numbers of publications (32% versus 16%, $p < 0.001$) and less likely to not achieve any publication, although this difference was not statistically significant (15% versus 20%, $p = 0.25$). No apparent association was found between expectations and outcomes. Among those who achieved fewer or no publications, 85% considered this to be unfair. Points of criticism included insufficient supervision, excessive workload and unclear authorship designation.

Working environment and well-being

Reports on work environment and well-being were generally positive (**Figure 3**). Positive aspects included social inclusion, appreciation and credit, and their relationship with the co-supervisor. Negative aspects included lack of introduction to the research unit and project, mismatch between scientific outcome and expectations and workload.

FIGURE 3 Survey results on working environment and well-being.



DISCUSSION

In this cross-sectional survey, we found that pre-graduate research provided a conducive environment for medical students to engage in scientific research and publish their work. Most students committed to a full year of research and received a monthly salary of 10,000 DKK. Those who dedicated a year to research achieved higher scientific output than those who did six months of research. Reports on work environment and well-being were generally positive. Areas that require improvement include workload, onboarding and alignment of expectations.

Our study raises several concerns regarding pre-graduate research among medical students. Many students engage in research beyond the medical school, possibly because opportunities in the medical curriculum are

limited to one semester. Students who opt for longer durations are more likely to achieve publications and first authorships, but also delay the conclusion of their studies [11]. A major concern of doing research beyond medical school is the absence of a designated course manager or director of studies responsible for overseeing the research period. It may be challenging for students to address concerns or issues as their employer is typically a professor within their area of interest.

Many medical students dedicate more than 30-40 weekly hours on average to research and contribute *hours of interest*, indicating a potential strain on time or workload. Students' competencies vary greatly due to different entry points in their academic programmes and research suggests that medical school alone is inadequate for preparing students to conduct research [12]. Therefore, it is essential to have an educational plan and sufficient supervision to ensure an appropriate workload [13]. However, due to the high demand for pre-graduate research, less experienced researchers, such as PhD students or postdocs, may take on supervisory roles without having the skills and expertise needed to provide supervision [14].

Scholarships of 10,000 DKK a month and the SU grants were the primary income sources. However, many scholarships prohibit simultaneous receipt of SU. More than a third of the participants found that their income was insufficient to cover their living costs, and a quarter were unable to supplement income during their research period with a part-time job. These findings, alongside the high workload of pre-graduate research, raise several concerns. Firstly, medical students rely heavily on scholarships of 10,000 DKK per month to support themselves, which is below recommended research position salaries [15]. Secondly, this amount is not adjusted annually through collective agreements between employer organisations and labour unions. With increasing inflation, we expect that more medical students in the future will find a monthly salary of 10,000 DKK to be inadequate to cover daily living costs.

Our study confirmed that pre-graduate research may lead to significant scientific output. The scientific output may be underestimated in our study as it also included students who are currently enrolled or have just recently completed a pre-graduate research programme. One previous study found that undergraduate research students were three times more likely to publish a peer-reviewed article three years after completing a research year than one year after [3].

Despite concerns of high workload and low income, most participants reported a good work environment. However, this study highlights areas that may be improved to secure the well-being of medical students and ensure a positive work environment. We believe that these issues may be resolved by aligning expectations before starting pre-graduate research.

Strengths and limitations

The comprehensive questionnaire used in this study provided an up-to-date reflection of the current conditions of pre-graduate research. The study reflects a diverse range of specialties throughout Zealand, and the anonymous nature of the survey allowed students to provide honest responses. The achieved response rate of 36% is satisfactory for this type of online survey, which typically falls in the 25-30% range [16].

To ensure the anonymity of participants, "multiple participation" was difficult to prevent, and the voluntary nature of the survey poses a risk of selection bias. Furthermore, we used a non-validated questionnaire with potential bias and validity concerns. Future studies should investigate challenges of pre-graduate research from the perspective of research units and supervisors. It would also be relevant to conduct a comparative analysis of satisfaction and scientific output across various structures of pre-graduate research programmes by including other medical schools in Denmark. Study programmes should also explore the motivations of their medical students to engage in pre-graduate research as previous studies have suggested that the primary motivation may be to improve their CV and increase their chances of residency rather than satisfy their curiosity and follow

academic interests [6, 17].

CONCLUSION

Understanding and recognising challenges faced by medical students during pre-graduate research is important to optimise collaboration with research units. This ensures their well-being and enhances interest, motivation, successful completion of research projects and underpins further academic development. In conclusion, most medical students achieve scientific publications after conducting pre-graduate research, although it often requires long working hours and leave from medical school, and remuneration is often inadequate. Despite these challenges, most students report a good work and social environment.

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Supplementary <https://content.ugeskriftet.dk/sites/default/files/2024-01/a09230610-supplementary.pdf>

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