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Title Page

Disciplined doctors: does the sex of a doctor matter?

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Abstract

Objectives: To examine the association between doctors' sex and receiving sanctions on their medical registration, whilst controlling for other potentially confounding variables.

Design: Cross-sectional study.

Setting: The General Medical Council's (GMC) List of Registered Medical Practitioners (LRMP) database of doctors practising in the United Kingdom (UK).

Population: All doctors on the GMC's LRMP on 29th May 2013. The database included all doctors who are or have been registered to practice medicine in the UK since October 2005. The exposure of interest was doctor's sex. Confounding variables included years since primary medical qualification, world region of primary medical qualification and specialty.

Outcome measures: Sanctions on a doctor's medical registration. Sanction types included warning, undertakings, conditions, suspension or erasure from the register. Binary logistic regression modelling, controlling for the confounders, described the association between doctor's sex and sanctions on a doctor's medical registration.

Results: Of the 329,542 doctors on the LRMP, 2,697 doctors (0.8%) had sanctions against their registration, 516 (19.1%) of whom were female. In the fully adjusted model, female doctors had nearly a third of the odds (OR 0.37, 95% CI: 0.33-0.41) of having sanctions compared to male doctors. There was evidence that the association varies with specialty, with female doctors who had specialised as GPs being the least likely to receive sanctions compared to their male colleagues.

Conclusions: Female doctors have reduced odds of receiving sanctions on their medical registration when compared to their male colleagues. This association remained after adjustment for the confounding factors. These results are representative of all doctors registered to practice in the UK. Further exploration of why doctors' sex may impact their professional performance is underway.

Article summary

Strengths and limitations of this study

- We used a large national database with no missing data, so the findings of the study apply to all doctors registered to practise in the UK.
- Receiving sanctions is a rare outcome and using a large dataset is crucial when examining rare outcomes.
- This is one of the first studies of this nature on UK data that adjusted for known confounders.
- The study was constrained by the variables collected and made available by the GMC. So we were unable to examine the effect of other potential confounding factors.
- The data available did not provide the reasons for why a sanction had been imposed, nor data on those granted voluntary erasure. A more detailed evaluation of the reasons for referral to the GMC may go towards explaining the sex difference observed.

Introduction

The number of complaints about doctors' fitness to practise received by the UK medical regulatory body, the General Medical Council (GMC), has been increasing since 2007[1]. Following a triage and investigation process by the GMC the outcome of a case against a doctor can be closed, or can result in a sanction against the doctor's registration. The cost of this regulatory process, both in terms of financial cost of the actual complaints investigation procedure, but also in terms of the loss of the medical workforce during the process, can be significant. The level of stress that a doctor endures while undergoing a fitness to practise investigation was recently reported in the BMJ and highlights the impact the complaints investigation procedure can have on the mental well being of doctors[2].

One of the most significant changes in the medical profession has been the increase in the number of women entering this previously male dominated profession. The number of female medical students has been increasing since the mid-1960s with female medical students outnumbering male medical students since the mid-1990s[3]. It is predicted that female doctors will outnumber their male colleagues by 2017[3]. This change in the demographic profile of UK doctors has brought with it a heightened interest in how the increase of female doctors may impact the profession.

Examining and understanding the predictors of doctors receiving sanctions may aid the medical profession in identifying doctors whose performance might raise future concerns, in order to support these doctors and help prevent GMC referral. Research from the United States of America has suggested that male and female doctors differ in terms of risk of disciplinary action, with male doctors being at increased risk[4,5,6,7,8]. However, the applicability of the findings from these American studies to the UK may be limited due to differences in both the medical and legal systems in these countries. In 2011 Wakeford explored the situation in the UK[9]. He examined the factors associated with severest outcomes of the GMC disciplinary procedures, suspension or erasure from the medical register. In agreement with the American studies, he demonstrated that female doctors were four times less likely to be disciplined when compared to male doctors. However, the interpretation of this finding is limited because the measure of effect for doctors' sex was not adjusted for potential confounders.

We aimed to examine the effect of doctors' sex on receiving sanctions against their medical registration, while adjusting for known confounding factors. This would allow

for a meaningful comparison of male and female doctors and their experience of disciplinary action in the UK.

Methods

Study design, setting and source of data

We conducted a cross-sectional study using UK-wide data. The data were obtained from the GMC. Under the Medical Act 1983 the GMC is required to keep up-to-date registers of qualified doctors. The main register is the List of Registered Medical Practitioners (LRMP). The LRMP is a list of all doctors registered to practise medicine in the UK, and as such changes daily. The GMC provided us with a snapshot of doctors registered on the LRMP on the 29th May 2013. The list included doctors who have been registered with the GMC at any point in the period 20th October 2005[a] – 28th May 2013. The different categories of registration status included: provisionally registered with a licence; provisionally registered without a licence; registered with a licence; registered without a licence; suspended; not registered – administrative reason; not registered – deceased; not registered – erased after Fitness to Practise panel hearing; and not registered – having relinquished registration. The database provided details of doctor's sex; the year, country, and institutions of the doctor's primary medical qualification; date of entry on the GP and/or Specialist registers (when they complete specialty training and qualify as a specialist); and the doctor's current registration status, including whether they currently had any sanctions on their medical registration (see below for details).

Population

All doctors who were listed on the LRMP on the 29th May 2013 were included.

Primary outcome and exposure

The outcome of interest was sanctions on a doctor's medical registration on the 29th May 2013.

The types of sanctions included:

- **Warning:** issued when a doctor's performance has not been in keeping with the principles set by the GMC for doctors, but a restriction on the doctor's registration is not necessary. Warnings remain on the LRMP for a five year period;

[a] The 20th October 2005 was the date when the GMC first began to publish full details of a doctor's registration status on the LRMP online.

- **Undertakings:** an agreement between the GMC and the doctor about the doctor's future practice. The doctor must adhere to these undertakings to maintain their registration;
- **Conditions:** set out by the GMC and restrict a doctor's practice. The doctor must comply with these conditions to maintain their registration. Conditions can initially be imposed for a maximum of three years and then be renewed in periods of up to 36 months;
- **Suspension or erasure:** the doctor's licence is withdrawn by the GMC and they are no longer able to practise. Suspension from the register can last up to 12 months, but may be indefinite in certain circumstances.

A sanction can be imposed if a doctor's fitness to practise has been proved to be impaired. The impairment can result from misconduct; poor professional performance; physical or mental ill health; or a conviction or fitness to practise determination by another regulatory body either in the UK or overseas[10]. However it is recognised that the reason for impairment can cross more than one category (for example a doctor with a drug misuse problem could be classified as having mental ill health, yet the effects of the drug abuse could impact their professional performance). The duration of a sanction on a doctor's registration varies and it is possible for doctors to have more than one sanction against their registration and this typically represents the outcomes of different complaints. It was not possible to establish the date a sanction was imposed from the available data.

The outcome of interest was collapsed into a binary variable: doctors with sanctions against their registration; and doctors with no sanctions against their registration.

The exposure of interest was doctor's sex, as declared by the doctor to the GMC.

Selection of variables

The variables included in the study were selected before any statistical analysis. Data was available on the year of primary medical qualification (PMQ), country of PMQ and primary specialty, if on the Specialist or General Practitioner (GP) Registers. These variables were selected as a priori confounders based on findings from earlier research[6,7,9,11], which demonstrated that these factors may influence the risk of receiving sanctions.

Once the variables had been selected, we performed a variable reduction process, to reduce the number categories into meaningful categories. Once again, this was

performed before any statistical analysis. The variable 'year of PMQ' was converted into 'number of years since qualification' by subtracting the year of PMQ from 2013 [b]. We then collapsed the variable into six categories. The first category '0-2 years' represented Foundation Training, the second category '3-10 years' represented the bulk of time a doctor would likely spend in Specialty Training. The subsequent categories were divided into 10-year blocks. The variable 'country of PMQ' was collapsed into three categories; 'UK', 'EEA' (European Economic Area) and 'International'. The list of countries included in the EEA category was obtained from the European Union website[12] and included all countries that were members before May 2013. The variable 'specialty' was divided into fourteen categories. Doctors who were not present on either the Specialist Register or the GP Register were categorised as having 'no specialty'. Doctors on both the Specialist Register and the GP Register were recorded as having 'dual specialty' and doctors only on the GP register were categorised as 'GP'. For doctors only registered on the Specialist Register, their primary specialty was taken and recorded into one of eleven categories. To categorise those doctors on the Specialist Register two researchers (EU and CW) independently allocated each primary specialty to a specialty category. Kappa statistic demonstrated a good level of agreement (kappa = 0.72). Any disagreements about specialty category allocation were resolved through discussion.

Statistical methods

We took a causal modelling analysis approach to analyse the data. We firstly performed bivariate analyses to look for crude associations in the data, followed by Mantel-Haenszel analyses, before going on to complete multivariate analyses using binary logistic regression modelling. The initial logistic regression model included only the exposure (sex) and outcome (sanctions) variables to provide a crude measure of effect. The final logistic regression model was built to include all potential confounder variables, while checking for multicollinearity. The final logistic regression model enabled the calculation of an adjusted measure of effect. The final model was assessed for the presence of effect modifiers following the findings from the Mantel-Haenszel analyses.

Statistical analyses were conducted using the software Stata 12/SE.

[b] As mentioned above, a doctor could appear in the LRMP dataset if they had been removed from the medical register. The actual date of those doctors being removed could lie anytime between 20th October 2005 and 28th May 2013. However, as no actual removal dates were given for those doctors, we used 2013 for all doctors.

We used the STROBE Statement[13] to guide our study report.

Results

There were 329,542 doctors on the LRMP on the 29th May 2013, of whom 40.3% were female. Table 1 shows the distribution of variables by the sex of doctors. The median number of years since qualification was 19 years. The distribution of the number of years since a doctor had qualified was skewed to the right with the majority of the doctors qualifying 11-20 years ago (28.1%). The majority of the doctors had received their PMQ from a UK medical school (59.3%).

Approximately half of all the doctors were neither on the GP Register nor the Specialist Register (51.0%), of which the majority (58.0%) had received their PMQ greater than 10 years previously. Of those doctors who had specialised, General Practice was the most popular specialty (21.3%), followed by Medicine (6.6%). 0.5% of the doctors were on both the Specialist and GP Registers.

2697 (0.8%) doctors had sanctions against their registration on the 29th May 2013. There was a higher proportion of male doctors who had sanctions against their registration when compared to female doctors (1.1% of all male doctors compared with 0.4% of all female doctors, X^2=505.4, P<0.001). There was strong evidence for an association between receiving sanctions and the number of years since received PMQ, with doctors who qualified 31-40 years ago having the highest proportion of sanctions; world region of PMQ, with doctors who qualified outside the EEA with the highest proportion of doctors with sanctions; and specialty, with doctors on both the Specialist and GP Registers having the highest proportion of doctors with sanctions. These results are presented in Table 2.

Using bivariate analyses we compared female doctors to male doctors. There was a strong trend between sex of a doctor and the number of years since the doctor received their PMQ, with female doctors being more likely to have recently qualified and the proportion of female doctors reducing as the number of years since PMQ increased. We also found that female doctors were more likely to have qualified in the UK (65.5% of all female doctors compared to 55.0% of all male doctors) and male doctors were more likely to have qualified outside of the EEA (32.1% of all male doctors compared to 22.5% of all female doctors). Approximately equal proportions of male and female doctors qualified in the EEA (12.9% and 12.0% respectively). Both sexes were more likely to not to be registered in a specialty (GP or hospital), though there was a slightly higher proportion of women when compared to men who

were not on the Specialist or GP Registers. When examining those doctors who were registered in a specialty, a higher proportion of female doctors were on the GP Register compared to male doctors (24.3% of female doctors compared with 19.3% of male doctors) and a higher proportion of male doctors were registered with a hospital specialty (32.0% of male doctors compared with 20.1% of female doctors).

In summary, number of years since received PMQ, world region where PMQ was received, and registered specialty were associated with both the outcome (sanctions) and the exposure (sex of a doctor) and as such we considered these variables as confounders.

The unadjusted odds ratio for having sanctions against a doctor's registration comparing female doctors with male doctors was 0.35 (95% CI: 0.32-0.38), suggesting that being a female doctor is protective of receiving sanctions.

Mantel-Haenszel analyses and tests of homogeneity were conducted to examine the change in the strength of the association between sanctions and sex while controlling for each of the confounders separately.

There was strong evidence that the true odds ratios were different between the different specialty categories (P=0.0002), therefore specialty was considered as an effect modifier when conducting multivariate analyses.

Table 3 represents the results from the binary logistic regression model built to adjust for all the variables. After taking into account the number of years since PMQ, world region where the doctor received their PMQ and specialty, female doctors had nearly a third of the odds of having sanctions on their registration compared to male doctors (OR 0.37, 95% CI: 0.33-0.41, P<0.0001).

All of the a priori confounders were felt to be confounders because the adjusted odds ratio changed when each variable was added to the model. We found no evidence of multicollinearity.

The Mantel-Haenszel analyses suggested that specialty may be an effect modifier, we therefore performed a statistical test for effect modification by firstly collapsing the specialty variable into four groups to increase the power of the test. Table 4 demonstrates that specialty was felt to be an important effect modifier with female doctors being less likely to receive sanctions when compared to male doctors, but the effect was greater for GPs than for those doctors with no specialty or practising a hospital specialty.

Upon discovering the strong evidence for an association between doctor's sex and likelihood of receiving sanctions on a doctor's registration, we decided to further the findings by performing post-hoc analyses to establish whether the type of sanction imposed on a doctor's registration was associated with doctor's sex. All variables were categorised to create binary variables to ensure there were sufficient cases in each category of variable. The results displayed in Table 5 demonstrate that female doctors have reduced odds of having each type of sanction imposed on their registration when compared to their male colleagues. Female doctors had approximately one third of the odds of receiving a warning, being suspended or erased from the register and they had just over half the odds of receiving undertakings or conditions on their registration compared to male doctors. The Mantel-Haenszel analyses suggested that when examining the outcome 'warning' specialty may be an effect modifier, and when examining the outcome 'erased' world region where received PMQ may be an effect modifier, we therefore performed a statistical test for effect modification. Specialty was demonstrated to be an important effect modifier when examining the association between warning and sex, with female specialists having approximately half the odds of receiving a warning compared to male specialists, whereas for male and female doctors without a specialty there was no strong evidence for a difference in the odds of receiving a warning (see Table 6). World region where a doctor received their PMQ was also shown to be an important effect modifier when examining the association between erasure and sex. Female doctors who had received their PMQ in the UK had approximately one fifth of the odds of being erased, whereas female doctors who received their PMQ outside of the UK had approximately one third of the odds of being erased when compared to their male colleagues (see Table 7).

Discussion

In our large cross-sectional study we found strong evidence that being female was associated with a reduction in odds of receiving sanctions (OR 0.35, 95% CI: 0.32-0.38) in the unadjusted model. Controlling for years since PMQ, world region where received PMQ, and specialty did slightly increase this odds ratio (OR 0.37, 95% CI: 0.33-0.41, P<0.0001), but there remained strong evidence for the association between doctor's sex and receiving sanctions. There was evidence that the association varied with specialty, with female GPs being the least likely to have sanctions against their registration. Post hoc analyses demonstrated the association between receiving a warning varied with specialty registration, with female specialists having less than half the odds of receiving a warning when compared to their male

colleagues, but no real evidence for a difference between the sexes and receiving a warning in doctors who had not yet specialised. Post hoc analyses also provided evidence to show that the odds of being erased from the medical register varied depending on where a doctor had received their PMQ, with female doctors who had received their PMQ in the UK being the least likely to be erased from the medical register.

To our knowledge this is the first study in the UK to examine the association between doctor's sex and receiving sanctions against medical registration, while adjusting for known confounders.

Strengths and weaknesses of this study

One of the major strengths of this study is that we used a large national database. The advantage of using this dataset is two-fold; firstly, because a national database was used the findings of the study apply to all doctors registered to practise in the UK; secondly, receiving sanctions is a rare outcome and using a large dataset is crucial when examining rare outcomes.

A further strength of this study is that it adjusted for known confounders. Previous research on UK data did not adjust the measure of effect of sex for potential confounders[9].

Finally, a further advantage was the completeness of the dataset. The data is collected by the GMC for inclusion on the LRMP, and not research purposes. Doctors are required to provide the data to the GMC to be registered and as such there is no missing data. However, the fact the data is not collected for research purposes is also a limitation of the study. The study was constrained by the variables collected and made available by the GMC. As such, we were only able to explore the variables available and we were unable to examine the effect of other potential confounding factors.

It could be argued that the reason for referral to the GMC could be a source of residual confounding if systematic differences exist between the sexes. The GMC may take action against a doctor's registration for a number of reasons; including misconduct; poor performance; or physical or mental ill health. The data available did not provide the reasons for why a sanction had been imposed, but a more detailed evaluation of the reasons for referral to the GMC may go towards explaining the sex difference observed.

A further limitation is that a doctor can apply for voluntary erasure from the LRMP during an investigation process. Once again, this is a potential source of residual

confounding and it is possible that the sex of doctors who are subject to a complaints investigation and apply for voluntary erasure differs to those doctors who complete the investigative process and receive a sanction (however, it is important to note that the GMC's decision to grant a request for voluntary erasure is based on the public interest and the doctor's health and likelihood to return to practise[14]).

Comparison with other studies

Several studies have examined the association between doctors' sex and disciplinary action, with the majority of these studies demonstrating that female doctors are less likely to be subject to disciplinary action than male doctors[4,5,6,7,8,9]. However, the majority of these studies have been performed in the United States of America, where the medical and legal systems differ to the UK and therefore we felt that their findings may not be applicable to the UK population of doctors. To our knowledge, one study has been performed in the UK using national data[9], however when examining the association between doctors' sex and disciplinary action this study did not control for any potential confounders.

The findings of this study are in agreement with previous research that has shown that older doctors[7], doctors who qualified outside of the country in which they are practising[9,11] and doctors of certain specialties[6] are more likely to be subjected to disciplinary action from a medical regulatory board. It has also been demonstrated in previous studies that female doctors are more likely to be have qualified more recently than male doctors[3], are more likely to have qualified in the country in which they are practising[15] and choose different specialties to male doctors[16].

This study showed that the reason that male doctors receive more sanctions is not because they qualified longer ago, nor because they are more likely to have qualified outside the UK, despite both of those factors being associated with increased likelihood of sanctions.

Unanswered questions and future research

This study has demonstrated that female doctors are less likely to receive sanctions against their medical registration compared to male doctors, however it is not clear why women are less likely to receive sanctions when compared to men. Exploring the possible reasons for this sex difference in professional performance is required, using a theoretical based approach. One theory suggested by some researchers is that male and female doctors differ in communication style and hence the interaction with patients and colleagues differed between the sexes, which could affect the risk

of being subject to a complaint[17,18]. Future research could be performed to explore this further.

We have also demonstrated that the effect of sex on likelihood to receive sanctions varied by specialty, with female GPs being the least likely to receive sanctions. It has been demonstrated by an observational study of primary care physicians in the USA that female primary care physicians spend more time with their patients when compared to their male colleagues and they engaged more in conversation, displaying more positive-talk, partnership-building, question-asking and information-giving[19]. These differences in communication style and time spent with patients may go towards explaining the larger sex discrepancy observed in GPs, however future research is required to explore these possible reasons further.

We have also shown that female specialists are much less likely than male specialists to receive a warning, but the sex difference disappears for doctors who have not yet specialised. The association between sex and the other types of sanctions was not found to vary with specialty registration. Examining why receiving warnings varies according to specialty registration, with a sex difference being observed in specialists, merits being explored. Possibilities include that the threshold for delivering a warning to a non-specialist is lower than for a specialist because it may be more likely that a non-specialist is at an early stage of their career and perhaps the medical regulatory body feel it is important to highlight that behaviour which demonstrates a significant departure from the principles of Good Medical Practice as set out by the GMC will be dealt with seriously and the warning may be hoped to act as a deterrent for any future more serious demonstrations of departure from the principles set out by the GMC.

Our results have demonstrated that female doctors who qualified in the UK are the least likely to be erased from the medical register (the most severe sanction to be imposed). Female doctors who qualified outside of the UK are less likely to be erased from the medical register than their male colleagues who qualified outside of the UK, but they are more likely to be erased than their female colleagues who qualified in the UK. These results echo the findings of a cohort study conducted by Humphrey et al.[11] who demonstrated that referrals to the GMC concerning doctors who had received their PMQ outside of the UK was associated with the most severe sanctions on their registration (suspension or erasure).

Our results also show that female doctors have approximately one third of the odds of being erased or suspended, and just over half the odds of receiving undertakings or conditions when compared to their male colleagues. These results suggest that, with the exception of the sanction 'warning', the more severe the sanction (suspension or erasure from the medical register) the more likely men will receive it. Exploring the reasons for this sex difference in the severity of sanctions imposed would be of interest. It is possible that male doctors' behaviour and actions warrant the severest types of sanctions to be imposed, whereas female doctors' behaviour and actions do not require such severe sanctions. Examining the reasons for why doctors have received sanctions would go towards showing whether this is in fact the case.

It should also be noted that this study was observational in design and as such causality cannot be determined. It is possible that other factors, such as ethnicity, may be confounding the association between doctors' sex and disciplinary action. Research examining whether other potential confounders could explain the observed association is required.

Further exploration of why doctors' sex may impact their professional performance is needed to enable the profession to develop a better understanding of the factors associated with impaired fitness to practise and crucially, how to better support those doctors and ensure patient safety.

Conclusion

In this study we demonstrated that female doctors practising in the UK were less likely to receive sanctions on their medical registration when compared with their male colleagues. These findings remained after adjusting for known confounders. Reasons for why this sex difference exists needs to be examined.

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Footnotes

Contributorship statement: EU conceived and designed the study with input from KW and JD. EU and CW categorised the data. EU analysed and interpreted the data with support from KW. EU drafted the manuscript and all authors participated in the revision process and have approved this submission for publication. EU is guarantor, had full access to all of the data in the study, and can take responsibility for the integrity of the data and the accuracy of the data analysis.

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Competing interests: All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf. All authors declare no competing interests that may be relevant to the submitted work.

Ethical approval: The study is part of a research project that has received ethical approval from the UCL Research Ethics Committee.

Data sharing statement: No additional data available.

Transparency declaration: EU, as guarantor, affirms that this manuscript is an honest, accurate and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

Table 1: Distribution of variables by sex of doctors.

Variable		Male N=196,814	Female N=132,728	Total N=329,542
Sanction imposed on registration				
	No	194,633 (98.9%)	132,212 (99.6%)	326,845 (99.2%)
	Yes	2,181 (1.1%)	516 (0.4%)	2,697 (0.8%)
No. of years since received PMQ[i]				
	0-2 years	6,332 (3.2%)	8,830 (6.7%)	15,162 (4.6%)
	3-10 years	28,548 (14.5%)	37,220 (28.0%)	65,768 (20.0%)
	11-20 years	52,437 (26.6%)	40,023 (30.2%)	92,460 (28.1%)
	21-30 years	39,146 (19.9%)	23,069 (17.4%)	62,215 (18.9%)
	31-40 years	30,206 (15.4%)	12,136 (9.1%)	42,342 (12.9%)
	≥41 years	40,145 (20.4%)	11,450 (8.6%)	51,595 (15.7%)
Region where received PMQ				
	UK	108,323 (55.0%)	86,989 (65.5%)	195,312 (59.3%)
	EEA[ii]	25,333 (12.9%)	15,880 (12.0%)	41,213 (12.5%)
	International	63,158 (32.1%)	29,859 (22.5%)	93,017 (28.2%)
Specialty				
	No Specialty	94,815 (48.2%)	73,309 (55.2%)	168,124 (51.0%)
	Anaesthetics	8,710 (4.4%)	3,797 (2.9%)	12,507 (3.8%)
	EM[iii]	754 (0.4%)	209 (0.2%)	963 (0.3%)
	GP[iv]	37,959 (19.3%)	32,264 (24.3%)	70,223 (21.3%)
	Medicine	15,076 (7.7%)	6,775 (5.1%)	21,851 (6.6%)
	O&G[v]	2,934 (1.5%)	1,966 (1.5%)	4,900 (1.5%)
	Ophthalmology	2,508 (1.3%)	1,078 (0.8%)	3,586 (1.1%)
	Paediatrics	3,906 (2.0%)	3,891 (2.9%)	7,797 (2.4%)
	Pathology	5,589 (2.8%)	2,965 (2.2%)	8,554 (2.6%)
	Psychiatry	5,494 (2.8%)	3,077 (2.3%)	8,571 (2.6%)
	Radiology	172 (0.1%)	41 (0.03%)	213 (0.1%)
	Surgery	16,452 (8.4%)	1,942 (1.5%)	18,394 (5.6%)
	Other	1,330 (0.7%)	867 (0.7%)	2,197 (0.7%)
	Dual Specialty	1,115 (0.6%)	547 (0.4%)	1,662 (0.5%)

[i]Primary Medical Qualification
[ii]European Economic Area
[iii]Emergency Medicine
[iv]General Practice
[v]Obstetrics & Gynaecology

Table 2: The distribution of sanctions for each variable and the association of individual factors with sanctions.

Variable		Total number of doctors	Sanctions (%)	p-value
Sex				<0.001
	Male	196,814	1.1%	
	Female	132,728	0.4%	
No. of years since received PMQ[i]				<0.001
	0-2	15,162	0.1%	
	3-10	65,768	0.6%	
	11-20	92,460	0.8%	
	21-30	62,215	1.1%	
	31-40	42,342	1.4%	
	≥41	51,595	0.7%	
Region where received PMQ				<0.001
	UK	195,312	0.6%	
	EEA[ii]	41,213	0.9%	
	International	93,017	1.2%	
Specialty				<0.001
	No Specialty	168,124	0.7%	
	Anaesthetics	12,507	0.7%	
	EM[iii]	963	0.7%	
	GP[iv]	70,223	1.2%	
	Medicine	21,851	0.5%	
	O&G[v]	4,900	1.2%	
	Ophthalmology	3,586	0.5%	
	Paediatrics	7,797	0.6%	
	Pathology	8,554	0.6%	
	Psychiatry	8,571	0.8%	
	Radiology	213	0.5%	
	Surgery	18,394	0.9%	
	Other	2,197	0.3%	
	Dual Specialty	1,662	1.4%	

[i]Primary Medical Qualification
[ii]European Economic Area
[iii]Emergency Medicine
[iv]General Practice
[v]Obstetrics & Gynaecology

Table 3: The adjusted odds ratio for having sanctions against registration for each variable compared to its baseline having adjusted for all other variables.

Variable		Adjusted OR[i]	95% CI[ii]	p-value
Sex of a doctor				<0.0001
	Male	1		
	Female	0.37	0.33-0.41	
No. of years since received PMQ				<0.0001
	0-2	1		
	3-10	3.42	2.20-5.32	
	11-20	3.85	2.48-5.98	
	21-30	5.66	3.63-8.81	
	31-40	6.44	4.13-10.05	
	≥41	3.12	1.20-4.87	
Region where received PMQ				<0.0001
	UK	1		
	EEA	1.33	1.17-1.50	
	International	1.65	1.51-1.80	
Specialty				<0.0001
	No Specialty	1		
	Anaesthetics	0.65	0.52-0.82	
	EM	0.66	0.31-1.39	
	GP	1.43	1.29-1.58	
	Medicine	0.49	0.40-0.60	
	O&G	1.22	0.93-1.59	
	Ophthalmology	0.53	0.33-0.83	
	Paediatrics	0.64	0.47-0.88	
	Pathology	0.65	0.50-0.86	
	Psychiatry	0.81	0.63-1.04	
	Radiology	0.47	0.07-3.38	
	Surgery	0.78	0.66-0.93	
	Other	0.36	0.17-0.77	
	Dual Specialty	1.37	0.90-2.09	

[i] Odds Ratio
[ii] Confidence Interval

Table 4: Stratum-specific odds ratios for having sanctions imposed on registration if the doctor is female for each specialty divided into four categories.

Variable	Stratum-Specific OR[i]	95% CI[ii]	p-value
Specialty Category			<0.0001
No Specialty	0.43	0.38-0.49	
GP	0.26	0.22-0.31	
Hospital Specialty	0.44	0.36-0.56	
Dual Specialty	0.09	0.13-0.70	

[i] Odds Ratio
[ii] Confidence Interval

Table 5: The unadjusted and adjusted odds ratio for having each type of sanction against registration for a female doctor when compared to a male doctor.

	Model 1		Model 2[i]	
Sanction type	**Unadjusted OR[ii]**	**95% CI[iii]**	**Adjusted OR[ii]**	**95% CI[iii]**
Warning	0.29	0.24-0.35	0.30	0.25-0.36
Undertakings	0.64	0.52-0.79	0.66	0.53-0.81
Conditions	0.48	0.39-0.59	0.54	0.44-0.67
Suspended	0.28	0.21-0.36	0.32	0.25-0.42
Erased	0.21	0.17-0.27	0.26	0.21-0.34

[i] Model adjusted for number of years since received PMQ, region where received PMQ and specialty
[ii] Odds Ratio
[iii] Confidence Interval

Table 6: Stratum-specific odds ratios for having a warning imposed on registration if the doctor is female for each specialty divided into two categories.

Variable	**Stratum-Specific OR[i]**	**95% CI[ii]**	**p-value**
Specialty Category			0.0031
No Specialty	0.90	0.67-1.20	
On Specialist and/or GP Registers	0.48	0.35-0.65	

[i] Odds Ratio
[ii] Confidence Interval

Table 7: Stratum-specific odds ratios for being erased from the LRMP if the doctor is female for each region where received PMQ divided into two categories.

Variable	**Stratum-Specific OR[i]**	**95% CI[ii]**	**p-value**
Region where received PMQ Category			0.0301
EEA and/or International	0.32	0.24-0.44	
UK	0.18	0.11-0.28	

[i] Odds Ratio
[ii] Confidence Interval

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	**Y**
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	**Y**
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	**Y**
Objectives	3	State specific objectives, including any prespecified hypotheses	**Y**
Methods			
Study design	4	Present key elements of study design early in the paper	**Y**
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	**Y**
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	**Y**
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	**Y**
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	**Y**
Bias	9	Describe any efforts to address potential sources of bias	**N/A**
Study size	10	Explain how the study size was arrived at	**N/A**
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	**Y**
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	**Y**
		(*b*) Describe any methods used to examine subgroups and interactions	**Y**
		(*c*) Explain how missing data were addressed	**N/A**
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	**N/A**
		(*e*) Describe any sensitivity analyses	**N/A**
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	**N/A**
		(b) Give reasons for non-participation at each stage	**N/A**
		(c) Consider use of a flow diagram	**N/A**
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	**Y**
		(b) Indicate number of participants with missing data for each variable of interest	**N/A**
Outcome data	15*	Report numbers of outcome events or summary measures	**Y**
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	**Y**

		(*b*) Report category boundaries when continuous variables were categorized	**Y**
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	**N/A**
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	**Y**
Discussion			
Key results	18	Summarise key results with reference to study objectives	**Y**
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	**Y**
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	**Y**
Generalisability	21	Discuss the generalisability (external validity) of the study results	**Y**
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	**Y**

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Disciplined doctors: does the sex of a doctor matter? A cross-sectional study examining the association between a doctor's sex and receiving sanctions against their medical registration.

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Title Page

Disciplined doctors: does the sex of a doctor matter?

A cross-sectional study examining the association between a doctor's sex and receiving sanctions against their medical registration.

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Key words:
Law, Medical education & training, epidemiology, GMC, gender

Word count:
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Abstract

Objectives: To examine the association between doctors' sex and receiving sanctions on their medical registration, whilst controlling for other potentially confounding variables.

Design: Cross-sectional study.

Setting: The General Medical Council's (GMC) List of Registered Medical Practitioners (LRMP) database of doctors practising in the United Kingdom (UK).

Population: All doctors on the GMC's LRMP on 29th May 2013. The database included all doctors who are or have been registered to practice medicine in the UK since October 2005. The exposure of interest was doctor's sex. Confounding variables included years since primary medical qualification, world region of primary medical qualification and specialty.

Outcome measures: Sanctions on a doctor's medical registration. Sanction types included warning, undertakings, conditions, suspension or erasure from the register. Binary logistic regression modelling, controlling for the confounders, described the association between doctor's sex and sanctions on a doctor's medical registration.

Results: Of the 329,542 doctors on the LRMP, 2,697 doctors (0.8%) had sanctions against their registration, 516 (19.1%) of whom were female. In the fully adjusted model, female doctors had nearly a third of the odds (OR 0.37, 95% CI: 0.33-0.41) of having sanctions compared to male doctors. There was evidence that the association varies with specialty, with female doctors who had specialised as General Practitioners (GPs) being the least likely to receive sanctions compared to their male colleagues (OR 0.26, 95% CI: 0.22-0.31).

Conclusions: Female doctors have reduced odds of receiving sanctions on their medical registration when compared to their male colleagues. This association remained after adjustment for the confounding factors. These results are representative of all doctors registered to practice in the UK. Further exploration of why doctors' sex may impact their professional performance is underway.

Article summary

Strengths and limitations of this study

- We used a large national database with no missing data, so the findings of the study apply to all doctors registered to practise in the UK.
- Receiving sanctions is a rare outcome and using a large dataset is crucial when examining rare outcomes.
- This is one of the first studies of this nature on UK data that adjusted for known confounders.
- The study was constrained by the variables collected and made available by the GMC. So we were unable to examine the effect of other potential confounding factors.
- The data available did not provide the reasons for why a sanction had been imposed, nor data on those granted voluntary erasure. A more detailed evaluation of the reasons for referral to the GMC may go towards explaining the sex difference observed.

Introduction

The number of complaints about doctors' fitness to practise received by the UK medical regulatory body, the General Medical Council (GMC), has been increasing since 2007[1]. Following a triage and investigation process by the GMC the outcome of a case against a doctor can be closed, or can result in a sanction against the doctor's registration. The cost of this regulatory process, both in terms of financial cost of the actual complaints investigation procedure, but also in terms of the loss of the medical workforce during the process, can be significant. The level of stress that a doctor endures while undergoing a fitness to practise investigation was recently reported in the BMJ and highlights the impact the complaints investigation procedure can have on the mental well being of doctors[2].

One of the most significant changes in the medical profession has been the increase in the number of women entering this previously male dominated profession. The number of female medical students has been increasing since the mid-1960s with female medical students outnumbering male medical students since the mid-1990s[3]. It is predicted that female doctors will outnumber their male colleagues by 2017[3]. This change in the demographic profile of UK doctors has brought with it a heightened interest in how the increase of female doctors may impact the profession.

Examining and understanding the predictors of doctors receiving sanctions may aid the medical profession in identifying doctors whose performance might raise future concerns, in order to support these doctors and help prevent GMC referral. Research from Canada, the United States of America and Australia and New Zealand has suggested that male and female doctors differ in terms of risk of disciplinary action, with male doctors being at increased risk[4,5,6,7,8,9,10]. However, the applicability of the findings from these studies to the UK may be limited due to differences in both the medical and legal systems in these countries. In 2011 Wakeford explored the situation in the UK[11]. He examined the factors associated with severest outcomes of the GMC disciplinary procedures, suspension or erasure from the medical register. In agreement with these worldwide studies, he demonstrated that female doctors were four times less likely to be disciplined when compared to male doctors. However, the interpretation of this finding is limited because the measure of effect for doctors' sex was not adjusted for potential confounders.

We aimed to examine the effect of doctors' sex on receiving sanctions against their medical registration, while adjusting for known confounding factors. This would allow for a meaningful comparison of male and female doctors and their experience of disciplinary action in the UK.

Methods

Study design, setting and source of data

We conducted a cross-sectional study using UK-wide data. The data and permission to use the data for research purposes were obtained from the GMC. This study is part of a research project that has received ethical approval from the UCL Research Ethics Committee.

Under the Medical Act 1983 the GMC is required to keep up-to-date registers of qualified doctors. The main register is the List of Registered Medical Practitioners (LRMP). The LRMP is a list of all doctors registered to practise medicine in the UK, and as such changes daily. It lists those doctors who are (or could) practise medicine, as well as those doctors who have been suspended or erased. The GMC provided us with a snapshot of doctors registered on the LRMP on the 29th May 2013. The list included all doctors who have been registered with the GMC (and therefore eligible to actively practise medicine) at any point in the period 20th October 2005[a] – 28th May 2013. The different categories of registration status included: provisionally or fully registered; suspended; not registered – administrative reason, or deceased, or having relinquished registration; and not registered – erased after Fitness to Practise panel hearing. The database provided details of doctor's sex; the year, country, and institutions of the doctor's primary medical qualification and the doctor's current registration status, including whether they currently had any sanctions on their medical registration (see below for details). It classified doctors as General Practitioners (GPs) (on the GP register) and as hospital specialists (on the Specialist register). Doctors who are neither on the GP or Specialist registers are doctors who have not undertaken or completed speciality training.

Population

All doctors who were listed on the LRMP on the 29th May 2013 were included.

Primary outcome and exposure

[a] The 20th October 2005 was the date when the GMC first began to publish full details of a doctor's registration status on the LRMP online.

The outcome of interest was sanctions on a doctor's medical registration on the 29th May 2013.

The types of sanctions included:

- **Warning:** issued when a doctor's performance has not been in keeping with the principles set by the GMC for doctors, but a restriction on the doctor's registration is not necessary. Warnings remain on the LRMP for a five year period;
- **Undertakings:** an agreement between the GMC and the doctor about the doctor's future practice. The doctor must adhere to these undertakings to maintain their registration;
- **Conditions:** set out by the GMC and restrict a doctor's practice. The doctor must comply with these conditions to maintain their registration. Conditions can initially be imposed for a maximum of three years and then be renewed in periods of up to 36 months;
- **Suspension or erasure:** the doctor's licence is withdrawn by the GMC and they are no longer able to practise. Suspension from the register can last up to 12 months, but may be indefinite in certain circumstances.

A sanction can be imposed if a doctor's fitness to practise has been proved to be impaired. The impairment can result from misconduct; poor professional performance; physical or mental ill health; or a conviction or fitness to practise determination by another regulatory body either in the UK or overseas[12]. However it is recognised that the reason for impairment can cross more than one category (for example a doctor with a drug misuse problem could be classified as having mental ill health, yet the effects of the drug abuse could impact their professional performance). The duration of a sanction on a doctor's registration varies and it is possible for doctors to have more than one sanction against their registration and this typically represents the outcomes of different complaints. It was not possible to establish the date a sanction was imposed or the reason for why a sanction had been imposed from the available data.

The outcome of interest was collapsed into a binary variable: doctors with sanctions against their registration; and doctors with no sanctions against their registration.

The exposure of interest was doctor's sex, as declared by the doctor to the GMC.

Selection of variables

The variables included in the study were selected before any statistical analysis. Data was available on the year of primary medical qualification (PMQ), country of PMQ and primary specialty, if on the Specialist or General Practitioner (GP) Registers. These variables were selected as a priori confounders based on findings from earlier research[7,8,11,13], which demonstrated that these factors may influence the risk of receiving sanctions.

Once the variables had been selected, we performed a variable reduction process, to reduce the number categories into meaningful categories. Once again, this was performed before any statistical analysis. The variable 'year of PMQ' was converted into 'number of years since qualification' by subtracting the year of PMQ from 2013 [b]. We then collapsed the variable into six categories. The first category '0-2 years' represented Foundation Training, the second category '3-10 years' represented the bulk of time a doctor would likely spend in Specialty Training. The subsequent categories were divided into 10-year blocks. The variable 'country of PMQ' was collapsed into three categories; 'UK', 'EEA' (European Economic Area) and 'International'. The list of countries included in the EEA category was obtained from the European Union website[14] and included all countries that were members before May 2013. The variable 'specialty' was divided into fourteen categories. Doctors who were not present on either the Specialist Register or the GP Register were categorised as having 'no specialty' and represented trainee and other non-specialist doctors. Doctors on both the Specialist Register and the GP Register were recorded as having 'dual specialty' and doctors only on the GP register were categorised as 'GP'. For doctors only registered on the Specialist Register, their primary specialty was taken and recorded into one of eleven categories. To categorise those doctors on the Specialist Register two researchers (EU and CW) independently allocated each primary specialty to a specialty category. Kappa statistic demonstrated a good level of agreement (kappa = 0.72). Any disagreements about specialty category allocation were resolved through discussion.

Statistical methods

We took a causal modelling analysis approach to analyse the data. We firstly performed bivariate analyses to look for crude associations in the data, followed by Mantel-Haenszel analyses, before going on to complete multivariate analyses using

[b] As mentioned above, a doctor could appear in the LRMP dataset if they had been removed from the medical register. The actual date of those doctors being removed could lie anytime between 20th October 2005 and 28th May 2013. However, as no actual removal dates were given for those doctors, we used 2013 for all doctors.

binary logistic regression modelling. The initial logistic regression model included only the exposure (sex) and outcome (sanctions) variables to provide a crude measure of effect. The final logistic regression model was built to include all potential confounder variables, while checking for multicollinearity. The final logistic regression model enabled the calculation of an adjusted measure of effect. The final model was assessed for the presence of effect modifiers following the findings from the Mantel-Haenszel analyses.

Statistical analyses were conducted using the software Stata 12/SE.

We used the STROBE Statement[15] to guide our study report.

Results

There were 329,542 doctors on the LRMP on the 29th May 2013, of whom 40.3% were female. Table 1 shows the distribution of variables by the sex of doctors. The median number of years since qualification was 19 years. The distribution of the number of years since a doctor had qualified was skewed to the right with the majority of the doctors qualifying 11-20 years ago (28.1%). The majority of the doctors had received their PMQ from a UK medical school (59.3%).

Approximately half of all the doctors were neither on the GP Register nor the Specialist Register (51.0%), of which the majority (58.0%) had received their PMQ greater than 10 years previously. It is interesting to note that half of the doctors registered to practise medicine in the UK in this period were not registered specialists (they were neither on the GP or Specialist registers) and the majority of these doctors had qualified greater than ten years ago, suggesting that these doctors are not trainee doctors, but doctors who have elected not to complete specialty training. Of those doctors who had specialised, General Practice was the most popular specialty (21.3%), followed by Medicine (6.6%). 0.5% of the doctors were on both the Specialist and GP Registers.

2697 (0.8%) doctors had sanctions against their registration on the 29th May 2013. There was a higher proportion of male doctors who had sanctions against their registration when compared to female doctors (1.1% of all male doctors compared with 0.4% of all female doctors, X^2=505.4, P<0.001). There was strong evidence for an association between receiving sanctions and the number of years since received PMQ, with doctors who qualified 31-40 years ago having the highest proportion of sanctions; world region of PMQ, with doctors who qualified outside the EEA with the

highest proportion of doctors with sanctions; and specialty, with doctors on both the Specialist and GP Registers having the highest proportion of doctors with sanctions. These results are presented in Table 2.

Using bivariate analyses we compared female doctors to male doctors. There was a strong trend between sex of a doctor and the number of years since the doctor received their PMQ, with female doctors being more likely to have recently qualified and the proportion of female doctors reducing as the number of years since PMQ increased. We also found that female doctors were more likely to have qualified in the UK (65.5% of all female doctors compared to 55.0% of all male doctors) and male doctors were more likely to have qualified outside of the EEA (32.1% of all male doctors compared to 22.5% of all female doctors). Approximately equal proportions of male and female doctors qualified in the EEA (12.9% and 12.0% respectively). Both sexes were more likely to be not registered in a specialty (GP or hospital), though there was a slightly higher proportion of women when compared to men who were not on the Specialist or GP Registers. When examining those doctors who were registered in a specialty, a higher proportion of female doctors were on the GP Register compared to male doctors (24.3% of female doctors compared with 19.3% of male doctors) and a higher proportion of male doctors were registered with a hospital specialty (32.0% of male doctors compared with 20.1% of female doctors).
In summary, number of years since received PMQ, world region where PMQ was received, and registered specialty were associated with both the outcome (sanctions) and the exposure (sex of a doctor) and as such we considered these variables as confounders.

The unadjusted odds ratio for having sanctions against a doctor's registration comparing female doctors with male doctors was 0.35 (95% CI: 0.32-0.38), suggesting that being a female doctor is protective of receiving sanctions.
Mantel-Haenszel analyses and tests of homogeneity were conducted to examine the change in the strength of the association between sanctions and sex while controlling for each of the confounders separately.
There was strong evidence that the true odds ratios were different between the different specialty categories (P=0.0002), therefore specialty was considered as an effect modifier when conducting multivariate analyses.

Table 3 represents the results from the binary logistic regression model built to adjust for all the variables. After taking into account the number of years since PMQ, world

region where the doctor received their PMQ and specialty, female doctors had nearly a third of the odds of having sanctions on their registration compared to male doctors (OR 0.37, 95% CI: 0.33-0.41, P<0.0001).

All of the a priori confounders were felt to be confounders because the adjusted odds ratio changed when each variable was added to the model. We found no evidence of multicollinearity.

The Mantel-Haenszel analyses suggested that specialty may be an effect modifier, we therefore performed a statistical test for effect modification by firstly collapsing the specialty variable into four groups to increase the power of the test. Table 4 demonstrates that specialty was felt to be an important effect modifier with female doctors being less likely to receive sanctions when compared to male doctors, but the effect was greater for GPs than for those doctors with no specialty or practising a hospital specialty.

Discussion

In our large cross-sectional study we found strong evidence that being female was associated with a reduction in odds of receiving sanctions (OR 0.35, 95% CI: 0.32-0.38) in the unadjusted model. Controlling for years since PMQ, world region where received PMQ, and specialty did slightly increase this odds ratio (OR 0.37, 95% CI: 0.33-0.41, P<0.0001), but there remained strong evidence for the association between doctor's sex and receiving sanctions. There was evidence that the association varied with specialty, with female GPs being the least likely to have sanctions against their registration.

To our knowledge this is the first study in the UK to examine the association between doctor's sex and receiving sanctions against medical registration, while adjusting for known confounders. We believe that these known confounders have only been adjusted for in one other study which was conducted in the USA[8].

Strengths and weaknesses of this study

One of the major strengths of this study is that we used a large national database. The advantage of using this dataset is two-fold; firstly, because a national database was used the findings of the study apply to all doctors registered to practise in the UK; secondly, receiving sanctions is a rare outcome and using a large dataset is crucial when examining rare outcomes.

A further strength of this study is that it adjusted for known confounders, all these confounders have only been adjusted for in one previous study, which was conducted in California[8]. Previous research on UK data did not adjust the measure of effect of sex for potential confounders[11].

Finally, a further advantage was the completeness of the dataset. The data is collected by the GMC for inclusion on the LRMP, and not research purposes. Doctors are required to provide the data to the GMC to be registered and as such there is no missing data. However, the fact the data is not collected for research purposes is also a limitation of the study. The study was constrained by the variables collected and made available by the GMC. As such, we were only able to explore the variables available and we were unable to examine the effect of other potential confounding factors or explore the reasons for why a sanction had been imposed.

It could be argued that the reason for referral to the GMC could be a source of residual confounding if systematic differences exist between the sexes. The GMC may take action against a doctor's registration for a number of reasons, which can be broadly divided into three major categories; misconduct; poor professional performance; or physical or mental ill health. The data available did not provide the reasons or the category for why a sanction had been imposed, but a more detailed evaluation of the reasons for referral to the GMC may go towards explaining the sex difference observed. In their research, Alam et al.[4] and Elkin et al.[10], demonstrated not only that male doctors were more likely to be subject to disciplinary action, but that the main offense for which a doctor was being disciplined was sexual misconduct. It is possible that male doctors are more likely to commit an offense involving sexual misconduct than their female colleagues, which may go towards explaining the sex difference seen in these populations. However, other studies in this area did not find sexual misconduct to be the most common offense[6,7,9]. As such, exploring the offenses for which a doctor may receive disciplinary action in this population may go towards explaining the sex difference observed and may help the regulatory body and medical profession to introduce targeted interventions, such as education programmes, to reduce the number of offenses.

A further source of residual confounding could be the route of referral. Doctors practising in the UK can be referred to the GMC through five main routes; the public; employers; doctors; the GMC; and the police[16]. It would be interesting to examine whether the referral rate for each route demonstrates any sex differences, and if so, exploring the reasons for this difference.

A further limitation is that a doctor can apply for voluntary erasure from the LRMP during an investigation process. Once again, this is a potential source of residual confounding and it is possible that the sex of doctors who are subject to a complaints investigation and apply for voluntary erasure differs to those doctors who complete the investigative process and receive a sanction (however, the GMC's decision to grant a request for voluntary erasure is based on the public interest and the doctor's health and likelihood to return to practise[17]). It is important to note that voluntary erasure is requested by doctors for multiple reasons other than being involved in an investigation process, including retiring permanently from practising medicine or leaving the UK to work permanently abroad. To explore whether voluntary erasure requests may explain the sex difference seen, the reason for why a voluntary erasure request was submitted would first have to be ascertained. This information was not available in the dataset used for this research, but could be requested and explored in future studies.

It is also of interest to note that certain sanctions (erasure and some suspensions) are permanent, whereas other sanctions are time limited. As such, the permanent sanctions may be over represented because they will never be removed from a doctor's registration. If male doctors are more likely to receive these permanent sanctions, this could lead to male doctors being over represented when examining the association between sex and sanctions, and may go towards explaining the sex difference observed between doctors who had sanctions imposed against their registration.

Comparison with other studies

Our main finding, that female doctors are less likely to be subject to disciplinary action when compared to their male colleagues, mirrors the results of several studies from across the world which have also examined the association between doctors' sex and disciplinary action[4,6,7,8,9,10,11]. However, the majority of these studies have been performed in the United States of America[6,7,8,9], Canada[4], Australia and New Zealand[10], where the medical and legal systems differ to the UK and therefore we felt that their findings may not be applicable to the UK population of doctors. These studies' main objective was not necessarily to explore the association between doctors' sex and disciplinary action. Some of these studies were descriptive and those studies that did control for confounders did not, albeit for one study[8], control for the same confounders we have selected. To our knowledge, one study has been performed in the UK using national data[11], however when examining the association

between doctors' sex and disciplinary action this study did not control for any potential confounders.

The findings of this study are in agreement with previous research that has shown that older doctors[8], doctors who qualified outside of the country in which they are practising[11,13] and doctors of certain specialties[7] are more likely to be subjected to disciplinary action from a medical regulatory board. It has also been demonstrated in previous studies that female doctors are more likely to be have qualified more recently than male doctors[3], are more likely to have qualified in the country in which they are practising[18] and choose different specialties to male doctors[19].

This study showed that the reason that male doctors receive more sanctions is not because they qualified longer ago, nor because they are more likely to have qualified outside the UK, despite both of those factors being associated with increased likelihood of sanctions.

Unanswered questions and future research

This study has demonstrated that female doctors are less likely to receive sanctions against their medical registration compared to male doctors, however it is not clear why women are less likely to receive sanctions when compared to men. Exploring the possible reasons for this sex difference in professional performance is required, using a theoretical based approach. One theory suggested by some researchers is that male and female doctors differ in communication style and hence the interaction with patients and colleagues differed between the sexes, which could affect the risk of being subject to a complaint[20,21]. Future research could be performed to explore this further and examine whether communication styles differ between male and female doctors, and also whether the communication styles of doctors who receive sanctions differ from doctors who have never received sanctions.

We have also demonstrated that the effect of sex on likelihood to receive sanctions varied by specialty, with female GPs being the least likely to receive sanctions. It has been demonstrated by an observational study of primary care physicians in the USA that female primary care physicians spend more time with their patients when compared to their male colleagues and they engaged more in conversation, displaying more positive-talk, partnership-building, question-asking and information-giving[22]. These differences in communication style and time spent with patients may go towards explaining the larger sex discrepancy observed in GPs, however future research is required to explore these possible reasons further.

Our results show that doctors who had been qualified for longer were more likely to receive sanctions, it is therefore reasonable to hypothesise that the risk of receiving a sanction increases with exposure. Therefore doctors who work part-time or have fewer patient encounters may be less likely to receive sanctions against their registration. Previous studies have demonstrated that female consultants have fewer patient episodes and are more likely to work part-time when compared to their male colleagues[23,24], it is therefore reasonable to hypothesise that the sex difference observed in disciplinary action may be partly explained by the difference in work patterns between the sexes. This hypothesis merits being explored further by examining whether those doctors who receive sanctions are more likely to work full-time and have more patient encounters than those doctors who have never received sanctions.

A further possible explanation for the sex difference observed is perhaps that male and female doctors are viewed and treated differently by the public, the profession and the regulatory body. It is possible that there is a higher threshold of tolerance for female doctors. The GMC are twice as likely to receive a complaint about a male doctor than a female doctor[16]. It is reasonable to assume that as a result male doctors are more likely to receive sanctions against their medical registration. Research examining the perception of male and female doctors would be warranted.

It should also be noted that this study was observational in design and as such causality cannot be determined. It is possible that other factors, such as ethnicity, may be confounding the association between doctors' sex and disciplinary action. Research examining whether other potential confounders could explain the observed association is required

The points discussed above highlight that the real interest of this research is not about the outcome sanctions itself, but about trying to understand the differences between male and female doctors that lead to the observed sex difference in receiving sanctions. Investigations into why and how male and female medical practises differ will in turn lead to being able to propose interventions to reduce not only the number of doctors referred to the medical regulatory body, but also the difference between the sexes of doctors who are referred. Further exploration of why doctors' sex may impact their professional performance is needed to enable the profession to develop a better understanding of the factors associated with impaired

fitness to practise and crucially, how to better support those doctors and ensure patient safety.

Conclusion

In this study we demonstrated that female doctors practising in the UK were less likely to receive sanctions on their medical registration when compared with their male colleagues. These findings remained after adjusting for known confounders. Reasons for why this sex difference exists needs to be examined.

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Footnotes

Contributorship statement: EU conceived and designed the study with input from KW and JD. EU and CW categorised the data. EU analysed and interpreted the data with support from KW. EU drafted the manuscript and all authors participated in the revision process and have approved this submission for publication. EU is guarantor, had full access to all of the data in the study, and can take responsibility for the integrity of the data and the accuracy of the data analysis.

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Competing interests: All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf. All authors declare no competing interests that may be relevant to the submitted work.

Ethical approval: The study is part of a research project that has received ethical approval from the UCL Research Ethics Committee.

Data sharing statement: No additional data available.

Transparency declaration: EU, as guarantor, affirms that this manuscript is an honest, accurate and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

Table 1: Distribution of variables by sex of doctors.

Variable		Male N=196,814	Female N=132,728	Total N=329,542
Sanction imposed on registration				
	No	194,633 (98.9%)	132,212 (99.6%)	326,845 (99.2%)
	Yes	2,181 (1.1%)	516 (0.4%)	2,697 (0.8%)
No. of years since received PMQ[i]				
	0-2 years	6,332 (3.2%)	8,830 (6.7%)	15,162 (4.6%)
	3-10 years	28,548 (14.5%)	37,220 (28.0%)	65,768 (20.0%)
	11-20 years	52,437 (26.6%)	40,023 (30.2%)	92,460 (28.1%)
	21-30 years	39,146 (19.9%)	23,069 (17.4%)	62,215 (18.9%)
	31-40 years	30,206 (15.4%)	12,136 (9.1%)	42,342 (12.9%)
	≥41 years	40,145 (20.4%)	11,450 (8.6%)	51,595 (15.7%)
Region where received PMQ				
	UK	108,323 (55.0%)	86,989 (65.5%)	195,312 (59.3%)
	EEA[ii]	25,333 (12.9%)	15,880 (12.0%)	41,213 (12.5%)
	International	63,158 (32.1%)	29,859 (22.5%)	93,017 (28.2%)
Specialty				
	No Specialty	94,815 (48.2%)	73,309 (55.2%)	168,124 (51.0%)
	Anaesthetics	8,710 (4.4%)	3,797 (2.9%)	12,507 (3.8%)
	EM[iii]	754 (0.4%)	209 (0.2%)	963 (0.3%)
	GP[iv]	37,959 (19.3%)	32,264 (24.3%)	70,223 (21.3%)
	Medicine	15,076 (7.7%)	6,775 (5.1%)	21,851 (6.6%)
	O&G[v]	2,934 (1.5%)	1,966 (1.5%)	4,900 (1.5%)
	Ophthalmology	2,508 (1.3%)	1,078 (0.8%)	3,586 (1.1%)
	Paediatrics	3,906 (2.0%)	3,891 (2.9%)	7,797 (2.4%)
	Pathology	5,589 (2.8%)	2,965 (2.2%)	8,554 (2.6%)
	Psychiatry	5,494 (2.8%)	3,077 (2.3%)	8,571 (2.6%)
	Radiology	172 (0.1%)	41 (0.03%)	213 (0.1%)
	Surgery	16,452 (8.4%)	1,942 (1.5%)	18,394 (5.6%)
	Other	1,330 (0.7%)	867 (0.7%)	2,197 (0.7%)
	Dual Specialty	1,115 (0.6%)	547 (0.4%)	1,662 (0.5%)

[i]Primary Medical Qualification
[ii]European Economic Area
[iii]Emergency Medicine
[iv]General Practice
[v]Obstetrics & Gynaecology

Table 2: The distribution of sanctions for each variable and the association of individual factors with sanctions.

Variable		Total number of doctors	Sanctions (%)	p-value
Sex				<0.001
	Male	196,814	1.1%	
	Female	132,728	0.4%	
No. of years since received PMQ[i]				<0.001
	0-2	15,162	0.1%	
	3-10	65,768	0.6%	
	11-20	92,460	0.8%	
	21-30	62,215	1.1%	
	31-40	42,342	1.4%	
	≥41	51,595	0.7%	
Region where received PMQ				<0.001
	UK	195,312	0.6%	
	EEA[ii]	41,213	0.9%	
	International	93,017	1.2%	
Specialty				<0.001
	No Specialty	168,124	0.7%	
	Anaesthetics	12,507	0.7%	
	EM[iii]	963	0.7%	
	GP[iv]	70,223	1.2%	
	Medicine	21,851	0.5%	
	O&G[v]	4,900	1.2%	
	Ophthalmology	3,586	0.5%	
	Paediatrics	7,797	0.6%	
	Pathology	8,554	0.6%	
	Psychiatry	8,571	0.8%	
	Radiology	213	0.5%	
	Surgery	18,394	0.9%	
	Other	2,197	0.3%	
	Dual Specialty	1,662	1.4%	

[i]Primary Medical Qualification
[ii]European Economic Area
[iii]Emergency Medicine
[iv]General Practice
[v]Obstetrics & Gynaecology

Table 3: The adjusted odds ratio for having sanctions against registration for each variable compared to its baseline having adjusted for all other variables.

Variable		Adjusted OR[i]	95% CI[ii]	p-value
Sex of a doctor				<0.0001
	Male	1		
	Female	0.37	0.33-0.41	
No. of years since received PMQ				<0.0001
	0-2	1		
	3-10	3.42	2.20-5.32	
	11-20	3.85	2.48-5.98	
	21-30	5.66	3.63-8.81	
	31-40	6.44	4.13-10.05	
	≥41	3.12	1.20-4.87	
Region where received PMQ				<0.0001
	UK	1		
	EEA	1.33	1.17-1.50	
	International	1.65	1.51-1.80	
Specialty				<0.0001
	No Specialty	1		
	Anaesthetics	0.65	0.52-0.82	
	EM	0.66	0.31-1.39	
	GP	1.43	1.29-1.58	
	Medicine	0.49	0.40-0.60	
	O&G	1.22	0.93-1.59	
	Ophthalmology	0.53	0.33-0.83	
	Paediatrics	0.64	0.47-0.88	
	Pathology	0.65	0.50-0.86	
	Psychiatry	0.81	0.63-1.04	
	Radiology	0.47	0.07-3.38	
	Surgery	0.78	0.66-0.93	
	Other	0.36	0.17-0.77	
	Dual Specialty	1.37	0.90-2.09	

[i] Odds Ratio
[ii] Confidence Interval

Table 4: Stratum-specific odds ratios for having sanctions imposed on registration if the doctor is female for each specialty divided into four categories.

Variable	Stratum-Specific OR[i]	95% CI[ii]	p-value
Specialty Category			<0.0001
No Specialty	0.43	0.38-0.49	
GP	0.26	0.22-0.31	
Hospital Specialty	0.44	0.36-0.56	
Dual Specialty	0.09	0.13-0.70	

[i] Odds Ratio
[ii] Confidence Interval

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Title Page

Disciplined doctors: does the sex of a doctor matter?

A cross-sectional study examining the association between a doctor's sex and receiving sanctions against their medical registration.

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Abstract

Objectives: To examine the association between doctors' sex and receiving sanctions on their medical registration, whilst controlling for other potentially confounding variables.

Design: Cross-sectional study.

Setting: The General Medical Council's (GMC) List of Registered Medical Practitioners (LRMP) database of doctors practising in the United Kingdom (UK).

Population: All doctors on the GMC's LRMP on 29th May 2013. The database included all doctors who are or have been registered to practice medicine in the UK since October 2005. The exposure of interest was doctor's sex. Confounding variables included years since primary medical qualification, world region of primary medical qualification and specialty.

Outcome measures: Sanctions on a doctor's medical registration. Sanction types included warning, undertakings, conditions, suspension or erasure from the register. Binary logistic regression modelling, controlling for the confounders, described the association between doctor's sex and sanctions on a doctor's medical registration.

Results: Of the 329,542 doctors on the LRMP, 2,697 doctors (0.8%) had sanctions against their registration, 516 (19.1%) of whom were female. In the fully adjusted model, female doctors had nearly a third of the odds (OR 0.37, 95% CI: 0.33-0.41) of having sanctions compared to male doctors. There was evidence that the association varies with specialty, with female doctors who had specialised as General Practitioners (GPs) being the least likely to receive sanctions compared to their male colleagues (OR 0.26, 95% CI: 0.22-0.31).

Conclusions: Female doctors have reduced odds of receiving sanctions on their medical registration when compared to their male colleagues. This association remained after adjustment for the confounding factors. These results are representative of all doctors registered to practice in the UK. Further exploration of why doctors' sex may impact their professional performance is underway.

Article summary

Strengths and limitations of this study

- We used a large national database with no missing data, so the findings of the study apply to all doctors registered to practise in the UK.
- Receiving sanctions is a rare outcome and using a large dataset is crucial when examining rare outcomes.
- This is one of the first studies of this nature on UK data that adjusted for known confounders.
- The study was constrained by the variables collected and made available by the GMC. So we were unable to examine the effect of other potential confounding factors.
- The data available did not provide the reasons for why a sanction had been imposed, nor data on those granted voluntary erasure. A more detailed evaluation of the reasons for referral to the GMC may go towards explaining the sex difference observed.

Introduction

The number of complaints about doctors' fitness to practise received by the UK medical regulatory body, the General Medical Council (GMC), has been increasing since 2007[1]. Following a triage and investigation process by the GMC the outcome of a case against a doctor can be closed, or can result in a sanction against the doctor's registration. The cost of this regulatory process, both in terms of financial cost of the actual complaints investigation procedure, but also in terms of the loss of the medical workforce during the process, can be significant. The level of stress that a doctor endures while undergoing a fitness to practise investigation was recently reported in the BMJ and highlights the impact the complaints investigation procedure can have on the mental well being of doctors[2].

One of the most significant changes in the medical profession has been the increase in the number of women entering this previously male dominated profession. The number of female medical students has been increasing since the mid-1960s with female medical students outnumbering male medical students since the mid-1990s[3]. It is predicted that female doctors will outnumber their male colleagues by 2017[3]. This change in the demographic profile of UK doctors has brought with it a heightened interest in how the increase of female doctors may impact the profession.

Examining and understanding the predictors of doctors receiving sanctions may aid the medical profession in identifying doctors whose performance might raise future concerns, in order to support these doctors and help prevent GMC referral. Research from Canada, the United States of America and Australia and New Zealand has suggested that male and female doctors differ in terms of risk of disciplinary action, with male doctors being at increased risk[4,5,6,7,8,9,10]. However, the applicability of the findings from these ~~American~~ studies to the UK may be limited due to differences in both the medical and legal systems in these countries. In 2011 Wakeford explored the situation in the UK[11]. He examined the factors associated with severest outcomes of the GMC disciplinary procedures, suspension or erasure from the medical register. In agreement with these worldwide ~~American~~ studies, he demonstrated that female doctors were four times less likely to be disciplined when compared to male doctors. However, the interpretation of this finding is limited because the measure of effect for doctors' sex was not adjusted for potential confounders.

We aimed to examine the effect of doctors' sex on receiving sanctions against their medical registration, while adjusting for known confounding factors. This would allow for a meaningful comparison of male and female doctors and their experience of disciplinary action in the UK.

Methods

Study design, setting and source of data

We conducted a cross-sectional study using UK-wide data. The data and permission to use the data for research purposes were obtained from the GMC. This study is part of a research project that has received ethical approval from the UCL Research Ethics Committee.

Under the Medical Act 1983 the GMC is required to keep up-to-date registers of qualified doctors. The main register is the List of Registered Medical Practitioners (LRMP). The LRMP is a list of all doctors registered to practise medicine in the UK, and as such changes daily. It lists those doctors who are (or could) practise medicine, as well as those doctors who have been suspended or erased. The GMC provided us with a snapshot of doctors registered on the LRMP on the 29th May 2013. The list included all doctors who have been registered with the GMC (and therefore eligible to actively practise medicine) at any point in the period 20th October 2005[a] – 28th May 2013. The different categories of registration status included: provisionally or fully registered ~~with a licence; provisionally registered without a licence; registered with a licence; registered without a licence~~; suspended; not registered – administrative reason, or ~~; not registered – deceased~~, or having relinquished registration; and not registered – erased after Fitness to Practise panel hearing~~; and not registered – having relinquished registration~~. The database provided details of doctor's sex; the year, country, and institutions of the doctor's primary medical qualification and the doctor's current registration status, including whether they currently had any sanctions on their medical registration (see below for details). It classified doctors as General Practitioners (GPs) (on the GP register) and as hospital specialists (on the Specialist register). Doctors who are neither on the GP or Specialist registers are doctors who have not undertaken or completed speciality training.~~;~~ ~~date of entry on the GP and/or Specialist registers (when they complete specialty training and qualify as a specialist); and the doctor's current registration status, including whether they currently had any sanctions on their medical registration (see below for details).~~

[a] The 20th October 2005 was the date when the GMC first began to publish full details of a doctor's registration status on the LRMP online.

Population

All doctors who were listed on the LRMP on the 29th May 2013 were included.

Primary outcome and exposure

The outcome of interest was sanctions on a doctor's medical registration on the 29th May 2013.

The types of sanctions included:

- **Warning:** issued when a doctor's performance has not been in keeping with the principles set by the GMC for doctors, but a restriction on the doctor's registration is not necessary. Warnings remain on the LRMP for a five year period;
- **Undertakings:** an agreement between the GMC and the doctor about the doctor's future practice. The doctor must adhere to these undertakings to maintain their registration;
- **Conditions:** set out by the GMC and restrict a doctor's practice. The doctor must comply with these conditions to maintain their registration. Conditions can initially be imposed for a maximum of three years and then be renewed in periods of up to 36 months;
- **Suspension or erasure:** the doctor's licence is withdrawn by the GMC and they are no longer able to practise. Suspension from the register can last up to 12 months, but may be indefinite in certain circumstances.

A sanction can be imposed if a doctor's fitness to practise has been proved to be impaired. The impairment can result from misconduct; poor professional performance; physical or mental ill health; or a conviction or fitness to practise determination by another regulatory body either in the UK or overseas[12]. However it is recognised that the reason for impairment can cross more than one category (for example a doctor with a drug misuse problem could be classified as having mental ill health, yet the effects of the drug abuse could impact their professional performance). The duration of a sanction on a doctor's registration varies and it is possible for doctors to have more than one sanction against their registration and this typically represents the outcomes of different complaints. It was not possible to establish the date a sanction was imposed or the reason for why a sanction had been imposed from the available data.

The outcome of interest was collapsed into a binary variable: doctors with sanctions against their registration; and doctors with no sanctions against their registration.

The exposure of interest was doctor's sex, as declared by the doctor to the GMC.

Selection of variables

The variables included in the study were selected before any statistical analysis. Data was available on the year of primary medical qualification (PMQ), country of PMQ and primary specialty, if on the Specialist or General Practitioner (GP) Registers. These variables were selected as a priori confounders based on findings from earlier research[7,8,11,13], which demonstrated that these factors may influence the risk of receiving sanctions.

Once the variables had been selected, we performed a variable reduction process, to reduce the number categories into meaningful categories. Once again, this was performed before any statistical analysis. The variable 'year of PMQ' was converted into 'number of years since qualification' by subtracting the year of PMQ from 2013 [b]. We then collapsed the variable into six categories. The first category '0-2 years' represented Foundation Training, the second category '3-10 years' represented the bulk of time a doctor would likely spend in Specialty Training. The subsequent categories were divided into 10-year blocks. The variable 'country of PMQ' was collapsed into three categories; 'UK', 'EEA' (European Economic Area) and 'International'. The list of countries included in the EEA category was obtained from the European Union website[14] and included all countries that were members before May 2013. The variable 'specialty' was divided into fourteen categories. Doctors who were not present on either the Specialist Register or the GP Register were categorised as having 'no specialty' and represented trainee and other non-specialist doctors. Doctors on both the Specialist Register and the GP Register were recorded as having 'dual specialty' and doctors only on the GP register were categorised as 'GP'. For doctors only registered on the Specialist Register, their primary specialty was taken and recorded into one of eleven categories. To categorise those doctors on the Specialist Register two researchers (EU and CW) independently allocated each primary specialty to a specialty category. Kappa statistic demonstrated a good level of agreement (kappa = 0.72). Any disagreements about specialty category allocation were resolved through discussion.

[b] As mentioned above, a doctor could appear in the LRMP dataset if they had been removed from the medical register. The actual date of those doctors being removed could lie anytime between 20th October 2005 and 28th May 2013. However, as no actual removal dates were given for those doctors, we used 2013 for all doctors.

Statistical methods

We took a causal modelling analysis approach to analyse the data. We firstly performed bivariate analyses to look for crude associations in the data, followed by Mantel-Haenszel analyses, before going on to complete multivariate analyses using binary logistic regression modelling. The initial logistic regression model included only the exposure (sex) and outcome (sanctions) variables to provide a crude measure of effect. The final logistic regression model was built to include all potential confounder variables, while checking for multicollinearity. The final logistic regression model enabled the calculation of an adjusted measure of effect. The final model was assessed for the presence of effect modifiers following the findings from the Mantel-Haenszel analyses.

Statistical analyses were conducted using the software Stata 12/SE.

We used the STROBE Statement[15] to guide our study report.

Results

There were 329,542 doctors on the LRMP on the 29th May 2013, of whom 40.3% were female. Table 1 shows the distribution of variables by the sex of doctors. The median number of years since qualification was 19 years. The distribution of the number of years since a doctor had qualified was skewed to the right with the majority of the doctors qualifying 11-20 years ago (28.1%). The majority of the doctors had received their PMQ from a UK medical school (59.3%).

Approximately half of all the doctors were neither on the GP Register nor the Specialist Register (51.0%), of which the majority (58.0%) had received their PMQ greater than 10 years previously. It is interesting to note that half of the doctors registered to practise medicine in the UK in this period were not registered specialists (they were neither on the GP or Specialist registers) and the majority of these doctors had qualified greater than ten years ago, suggesting that these doctors are not trainee doctors, but doctors who have elected not to complete specialty training. Of those doctors who had specialised, General Practice was the most popular specialty (21.3%), followed by Medicine (6.6%). 0.5% of the doctors were on both the Specialist and GP Registers.

2697 (0.8%) doctors had sanctions against their registration on the 29th May 2013. There was a higher proportion of male doctors who had sanctions against their

registration when compared to female doctors (1.1% of all male doctors compared with 0.4% of all female doctors, X^2=505.4, P<0.001). There was strong evidence for an association between receiving sanctions and the number of years since received PMQ, with doctors who qualified 31-40 years ago having the highest proportion of sanctions; world region of PMQ, with doctors who qualified outside the EEA with the highest proportion of doctors with sanctions; and specialty, with doctors on both the Specialist and GP Registers having the highest proportion of doctors with sanctions. These results are presented in Table 2.

Using bivariate analyses we compared female doctors to male doctors. There was a strong trend between sex of a doctor and the number of years since the doctor received their PMQ, with female doctors being more likely to have recently qualified and the proportion of female doctors reducing as the number of years since PMQ increased. We also found that female doctors were more likely to have qualified in the UK (65.5% of all female doctors compared to 55.0% of all male doctors) and male doctors were more likely to have qualified outside of the EEA (32.1% of all male doctors compared to 22.5% of all female doctors). Approximately equal proportions of male and female doctors qualified in the EEA (12.9% and 12.0% respectively). Both sexes were more likely to be not registered in a specialty (GP or hospital), though there was a slightly higher proportion of women when compared to men who were not on the Specialist or GP Registers. When examining those doctors who were registered in a specialty, a higher proportion of female doctors were on the GP Register compared to male doctors (24.3% of female doctors compared with 19.3% of male doctors) and a higher proportion of male doctors were registered with a hospital specialty (32.0% of male doctors compared with 20.1% of female doctors).
In summary, number of years since received PMQ, world region where PMQ was received, and registered specialty were associated with both the outcome (sanctions) and the exposure (sex of a doctor) and as such we considered these variables as confounders.

The unadjusted odds ratio for having sanctions against a doctor's registration comparing female doctors with male doctors was 0.35 (95% CI: 0.32-0.38), suggesting that being a female doctor is protective of receiving sanctions.
Mantel-Haenszel analyses and tests of homogeneity were conducted to examine the change in the strength of the association between sanctions and sex while controlling for each of the confounders separately.

There was strong evidence that the true odds ratios were different between the different specialty categories (P=0.0002), therefore specialty was considered as an effect modifier when conducting multivariate analyses.

Table 3 represents the results from the binary logistic regression model built to adjust for all the variables. After taking into account the number of years since PMQ, world region where the doctor received their PMQ and specialty, female doctors had nearly a third of the odds of having sanctions on their registration compared to male doctors (OR 0.37, 95% CI: 0.33-0.41, P<0.0001).

All of the a priori confounders were felt to be confounders because the adjusted odds ratio changed when each variable was added to the model. We found no evidence of multicollinearity.

The Mantel-Haenszel analyses suggested that specialty may be an effect modifier, we therefore performed a statistical test for effect modification by firstly collapsing the specialty variable into four groups to increase the power of the test. Table 4 demonstrates that specialty was felt to be an important effect modifier with female doctors being less likely to receive sanctions when compared to male doctors, but the effect was greater for GPs than for those doctors with no specialty or practising a hospital specialty.

~~Upon discovering the strong evidence for an association between doctor's sex and likelihood of receiving sanctions on a doctor's registration, we decided to further the findings by performing post-hoc analyses to establish whether the type of sanction imposed on a doctor's registration was associated with doctor's sex. All variables were categorised to create binary variables to ensure there were sufficient cases in each category of variable. The results displayed in Table 5 demonstrate that female doctors have reduced odds of having each type of sanction imposed on their registration when compared to their male colleagues. Female doctors had approximately one third of the odds of receiving a warning, being suspended or erased from the register and they had just over half the odds of receiving undertakings or conditions on their registration compared to male doctors. The Mantel-Haenszel analyses suggested that when examining the outcome 'warning' specialty may be an effect modifier, and when examining the outcome 'erased' world region where received PMQ may be an effect modifier, we therefore performed a statistical test for effect modification. Specialty was demonstrated to be an important effect modifier when examining the association between warning and sex, with female specialists having approximately half the odds of receiving a warning~~

~~compared to male specialists, whereas for male and female doctors without a specialty there was no strong evidence for a difference in the odds of receiving a warning (see Table 6). World region where a doctor received their PMQ was also shown to be an important effect modifier when examining the association between erasure and sex. Female doctors who had received their PMQ in the UK had approximately one fifth of the odds of being erased, whereas female doctors who received their PMQ outside of the UK had approximately one third of the odds of being erased when compared to their male colleagues (see Table 7).~~

Discussion

In our large cross-sectional study we found strong evidence that being female was associated with a reduction in odds of receiving sanctions (OR 0.35, 95% CI: 0.32-0.38) in the unadjusted model. Controlling for years since PMQ, world region where received PMQ, and specialty did slightly increase this odds ratio (OR 0.37, 95% CI: 0.33-0.41, P<0.0001), but there remained strong evidence for the association between doctor's sex and receiving sanctions. There was evidence that the association varied with specialty, with female GPs being the least likely to have sanctions against their registration. ~~Post hoc analyses demonstrated the association between receiving a warning varied with specialty registration, with female specialists having less than half the odds of receiving a warning when compared to their male colleagues, but no real evidence for a difference between the sexes and receiving a warning in doctors who had not yet specialised. Post hoc analyses also provided evidence to show that the odds of being erased from the medical register varied depending on where a doctor had received their PMQ, with female doctors who had received their PMQ in the UK being the least likely to be erased from the medical register.~~

To our knowledge this is the first study in the UK to examine the association between doctor's sex and receiving sanctions against medical registration, while adjusting for known confounders. We believe that these known confounders have only been adjusted for in one other study which was conducted in the USA[8].

Strengths and weaknesses of this study

One of the major strengths of this study is that we used a large national database. The advantage of using this dataset is two-fold; firstly, because a national database was used the findings of the study apply to all doctors registered to practise in the

UK; secondly, receiving sanctions is a rare outcome and using a large dataset is crucial when examining rare outcomes.

A further strength of this study is that it adjusted for known confounders, all these confounders have only been adjusted for in one previous study, which was conducted in California[8]. Previous research on UK data did not adjust the measure of effect of sex for potential confounders[11].

Finally, a further advantage was the completeness of the dataset. The data is collected by the GMC for inclusion on the LRMP, and not research purposes. Doctors are required to provide the data to the GMC to be registered and as such there is no missing data. However, the fact the data is not collected for research purposes is also a limitation of the study. The study was constrained by the variables collected and made available by the GMC. As such, we were only able to explore the variables available and we were unable to examine the effect of other potential confounding factors or explore the reasons for why a sanction had been imposed.

It could be argued that the reason for referral to the GMC could be a source of residual confounding if systematic differences exist between the sexes. The GMC may take action against a doctor's registration for a number of reasons, which can be broadly divided into three major categories; ~~including~~ misconduct; poor professional performance; or physical or mental ill health. The data available did not provide the reasons or the category for why a sanction had been imposed, but a more detailed evaluation of the reasons for referral to the GMC may go towards explaining the sex difference observed. In their research, Alam et al.[4] and Elkin et al.[10], demonstrated not only that male doctors were more likely to be subject to disciplinary action, but that the main offense for which a doctor was being disciplined was sexual misconduct. It is possible that male doctors are more likely to commit an offense involving sexual misconduct than their female colleagues, which may go towards explaining the sex difference seen in these populations. However, other studies in this area did not find sexual misconduct to be the most common offense[6,7,9]. As such, exploring the offenses for which a doctor may receive disciplinary action in this population may go towards explaining the sex difference observed and may help the regulatory body and medical profession to introduce targeted interventions, such as education programmes, to reduce the number of offenses.

A further source of residual confounding could be the route of referral. Doctors practising in the UK can be referred to the GMC through five main routes; the public; employers; doctors; the GMC; and the police[16]. It would be interesting to examine

whether the referral rate for each route demonstrates any sex differences, and if so, exploring the reasons for this difference.

A further limitation is that a doctor can apply for voluntary erasure from the LRMP during an investigation process. Once again, this is a potential source of residual confounding and it is possible that the sex of doctors who are subject to a complaints investigation and apply for voluntary erasure differs to those doctors who complete the investigative process and receive a sanction (however, ~~it is important to note that~~ the GMC's decision to grant a request for voluntary erasure is based on the public interest and the doctor's health and likelihood to return to practise[174]). It is important to note that voluntary erasure is requested by doctors for multiple reasons other than being involved in an investigation process, including retiring permanently from practising medicine or leaving the UK to work permanently abroad. To explore whether voluntary erasure requests may explain the sex difference seen, the reason for why a voluntary erasure request was submitted would first have to be ascertained. This information was not available in the dataset used for this research, but could be requested and explored in future studies.

It is also of interest to note that certain sanctions (erasure and some suspensions) are permanent, whereas other sanctions are time limited. As such, the permanent sanctions may be over represented because they will never be removed from a doctor's registration. If male doctors are more likely to receive these permanent sanctions, this could lead to male doctors being over represented when examining the association between sex and sanctions, and may go towards explaining the sex difference observed between doctors who had sanctions imposed against their registration.

Comparison with other studies

Our main finding, that female doctors are less likely to be subject to disciplinary action when compared to their male colleagues, mirrors the results of several studies from across the world which have also examined the association between doctors' sex and disciplinary action~~Several studies have examined the association between doctors' sex and disciplinary action, with the majority of these studies demonstrating that female doctors are less likely to be subject to disciplinary action than male doctors~~[4,~~4~~,6,7,8,9,10,11~~5,6,7,8,9~~]. However, the majority of these studies have been performed in the United States of America[6,7,8,9], Canada[4], Australia and New Zealand[10], where the medical and legal systems differ to the UK and therefore we felt that their findings may not be applicable to the UK population of doctors. These

studies' main objective was not necessarily to explore the association between doctors' sex and disciplinary action. Some of these studies were descriptive and those studies that did control for confounders did not, albeit for one study[8], control for the same confounders we have selected. To our knowledge, one study has been performed in the UK using national data[11], however when examining the association between doctors' sex and disciplinary action this study did not control for any potential confounders.

The findings of this study are in agreement with previous research that has shown that older doctors[8], doctors who qualified outside of the country in which they are practising[11,13] and doctors of certain specialties[7] are more likely to be subjected to disciplinary action from a medical regulatory board. It has also been demonstrated in previous studies that female doctors are more likely to be have qualified more recently than male doctors[3], are more likely to have qualified in the country in which they are practising[18] and choose different specialties to male doctors[19].

This study showed that the reason that male doctors receive more sanctions is not because they qualified longer ago, nor because they are more likely to have qualified outside the UK, despite both of those factors being associated with increased likelihood of sanctions.

Unanswered questions and future research

This study has demonstrated that female doctors are less likely to receive sanctions against their medical registration compared to male doctors, however it is not clear why women are less likely to receive sanctions when compared to men. Exploring the possible reasons for this sex difference in professional performance is required, using a theoretical based approach. One theory suggested by some researchers is that male and female doctors differ in communication style and hence the interaction with patients and colleagues differed between the sexes, which could affect the risk of being subject to a complaint[20,21]. Future research could be performed to explore this further and examine whether communication styles differ between male and female doctors, and also whether the communication styles of doctors who receive sanctions differ from doctors who have never received sanctions.

We have also demonstrated that the effect of sex on likelihood to receive sanctions varied by specialty, with female GPs being the least likely to receive sanctions. It has been demonstrated by an observational study of primary care physicians in the USA that female primary care physicians spend more time with their patients when compared to their male colleagues and they engaged more in conversation,

displaying more positive-talk, partnership-building, question-asking and information-giving[22]. These differences in communication style and time spent with patients may go towards explaining the larger sex discrepancy observed in GPs, however future research is required to explore these possible reasons further.

Our results show that doctors who had been qualified for longer were more likely to receive sanctions, it is therefore reasonable to hypothesise that the risk of receiving a sanction increases with exposure. Therefore doctors who work part-time or have fewer patient encounters may be less likely to receive sanctions against their registration. Previous studies have demonstrated that female consultants have fewer patient episodes and are more likely to work part-time when compared to their male colleagues[23,24], it is therefore reasonable to hypothesise that the sex difference observed in disciplinary action may be partly explained by the difference in work patterns between the sexes. This hypothesis merits being explored further by examining whether those doctors who receive sanctions are more likely to work full-time and have more patient encounters than those doctors who have never received sanctions.

A further possible explanation for the sex difference observed is perhaps that male and female doctors are viewed and treated differently by the public, the profession and the regulatory body. It is possible that there is a higher threshold of tolerance for female doctors. The GMC are twice as likely to receive a complaint about a male doctor than a female doctor[16]. It is reasonable to assume that as a result male doctors are more likely to receive sanctions against their medical registration. Research examining the perception of male and female doctors would be warranted.~~We have also shown that female specialists are much less likely than male specialists to receive a warning, but the sex difference disappears for doctors who have not yet specialised. The association between sex and the other types of sanctions was not found to vary with specialty registration. Examining why receiving warnings varies according to specialty registration, with a sex difference being observed in specialists, merits being explored. Possibilities include that the threshold for delivering a warning to a non-specialist is lower than for a specialist because it may be more likely that a non specialist is at an early stage of their career and perhaps the medical regulatory body feel it is important to highlight that behaviour which demonstrates a significant departure from the principles of Good Medical Practice as set out by the GMC will be dealt with seriously and the warning may be~~

~~hoped to act as a deterrent for any future more serious demonstrations of departure from the principles set out by the GMC.~~

~~Our results have demonstrated that female doctors who qualified in the UK are the least likely to be erased from the medical register (the most severe sanction to be imposed). Female doctors who qualified outside of the UK are less likely to be erased from the medical register than their male colleagues who qualified outside of the UK, but they are more likely to be erased than their female colleagues who qualified in the UK. These results echo the findings of a cohort study conducted by Humphrey et al.[11] who demonstrated that referrals to the GMC concerning doctors who had received their PMQ outside of the UK was associated with the most severe sanctions on their registration (suspension or erasure).~~

~~Our results also show that female doctors have approximately one third of the odds of being erased or suspended, and just over half the odds of receiving undertakings or conditions when compared to their male colleagues. These results suggest that, with the exception of the sanction 'warning', the more severe the sanction (suspension or erasure from the medical register) the more likely men will receive it. Exploring the reasons for this sex difference in the severity of sanctions imposed would be of interest. It is possible that male doctors' behaviour and actions warrant the severest types of sanctions to be imposed, whereas female doctors' behaviour and actions do not require such severe sanctions. Examining the reasons for why doctors have received sanctions would go towards showing whether this is in fact the case.~~

It should also be noted that this study was observational in design and as such causality cannot be determined. It is possible that other factors, such as ethnicity, may be confounding the association between doctors' sex and disciplinary action. Research examining whether other potential confounders could explain the observed association is required

The points discussed above highlight that the real interest of this research is not about the outcome sanctions itself, but about trying to understand the differences between male and female doctors that lead to the observed sex difference in receiving sanctions. Investigations into why and how male and female medical practises differ will in turn lead to being able to propose interventions to reduce not

only the number of doctors referred to the medical regulatory body, but also the difference between the sexes of doctors who are referred. Further exploration of why doctors' sex may impact their professional performance is needed to enable the profession to develop a better understanding of the factors associated with impaired fitness to practise and crucially, how to better support those doctors and ensure patient safety.

~~It should also be noted that this study was observational in design and as such causality cannot be determined. It is possible that other factors, such as ethnicity, may be confounding the association between doctors' sex and disciplinary action. Research examining whether other potential confounders could explain the observed association is require~~

~~Further exploration of why doctors' sex may impact their professional performance is needed to enable the profession to develop a better understanding of the factors associated with impaired fitness to practise and crucially, how to better support those doctors and ensure patient safe~~

Conclusion

In this study we demonstrated that female doctors practising in the UK were less likely to receive sanctions on their medical registration when compared with their male colleagues. These findings remained after adjusting for known confounders. Reasons for why this sex difference exists needs to be examined.

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Footnotes

Contributorship statement: EU conceived and designed the study with input from KW and JD. EU and CW categorised the data. EU analysed and interpreted the data with support from KW. EU drafted the manuscript and all authors participated in the revision process and have approved this submission for publication. EU is guarantor, had full access to all of the data in the study, and can take responsibility for the integrity of the data and the accuracy of the data analysis.

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Competing interests: All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf. All authors declare no competing interests that may be relevant to the submitted work.

Ethical approval: The study is part of a research project that has received ethical approval from the UCL Research Ethics Committee.

Data sharing statement: No additional data available.

Transparency declaration: EU, as guarantor, affirms that this manuscript is an honest, accurate and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

Table 1: Distribution of variables by sex of doctors.

Variable		Male N=196,814	Female N=132,728	Total N=329,542
Sanction imposed on registration				
	No	194,633 (98.9%)	132,212 (99.6%)	326,845 (99.2%)
	Yes	2,181 (1.1%)	516 (0.4%)	2,697 (0.8%)
No. of years since received PMQ[i]				
	0-2 years	6,332 (3.2%)	8,830 (6.7%)	15,162 (4.6%)
	3-10 years	28,548 (14.5%)	37,220 (28.0%)	65,768 (20.0%)
	11-20 years	52,437 (26.6%)	40,023 (30.2%)	92,460 (28.1%)
	21-30 years	39,146 (19.9%)	23,069 (17.4%)	62,215 (18.9%)
	31-40 years	30,206 (15.4%)	12,136 (9.1%)	42,342 (12.9%)
	≥41 years	40,145 (20.4%)	11,450 (8.6%)	51,595 (15.7%)
Region where received PMQ				
	UK	108,323 (55.0%)	86,989 (65.5%)	195,312 (59.3%)
	EEA[ii]	25,333 (12.9%)	15,880 (12.0%)	41,213 (12.5%)
	International	63,158 (32.1%)	29,859 (22.5%)	93,017 (28.2%)
Specialty				
	No Specialty	94,815 (48.2%)	73,309 (55.2%)	168,124 (51.0%)
	Anaesthetics	8,710 (4.4%)	3,797 (2.9%)	12,507 (3.8%)
	EM[iii]	754 (0.4%)	209 (0.2%)	963 (0.3%)
	GP[iv]	37,959 (19.3%)	32,264 (24.3%)	70,223 (21.3%)
	Medicine	15,076 (7.7%)	6,775 (5.1%)	21,851 (6.6%)
	O&G[v]	2,934 (1.5%)	1,966 (1.5%)	4,900 (1.5%)
	Ophthalmology	2,508 (1.3%)	1,078 (0.8%)	3,586 (1.1%)
	Paediatrics	3,906 (2.0%)	3,891 (2.9%)	7,797 (2.4%)
	Pathology	5,589 (2.8%)	2,965 (2.2%)	8,554 (2.6%)
	Psychiatry	5,494 (2.8%)	3,077 (2.3%)	8,571 (2.6%)
	Radiology	172 (0.1%)	41 (0.03%)	213 (0.1%)
	Surgery	16,452 (8.4%)	1,942 (1.5%)	18,394 (5.6%)
	Other	1,330 (0.7%)	867 (0.7%)	2,197 (0.7%)
	Dual Specialty	1,115 (0.6%)	547 (0.4%)	1,662 (0.5%)

[i]Primary Medical Qualification
[ii]European Economic Area
[iii]Emergency Medicine
[iv]General Practice
[v]Obstetrics & Gynaecology

Table 2: The distribution of sanctions for each variable and the association of individual factors with sanctions.

Variable		Total number of doctors	Sanctions (%)	p-value
Sex				<0.001
	Male	196,814	1.1%	
	Female	132,728	0.4%	
No. of years since received PMQ[i]				<0.001
	0-2	15,162	0.1%	
	3-10	65,768	0.6%	
	11-20	92,460	0.8%	
	21-30	62,215	1.1%	
	31-40	42,342	1.4%	
	≥41	51,595	0.7%	
Region where received PMQ				<0.001
	UK	195,312	0.6%	
	EEA[ii]	41,213	0.9%	
	International	93,017	1.2%	
Specialty				<0.001
	No Specialty	168,124	0.7%	
	Anaesthetics	12,507	0.7%	
	EM[iii]	963	0.7%	
	GP[iv]	70,223	1.2%	
	Medicine	21,851	0.5%	
	O&G[v]	4,900	1.2%	
	Ophthalmology	3,586	0.5%	
	Paediatrics	7,797	0.6%	
	Pathology	8,554	0.6%	
	Psychiatry	8,571	0.8%	
	Radiology	213	0.5%	
	Surgery	18,394	0.9%	
	Other	2,197	0.3%	
	Dual Specialty	1,662	1.4%	

[i]Primary Medical Qualification
[ii]European Economic Area
[iii]Emergency Medicine
[iv]General Practice
[v]Obstetrics & Gynaecology

Table 3: The adjusted odds ratio for having sanctions against registration for each variable compared to its baseline having adjusted for all other variables.

Variable		Adjusted OR[i]	95% CI[ii]	p-value
Sex of a doctor				<0.0001
	Male	1		
	Female	0.37	0.33-0.41	
No. of years since received PMQ				<0.0001
	0-2	1		
	3-10	3.42	2.20-5.32	
	11-20	3.85	2.48-5.98	
	21-30	5.66	3.63-8.81	
	31-40	6.44	4.13-10.05	
	≥41	3.12	1.20-4.87	
Region where received PMQ				<0.0001
	UK	1		
	EEA	1.33	1.17-1.50	
	International	1.65	1.51-1.80	
Specialty				<0.0001
	No Specialty	1		
	Anaesthetics	0.65	0.52-0.82	
	EM	0.66	0.31-1.39	
	GP	1.43	1.29-1.58	
	Medicine	0.49	0.40-0.60	
	O&G	1.22	0.93-1.59	
	Ophthalmology	0.53	0.33-0.83	
	Paediatrics	0.64	0.47-0.88	
	Pathology	0.65	0.50-0.86	
	Psychiatry	0.81	0.63-1.04	
	Radiology	0.47	0.07-3.38	
	Surgery	0.78	0.66-0.93	
	Other	0.36	0.17-0.77	
	Dual Specialty	1.37	0.90-2.09	

[i] Odds Ratio
[ii] Confidence Interval

Table 4: Stratum-specific odds ratios for having sanctions imposed on registration if the doctor is female for each specialty divided into four categories.

Variable	Stratum-Specific OR[i]	95% CI[ii]	p-value
Specialty Category			<0.0001
No Specialty	0.43	0.38-0.49	
GP	0.26	0.22-0.31	
Hospital Specialty	0.44	0.36-0.56	
Dual Specialty	0.09	0.13-0.70	

[i] Odds Ratio
[ii] Confidence Interval

Table 5: The unadjusted and adjusted odds ratio for having each type of sanction against registration for a female doctor when compared to a male doctor.

	Model 1		Model 2[i]	
Sanction type	**Unadjusted OR[ii]**	**95% CI[iii]**	**Adjusted OR[ii]**	**95% CI[iii]**
Warning	0.29	0.24-0.35	0.30	0.25-0.36
Undertakings	0.64	0.52-0.79	0.66	0.53-0.81
Conditions	0.48	0.39-0.59	0.54	0.44-0.67
Suspended	0.28	0.21-0.36	0.32	0.25-0.42
Erased	0.21	0.17-0.27	0.26	0.21-0.34

[i] Model adjusted for number of years since received PMQ, region where received PMQ and specialty
[ii] Odds Ratio
[iii] Confidence Interval

Table 6: Stratum-specific odds ratios for having a warning imposed on registration if the doctor is female for each specialty divided into two categories.

Variable	**Stratum-Specific OR[i]**	**95% CI[ii]**	**p-value**
Specialty Category			0.0031
No Specialty	0.90	0.67-1.20	
On Specialist and/or GP Registers	0.48	0.35-0.65	

[i] Odds Ratio
[ii] Confidence Interval

Table 7: Stratum-specific odds ratios for being erased from the LRMP if the doctor is female for each region where received PMQ divided into two categories.

Variable	**Stratum-Specific OR[i]**	**95% CI[ii]**	**p-value**
Region where received PMQ Category			0.0301
EEA and/or International	0.32	0.24-0.44	
UK	0.18	0.11-0.28	

[i] Odds Ratio
[ii] Confidence Interva

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	**Y**
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	**Y**
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	**Y**
Objectives	3	State specific objectives, including any prespecified hypotheses	**Y**
Methods			
Study design	4	Present key elements of study design early in the paper	**Y**
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	**Y**
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	**Y**
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	**Y**
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	**Y**
Bias	9	Describe any efforts to address potential sources of bias	**N/A**
Study size	10	Explain how the study size was arrived at	**N/A**
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	**Y**
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	**Y**
		(*b*) Describe any methods used to examine subgroups and interactions	**Y**
		(*c*) Explain how missing data were addressed	**N/A**
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	**N/A**
		(*e*) Describe any sensitivity analyses	**N/A**
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	**N/A**
		(b) Give reasons for non-participation at each stage	**N/A**
		(c) Consider use of a flow diagram	**N/A**
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	**Y**
		(b) Indicate number of participants with missing data for each variable of interest	**N/A**
Outcome data	15*	Report numbers of outcome events or summary measures	**Y**
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	**Y**

		(*b*) Report category boundaries when continuous variables were categorized	**Y**
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	**N/A**
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	**Y**
Discussion			
Key results	18	Summarise key results with reference to study objectives	**Y**
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	**Y**
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	**Y**
Generalisability	21	Discuss the generalisability (external validity) of the study results	**Y**
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	**Y**

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Disciplined doctors: does the sex of a doctor matter? A cross-sectional study examining the association between a doctor's sex and receiving sanctions against their medical registration.

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Title Page

Disciplined doctors: does the sex of a doctor matter?

A cross-sectional study examining the association between a doctor's sex and receiving sanctions against their medical registration.

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Key words:
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Word count:
4767

Abstract

Objectives: To examine the association between doctors' sex and receiving sanctions on their medical registration, whilst controlling for other potentially confounding variables.

Design: Cross-sectional study.

Setting: The General Medical Council's (GMC) List of Registered Medical Practitioners (LRMP) database of doctors practising in the United Kingdom (UK).

Population: All doctors on the GMC's LRMP on 29th May 2013. The database included all doctors who are or have been registered to practice medicine in the UK since October 2005. The exposure of interest was doctor's sex. Confounding variables included years since primary medical qualification, world region of primary medical qualification and specialty.

Outcome measures: Sanctions on a doctor's medical registration. Sanction types included warning, undertakings, conditions, suspension or erasure from the register. Binary logistic regression modelling, controlling for the confounders, described the association between doctor's sex and sanctions on a doctor's medical registration.

Results: Of the 329,542 doctors on the LRMP, 2,697 doctors (0.8%) had sanctions against their registration, 516 (19.1%) of whom were female. In the fully adjusted model, female doctors had nearly a third of the odds (OR 0.37, 95% CI: 0.33-0.41) of having sanctions compared to male doctors. There was evidence that the association varies with specialty, with female doctors who had specialised as General Practitioners (GPs) being the least likely to receive sanctions compared to their male colleagues (OR 0.26, 95% CI: 0.22-0.31).

Conclusions: Female doctors have reduced odds of receiving sanctions on their medical registration when compared to their male colleagues. This association remained after adjustment for the confounding factors. These results are representative of all doctors registered to practice in the UK. Further exploration of why doctors' sex may impact their professional performance is underway.

Article summary

Strengths and limitations of this study

- We used a large national database with no missing data, so the findings of the study apply to all doctors registered to practise in the UK.
- Receiving sanctions is a rare outcome and using a large dataset is crucial when examining rare outcomes.
- This is one of the first studies of this nature on UK data that adjusted for known confounders.
- The study was constrained by the variables collected and made available by the GMC. So we were unable to examine the effect of other potential confounding factors.
- The data available did not provide the reasons for why a sanction had been imposed, nor data on those granted voluntary erasure. A more detailed evaluation of the reasons for referral to the GMC may go towards explaining the sex difference observed.

Introduction

The number of complaints about doctors' fitness to practise received by the UK medical regulatory body, the General Medical Council (GMC), has been increasing since 2007[1]. Following a triage and investigation process by the GMC the outcome of a case against a doctor can be closed, or can result in a sanction against the doctor's registration. The cost of this regulatory process, both in terms of financial cost of the actual complaints investigation procedure, but also in terms of the loss of the medical workforce during the process, can be significant. The level of stress that a doctor endures while undergoing a fitness to practise investigation was recently reported in the BMJ and highlights the impact the complaints investigation procedure can have on the mental well being of doctors[2].

One of the most significant changes in the medical profession has been the increase in the number of women entering this previously male dominated profession. The number of female medical students has been increasing since the mid-1960s with female medical students outnumbering male medical students since the mid-1990s[3]. It is predicted that female doctors will outnumber their male colleagues by 2017[3]. This change in the demographic profile of UK doctors has brought with it a heightened interest in how the increase of female doctors may impact the profession.

Examining and understanding the predictors of doctors receiving sanctions may aid the medical profession in identifying doctors whose performance might raise future concerns, in order to support these doctors and help prevent GMC referral. Research from Canada, the United States of America and Australia and New Zealand has suggested that male and female doctors differ in terms of risk of disciplinary action, with male doctors being at increased risk[4,5,6,7,8,9,10]. However, the applicability of the findings from these studies to the UK may be limited due to differences in both the medical and legal systems in these countries. In 2011 Wakeford explored the situation in the UK[11]. He examined the factors associated with severest outcomes of the GMC disciplinary procedures, suspension or erasure from the medical register. In agreement with these worldwide studies, he demonstrated that female doctors were four times less likely to be disciplined when compared to male doctors. However, the interpretation of this finding is limited because the measure of effect for doctors' sex was not adjusted for potential confounders.

We aimed to examine the effect of doctors' sex on receiving sanctions against their medical registration, while adjusting for known confounding factors. This would allow for a meaningful comparison of male and female doctors and their experience of disciplinary action in the UK.

Methods

Study design, setting and source of data

We conducted a cross-sectional study using UK-wide data. The data and permission to use the data for research purposes were obtained from the GMC. This study is part of a research project that has received ethical approval from the UCL Research Ethics Committee.

Under the Medical Act 1983 the GMC is required to keep up-to-date registers of qualified doctors. The main register is the List of Registered Medical Practitioners (LRMP). The LRMP is a list of all doctors registered to practise medicine in the UK, and as such changes daily. It lists those doctors who are (or could) practise medicine, as well as those doctors who have been suspended or erased. The GMC provided us with a snapshot of doctors registered on the LRMP on the 29th May 2013. The list included all doctors who have been registered with the GMC (and therefore eligible to actively practise medicine) at any point in the period 20th October 2005[a] – 28th May 2013. The different categories of registration status included: provisionally or fully registered; suspended; not registered – administrative reason, or deceased, or having relinquished registration; and not registered – erased after Fitness to Practise panel hearing. The database provided details of doctor's sex; the year, country, and institutions of the doctor's primary medical qualification and the doctor's current registration status, including whether they currently had any sanctions on their medical registration (see below for details). It classified doctors as General Practitioners (GPs) (on the GP register) and as hospital specialists (on the Specialist register). To become registered on the GP or Specialist registers a doctor must be a fully qualified consultant or GP (i.e. the doctor has successfully completed their Specialty Training). Doctors who are neither on the GP or Specialist registers can be primarily divided into two groups; the first being doctors who are currently undertaking a Specialty Training programme with the aim of becoming a GP or a consultant in a specialty; and the second group being composed of doctors in non-training posts. Non-training posts are doctors who are not fully qualified consultants or GPs. Non-training posts are focused to meet the National Health Service (NHS)

[a] The 20th October 2005 was the date when the GMC first began to publish full details of a doctor's registration status on the LRMP online.

service requirements and the doctors who choose to undertake a non-training post do so for a variety of reasons including difficulty in obtaining a place in a Specialty Training program due to the high competition, or doctors who prefer the work-life balance the non-training post can provide[12].

Population

All doctors who were listed on the LRMP on the 29th May 2013 were included.

Primary outcome and exposure

The outcome of interest was sanctions on a doctor's medical registration on the 29th May 2013.

The types of sanctions included:

- **Warning:** issued when a doctor's performance has not been in keeping with the principles set by the GMC for doctors, but a restriction on the doctor's registration is not necessary. Warnings remain on the LRMP for a five year period;
- **Undertakings:** an agreement between the GMC and the doctor about the doctor's future practice. The doctor must adhere to these undertakings to maintain their registration;
- **Conditions:** set out by the GMC and restrict a doctor's practice. The doctor must comply with these conditions to maintain their registration. Conditions can initially be imposed for a maximum of three years and then be renewed in periods of up to 36 months;
- **Suspension or erasure:** the doctor's licence is withdrawn by the GMC and they are no longer able to practise. Suspension from the register can last up to 12 months, but may be indefinite in certain circumstances.

A sanction can be imposed if a doctor's fitness to practise has been proved to be impaired. The impairment can result from misconduct; poor professional performance; physical or mental ill health; or a conviction or fitness to practise determination by another regulatory body either in the UK or overseas[13]. However it is recognised that the reason for impairment can cross more than one category (for example a doctor with a drug misuse problem could be classified as having mental ill health, yet the effects of the drug abuse could impact their professional performance). The duration of a sanction on a doctor's registration varies and it is possible for doctors to have more than one sanction against their registration and this typically represents the outcomes of different complaints (For further information on

sanctions visit http://www.gmc-uk.org/concerns/index.asp). It was not possible to establish the date a sanction was imposed or the reason for why a sanction had been imposed from the available data.

The outcome of interest was collapsed into a binary variable: doctors with sanctions against their registration; and doctors with no sanctions against their registration.

The exposure of interest was doctor's sex, as declared by the doctor to the GMC.

Selection of variables

The variables included in the study were selected before any statistical analysis. Data was available on the year of primary medical qualification (PMQ), country of PMQ and primary specialty, if on the Specialist or General Practitioner (GP) Registers. These variables were selected as a priori confounders based on findings from earlier research[7,8,11,14], which demonstrated that these factors may influence the risk of receiving sanctions.

Once the variables had been selected, we performed a variable reduction process, to reduce the number categories into meaningful categories. Once again, this was performed before any statistical analysis. The variable 'year of PMQ' was converted into 'number of years since qualification' by subtracting the year of PMQ from 2013 [b]. We then collapsed the variable into six categories. The first category '0-2 years' represented Foundation Training, the second category '3-10 years' represented the bulk of time a doctor would likely spend in Specialty Training. The subsequent categories were divided into 10-year blocks. The variable 'country of PMQ' was collapsed into three categories; 'UK', 'EEA' (European Economic Area) and 'International'. The list of countries included in the EEA category was obtained from the European Union website[15] and included all countries that were members before May 2013. The variable 'specialty' was divided into fourteen categories. Doctors who were not present on either the Specialist Register or the GP Register were categorised as having 'no specialty' and represented trainee and other non-specialist doctors. Doctors on both the Specialist Register and the GP Register were recorded as having 'dual specialty' and doctors only on the GP register were categorised as 'GP'. For doctors only registered on the Specialist Register, their primary specialty was taken and recorded into one of eleven categories. To categorise those doctors

[b] As mentioned above, a doctor could appear in the LRMP dataset if they had been removed from the medical register. The actual date of those doctors being removed could lie anytime between 20th October 2005 and 28th May 2013. However, as no actual removal dates were given for those doctors, we used 2013 for all doctors.

on the Specialist Register two researchers (EU and CW) independently allocated each primary specialty to a specialty category. Kappa statistic demonstrated a good level of agreement (kappa = 0.72). Any disagreements about specialty category allocation were resolved through discussion.

Statistical methods

We took a causal modelling analysis approach to analyse the data. We firstly performed bivariate analyses to look for crude associations in the data, followed by Mantel-Haenszel analyses, before going on to complete multivariate analyses using binary logistic regression modelling. The initial logistic regression model included only the exposure (sex) and outcome (sanctions) variables to provide a crude measure of effect. The final logistic regression model was built to include all potential confounder variables, while checking for multicollinearity. The final logistic regression model enabled the calculation of an adjusted measure of effect. The final model was assessed for the presence of effect modifiers following the findings from the Mantel-Haenszel analyses.

Statistical analyses were conducted using the software Stata 12/SE.

We used the STROBE Statement[16] to guide our study report.

Results

There were 329,542 doctors on the LRMP on the 29th May 2013, of whom 40.3% were female. Table 1 shows the distribution of variables by the sex of doctors. The median number of years since qualification was 19 years. The distribution of the number of years since a doctor had qualified was skewed to the right with the majority of the doctors qualifying 11-20 years ago (28.1%). The majority of the doctors had received their PMQ from a UK medical school (59.3%).

Approximately half of all the doctors were neither on the GP Register nor the Specialist Register (51.0%), of which the majority (58.0%) had received their PMQ greater than 10 years previously. It is interesting to note that half of the doctors registered to practise medicine in the UK in this period were not registered specialists (they were neither on the GP or Specialist registers) and the majority of these doctors had qualified greater than ten years ago, suggesting that these doctors are not trainee doctors, but doctors who have elected not to complete specialty training and are currently working in a non-training post. Of those doctors who had

specialised, General Practice was the most popular specialty (21.3%), followed by Medicine (6.6%). 0.5% of the doctors were on both the Specialist and GP Registers.

2697 (0.8%) doctors had sanctions against their registration on the 29th May 2013. There was a higher proportion of male doctors who had sanctions against their registration when compared to female doctors (1.1% of all male doctors compared with 0.4% of all female doctors, X^2=505.4, P<0.001). There was strong evidence for an association between receiving sanctions and the number of years since received PMQ, with doctors who qualified 31-40 years ago having the highest proportion of sanctions; world region of PMQ, with doctors who qualified outside the EEA with the highest proportion of doctors with sanctions; and specialty, with doctors on both the Specialist and GP Registers having the highest proportion of doctors with sanctions. These results are presented in Table 2.

Using bivariate analyses we compared female doctors to male doctors. There was a strong trend between sex of a doctor and the number of years since the doctor received their PMQ, with female doctors being more likely to have recently qualified and the proportion of female doctors reducing as the number of years since PMQ increased. We also found that female doctors were more likely to have qualified in the UK (65.5% of all female doctors compared to 55.0% of all male doctors) and male doctors were more likely to have qualified outside of the EEA (32.1% of all male doctors compared to 22.5% of all female doctors). Approximately equal proportions of male and female doctors qualified in the EEA (12.9% and 12.0% respectively). Both sexes were more likely to be not registered in a specialty (GP or hospital), though there was a slightly higher proportion of women when compared to men who were not on the Specialist or GP Registers. When examining those doctors who were registered in a specialty, a higher proportion of female doctors were on the GP Register compared to male doctors (24.3% of female doctors compared with 19.3% of male doctors) and a higher proportion of male doctors were registered with a hospital specialty (32.0% of male doctors compared with 20.1% of female doctors).
In summary, number of years since received PMQ, world region where PMQ was received, and registered specialty were associated with both the outcome (sanctions) and the exposure (sex of a doctor) and as such we considered these variables as confounders.

The unadjusted odds ratio for having sanctions against a doctor's registration comparing female doctors with male doctors was 0.35 (95% CI: 0.32-0.38), suggesting that being a female doctor is protective of receiving sanctions.

Mantel-Haenszel analyses and tests of homogeneity were conducted to examine the change in the strength of the association between sanctions and sex while controlling for each of the confounders separately.

There was strong evidence that the true odds ratios were different between the different specialty categories (P=0.0002), therefore specialty was considered as an effect modifier when conducting multivariate analyses.

Table 3 represents the results from the binary logistic regression model built to adjust for all the variables. After taking into account the number of years since PMQ, world region where the doctor received their PMQ and specialty, female doctors had nearly a third of the odds of having sanctions on their registration compared to male doctors (OR 0.37, 95% CI: 0.33-0.41, P<0.0001).

All of the a priori confounders were felt to be confounders because the adjusted odds ratio changed when each variable was added to the model. We found no evidence of multicollinearity.

The Mantel-Haenszel analyses suggested that specialty may be an effect modifier, we therefore performed a statistical test for effect modification by firstly collapsing the specialty variable into four groups to increase the power of the test. Table 4 demonstrates that specialty was felt to be an important effect modifier with female doctors being less likely to receive sanctions when compared to male doctors, but the effect was greater for GPs than for those doctors with no specialty or practising a hospital specialty.

Discussion

In our large cross-sectional study we found strong evidence that being female was associated with a reduction in odds of receiving sanctions (OR 0.35, 95% CI: 0.32-0.38) in the unadjusted model. Controlling for years since PMQ, world region where received PMQ, and specialty did slightly increase this odds ratio (OR 0.37, 95% CI: 0.33-0.41, P<0.0001), but there remained strong evidence for the association between doctor's sex and receiving sanctions. There was evidence that the association varied with specialty, with female GPs being the least likely to have sanctions against their registration.

To our knowledge this is the first study in the UK to examine the association between doctor's sex and receiving sanctions against medical registration, while adjusting for known confounders. We believe that these known confounders have only been adjusted for in one other study which was conducted in the USA[8].

Strengths and weaknesses of this study

One of the major strengths of this study is that we used a large national database. The advantage of using this dataset is two-fold; firstly, because a national database was used the findings of the study apply to all doctors registered to practise in the UK; secondly, receiving sanctions is a rare outcome and using a large dataset is crucial when examining rare outcomes.

A further strength of this study is that it adjusted for known confounders, all these confounders have only been adjusted for in one previous study, which was conducted in California[8]. Previous research on UK data did not adjust the measure of effect of sex for potential confounders[11].

Finally, a further advantage was the completeness of the dataset. The data is collected by the GMC for inclusion on the LRMP, and not research purposes. Doctors are required to provide the data to the GMC to be registered and as such there is no missing data. However, the fact the data is not collected for research purposes is also a limitation of the study. The study was constrained by the information collected and made available by the GMC. As such, we were only able to explore the variables available. We were unable to examine the effect of other potential confounding factors or explore the reasons for why a sanction had been imposed, nor were we able to establish the date a sanction had been imposed.

It could be argued that the reason for referral to the GMC could be a source of residual confounding if systematic differences exist between the sexes. The GMC may take action against a doctor's registration for a number of reasons, which can be broadly divided into three major categories; misconduct; poor professional performance; or physical or mental ill health. The data available did not provide the reasons or the category for why a sanction had been imposed, but a more detailed evaluation of the reasons for referral to the GMC may go towards explaining the sex difference observed. In their research, Alam et al.[4] and Elkin et al.[10], demonstrated not only that male doctors were more likely to be subject to disciplinary action, but that the main offense for which a doctor was being disciplined was sexual misconduct. It is possible that male doctors are more likely to commit an offense involving sexual misconduct than their female colleagues, which may go towards explaining the sex difference seen in these populations. However, other studies in

this area did not find sexual misconduct to be the most common offense[6,7,9]. As such, exploring the offenses for which a doctor may receive disciplinary action in this population may go towards explaining the sex difference observed and may help the regulatory body and medical profession to introduce targeted interventions, such as education programmes, to reduce the number of offenses.

A further source of residual confounding could be the route of referral. Doctors practising in the UK can be referred to the GMC through five main routes; the public; employers; doctors; the GMC; and the police[17]. It would be interesting to examine whether the referral rate for each route demonstrates any sex differences, and if so, exploring the reasons for this difference.

A further limitation is that a doctor can apply for voluntary erasure from the LRMP during an investigation process. Once again, this is a potential source of residual confounding and it is possible that the sex of doctors who are subject to a complaints investigation and apply for voluntary erasure differs to those doctors who complete the investigative process and receive a sanction (however, the GMC's decision to grant a request for voluntary erasure is based on the public interest and the doctor's health and likelihood to return to practise[18]). It is important to note that voluntary erasure is requested by doctors for multiple reasons other than being involved in an investigation process, including retiring permanently from practising medicine or leaving the UK to work permanently abroad. To explore whether voluntary erasure requests may explain the sex difference seen, the reason for why a voluntary erasure request was submitted would first have to be ascertained. This information was not available in the dataset used for this research, but could be requested and explored in future studies.

It is also of interest to note that certain sanctions (erasure and some suspensions) are permanent, whereas other sanctions are time limited. As such, the permanent sanctions may be over represented because they will never be removed from a doctor's registration. If male doctors are more likely to receive these permanent sanctions, this could lead to male doctors being over represented when examining the association between sex and sanctions, and may go towards explaining the sex difference observed between doctors who had sanctions imposed against their registration.

Finally, a further limitation of the study is that nearly half of the doctors in the population were not recorded on the GP or Specialist registers and were therefore classified as not having a specialty. Doctors who are not on the GP or Specialist registers typically fall into one of two categories; either a doctor who is on a Specialty Training programme with the aim of becoming a GP or a consultant in a specialty; or

doctors who have chosen to work in a non-training post. It was not possible from the information made available by the GMC to examine these two categories. It would be of interest to explore if the proportions of male and female doctors differ in these two categories and to examine whether the risk of disciplinary action differs for doctors who are in a Specialty Training post compared to doctors who are working in a non-training post. It would also be of interest if further information about the type of non-training post these doctors were working in and to examine the association with receiving sanctions.

Comparison with other studies

Our main finding, that female doctors are less likely to be subject to disciplinary action when compared to their male colleagues, mirrors the results of several studies from across the world which have also examined the association between doctors' sex and disciplinary action[4,6,7,8,9,10,11]. However, the majority of these studies have been performed in the United States of America[6,7,8,9], Canada[4], Australia and New Zealand[10], where the medical and legal systems differ to the UK and therefore we felt that their findings may not be applicable to the UK population of doctors. These studies' main objective was not necessarily to explore the association between doctors' sex and disciplinary action. Some of these studies were descriptive and those studies that did control for confounders did not, albeit for one study[8], control for the same confounders we have selected. To our knowledge, one study has been performed in the UK using national data[11], however when examining the association between doctors' sex and disciplinary action this study did not control for any potential confounders.

The findings of this study are in agreement with previous research that has shown that older doctors[8], doctors who qualified outside of the country in which they are practising[11,14] and doctors of certain specialties[7] are more likely to be subjected to disciplinary action from a medical regulatory board. It has also been demonstrated in previous studies that female doctors are more likely to be have qualified more recently than male doctors[3], are more likely to have qualified in the country in which they are practising[19] and choose different specialties to male doctors[20].

This study showed that the reason that male doctors receive more sanctions is not because they qualified longer ago, nor because they are more likely to have qualified outside the UK, despite both of those factors being associated with increased likelihood of sanctions.

Unanswered questions and future research

This study has demonstrated that female doctors are less likely to receive sanctions against their medical registration compared to male doctors, however it is not clear why women are less likely to receive sanctions when compared to men. Exploring the possible reasons for this sex difference in professional performance is required, using a theoretical based approach. One theory suggested by some researchers is that male and female doctors differ in communication style and hence the interaction with patients and colleagues differed between the sexes, which could affect the risk of being subject to a complaint[21,22]. Future research could be performed to explore this further and examine whether communication styles differ between male and female doctors, and also whether the communication styles of doctors who receive sanctions differ from doctors who have never received sanctions.

We have also demonstrated that the effect of sex on likelihood to receive sanctions varied by specialty, with female GPs being the least likely to receive sanctions. It has been demonstrated by an observational study of primary care physicians in the USA that female primary care physicians spend more time with their patients when compared to their male colleagues and they engaged more in conversation, displaying more positive-talk, partnership-building, question-asking and information-giving[23]. These differences in communication style and time spent with patients may go towards explaining the larger sex discrepancy observed in GPs, however future research is required to explore these possible reasons further.

Our results show that doctors who had been qualified for longer were more likely to receive sanctions, it is therefore reasonable to hypothesise that the risk of receiving a sanction increases with exposure. Therefore doctors who have fewer patient encounters may be less likely to receive sanctions against their registration. Previous studies have demonstrated that female consultants have fewer patient episodes and are more likely to work part-time (and thus have fewer patient encounters) when compared to their male colleagues[24,25], it is therefore reasonable to hypothesise that the sex difference observed in disciplinary action may be partly explained by the difference in work patterns between the sexes. This hypothesis merits being explored further by examining whether certain work patterns (i.e. part-time compared to full-time work) are more likely to be associated with receiving sanctions.

A further possible explanation for the sex difference observed is perhaps that male and female doctors are viewed and treated differently by the public, the profession and the regulatory body. It is possible that there is a higher threshold of tolerance for female doctors. The GMC are twice as likely to receive a complaint about a male doctor than a female doctor[17]. It is reasonable to assume that as a result male doctors are more likely to receive sanctions against their medical registration. Research examining the perception of male and female doctors would be warranted.

It should also be noted that this study was observational in design and as such causality cannot be determined. It is possible that other factors, such as ethnicity, may be confounding the association between doctors' sex and disciplinary action. Research examining whether other potential confounders could explain the observed association is required

The points discussed above highlight that the real interest of this research is not about the outcome sanctions itself, but about trying to understand the differences between male and female doctors that lead to the observed sex difference in receiving sanctions. Investigations into why and how male and female medical practises differ will in turn lead to being able to propose interventions to reduce not only the number of doctors referred to the medical regulatory body, but also the difference between the sexes of doctors who are referred. Further exploration of why doctors' sex may impact their professional performance is needed to enable the profession to develop a better understanding of the factors associated with impaired fitness to practise and crucially, how to better support those doctors and ensure patient safety.

Conclusion

In this study we demonstrated that female doctors practising in the UK were less likely to receive sanctions on their medical registration when compared with their male colleagues. These findings remained after adjusting for known confounders. Reasons for why this sex difference exists needs to be examined.

Footnotes

Acknowledgements

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Contributorship statement: EU conceived and designed the study with input from KW and JD. EU and CW categorised the data. EU analysed and interpreted the data with support from KW. EU drafted the manuscript and all authors participated in the revision process and have approved this submission for publication. EU is guarantor, had full access to all of the data in the study, and can take responsibility for the integrity of the data and the accuracy of the data analysis.

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Ethical approval: The study is part of a research project that has received ethical approval from the UCL Research Ethics Committee.

Data sharing statement: No additional data available.

Transparency declaration: EU, as guarantor, affirms that this manuscript is an honest, accurate and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

Contribution, ii) translate the Contribution into other languages, create adaptations, reprints, include within collections and create summaries, extracts and/or, abstracts of the Contribution, iii) create any other derivative work(s) based on the Contribution, iv) to exploit all subsidiary rights in the Contribution, v) the inclusion of electronic links from the Contribution to third party material where-ever it may be located; and, iv) licence any third party to do any or all of the above.

Table 1: Distribution of variables by sex of doctors.

Variable		Male N=196,814	Female N=132,728	Total N=329,542
Sanction imposed on registration				
	No	194,633 (98.9%)	132,212 (99.6%)	326,845 (99.2%)
	Yes	2,181 (1.1%)	516 (0.4%)	2,697 (0.8%)
No. of years since received PMQ[i]				
	0-2 years	6,332 (3.2%)	8,830 (6.7%)	15,162 (4.6%)
	3-10 years	28,548 (14.5%)	37,220 (28.0%)	65,768 (20.0%)
	11-20 years	52,437 (26.6%)	40,023 (30.2%)	92,460 (28.1%)
	21-30 years	39,146 (19.9%)	23,069 (17.4%)	62,215 (18.9%)
	31-40 years	30,206 (15.4%)	12,136 (9.1%)	42,342 (12.9%)
	≥41 years	40,145 (20.4%)	11,450 (8.6%)	51,595 (15.7%)
Region where received PMQ				
	UK	108,323 (55.0%)	86,989 (65.5%)	195,312 (59.3%)
	EEA[ii]	25,333 (12.9%)	15,880 (12.0%)	41,213 (12.5%)
	International	63,158 (32.1%)	29,859 (22.5%)	93,017 (28.2%)
Specialty				
	No Specialty	94,815 (48.2%)	73,309 (55.2%)	168,124 (51.0%)
	Anaesthetics	8,710 (4.4%)	3,797 (2.9%)	12,507 (3.8%)
	EM[iii]	754 (0.4%)	209 (0.2%)	963 (0.3%)
	GP[iv]	37,959 (19.3%)	32,264 (24.3%)	70,223 (21.3%)
	Medicine	15,076 (7.7%)	6,775 (5.1%)	21,851 (6.6%)
	O&G[v]	2,934 (1.5%)	1,966 (1.5%)	4,900 (1.5%)
	Ophthalmology	2,508 (1.3%)	1,078 (0.8%)	3,586 (1.1%)
	Paediatrics	3,906 (2.0%)	3,891 (2.9%)	7,797 (2.4%)
	Pathology	5,589 (2.8%)	2,965 (2.2%)	8,554 (2.6%)
	Psychiatry	5,494 (2.8%)	3,077 (2.3%)	8,571 (2.6%)
	Radiology	172 (0.1%)	41 (0.03%)	213 (0.1%)
	Surgery	16,452 (8.4%)	1,942 (1.5%)	18,394 (5.6%)
	Other	1,330 (0.7%)	867 (0.7%)	2,197 (0.7%)
	Dual Specialty	1,115 (0.6%)	547 (0.4%)	1,662 (0.5%)

[i]Primary Medical Qualification
[ii]European Economic Area
[iii]Emergency Medicine
[iv]General Practice
[v]Obstetrics & Gynaecology

Table 2: The distribution of sanctions for each variable and the association of individual factors with sanctions.

Variable		Total number of doctors	Sanctions (%)	p-value
Sex				<0.001
	Male	196,814	1.1%	
	Female	132,728	0.4%	
No. of years since received PMQ[i]				<0.001
	0-2	15,162	0.1%	
	3-10	65,768	0.6%	
	11-20	92,460	0.8%	
	21-30	62,215	1.1%	
	31-40	42,342	1.4%	
	≥41	51,595	0.7%	
Region where received PMQ				<0.001
	UK	195,312	0.6%	
	EEA[ii]	41,213	0.9%	
	International	93,017	1.2%	
Specialty				<0.001
	No Specialty	168,124	0.7%	
	Anaesthetics	12,507	0.7%	
	EM[iii]	963	0.7%	
	GP[iv]	70,223	1.2%	
	Medicine	21,851	0.5%	
	O&G[v]	4,900	1.2%	
	Ophthalmology	3,586	0.5%	
	Paediatrics	7,797	0.6%	
	Pathology	8,554	0.6%	
	Psychiatry	8,571	0.8%	
	Radiology	213	0.5%	
	Surgery	18,394	0.9%	
	Other	2,197	0.3%	
	Dual Specialty	1,662	1.4%	

[i]Primary Medical Qualification
[ii]European Economic Area
[iii]Emergency Medicine
[iv]General Practice
[v]Obstetrics & Gynaecology

Table 3: The adjusted odds ratio for having sanctions against registration for each variable compared to its baseline having adjusted for all other variables.

Variable		Adjusted OR[i]	95% CI[ii]	p-value
Sex of a doctor				<0.0001
	Male	1		
	Female	0.37	0.33-0.41	
No. of years since received PMQ				<0.0001
	0-2	1		
	3-10	3.42	2.20-5.32	
	11-20	3.85	2.48-5.98	
	21-30	5.66	3.63-8.81	
	31-40	6.44	4.13-10.05	
	≥41	3.12	1.20-4.87	
Region where received PMQ				<0.0001
	UK	1		
	EEA	1.33	1.17-1.50	
	International	1.65	1.51-1.80	
Specialty				<0.0001
	No Specialty	1		
	Anaesthetics	0.65	0.52-0.82	
	EM	0.66	0.31-1.39	
	GP	1.43	1.29-1.58	
	Medicine	0.49	0.40-0.60	
	O&G	1.22	0.93-1.59	
	Ophthalmology	0.53	0.33-0.83	
	Paediatrics	0.64	0.47-0.88	
	Pathology	0.65	0.50-0.86	
	Psychiatry	0.81	0.63-1.04	
	Radiology	0.47	0.07-3.38	
	Surgery	0.78	0.66-0.93	
	Other	0.36	0.17-0.77	
	Dual Specialty	1.37	0.90-2.09	

[i] Odds Ratio
[ii] Confidence Interval

Table 4: Stratum-specific odds ratios for having sanctions imposed on registration if the doctor is female for each specialty divided into four categories.

Variable	Stratum-Specific OR[i]	95% CI[ii]	p-value
Specialty Category			<0.0001
No Specialty	0.43	0.38-0.49	
GP	0.26	0.22-0.31	
Hospital Specialty	0.44	0.36-0.56	
Dual Specialty	0.09	0.13-0.70	

[i] Odds Ratio
[ii] Confidence Interval

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Title Page

Disciplined doctors: does the sex of a doctor matter?

A cross-sectional study examining the association between a doctor's sex and receiving sanctions against their medical registration.

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Abstract

Objectives: To examine the association between doctors' sex and receiving sanctions on their medical registration, whilst controlling for other potentially confounding variables.

Design: Cross-sectional study.

Setting: The General Medical Council's (GMC) List of Registered Medical Practitioners (LRMP) database of doctors practising in the United Kingdom (UK).

Population: All doctors on the GMC's LRMP on 29th May 2013. The database included all doctors who are or have been registered to practice medicine in the UK since October 2005. The exposure of interest was doctor's sex. Confounding variables included years since primary medical qualification, world region of primary medical qualification and specialty.

Outcome measures: Sanctions on a doctor's medical registration. Sanction types included warning, undertakings, conditions, suspension or erasure from the register. Binary logistic regression modelling, controlling for the confounders, described the association between doctor's sex and sanctions on a doctor's medical registration.

Results: Of the 329,542 doctors on the LRMP, 2,697 doctors (0.8%) had sanctions against their registration, 516 (19.1%) of whom were female. In the fully adjusted model, female doctors had nearly a third of the odds (OR 0.37, 95% CI: 0.33-0.41) of having sanctions compared to male doctors. There was evidence that the association varies with specialty, with female doctors who had specialised as General Practitioners (GPs) being the least likely to receive sanctions compared to their male colleagues (OR 0.26, 95% CI: 0.22-0.31).

Conclusions: Female doctors have reduced odds of receiving sanctions on their medical registration when compared to their male colleagues. This association remained after adjustment for the confounding factors. These results are representative of all doctors registered to practice in the UK. Further exploration of why doctors' sex may impact their professional performance is underway.

Article summary

Strengths and limitations of this study

- We used a large national database with no missing data, so the findings of the study apply to all doctors registered to practise in the UK.
- Receiving sanctions is a rare outcome and using a large dataset is crucial when examining rare outcomes.
- This is one of the first studies of this nature on UK data that adjusted for known confounders.
- The study was constrained by the variables collected and made available by the GMC. So we were unable to examine the effect of other potential confounding factors.
- The data available did not provide the reasons for why a sanction had been imposed, nor data on those granted voluntary erasure. A more detailed evaluation of the reasons for referral to the GMC may go towards explaining the sex difference observed.

Introduction

The number of complaints about doctors' fitness to practise received by the UK medical regulatory body, the General Medical Council (GMC), has been increasing since 2007[1]. Following a triage and investigation process by the GMC the outcome of a case against a doctor can be closed, or can result in a sanction against the doctor's registration. The cost of this regulatory process, both in terms of financial cost of the actual complaints investigation procedure, but also in terms of the loss of the medical workforce during the process, can be significant. The level of stress that a doctor endures while undergoing a fitness to practise investigation was recently reported in the BMJ and highlights the impact the complaints investigation procedure can have on the mental well being of doctors[2].

One of the most significant changes in the medical profession has been the increase in the number of women entering this previously male dominated profession. The number of female medical students has been increasing since the mid-1960s with female medical students outnumbering male medical students since the mid-1990s[3]. It is predicted that female doctors will outnumber their male colleagues by 2017[3]. This change in the demographic profile of UK doctors has brought with it a heightened interest in how the increase of female doctors may impact the profession.

Examining and understanding the predictors of doctors receiving sanctions may aid the medical profession in identifying doctors whose performance might raise future concerns, in order to support these doctors and help prevent GMC referral. Research from Canada, the United States of America and Australia and New Zealand has suggested that male and female doctors differ in terms of risk of disciplinary action, with male doctors being at increased risk[4,5,6,7,8,9,10]. However, the applicability of the findings from these studies to the UK may be limited due to differences in both the medical and legal systems in these countries. In 2011 Wakeford explored the situation in the UK[11]. He examined the factors associated with severest outcomes of the GMC disciplinary procedures, suspension or erasure from the medical register. In agreement with these worldwide studies, he demonstrated that female doctors were four times less likely to be disciplined when compared to male doctors. However, the interpretation of this finding is limited because the measure of effect for doctors' sex was not adjusted for potential confounders.

We aimed to examine the effect of doctors' sex on receiving sanctions against their medical registration, while adjusting for known confounding factors. This would allow for a meaningful comparison of male and female doctors and their experience of disciplinary action in the UK.

Methods

Study design, setting and source of data

We conducted a cross-sectional study using UK-wide data. The data and permission to use the data for research purposes were obtained from the GMC. This study is part of a research project that has received ethical approval from the UCL Research Ethics Committee.

Under the Medical Act 1983 the GMC is required to keep up-to-date registers of qualified doctors. The main register is the List of Registered Medical Practitioners (LRMP). The LRMP is a list of all doctors registered to practise medicine in the UK, and as such changes daily. It lists those doctors who are (or could) practise medicine, as well as those doctors who have been suspended or erased. The GMC provided us with a snapshot of doctors registered on the LRMP on the 29th May 2013. The list included all doctors who have been registered with the GMC (and therefore eligible to actively practise medicine) at any point in the period 20th October 2005[a] – 28th May 2013. The different categories of registration status included: provisionally or fully registered; suspended; not registered – administrative reason, or deceased, or having relinquished registration; and not registered – erased after Fitness to Practise panel hearing. The database provided details of doctor's sex; the year, country, and institutions of the doctor's primary medical qualification and the doctor's current registration status, including whether they currently had any sanctions on their medical registration (see below for details). It classified doctors as General Practitioners (GPs) (on the GP register) and as hospital specialists (on the Specialist register). To become registered on the GP or Specialist registers a doctor must be a fully qualified consultant or GP (i.e. the doctor has successfully completed their Specialty Training). Doctors who are neither on the GP or Specialist registers can be primarily divided into two groups; the first being doctors who are currently undertaking a Specialty Training programme with the aim of becoming a GP or a consultant in a specialty; and the second group being composed of doctors in non-training posts~~are doctors who have not undertaken or completed speciality training.~~ Non-training posts are doctors who are not fully qualified consultants or GPs. Non-

[a] The 20th October 2005 was the date when the GMC first began to publish full details of a doctor's registration status on the LRMP online.

training posts are focused to meet the National Health Service (NHS) service requirements and the doctors who choose to undertake a non-training post do so for a variety of reasons including difficulty in obtaining a place in a Specialty Training program due to the high competition, or doctors who prefer the work-life balance the non-training post can provide[12].

Population

All doctors who were listed on the LRMP on the 29th May 2013 were included.

Primary outcome and exposure

The outcome of interest was sanctions on a doctor's medical registration on the 29th May 2013.

The types of sanctions included:

- **Warning:** issued when a doctor's performance has not been in keeping with the principles set by the GMC for doctors, but a restriction on the doctor's registration is not necessary. Warnings remain on the LRMP for a five year period;
- **Undertakings:** an agreement between the GMC and the doctor about the doctor's future practice. The doctor must adhere to these undertakings to maintain their registration;
- **Conditions:** set out by the GMC and restrict a doctor's practice. The doctor must comply with these conditions to maintain their registration. Conditions can initially be imposed for a maximum of three years and then be renewed in periods of up to 36 months;
- **Suspension or erasure:** the doctor's licence is withdrawn by the GMC and they are no longer able to practise. Suspension from the register can last up to 12 months, but may be indefinite in certain circumstances.

A sanction can be imposed if a doctor's fitness to practise has been proved to be impaired. The impairment can result from misconduct; poor professional performance; physical or mental ill health; or a conviction or fitness to practise determination by another regulatory body either in the UK or overseas[13]. However it is recognised that the reason for impairment can cross more than one category (for example a doctor with a drug misuse problem could be classified as having mental ill health, yet the effects of the drug abuse could impact their professional performance). The duration of a sanction on a doctor's registration varies and it is possible for doctors to have more than one sanction against their registration and this

typically represents the outcomes of different complaints. (For further information on sanctions visit http://www.gmc-uk.org/concerns/index.asp). It was not possible to establish the date a sanction was imposed or the reason for why a sanction had been imposed from the available data.

The outcome of interest was collapsed into a binary variable: doctors with sanctions against their registration; and doctors with no sanctions against their registration.

The exposure of interest was doctor's sex, as declared by the doctor to the GMC.

Selection of variables

The variables included in the study were selected before any statistical analysis. Data was available on the year of primary medical qualification (PMQ), country of PMQ and primary specialty, if on the Specialist or General Practitioner (GP) Registers. These variables were selected as a priori confounders based on findings from earlier research[7,8,11,14], which demonstrated that these factors may influence the risk of receiving sanctions.

Once the variables had been selected, we performed a variable reduction process, to reduce the number categories into meaningful categories. Once again, this was performed before any statistical analysis. The variable 'year of PMQ' was converted into 'number of years since qualification' by subtracting the year of PMQ from 2013 [b]. We then collapsed the variable into six categories. The first category '0-2 years' represented Foundation Training, the second category '3-10 years' represented the bulk of time a doctor would likely spend in Specialty Training. The subsequent categories were divided into 10-year blocks. The variable 'country of PMQ' was collapsed into three categories; 'UK', 'EEA' (European Economic Area) and 'International'. The list of countries included in the EEA category was obtained from the European Union website[15] and included all countries that were members before May 2013. The variable 'specialty' was divided into fourteen categories. Doctors who were not present on either the Specialist Register or the GP Register were categorised as having 'no specialty' and represented trainee and other non-specialist doctors. Doctors on both the Specialist Register and the GP Register were recorded as having 'dual specialty' and doctors only on the GP register were categorised as 'GP'. For doctors only registered on the Specialist Register, their primary specialty

[b] As mentioned above, a doctor could appear in the LRMP dataset if they had been removed from the medical register. The actual date of those doctors being removed could lie anytime between 20th October 2005 and 28th May 2013. However, as no actual removal dates were given for those doctors, we used 2013 for all doctors.

was taken and recorded into one of eleven categories. To categorise those doctors on the Specialist Register two researchers (EU and CW) independently allocated each primary specialty to a specialty category. Kappa statistic demonstrated a good level of agreement (kappa = 0.72). Any disagreements about specialty category allocation were resolved through discussion.

Statistical methods

We took a causal modelling analysis approach to analyse the data. We firstly performed bivariate analyses to look for crude associations in the data, followed by Mantel-Haenszel analyses, before going on to complete multivariate analyses using binary logistic regression modelling. The initial logistic regression model included only the exposure (sex) and outcome (sanctions) variables to provide a crude measure of effect. The final logistic regression model was built to include all potential confounder variables, while checking for multicollinearity. The final logistic regression model enabled the calculation of an adjusted measure of effect. The final model was assessed for the presence of effect modifiers following the findings from the Mantel-Haenszel analyses.

Statistical analyses were conducted using the software Stata 12/SE.

We used the STROBE Statement[16] to guide our study report.

Results

There were 329,542 doctors on the LRMP on the 29th May 2013, of whom 40.3% were female. Table 1 shows the distribution of variables by the sex of doctors. The median number of years since qualification was 19 years. The distribution of the number of years since a doctor had qualified was skewed to the right with the majority of the doctors qualifying 11-20 years ago (28.1%). The majority of the doctors had received their PMQ from a UK medical school (59.3%).

Approximately half of all the doctors were neither on the GP Register nor the Specialist Register (51.0%), of which the majority (58.0%) had received their PMQ greater than 10 years previously. It is interesting to note that half of the doctors registered to practise medicine in the UK in this period were not registered specialists (they were neither on the GP or Specialist registers) and the majority of these doctors had qualified greater than ten years ago, suggesting that these doctors are not trainee doctors, but doctors who have elected not to complete specialty training and are currently working in a non-training post. Of those doctors who had

specialised, General Practice was the most popular specialty (21.3%), followed by Medicine (6.6%). 0.5% of the doctors were on both the Specialist and GP Registers.

2697 (0.8%) doctors had sanctions against their registration on the 29th May 2013. There was a higher proportion of male doctors who had sanctions against their registration when compared to female doctors (1.1% of all male doctors compared with 0.4% of all female doctors, X^2=505.4, P<0.001). There was strong evidence for an association between receiving sanctions and the number of years since received PMQ, with doctors who qualified 31-40 years ago having the highest proportion of sanctions; world region of PMQ, with doctors who qualified outside the EEA with the highest proportion of doctors with sanctions; and specialty, with doctors on both the Specialist and GP Registers having the highest proportion of doctors with sanctions. These results are presented in Table 2.

Using bivariate analyses we compared female doctors to male doctors. There was a strong trend between sex of a doctor and the number of years since the doctor received their PMQ, with female doctors being more likely to have recently qualified and the proportion of female doctors reducing as the number of years since PMQ increased. We also found that female doctors were more likely to have qualified in the UK (65.5% of all female doctors compared to 55.0% of all male doctors) and male doctors were more likely to have qualified outside of the EEA (32.1% of all male doctors compared to 22.5% of all female doctors). Approximately equal proportions of male and female doctors qualified in the EEA (12.9% and 12.0% respectively). Both sexes were more likely to be not registered in a specialty (GP or hospital), though there was a slightly higher proportion of women when compared to men who were not on the Specialist or GP Registers. When examining those doctors who were registered in a specialty, a higher proportion of female doctors were on the GP Register compared to male doctors (24.3% of female doctors compared with 19.3% of male doctors) and a higher proportion of male doctors were registered with a hospital specialty (32.0% of male doctors compared with 20.1% of female doctors).
In summary, number of years since received PMQ, world region where PMQ was received, and registered specialty were associated with both the outcome (sanctions) and the exposure (sex of a doctor) and as such we considered these variables as confounders.

The unadjusted odds ratio for having sanctions against a doctor's registration comparing female doctors with male doctors was 0.35 (95% CI: 0.32-0.38), suggesting that being a female doctor is protective of receiving sanctions.

Mantel-Haenszel analyses and tests of homogeneity were conducted to examine the change in the strength of the association between sanctions and sex while controlling for each of the confounders separately.

There was strong evidence that the true odds ratios were different between the different specialty categories (P=0.0002), therefore specialty was considered as an effect modifier when conducting multivariate analyses.

Table 3 represents the results from the binary logistic regression model built to adjust for all the variables. After taking into account the number of years since PMQ, world region where the doctor received their PMQ and specialty, female doctors had nearly a third of the odds of having sanctions on their registration compared to male doctors (OR 0.37, 95% CI: 0.33-0.41, P<0.0001).

All of the a priori confounders were felt to be confounders because the adjusted odds ratio changed when each variable was added to the model. We found no evidence of multicollinearity.

The Mantel-Haenszel analyses suggested that specialty may be an effect modifier, we therefore performed a statistical test for effect modification by firstly collapsing the specialty variable into four groups to increase the power of the test. Table 4 demonstrates that specialty was felt to be an important effect modifier with female doctors being less likely to receive sanctions when compared to male doctors, but the effect was greater for GPs than for those doctors with no specialty or practising a hospital specialty.

Discussion

In our large cross-sectional study we found strong evidence that being female was associated with a reduction in odds of receiving sanctions (OR 0.35, 95% CI: 0.32-0.38) in the unadjusted model. Controlling for years since PMQ, world region where received PMQ, and specialty did slightly increase this odds ratio (OR 0.37, 95% CI: 0.33-0.41, P<0.0001), but there remained strong evidence for the association between doctor's sex and receiving sanctions. There was evidence that the association varied with specialty, with female GPs being the least likely to have sanctions against their registration.

To our knowledge this is the first study in the UK to examine the association between doctor's sex and receiving sanctions against medical registration, while adjusting for known confounders. We believe that these known confounders have only been adjusted for in one other study which was conducted in the USA[8].

Strengths and weaknesses of this study

One of the major strengths of this study is that we used a large national database. The advantage of using this dataset is two-fold; firstly, because a national database was used the findings of the study apply to all doctors registered to practise in the UK; secondly, receiving sanctions is a rare outcome and using a large dataset is crucial when examining rare outcomes.

A further strength of this study is that it adjusted for known confounders, all these confounders have only been adjusted for in one previous study, which was conducted in California[8]. Previous research on UK data did not adjust the measure of effect of sex for potential confounders[11].

Finally, a further advantage was the completeness of the dataset. The data is collected by the GMC for inclusion on the LRMP, and not research purposes. Doctors are required to provide the data to the GMC to be registered and as such there is no missing data. However, the fact the data is not collected for research purposes is also a limitation of the study. The study was constrained by the information~~variables~~ collected and made available by the GMC. As such, we were only able to explore the variables available. W~~and w~~e were unable to examine the effect of other potential confounding factors or explore the reasons for why a sanction had been imposed, nor were we able to establish the date a sanction had been imposed.

It could be argued that the reason for referral to the GMC could be a source of residual confounding if systematic differences exist between the sexes. The GMC may take action against a doctor's registration for a number of reasons, which can be broadly divided into three major categories; misconduct; poor professional performance; or physical or mental ill health. The data available did not provide the reasons or the category for why a sanction had been imposed, but a more detailed evaluation of the reasons for referral to the GMC may go towards explaining the sex difference observed. In their research, Alam et al.[4] and Elkin et al.[10], demonstrated not only that male doctors were more likely to be subject to disciplinary action, but that the main offense for which a doctor was being disciplined was sexual misconduct. It is possible that male doctors are more likely to commit an offense involving sexual misconduct than their female colleagues, which may go towards

explaining the sex difference seen in these populations. However, other studies in this area did not find sexual misconduct to be the most common offense[6,7,9]. As such, exploring the offenses for which a doctor may receive disciplinary action in this population may go towards explaining the sex difference observed and may help the regulatory body and medical profession to introduce targeted interventions, such as education programmes, to reduce the number of offenses.

A further source of residual confounding could be the route of referral. Doctors practising in the UK can be referred to the GMC through five main routes; the public; employers; doctors; the GMC; and the police[17]. It would be interesting to examine whether the referral rate for each route demonstrates any sex differences, and if so, exploring the reasons for this difference.

A further limitation is that a doctor can apply for voluntary erasure from the LRMP during an investigation process. Once again, this is a potential source of residual confounding and it is possible that the sex of doctors who are subject to a complaints investigation and apply for voluntary erasure differs to those doctors who complete the investigative process and receive a sanction (however, the GMC's decision to grant a request for voluntary erasure is based on the public interest and the doctor's health and likelihood to return to practise[18]). It is important to note that voluntary erasure is requested by doctors for multiple reasons other than being involved in an investigation process, including retiring permanently from practising medicine or leaving the UK to work permanently abroad. To explore whether voluntary erasure requests may explain the sex difference seen, the reason for why a voluntary erasure request was submitted would first have to be ascertained. This information was not available in the dataset used for this research, but could be requested and explored in future studies.

It is also of interest to note that certain sanctions (erasure and some suspensions) are permanent, whereas other sanctions are time limited. As such, the permanent sanctions may be over represented because they will never be removed from a doctor's registration. If male doctors are more likely to receive these permanent sanctions, this could lead to male doctors being over represented when examining the association between sex and sanctions, and may go towards explaining the sex difference observed between doctors who had sanctions imposed against their registration.

Finally, a further limitation of the study is that nearly half of the doctors in the population were not recorded on the GP or Specialist registers and were therefore classified as not having a specialty. Doctors who are not on the GP or Specialist registers typically fall into one of two categories; either a doctor who is on a Specialty

Training programme with the aim of becoming a GP or a consultant in a specialty; or doctors who have chosen to work in a non-training post. It was not possible from the information made available by the GMC to examine these two categories. It would be of interest to explore if the proportions of male and female doctors differ in these two categories and to examine whether the risk of disciplinary action differs for doctors who are in a Specialty Training post compared to doctors who are working in a non-training post. It would also be of interest if further information about the type of non-training post these doctors were working in and to examine the association with receiving sanctions.

Comparison with other studies

Our main finding, that female doctors are less likely to be subject to disciplinary action when compared to their male colleagues, mirrors the results of several studies from across the world which have also examined the association between doctors' sex and disciplinary action[4,6,7,8,9,10,11]. However, the majority of these studies have been performed in the United States of America[6,7,8,9], Canada[4], Australia and New Zealand[10], where the medical and legal systems differ to the UK and therefore we felt that their findings may not be applicable to the UK population of doctors. These studies' main objective was not necessarily to explore the association between doctors' sex and disciplinary action. Some of these studies were descriptive and those studies that did control for confounders did not, albeit for one study[8], control for the same confounders we have selected. To our knowledge, one study has been performed in the UK using national data[11], however when examining the association between doctors' sex and disciplinary action this study did not control for any potential confounders.

The findings of this study are in agreement with previous research that has shown that older doctors[8], doctors who qualified outside of the country in which they are practising[11,14] and doctors of certain specialties[7] are more likely to be subjected to disciplinary action from a medical regulatory board. It has also been demonstrated in previous studies that female doctors are more likely to be have qualified more recently than male doctors[3], are more likely to have qualified in the country in which they are practising[19] and choose different specialties to male doctors[20].

This study showed that the reason that male doctors receive more sanctions is not because they qualified longer ago, nor because they are more likely to have qualified outside the UK, despite both of those factors being associated with increased likelihood of sanctions.

Unanswered questions and future research

This study has demonstrated that female doctors are less likely to receive sanctions against their medical registration compared to male doctors, however it is not clear why women are less likely to receive sanctions when compared to men. Exploring the possible reasons for this sex difference in professional performance is required, using a theoretical based approach. One theory suggested by some researchers is that male and female doctors differ in communication style and hence the interaction with patients and colleagues differed between the sexes, which could affect the risk of being subject to a complaint[21,22]. Future research could be performed to explore this further and examine whether communication styles differ between male and female doctors, and also whether the communication styles of doctors who receive sanctions differ from doctors who have never received sanctions.

We have also demonstrated that the effect of sex on likelihood to receive sanctions varied by specialty, with female GPs being the least likely to receive sanctions. It has been demonstrated by an observational study of primary care physicians in the USA that female primary care physicians spend more time with their patients when compared to their male colleagues and they engaged more in conversation, displaying more positive-talk, partnership-building, question-asking and information-giving[23]. These differences in communication style and time spent with patients may go towards explaining the larger sex discrepancy observed in GPs, however future research is required to explore these possible reasons further.

Our results show that doctors who had been qualified for longer were more likely to receive sanctions, it is therefore reasonable to hypothesise that the risk of receiving a sanction increases with exposure. Therefore doctors who ~~work part-time or~~ have fewer patient encounters may be less likely to receive sanctions against their registration. Previous studies have demonstrated that female consultants have fewer patient episodes and are more likely to work part-time (and thus have fewer patient encounters) when compared to their male colleagues[24,25], it is therefore reasonable to hypothesise that the sex difference observed in disciplinary action may be partly explained by the difference in work patterns between the sexes. This hypothesis merits being explored further by examining whether certain work patterns (i.e. part-time compared to full-time work) are more likely to be associated with receiving sanctions.~~those doctors who receive sanctions are more likely to work full-time and~~

~~have more patient encounters than those doctors who have never received sanctions.~~

A further possible explanation for the sex difference observed is perhaps that male and female doctors are viewed and treated differently by the public, the profession and the regulatory body. It is possible that there is a higher threshold of tolerance for female doctors. The GMC are twice as likely to receive a complaint about a male doctor than a female doctor[17]. It is reasonable to assume that as a result male doctors are more likely to receive sanctions against their medical registration. Research examining the perception of male and female doctors would be warranted.

It should also be noted that this study was observational in design and as such causality cannot be determined. It is possible that other factors, such as ethnicity, may be confounding the association between doctors' sex and disciplinary action. Research examining whether other potential confounders could explain the observed association is required

The points discussed above highlight that the real interest of this research is not about the outcome sanctions itself, but about trying to understand the differences between male and female doctors that lead to the observed sex difference in receiving sanctions. Investigations into why and how male and female medical practises differ will in turn lead to being able to propose interventions to reduce not only the number of doctors referred to the medical regulatory body, but also the difference between the sexes of doctors who are referred. Further exploration of why doctors' sex may impact their professional performance is needed to enable the profession to develop a better understanding of the factors associated with impaired fitness to practise and crucially, how to better support those doctors and ensure patient safety.

Conclusion

In this study we demonstrated that female doctors practising in the UK were less likely to receive sanctions on their medical registration when compared with their male colleagues. These findings remained after adjusting for known confounders. Reasons for why this sex difference exists needs to be examined.

Acknowledgements

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Footnotes

Contributorship statement: EU conceived and designed the study with input from KW and JD. EU and CW categorised the data. EU analysed and interpreted the data with support from KW. EU drafted the manuscript and all authors participated in the revision process and have approved this submission for publication. EU is guarantor, had full access to all of the data in the study, and can take responsibility for the integrity of the data and the accuracy of the data analysis.

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Competing interests: All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf. All authors declare no competing interests that may be relevant to the submitted work.

Ethical approval: The study is part of a research project that has received ethical approval from the UCL Research Ethics Committee.

Data sharing statement: No additional data available.

Transparency declaration: EU, as guarantor, affirms that this manuscript is an honest, accurate and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

Table 1: Distribution of variables by sex of doctors.

Variable		Male N=196,814	Female N=132,728	Total N=329,542
Sanction imposed on registration				
	No	194,633 (98.9%)	132,212 (99.6%)	326,845 (99.2%)
	Yes	2,181 (1.1%)	516 (0.4%)	2,697 (0.8%)
No. of years since received PMQ[i]				
	0-2 years	6,332 (3.2%)	8,830 (6.7%)	15,162 (4.6%)
	3-10 years	28,548 (14.5%)	37,220 (28.0%)	65,768 (20.0%)
	11-20 years	52,437 (26.6%)	40,023 (30.2%)	92,460 (28.1%)
	21-30 years	39,146 (19.9%)	23,069 (17.4%)	62,215 (18.9%)
	31-40 years	30,206 (15.4%)	12,136 (9.1%)	42,342 (12.9%)
	≥41 years	40,145 (20.4%)	11,450 (8.6%)	51,595 (15.7%)
Region where received PMQ				
	UK	108,323 (55.0%)	86,989 (65.5%)	195,312 (59.3%)
	EEA[ii]	25,333 (12.9%)	15,880 (12.0%)	41,213 (12.5%)
	International	63,158 (32.1%)	29,859 (22.5%)	93,017 (28.2%)
Specialty				
	No Specialty	94,815 (48.2%)	73,309 (55.2%)	168,124 (51.0%)
	Anaesthetics	8,710 (4.4%)	3,797 (2.9%)	12,507 (3.8%)
	EM[iii]	754 (0.4%)	209 (0.2%)	963 (0.3%)
	GP[iv]	37,959 (19.3%)	32,264 (24.3%)	70,223 (21.3%)
	Medicine	15,076 (7.7%)	6,775 (5.1%)	21,851 (6.6%)
	O&G[v]	2,934 (1.5%)	1,966 (1.5%)	4,900 (1.5%)
	Ophthalmology	2,508 (1.3%)	1,078 (0.8%)	3,586 (1.1%)
	Paediatrics	3,906 (2.0%)	3,891 (2.9%)	7,797 (2.4%)
	Pathology	5,589 (2.8%)	2,965 (2.2%)	8,554 (2.6%)
	Psychiatry	5,494 (2.8%)	3,077 (2.3%)	8,571 (2.6%)
	Radiology	172 (0.1%)	41 (0.03%)	213 (0.1%)
	Surgery	16,452 (8.4%)	1,942 (1.5%)	18,394 (5.6%)
	Other	1,330 (0.7%)	867 (0.7%)	2,197 (0.7%)
	Dual Specialty	1,115 (0.6%)	547 (0.4%)	1,662 (0.5%)

[i]Primary Medical Qualification
[ii]European Economic Area
[iii]Emergency Medicine
[iv]General Practice
[v]Obstetrics & Gynaecology

Table 2: The distribution of sanctions for each variable and the association of individual factors with sanctions.

Variable		Total number of doctors	Sanctions (%)	p-value
Sex				<0.001
	Male	196,814	1.1%	
	Female	132,728	0.4%	
No. of years since received PMQ[i]				<0.001
	0-2	15,162	0.1%	
	3-10	65,768	0.6%	
	11-20	92,460	0.8%	
	21-30	62,215	1.1%	
	31-40	42,342	1.4%	
	≥41	51,595	0.7%	
Region where received PMQ				<0.001
	UK	195,312	0.6%	
	EEA[ii]	41,213	0.9%	
	International	93,017	1.2%	
Specialty				<0.001
	No Specialty	168,124	0.7%	
	Anaesthetics	12,507	0.7%	
	EM[iii]	963	0.7%	
	GP[iv]	70,223	1.2%	
	Medicine	21,851	0.5%	
	O&G[v]	4,900	1.2%	
	Ophthalmology	3,586	0.5%	
	Paediatrics	7,797	0.6%	
	Pathology	8,554	0.6%	
	Psychiatry	8,571	0.8%	
	Radiology	213	0.5%	
	Surgery	18,394	0.9%	
	Other	2,197	0.3%	
	Dual Specialty	1,662	1.4%	

[i]Primary Medical Qualification
[ii]European Economic Area
[iii]Emergency Medicine
[iv]General Practice
[v]Obstetrics & Gynaecology

Table 3: The adjusted odds ratio for having sanctions against registration for each variable compared to its baseline having adjusted for all other variables.

Variable		Adjusted OR[i]	95% CI[ii]	p-value
Sex of a doctor				<0.0001
	Male	1		
	Female	0.37	0.33-0.41	
No. of years since received PMQ				<0.0001
	0-2	1		
	3-10	3.42	2.20-5.32	
	11-20	3.85	2.48-5.98	
	21-30	5.66	3.63-8.81	
	31-40	6.44	4.13-10.05	
	≥41	3.12	1.20-4.87	
Region where received PMQ				<0.0001
	UK	1		
	EEA	1.33	1.17-1.50	
	International	1.65	1.51-1.80	
Specialty				<0.0001
	No Specialty	1		
	Anaesthetics	0.65	0.52-0.82	
	EM	0.66	0.31-1.39	
	GP	1.43	1.29-1.58	
	Medicine	0.49	0.40-0.60	
	O&G	1.22	0.93-1.59	
	Ophthalmology	0.53	0.33-0.83	
	Paediatrics	0.64	0.47-0.88	
	Pathology	0.65	0.50-0.86	
	Psychiatry	0.81	0.63-1.04	
	Radiology	0.47	0.07-3.38	
	Surgery	0.78	0.66-0.93	
	Other	0.36	0.17-0.77	
	Dual Specialty	1.37	0.90-2.09	

[i] Odds Ratio
[ii] Confidence Interval

Table 4: Stratum-specific odds ratios for having sanctions imposed on registration if the doctor is female for each specialty divided into four categories.

Variable	Stratum-Specific OR[i]	95% CI[ii]	p-value
Specialty Category			<0.0001
No Specialty	0.43	0.38-0.49	
GP	0.26	0.22-0.31	
Hospital Specialty	0.44	0.36-0.56	
Dual Specialty	0.09	0.13-0.70	

[i] Odds Ratio
[ii] Confidence Interval

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	**Y**
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	**Y**
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	**Y**
Objectives	3	State specific objectives, including any prespecified hypotheses	**Y**
Methods			
Study design	4	Present key elements of study design early in the paper	**Y**
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	**Y**
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	**Y**
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	**Y**
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	**Y**
Bias	9	Describe any efforts to address potential sources of bias	**N/A**
Study size	10	Explain how the study size was arrived at	**N/A**
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	**Y**
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	**Y**
		(*b*) Describe any methods used to examine subgroups and interactions	**Y**
		(*c*) Explain how missing data were addressed	**N/A**
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	**N/A**
		(*e*) Describe any sensitivity analyses	**N/A**
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	**N/A**
		(b) Give reasons for non-participation at each stage	**N/A**
		(c) Consider use of a flow diagram	**N/A**
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	**Y**
		(b) Indicate number of participants with missing data for each variable of interest	**N/A**
Outcome data	15*	Report numbers of outcome events or summary measures	**Y**
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	**Y**

		(*b*) Report category boundaries when continuous variables were categorized	**Y**
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	**N/A**
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	**Y**
Discussion			
Key results	18	Summarise key results with reference to study objectives	**Y**
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	**Y**
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	**Y**
Generalisability	21	Discuss the generalisability (external validity) of the study results	**Y**
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	**Y**

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.