

# Research integrity among PhD students within clinical research at the University of Southern Denmark

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## ABSTRACT

**INTRODUCTION:** Responsible conduct of research is the basis for the credibility of all research. Research misconduct is defined as the fabrication, falsification or plagiarism committed willfully or grossly negligently in the planning, performing or reporting of research. We undertook a survey of knowledge of the attitudes towards and experiences with research misconduct among PhD students in clinical research.

**METHODS:** A questionnaire previously used in Swedish and Norwegian studies was distributed to PhD students (n = 330) affiliated with the Department of Clinical Research or Department of Regional Health Research, University of Southern Denmark.

**RESULTS:** A total of 165 PhD students completed the questionnaire in full or in part, yielding an overall response rate of 50%. 18-34% reported to have heard (within the past year) about researchers who had plagiarised, falsified or fabricated data, or plagiarised publications. None reported this to occur in their own department. Few stated that they had felt under pressure to either falsify data (1%) or present results in a misleading way (3%). However, 22% stated to have felt an unethical pressure (within the past year) regarding the inclusion or order of authors.

**CONCLUSIONS:** Results indicate that, albeit at a low frequency, research misconduct involving PhD students is taking place. Likewise, a high fraction of respondents reported to have been under pressure regarding authorships, which points to questionable research practices in clinical research.

**FUNDING:** not relevant.

**TRIAL REGISTRATION:** not relevant.

Responsible conduct of research (RCR) is the basis for the credibility of all research being carried out. Research misconduct is most often defined as falsification, fabrication or plagiarism [1, 2]. A recent report from an expert committee on the Danish system that handles research misconduct produced a number of recommendations for changes [3]. Among these changes, a revision was recommended for the definition of research misconduct so that it resembles the American definition.

The amendment of the Danish act on research misconduct came into force on July 1, 2017 [4]. The Danish definition of research misconduct is now (English trans-

lation from The Danish Ministry of Higher Education and Science): "Fabrication, falsification, and plagiarism which has been committed willfully or with gross negligence in planning, performing, or reporting of research. Fabrication: Undisclosed construction of data or substitution with fictitious data. Falsification: Manipulation of research material, equipment or process as well as changing or omitting data or results making the research misleading. Plagiarism: Appropriation of others' ideas, processes, results, texts or specific terms without rightful crediting" [5].

The law defines the grey zone between research misconduct and RCR, also referred to as questionable research practice (QRP), as: "Breaches of current standards on RCR, including those of the Danish code of conduct, and other applicable institutional, national and international practices and guidelines on research integrity" [5].

The true frequency of research misconduct may be very difficult to estimate. Meta-analyses of survey data report that a pooled weighted average of 1.97% of researchers admitted to having fabricated or falsified data or results at least once [6], and a pooled estimate of 1.7% reported having committed plagiarism [7]. QRP seems to occur much more frequently with up to 33.7% admitting to having engaged in such practices [6].

Early career researchers have a crucial role in forming future research environments. Several survey studies of medical PhD students' knowledge, attitude and experiences related to research integrity have been carried out in recent years in Norway and Sweden [8-11]. Similar insights have not yet been obtained in Denmark. The Faculty of Health at University of Denmark (SDU) introduced a mandatory course in RCR for PhD students in 2014. The course was introduced to educate young researchers in responsible research and thereby mitigate potential research ethical conflicts. We therefore undertook a survey of knowledge of, attitudes to and experiences with research misconduct among PhD students within the field of clinical research at SDU.

## METHODS

The questionnaire combined questionnaires initially developed in Sweden [8] and the USA [12], and previously used in Swedish and Norwegian studies [9-11]. The pa-

## ORIGINAL ARTICLE

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Dan Med J  
2018;65(4):A5469

 TABLE 1

Background characteristics of respondents. The values are n (%).

<b>Master's degree programme</b>	
Denmark	155 (93.9)
Elsewhere	10 (6.1)
<b>Gender</b>	
Male	48 (29.1)
Female	117 (70.9)
<b>Research area</b>	
Clinical research	133 (80.6)
Basic research in the life sciences	14 (8.5)
Other	18 (10.9)
<b>Time enrolled as a PhD student</b>	
< 1 yr	47 (28.5)
1-2 yrs	53 (32.1)
> 2 yrs	65 (39.4)
<b>Previously attended courses in science ethics as part of graduate or undergraduate programme</b>	
Yes	102 (61.8)
No	34 (20.6)
Do not recall	29 (17.6)

 TABLE 2

Knowledge on international, national and local prevalence of research misconduct and department policies.

Question	n (%) <sup>a</sup>
<i>Have you nationally or internationally heard about anyone who during the past 12 mo.s has</i>	
Fabricated data?	34 (21.0)
Falsified data?	28 (17.3)
Plagiarised data?	18 (11.1)
Plagiarised publications, in whole or in part?	33 (20.4)
<i>Do you know anyone in your department who during the last 12 mo.s has</i>	
Fabricated data?	0
Falsified data?	0
Plagiarised data?	0
Plagiarised publications, in whole or in part?	0
Presented results in some other misleading way?	0
<i>Does your department have a written policy about</i>	
Application for funds?	37 (23.6)
Use of funds?	55 (35.0)
Changes in design/method?	13 (8.3)
Changes in results?	18 (11.5)
Fabrication of data?	28 (17.8)
Falsification of data?	29 (18.5)
Handling of scientific authorship?	30 (19.1)
Plagiarism?	29 (18.5)
Duplicate publication?	17 (10.8)

a) The frequencies refer to respondents who answered "Yes" to the stated questions. Other response options were: "No" or "I am uncertain".

ated with either of the two clinical departments at the Faculty of Health Sciences, SDU (as of 30 May 2017; n = 330). In order to obtain the most valid picture of the present state of knowledge, attitudes and practices among the PhD students, we included all PhD students in the study, and not just newly enrolled PhD students.

An invitation to participate, along with a link to the questionnaire, was sent out by e-mail on 2 June 2017, with two weeks for completion. Two follow-up e-mails were sent to non-respondents. A recommendation to participate was also included in department staff newsletters.

Participation was voluntary. The mail invitation informed recipients that data from the survey would only be processed statistically and would not be traced back to individuals. According to Danish law, questionnaire surveys are not recorded with the Health Research Ethics Committee.

Results are presented based on descriptive statistics. Chi-squared tests were used on categorical variables to identify any dependence between background variables and responses. For continuous variables, t tests were applied. 5% was used as the significance level.

*Trial registration:* not relevant.

## RESULTS

A total of 329 PhD students successfully received the invitation to participate. In all, 165 completed the questionnaire in full or in part, yielding an overall response rate of 50% (similar response rates within each of the participating departments: 50% and 51%). **Table 1** presents the characteristics of the respondents, the majority holding a master's degree from Denmark, being female and doing clinical research. Length of enrolment shows an equal division between first-, second-, and third-year PhD students. This is in line with current enrolment. Likewise, the gender split of the data does not give rise to specific concerns (63% of the PhD students enrolled at the Faculty of Health Sciences are female [13]).

The PhD students' knowledge of research misconduct practices is summarised in **Table 2**. Attitudes towards research misconduct are shown in **Table 3**. Experiences with research misconduct are summarised in **Table 4**. Results show that many PhD students have heard about research misconduct behaviour (Table 2): 18-34% report to have heard, within the past year, about researchers who have plagiarised, falsified or fabricated data, or plagiarised publications. No one reports this to occur in their own department. The knowledge of written department policies is limited (Table 2). The highest knowledge levels occur for policies regarding

per-based, English questionnaire was converted into an online, electronic questionnaire (SurveyXact), with a few linguistic adaptations to enhance comprehension. The questionnaire was distributed to all PhD students affili-

application for funds or use of funds (24% and 35%). Overall, however, large proportions reply "I am uncertain" to the questions worded "Does your department have a written policy about ..." (40-57%).

Nearly all find it unacceptable to report experimental data without actually having conducted the experiment, or to alter such data to improve the significance of experimental results (94-99%) (Table 3). Likewise, taking credit for the words, writing, data or ideas generated by someone else is considered unacceptable (97-99%), as is falsifying or fabricating data to speed up publication (97%). The large majority also finds it inappropriate to selectively omit contradictory results (90%) or to try out different methods of analysis until a statistically significant result is found (84%).

Apparently, writing grant publications is regarded a different business, not subject to exactly the same behavioural norms as research; only about half of the respondents regard it as important to report data as truthfully in a grant application as in a publication.

Most agree to having an ethical obligation to act if they discover that someone is committing research misconduct (88%). Slightly fewer would be willing to act personally by reporting for instance a co-worker or a supervisor (71-74%). Slightly less than half (46%) think that co-authors must equally share the blame if a publication is produced on fabricated data, but only about one in five (23%) think that all co-authors should receive the same punishment.

Results show small but statistically significant differences in responses based on gender. Female PhD students agreed significantly more to it being inappropriate to alter experimental data ( $p = 0.045$ ), or to take credit for the words or writings of others ( $p = 0.026$ ), or for their ideas ( $p = 0.028$ ). Likewise, female PhD students agreed more that all must equally share the blame and punishment if fabricated data are discovered in a paper ( $p = 0.019$  and  $p = 0.02$ ).

None of the participating PhD students have – or admit to having – committed research misconduct themselves in terms of fabricating, falsifying or plagiarising data, or plagiarising publications (Table 4). A few state that they have felt under pressure to either falsify data (1%) or present results in a misleading way (3%). The real pressure on the PhD students concerns authorships: One in five (22%) state having felt an unethical pressure (within the past 12 months), when it comes to either the inclusion or the order of authors. One in ten replies 'I am uncertain' to this item (10%, as opposed to 1-3% in remaining questions in the section): thus, a total of 32% think they may have been under unethical pressure regarding the inclusion or order of authors. Perceptions of unethical pressure regarding design/method, analysis and results also exist, but are not

TABLE 3

Attitudes to research misconduct and responsibilities<sup>a</sup>.

Statement	n (%) <sup>a</sup>
<i>It is never appropriate to</i>	
Report experimental data without actually having conducted the experiment	144 (94.1)
Alter experimental data to make an experiment look better than it actual was	151 (98.7)
Try different methods of analysis until a statistically significant result is found	129 (84.3)
Take credit for the words or writing of someone else	151 (98.7)
Take credit for the data generated by someone else	148 (96.7)
Take credit for the ideas generated by someone else	148 (96.7)
<i>If you are confident of your findings, it is acceptable to</i>	
Selectively omit contradictory results to expedite publication	3 (2.7)
Falsify or fabricate data to expedite publication	3 (2.7)
It is more important that data are reported completely truthfully in a publication than a grant application	82 (53.6)
<i>If you have witnessed</i>	
Someone committing research misconduct, you have an ethical obligation to act	135 (88.2)
A co-worker or peer committing research misconduct, you would be willing to report the misconduct	114 (74.5)
A supervisor or principal investigator committing research misconduct, you would be willing to report the misconduct	109 (71.2)
<i>If fabricated data are discovered in a published paper, all co-authors must</i>	
Equally share the blame	70 (45.7)
Get the same punishment	35 (22.9)

a) The frequencies refer to respondents who answered "Agree" or "Strongly agree" to the stated questions. Responses were given on a 5-point Likert scale.

TABLE 4

Experiences with research misconduct.

Question	n (%) <sup>a</sup>
<i>Have you yourself during the last 12 mo.s ever</i>	
Fabricated data?	0
Falsified data?	0
Plagiarised data?	0
Plagiarised publications, in whole or in part?	0
Presented results in some other misleading way?	0
<i>Have you yourself during the last 12 mo.s been the object of pressure to</i>	
Fabricate data?	0
Falsify data?	1 (0.6)
Plagiarise data?	0
Plagiarise publications, in whole or in part?	0
Present results in some other misleading way?	4 (2.5)
<i>Have you during the last 12 mo.s been exposed to unethical pressure concerning</i>	
Inclusion or order of authors?	35 (22.2)
Design/method?	7 (4.4)
Analysis?	3 (1.9)
Results?	3 (1.9)
<i>Have you during the last 12 mo.s been affected by any consequences of research misconduct</i>	
Ethical?	2 (1.3)
Legal?	1 (0.6)
Methodological?	1 (0.6)
Other aspects?	1 (0.6)

a) The frequencies refer to respondents who answered "Yes" to the stated questions.

nearly as prevalent (2-4%). In summary, only very few state that they have been affected by the consequences of research misconduct (1%).

Results show perceived pressure concerning authorships to differ with length of enrolment ( $p = 0.039$ ). Among third year PhD students, 30% state to have been under pressure with regard to inclusion or order of authors, compared to only 16% and 19% among first and second year PhD students.

## DISCUSSION

None of the respondents reported having fabricated, falsified or plagiarised data or publications (Table 4), or knew of anyone in their department who had done so (Table 2). Pressure to falsify data or present data in a misleading way was reported by a small number of respondents (Table 4), indicating that albeit it seems to occur at a low frequency, research misconduct involving PhD students is taking place.

Most were aware of their ethical obligation to act on research misconduct actions of others, but showed limited willingness to actually take action if a co-worker or supervisor commits research misconduct (Table 3). This may be explained by the unequal power relationship between the PhD student and his or her supervisor, which may keep some from such an overt act as reporting. Furthermore, misconduct may involve the PhD student personally, for instance through co-authoring of a flawed publication.

Interestingly, less than half agreed that co-authors should equally share the blame if a publication is produced on fabricated data and even fewer (23%; Table 3) agreed that all co-authors should get the same punishment. This indicates that co-authoring is not equated with equal responsibility. This is in line with the authorship guidelines of The Danish Code of Conduct for Research Integrity [14]. Inspired by the internationally acknowledged and commonly used authorship guidelines by The International Committee of Medical Journal Editors (ICMJE; the Vancouver guidelines) [15], these guidelines state that all authors are responsible for the content of the publication. The Danish guidelines do, however, also state that the responsibility should be assessed with due account of area of expertise, level of experience and seniority (as well as other relevant factors).

A disturbing 22% of respondents state that they have been exposed to unethical pressure concerning authorships (Table 4). Who is allocated authorships and the position in the author list of a publication is crucial to researchers, and reflects the intensely competitive environment of much medical research where being first author and being an author of many publications meet the current reward mechanisms in research (money and recognition). Perceived unethical pressure may also be

due to poor matching of expectations regarding contributions prior to a research project; neither the Danish Code of Conduct for Research Integrity nor the ICMJE guidelines for authorship include specific descriptions or instructions for the ordering of authors on research publications [14, 15].

The perceived pressure on authorships is considerably higher than in the studies conducted in Sweden and Norway where the same questionnaire was used [8-11]. The studies are not completely comparable though: While we have included all enrolled PhD students in the study population, the studies in Sweden and Norway covered only newly enrolled PhD students. Social pressure regarding authorships is likely to be higher in later phases of the PhD process, which is when the PhD student typically starts to more actively publish.

Knowledge of existing written department policies on research misconduct and QRP was limited (Table 2). This indicates that written department policies are somewhat invisible, at least to PhD students. Department policies may also be unknown or invisible to the supervisors and other senior researchers who interact and collaborate with the PhD students. This may contribute to the pressure regarding authorship perceived by the PhD students, as well as to other uncertainties.

The small study population is a limitation since the study is based on PhD students enrolled in only one of the Danish universities. The question is, however, how generalisable our study results actually are? Larger studies are needed to clarify if our findings – such as the high fraction perceiving unethical pressure on authorships – reveal a common picture among PhD students in Danish research. Another limitation may be in the individual's understanding of the questionnaire items. Here, we have been very cautious to present definitions in the clearest way possible. We cannot exclude, though, from the existing questionnaire, that the identified gender differences are rooted in a possible response bias (towards agreeing more with items) since the statements of the original questionnaire are generally not reversely formulated.

## CONCLUSIONS

The study indicates that research misconduct and QRP involving PhD students are taking place in Danish research, the main issue being related to authorships.

As a means to limit research misconduct and QRP, the next generation of researchers at least needs to be able to perform research on good grounding. Methodological courses and institutional courses on RCR for PhD students may be a useful tool to this end. Likewise, clear, visible and operable institutional policies will support researchers not wanting to act in wrongful ways. Furthermore, we recommend that opportunities for

open ethical dialogue among staff be provided to foster healthy research environments and strengthen researchers' abilities to deal in responsible ways with the dilemmas and grey zones that may occur in research projects, despite regulations and written guidelines.

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**ACCEPTED:** 2 February 2018

**CONFLICTS OF INTEREST:** none. Disclosure forms provided by the authors are available with the full text of this article at [www.danmedj.dk](http://www.danmedj.dk).

**ACKNOWLEDGEMENTS:** Thanks to *Bjørn Hofmann*, Norwegian University of Science and Technology, and *Søren Holm*, University of Manchester and University of Oslo, for sharing their questionnaire, and for kindly answering questions relating to the survey.

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