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The effects of sex and professionalism on specialty training application outcomes: a longitudinal administrative data study of United Kingdom medical graduates

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The effects of sex and professionalism on specialty training application outcomes: a longitudinal administrative data study of United Kingdom medical graduates

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Abstract

Objectives

To examine sex differences in the specialty training recruitment outcomes of United Kingdom (UK) medical graduates; and whether sex differences were explained by prior academic attainment and medical school fitness to practise (FtP) declarations.

Design

Retrospective longitudinal cohort study.

Setting

Administrative data on entrants to all UK medical schools from the UK Medical Education Database.

Participants

10 559 doctors (6 155; 58% female) who entered a UK medical school in 2007 or 2008 and were eligible to apply for UK Specialty Training by 2015.

Primary outcome measure

Odds of application, offer, and acceptance to any specialty training programme, and on to each of the nine largest training programmes, adjusting for sex, other demographics, prior academic attainment, FtP declaration, and medical school.

Results

Across all specialties, women were no more likely to apply for specialty training, but were more likely to get an offer (odds ratio=1.40; 95% CI=1.25-1.57; p<.001) and to accept one (OR=1.43; 95% CI=1.19-1.71; p<.001). Of the nine largest specialties, seven showed significant sex differences in applications, which remained after adjusting for other factors. In the adjusted models, the only specialty to show sex differences at offer and acceptance was General Practice. Women therefore had increased odds of application (OR=1.51; 95% CI=1.37-1.67; p<.001), offer (OR= 1.29; 95% CI=1.03-1.11; p=0.004) and acceptance (OR=1.34; 95% CI=1.03-1.76; p=0.03) to GP training. Doctors with an FtP declaration were more likely to apply to ACCS Emergency Medicine (OR=1.44; 95% CI=1.05-1.99; p=0.02) and less likely to accept an offer to any programme (OR=0.78; 95% CI=0.53-1.00; p=0.05), after adjusting for confounders.

Conclusions

Sex segregation between medical specialties is due to differential application, although research is needed to understand why men are less likely to be offered and accept a place on to GP training.

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Strengths and limitations of the study

- First study to assess sex differences in the likelihood of receiving and accepting an offer to UK specialty training overall and within nine specialties.
- Sex differences controlled for confounders including prior attainment.
- Large sample size and longitudinal data obtained from the UK Medical Education Database.
- Did not consider the impact of multiple applications or acceptances from multiple offers, and did not formally compare specialties.
- Large number of tests increased the likelihood of type II error.

Background

The proportion of men and women in different medical specialties varies greatly, with relatively more women in General Practice (GP), Paediatrics, and Obstetrics and Gynaecology (O&G), and more men in Surgery and Radiology. This so-called sex segregation is the result of preferences and constraints, themselves influenced by experiences and gendered societal norms and expectations.(1-6)

Less is known about whether selection processes influence sex ratios in different specialties, either directly - if the methods used to select applicants show sex differences - or indirectly - if selection methods rely on other measures such as previous academic attainment that themselves show sex differences. For example, it is known that women generally do better on Situational Judgement Tests (SJTs),(7) which are used in some specialty selection programmes in the UK, and they also have slightly higher medical school performance as judged by the Educational Performance Measure (EPM) used to select newly qualified doctors to UK Foundation Training.(8) Understanding whether selection processes contribute to differences in the proportions of men and women in different specialties is important for effective workforce planning and the provision of future healthcare, and could influence efforts to reduce sex segregation in some specialties.

Relatively little published research addresses the potential influence of selection processes on outcomes. Studies and data tend to show either no sex differences, or women doing slightly better than men. In the UK, a 2013 evaluation of selection in five English regions into five specialties (Core Medical Training, Core Surgical Training, Psychiatry, O&G, and Paediatrics), found women in the sample achieved higher scores in selection into Core Surgical Training and Psychiatry after adjusting for other demographic factors, with no significant sex differences in the other specialties.(9) A 2016 evaluation of GP selection found women were more likely to be successful.(10) A 2017 study of selection into general and vascular surgery found no effect of sex on selection scores.(11) Publically available Canadian Resident Matching Service data from 2017 showed female Canadian medical graduates were slightly more likely to be successfully matched to a surgical specialty, with no differences in other specialties.(12) Similar data for the US are not publically available, but an historic analysis of data from 1987 found women were more likely to get their first

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choice of specialty and less likely not to be matched.(13) More recent studies of Radiology and Anaesthesia residency selection found female applicants outperformed men.(14, 15)

Research in this area may also help us understand other areas of stark sex differences in medicine, such as disciplinary action, where male doctors have nearly 2.5 times the odds of facing medico-legal action.(16) Recent research has shown male UK medical graduates have increased odds of a Fitness to Practise issue at medical school,(17) and professionalism problems at medical school are known to predict later sanctions.(18-20) It is also known that doctors from certain specialties are at higher risk of receiving sanctions.(21) It is unknown however whether graduates with an FtP declaration may favour certain specialties.

The aims of this study are:

1. To measure sex differences in specialty applications, offers and acceptances.
2. To examine whether sex differences are present in specialty applications, offers and acceptances after controlling for previous academic attainment, and other potential confounders.
3. To examine whether medical school Fitness to Practise declarations predict specialty choice, taking into account sex and prior academic attainment.

Methods

Design and setting

Longitudinal study using data from the UK Medical Education Database (UKMED). UKMED contains administrative data on UK medical students. The data and permission to use the data for research purposes was obtained from the General Medical Council (GMC).

Participants

At the time this study was undertaken, UKMED contained data on 13 763 people - 5 913 (43%) men and 7 850 (57%) women - who entered medical school in 2007 and 2008. Our study population comprised 10 559 doctors who entered a UK medical school in 2007 or 2008 and who had completed Foundation training and thus were eligible to apply for Specialty Training by 2015. Compared to the full dataset, there were slightly fewer men (n=4 404; 42%) in this sample.

Study variables

A summary of all variables included in the analysis is given in Table 1. Further details can be found in the UKMED data dictionary.(22)

The primary exposure of interest was a doctor's sex (male or female). The secondary exposure of interest was having a Fitness to Practise declaration at application to the Foundation Programme vs having none. The primary outcomes of interest were:

- Specialty Training Programme(s) applied to.

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- Specialty Training Programme offered (of those applied to).
- Specialty Training Programme accepted (of those offered).
- Application to a Specialty Training Programme vs no application.

We only included first applications. We did not analyse the number of applications made, and we analysed data for each specialty separately. Men and women did not differ significantly in the number of multiple applications they made (p=0.77). We combined applications from different years for the analysis.

Prior attainment included both medical school and pre-medical school academic attainment. Pre-medical school attainment consisted of Higher Education Statistics Agency (HESA) tariff points, which is a measure of qualifications on entry to medical school (typically A-levels), and first attempt aptitude test score, either UK Clinical Aptitude Test (UKCAT) or Graduate Medical School Admissions Test (GAMSAT). We also looked at whether or not a doctor had a university degree before entering medical school. Medical school attainment consisted of Foundation Programme Application System (FPAS) scores, available from 2012 to 2015. This included the Educational Performance Measure or EPM, which is a quartile (2012) or decile (2013 onwards) ranking of an applicant compared to others within their medical school, Situational Judgement Test (SJT) score (2013 onwards), degree points (awarded for university degrees other than the primary medical degree), and publication points (awarded for peer reviewed research publications).

We controlled for the medical school doctors graduated from since it is known that graduates of different medical schools differ significantly in terms of the specialties they apply to and their academic performance (e.g. (23-25)). We also controlled for ethnicity, socio-economic status, and pre-medical school country of domicile, since these are known to influence academic performance.(26, 27) Ethnicity was a binary variable (black and minority ethnic or BME vs white) created by collapsing all 'non-white' groups, including mixed, into the BME category, and all white groups into the white category. Socio-economic status was a seven-point variable (0=low SES, 6=high SES) created by collapsing the following variables into binary variables, and then combining them with equal weights: secondary school type (fee-paying vs non-fee-paying), parental occupation (higher managerial vs all others), parental degree (degree vs no degree), free school meals (no free school meals vs free school meals), income support (no income support vs income support), and POLAR 3 (low neighbourhood higher education participation vs all other; non-UK missing).

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Table 1: Description of variables

Variable group	*Factor*	*Level*	*Details*	*Missing (N, %)*
Demographics	Socioeconomic status (composite of school type, parent graduate, free school meals, social class, income support, low participation neighbourhood)	Continuous	7-point scale 0=lowest SES; 6=highest SES Mean=3.94, SD=1.53	N=299, 2.8%
	Ethnicity	Binary	Black and Minority Ethnic (BME) vs white	N=55, 0.5%
	Gender	Binary	Male vs female	N=0.
	Pre-medical school domicile	Binary	UK vs non-UK domicile	N=0.
Pre-medical school academic attainment	HESA tariff	Continuous	Tariff points Min=20, Max=1036. Mean=473, SD=109.	N=2 743, 26%
	University degree prior to medical school	Binary	Prior degree vs no prior degree	N=0
	First attempt score UK Clinical Aptitude Test (UKCAT)	Continuous	UKCAT points Min=1600, Max=3340 Mean=2504, SD=222	N=1 524, 14.4%
Medical school	Medical School	Categorical	Last recorded medical school name n= 30	N=0
	FPAS Educational Progress Measure	Continuous	Min=34, Max=43 Mean=38.7, SD=2.8	N=1 035, 9.8%
	FPAS Situational Judgement Test (SJT) score	Continuous	Min=4.50, Max=50 Mean=40.8, SD=3.2	N=4 588, 43.5%
	FPAS degree points	Continuous	Min=0, Max=5, Mean=2.2, SD=1.6	N=3 541, 33.6%
	FPAS publication points	Continuous	Min=0, Max=5, Mean=0.3, SD=0.7	N=1035, 9.8%
	Fitness to Practise declaration	Binary	Declaration vs no declaration	N=0
Specialty application	Applied to at least one of 22 specialties	Binary	Applied vs not applied	N=0
	Applied to each specialty	Binary	Applied vs not applied 9 largest specialties	N=0
	Offered at least one of 22 specialties	Binary	Offered vs not offered	N=0. Excludes non-applicants
	Offered each specialty	Binary	Offered vs not offered 9 largest specialties	N=0. Excludes non-applicants
	Accepted at least one of 22 specialties	Binary	Accepted vs not accepted	N=0. Excludes not offered
	Accepted each specialty	Binary	Accepted vs not accepted 9 largest specialties	N=0. Excludes not offered

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Statistical analysis

Missing values were multiply imputed for HESA tariff score, UKCAT score, SJT and EPM scores, and degree and publication points, using 25 iterations of the Multiple Imputation function in SPSS, using the following as indicators for the imputation: birth year, gender, ethnicity, HESA entry year, HESA tariff score (min=0, no max), UKCAT total score (min=1600, max 3360), GAMSAT total score, FPAS SJT score (min 0, max=50), FPAS EPM score (min=34, max=43), FPAS degree points (min=0, max=5), FPAS publication points (min=0, max=5).

Univariate tests (t-tests, Mann-Whitney tests, χ^2-tests) were conducted in SPSS v22. Multilevel binomial logistic regressions with a random effect of medical school and fixed effects of background variables were conducted using lme4 in R. The multilevel models were fitted to predict applications, offers, and acceptances overall and for each of the nine larger specialties that showed a univariate effect of sex on outcome. We considered medical school a random effect because the medical schools are a sample of all medical schools in the world. We considered all other predictors (sex, ethnicity, SES, pre-medical school domicile, HESA tariff, UKCAT score, prior undergraduate degree, EPM score, SJT score, degree score, publication score) as fixed effects. Imputed scores were used in the models.

Patient involvement

No patients were involved in this study.

Results

Nearly three quarters of doctors (7 634/10 559; 72.2%) had applied for specialty training. Of 22 specialties recorded, nine had 250+ applicants and 90+ acceptances: Acute Care Common Stem Emergency Medicine (ACCS EM), Clinical Radiology, Core Anaesthetics Training, Core Medical Training, Core Psychiatry Training, Core Surgical Training, General Practice (GP), Obstetrics and Gynaecology (O&G), and Paediatrics. 173 doctors had only applied to smaller specialties and were excluded from the analyses on the larger specialties.

Univariate results

Across all specialties, sex was not related to whether any application versus none was made (p=0.25), but women were more likely to get at least one offer versus none (odds ratio=1.40; 95% CI=1.25-1.57; p<.001) and to accept an offer versus none (OR=1.43; 95%CI=1.19-1.71; p<.001). There were significant sex differences in applications to seven of the nine largest specialties (women favouring GP, O&G, Paediatrics, and men favouring ACCS EM, Clinical Radiology, and Core Surgical Training), sex differences in offers to two (GP and Paediatrics, both favouring women), and sex differences in acceptances to two (GP and ACCS EM, both with more women accepting). See Table 2 for details. GP was the only specialty that showed a significant sex difference in applications (unadjusted OR= 1.51; 95% CI=1.37-1.66; p<.001), offers (unadjusted OR = 1.42; 95% CI=1.21-1.66; p<.001) and acceptances (unadjusted OR= 1.34; 95% CI=1.03-1.76; p=0.03), with all favouring women.

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There were various sex differences in prior attainment. At application to medical school, men in the sample had on average 36 more UKCAT points than women (p<0.001), but had statistically equivalent HESA tariff points and were no more likely to have a degree at entry to medical school. At application to Foundation Training, women had higher EPM (p<.001) and SJT scores (p<.001), whereas men had more publications (p=0.007) and degree points (p<0.001). Men were significantly more likely to have a Fitness to Practise declaration (OR=2.12; 95%CI=1.82-2.45; p<0.001).

Doctors who had not applied for specialty training had lower HESA tariff points (p<0.001), UKCAT score (p<0.001), and FPAS degree points (p<0.001) than those who had. There was no difference in EPM (p=0.23) or SJT scores (p=0.13).

There were significant differences by medical school on all predictor variables, including the proportion of women (range: 44.7 to 67.0; p<.001), average prior attainment (all measures significant at p<.001), and the proportion with an FtP declaration (range: 3.5% to 16.7%; p<.001). Medical schools also differed in the proportion of their graduates who applied to specialty training (range: 62.5% to 87.4%; p<.001), received an offer (range: 65.0% to 92.9%; p<.001) and accepted an offer (range: 83.5 to 95.7%; p<.001). All the nine largest specialties except Core Anaesthetics, O&G, and Paediatrics showed significant medical school differences in applications. By contrast, only Core Medical Training, Core Surgical Training, and GP showed medical school differences in offers, and only ACCS EM, Core Surgical Training, and GP showed medical school differences in acceptances. Only GP and Core Surgical Training showed medical school differences in applications, offers, and acceptances.

Multivariate results

Sex differences in applications remained in the same seven specialties with similar magnitudes after controlling for medical school attended, prior attainment, and demographics. In the fully adjusted models, the only specialty to show sex differences beyond applications was GP. Women were more likely to apply (odds= 1.51; 95% CI=1.37 to 1.67; p<.001), to be offered a place (odds = 1.29; 95% CI=1.03 to 1.11; p=0.004) and to accept an offer (odds= 1.34; 95% CI=1.05 to 1.70; p<.05) to GP training. See Table 2.

Having a FtP declaration did not significantly predict offers to specialty training overall, but those with a declaration were slightly more likely to apply to ACCS Emergency Medicine than to another specialty (odds= 1.44; 95% CI=1.05 to 1.99; p=0.02). Of those who had received an offer, those with an FtP declaration were slightly less likely to accept one (vs none) (odds= 0.78; 95% CI=0.53 to 1.00; p=0.05), after adjusting for all other factors. It is important to bear in mind in interpreting these findings that we performed a large number of tests, with analyses done for all specialties and then repeated for each of nine specialties separately, increasing the probability of getting a statistically significant result by chance alone (i.e. increasing the chance of type II error). Significant independent predictors of applying, being offered a place, and accepting a place on any specialty are shown in Tables 3 to 5.

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Table 2: Sex differences in applications, offers, and acceptances across all specialties and in the nine largest specialties (32% of doctors applied to multiple specialties). Odds adjusted for socioeconomic status, ethnicity, pre-medical school attainment, graduate status, pre-medical school country of domicile, medical school attended, Foundation Programme Application Scores, and medical school Fitness to Practise declaration. Statistically significant values in bold: *p<.05 **p<0.001.

	% applied (Women, Men)	*Unadjusted odds woman applied (95%CI)*	*Adjusted odds woman applied (95%CI)*	*% offered (Women, Men)*	*Unadjusted odds woman offered (95%CI)*	*Adjusted odds woman offered (95%CI)*	*% accepted (Women, Men)*	*Unadjusted odds woman accepted (95%CI)*	*Adjusted odds woman accepted (95%CI)*
All Specialties	72.3 (72.0, 72.7)	0.96 (0.88,1.05)	0.95 (0.86,1.04)	81.3 (83.5, 78.3)	**1.40 (1.25,1.57)****	**1.31 (1.15,1.48)****	90.8 (92.1, 88.7)	**1.43 (1.19,1.71)****	**1.43 (1.19,1.72)****
ACCS EM	5.8 (5.0, 6.9)	**0.71 (0.59,0.86)****	**0.74 (0.59,0.90)****	72.2 (74.8, 69.7)	1.29 (0.85,1.96)	1.30 (0.81,2.07)	67.4 (73.5, 60.8)	**1.79 (1.11,2.87)***	1.44 (0.84,2.47)
Clinical Radiology	3.8 (3.0, 5.0)	**0.58 (0.46,0.73)****	**0.61 (0.47,0.79)****	49.5 (46.6, 51.9)	0.81 (0.51,1.28)	0.74 (0.42,1.28)	63.2 (67.2, 60.2)	1.35 (0.68,2.70)	1.92 (0.86,4.27)
Core Anaesthetics	12.0 (10.1, 14.7)	**0.65 (0.57,0.75)****	**0.60 (0.51,0.70)****	66.5 (69.2, 64.0)	1.27 (0.96,1.67)	1.19 (0.88,1.61)	76.1 (75.2, 77.0)	0.90 (0.62,1.31)	0.91 (0.61,1.36)
Core Medical	29.9 (29.9, 29.8)	1.00 (0.90,1.11)	0.99 (0.89,1.11)	72.9 (73.5, 72.1)	1.07 (0.89,1.29)	1.08 (0.89,1.32)	75.5 (75.2, 76.0)	0.76 (0.45,1.29)	0.96 (0.76,1.22)
Core Psychiatry	5.3 (4.9, 5.8)	0.85 (0.69,1.04)	0.98 (0.79,1.22)	77.7 (80.4, 74.6)	1.39 (0.87,2.23)	1.26 (0.72,2.21)	75.7 (73.3. 78.3)	0.95 (0.76,1.19)	0.92 (0.52,1.62)
Core Surgical	13.8 (8.8, 20.8)	**0.37 (0.32,0.42)****	**0.38 (0.33,0.44)****	64.9 (64.8, 65.1)	0.99 (0.76,1.28)	1.06 (0.79,1.43)	77.1 (80.3, 75.3)	1.34 (0.92,1.96)	1.15 (0.76,1.74)
GP	43.4 (47.5, 37.5)	**1.51 (1.38,1.66)****	**1.51 (1.37,1.67)****	74.5 (76.9, 70.2)	**1.42 (1.21,1.66)****	**1.29 (1.08,1.53)***	87.1 (88.3, 84.9)	**1.34 (1.05,1.70)***	**1.34 (1.02,1.76)***
O&G	4.8 (7.0, 1.7)	**4.33 (3.24,5.79)****	**4.48 (3.29,6.11)****	59.7 (59.9, 58.2)	1.08 (0.60,1.92)	1.09 (0.55,2.15)	77.6 (77.0, 81.3)	1.77 (0.29,1.99)	0.78 (0.23,2.29)
Paediatrics	8.3 (10.7, 4.9)**	**2.34 (1.94,2.82)****	**2.22 (1.82,2.71)****	76.2 (78.3, 69.9)	**1.56 (1.04,2.34)***	1.38 (0.87,2.17)	76.5 (75.8, 78.9)	0.84 (0.49,1.40)	0.77 (0.43,1.35)

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Table 3: Mixed effects logistic regression of medical school (random effect), demographics, prior attainment, and fitness to practise declaration (fixed effects) on the probability of applying to specialty training versus not applying. Statistically significant predictors in bold: *p<.05 **p<0.001.

	Estimate	*SE*	*Odds ratio*	*Lower 95% CI limit*	*Upper 95% CI limit*	*P value*
Intercept	1.6479	0.4968	5.1963	1.9625	13.7585	0.0009
FtP declaration	-0.1414	0.0870	0.8681	0.7320	1.0295	0.1041
Low socioeconomic status*	**-0.0400**	**0.0171**	**0.9608**	**0.9292**	**0.9936**	**0.0194**
Female	-0.0526	0.0481	0.9488	0.8634	1.0425	0.2741
BME	-0.0050	0.0042	0.9950	0.9870	1.0032	0.2304
UK domicile	0.1493	0.1092	1.1610	0.9372	1.4382	0.1718
HESA tariff	0.0001	0.0003	1.0001	0.9996	1.0006	0.5951
Graduate entry**	**1.0641**	**0.0835**	**2.8983**	**2.4609**	**3.4135**	**<0.0001**
UKCAT score*	**-0.0003**	**0.0001**	**0.9997**	**0.9995**	**1.0000**	**0.0205**
EPM score**	**0.0366**	**0.0094**	**1.0372**	**1.0182**	**1.0566**	**0.0001**
SJT score*	**-0.0212**	**0.0095**	**0.9790**	**0.9610**	**0.9974**	**0.0258**
Degree points**	**-0.3345**	**0.0203**	**0.7157**	**0.6878**	**0.7447**	**<0.0001**
Publication points**	**0.1816**	**0.0361**	**1.1992**	**1.1173**	**1.2871**	**<0.0001**

Table 4: Mixed effects logistic regression of medical school (random effect), demographics, prior attainment, and fitness to practise declaration (fixed effects) on the probability of being offered a place on any specialty training programme or not. Statistically significant predictors in bold: *p<.05 **p<0.001.

	Estimate	*SE*	*Odds ratio*	*Lower 95% CI limit*	*Upper 95% CI limit*	*P value*
Intercept	-4.1076	0.6668	0.0164	0.0045	0.0608	<0.0001
FtP declaration	-0.0471	0.1141	0.9540	0.7629	1.1931	0.6799
Low socioeconomic status	0.0041	0.0225	1.0041	0.9608	1.0494	0.8558
Female**	**0.2696**	**0.0644**	**1.3094**	**1.1542**	**1.4855**	**<0.0001**
BME	0.0005	0.0054	1.0005	0.9901	1.0111	0.9188
UK domicile	-0.2252	0.1279	0.7984	0.6214	1.0257	0.0782
HESA tariff**	**0.0013**	**0.0003**	**1.0013**	**1.0006**	**1.0020**	**0.0002**
Graduate entry	-0.1454	0.1040	0.8647	0.7052	1.0603	0.1623
UKCAT score	-0.0002	0.0002	0.9998	0.9995	1.0001	0.2988
EPM score**	**0.1137**	**0.0133**	**1.1204**	**1.0915**	**1.1500**	**<0.0001**
SJT score	0.0229	0.0144	1.0232	0.9948	1.0524	0.1110
Degree points**	**0.1739**	**0.0260**	**1.1900**	**1.1308**	**1.2523**	**<0.0001**
Publication points	-0.0694	0.0461	0.9329	0.8524	1.0211	0.1317

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Table 5: Mixed effects logistic regression of medical school (random effect), demographics, prior attainment, and fitness to practise declaration (fixed effects) on the probability of accepting an offer to specialty training or not. Statistically significant predictors in bold: *p<.05 **p<0.001.

	Estimate	*SE*	*Odds ratio*	*Lower 95% CI limit*	*Upper 95% CI limit*	*P value*
Intercept	2.6120	0.9520	13.6263	2.1087	88.0513	0.0061
FtP declaration*	**-0.3152**	**0.1611**	**0.7296**	**0.5321**	**1.0006**	**0.0503**
Low socioeconomic status	-0.0369	0.0335	0.9638	0.9025	1.0292	0.2706
Female**	**0.3593**	**0.0945**	**1.4323**	**1.1901**	**1.7238**	**0.0001**
BME	0.0045	0.0097	1.0045	0.9855	1.0239	0.6423
UK domicile**	**-0.6105**	**0.1772**	**0.5431**	**0.3837**	**0.7686**	**0.0006**
HESA tariff	-0.0007	0.0005	0.9993	0.9984	1.0003	0.1789
Graduate entry**	**0.5583**	**0.1551**	**1.7477**	**1.2896**	**2.3686**	**0.0003**
UKCAT score	0.0000	0.0002	1.0000	0.9995	1.0004	0.9286
EPM score*	**0.0395**	**0.0188**	**1.0403**	**1.0026**	**1.0794**	**0.0357**
SJT score	-0.0081	0.0193	0.9919	0.9552	1.0301	0.6736
Degree points**	**-0.2496**	**0.0398**	**0.7791**	**0.7207**	**0.8423**	**<0.0001**
Publication points	-0.1130	0.0638	0.8932	0.7882	1.0121	0.0764

Discussion

There were significant sex differences in the specialty applications of this sample of 10 559 UK medical graduates. Women were more likely to apply to GP, O&G and Paediatrics, and men were more likely to apply to Core Surgical Training, ACCS EM, and Clinical Radiology. Women were more likely to receive an offer versus none, and to receive an offer in GP and Paediatrics specifically. Women were more likely to accept an offer versus no offer, and to accept an offer in GP and ACCS EM specifically. Sex differences largely remained after controlling for prior academic attainment and having a fitness to practise (FtP) declaration, as well as medical school attended and other demographics. In the fully adjusted models, GP was the only specialty with significant sex differences in applications, offers, and acceptances – and all favoured women. Having an FtP declaration was a small predictor of applying to ACCS EM, and of rejecting an offer across all specialties, although the large number of tests performed increases the possibility that this was due to type II error.

The raw sex differences in applications are consistent with previous research from the UK and other countries.(2, 3, 13, 24, 28) Our finding that women outperformed men in GP selection, but not in selection for Core Surgical Training reflects Davison and colleagues' analysis of national data (10) but differs from Thomas and colleagues' analysis of a smaller subsample.(9) To our knowledge this is the first study to assess sex differences in the likelihood of receiving and accepting an offer to specialty training after controlling for prior attainment, as well as controlling for medical school, other demographics, and medical

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school professionalism. It is also the first that we know of to assess whether professionalism problems predict specialty preferences and selection outcomes.

A considerable strength of the study is the large sample size (three quarters of all entrants to medical school from 2007 to 2008) and the longitudinal nature of the data, obtained from the UK Medical Education Database (UKMED). This made it possible to examine recruitment to nine different specialties in the UK. It also meant we could conduct multivariate analyses to understand whether sex segregation in some specialties is due to sex differences on the potential confounder of academic attainment, both prior to and during medical school. Because UKMED data are collected by the GMC as part of their statutory duty to regulate medical education in the UK, we did not have to rely on voluntary completion of surveys for data, unlike previous analyses.(9)

The study has some methodological weaknesses. We did not consider multiple applications, or acceptances from multiple offers. 70% of doctors in our sample applied to one specialty only, and this did not differ by sex (p=0.77); however it is likely that the number of multiple applications varies by specialty. For example, a previous study using the same dataset but looking only at GP applicants found that only 59% (vs 70%) made a single specialty training application; however, women were more likely to apply to GP after controlling for prior attainment and other demographics regardless of whether they had applied to multiple specialties or not.(24) We also did not formally compare sex differences between specialties taking into account competition ratios, and we only analysed data from first applications. Since women were more likely to receive and accept and offer first time around, it is possible that men are more likely to apply a second time around, which may then influence the final proportions of men and women in different specialties. We combined applications across years, which meant we could not account for the possibility that different selection processes occurred during different application cycles. We did not include age or time since completing Foundation Training as a predictor, which - given that previous research suggests these factors may influence reasons for specialty choice (29, 30) - means we may have missed any interactions between sex and age. We also did not look at other potential interactions, for example between medical school and sex, which have been shown in other studies to influence specialty choice.(23, 31) Using administrative data rather than data collected for research purposes limited our ability to infer reasons for the sex differences observed. There were also considerable amounts of missing data on some variables, in particular because some of the cohorts within the sample had not taken a test, with multiple imputation used to avoid excluding large amounts of data. Our dataset was truncated because we could only include graduates who were eligible to apply to specialty training by 2015. The study findings are not generalizable outside of the UK.

This study suggests that sex differences in specialty applications and outcomes are driven largely by factors unmeasured in this study, rather than by academic, demographic, or medical school differences. In terms of differential applications, previous research has

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shown that these factors are likely to include how plannable, technical, and people-oriented a specialty is (2), the career prospects a specialty offers, a trainee's domestic circumstances, and their perceptions of their own ability and interests.(32) There is also evidence that, while some specialties such as Surgery and Paediatrics show sex differences very early in medical school training,(33) experiences during medical school and postgraduate training can influence specialty choices.(10, 34) This suggests that efforts to reduce sex segregation should focus on understanding and addressing medical career choice early on, as well as on understanding whether men and women have different experiences during training, and on removing any perceived or real barriers to career progression and enjoyment within sex-segregated specialties. In terms of sex differences in receiving and accepting an offer, it is unclear why women were more likely to receive an offer, and to accept an offer compared to men, although it may be that this was largely due to the effects within General Practice. Indeed, the sex differences in GP were the most striking of any of the nine largest specialties, and this itself requires more research to understand. It reflects career progression in GP, with women outperforming men in the Membership of the Royal College of General Practitioners exit examinations.(35, 36)

Conclusions

Sex differences in specialty applications, offers, and acceptances result from factors other than prior academic attainment, Fitness to Practise declarations, medical school, and demographics. General Practice was the only specialty with significant sex differences in applications, offers, and acceptances, all of which favoured women. Further research exploring these reasons is important for future work place planning and equity.

Keywords

Medical workforce, academic attainment, sex differences, fitness to practise, professionalism

Original protocol for the study

See Supplementary file.

Funding statement

This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Author contributions

KK, CV, and EU conceived of the study and EU wrote the first draft of the original protocol. KK, CV, HWWP, KW and HJ designed the data analysis, with KW and HJ conducting the data analysis. KW wrote the first draft of the report. All authors read and approved the final version of the article. KW is the article guarantor.

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Data sharing statement

Data files used in the study are securely held by the UK Medical Education Database and cannot be shared by the authors, but are available via application - see www.ukmed.ac.uk.

Acknowledgements

The UK Medical Education Database (UKMED) UKMEDP20 provided the data via an extract generated on 01/08/2016, and it was approved for publication by the UKMED Advisory Board on 25/09/2017. We are grateful to UKMED for the use of these data; however UKMED bears no responsibility for our analysis or interpretation. The data includes information derived from that collected by the Higher Education Statistics Agency Limited (HESA) and provided to the General Medical Council (GMC). Source: HESA Student Record 2007/2008 and 2008/2009 Copyright Higher Education Statistics Agency Limited. The Higher Education Statistics Agency Limited makes no warranty as to the accuracy of the HESA Data, and cannot accept responsibility for any inferences or conclusions derived by third parties from data or other information supplied by it. We thank Daniel Smith from GMC for his advice on our application for data and support with data linkage.

Ethics approval and consent to participate

The UK Medical Schools Council agreed that all approved applications for research projects using data exclusively held by UKMED would meet the criteria for a blanket exemption from the need to apply for ethics approval that would be recognised by ethics committees relevant to the UK medical schools. Queen Mary University of London Research Ethics Committee, on behalf of all UK medical schools, confirms ethics exemption, noting that NHS review is not required and that only de-identified data accessed under safe haven conditions is used.

Consent for publication

Not applicable.

References

1. Lambert EM, Holmboe ES. The Relationship between Specialty Choice and Gender of U.S. Medical Students, 1990-2003. Academic Medicine. 2005;80(9):797-802.

2. Elston M. Women and Medicine: The Future. London: Royal College of Physicians; 2009.

3. Buddeberg-Fischer B, Klaghofer R, Abel T, Buddeberg C. Swiss residents' speciality choices – impact of gender, personality traits, career motivation and life goals. BMC Health Services Research. 2006;6(1):137.

4. McManus IC, Sproston KA. Women in hospital medicine in the United Kingdom: glass ceiling, preference, prejudice or cohort effect? Journal of Epidemiology and Community Health. 2000;54(1):10-6.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

5. Ku MC. When Does Gender Matter?:Gender Differences in Specialty Choice Among Physicians. Work and Occupations. 2011;38(2):221-62.

6. Rodriguez Santana I, Chalkley M. Getting the right balance? A mixed logit analysis of the relationship between UK training doctors' characteristics and their specialties using the 2013 National Training Survey. BMJ Open. 2017;7(8).

7. Patterson F, Ashworth V, Zibarras L, Coan P, Kerrin M, O'Neill P. Evaluations of situational judgement tests to assess non-academic attributes in selection. Medical Education. 2012;46(9):850-68.

8. MacKenzie RK, Dowell J, Ayansina D, Cleland JA. Do personality traits assessed on medical school admission predict exit performance? A UK-wide longitudinal cohort study. Advances in Health Sciences Education. 2017;22(2):365-85.

9. Thomas H, Davison I, Gee H, Grant J, Taylor C. The fairness, effectiveness and acceptability of selection for specialty training in the UK. British Journal of Hospital Medicine. 2013;74(1):47-51.

10. Davison I, McManus IC, Taylor C. Evaluation of GP Specialty Selection. 2016.

11. Scrimgeour DSG, Cleland J, Lee AJ, Griffiths G, McKinley AJ, Marx C, et al. Impact of performance in a mandatory postgraduate surgical examination on selection into specialty training. BJS Open. 2017;1(3):67-74.

12. Canadian Resident Matching Service: CARMS; 2018 [Available from: https://www.carms.ca/en/data-and-reports/r-1/r-1-match-reports-2017/.

13. Colquitt WL, Smith IP, Killian CD. Specialty selection and success in obtaining choice of residency training among 1987 U.S. medical graduates by race-ethnicity and gender. Acad Med. 1992;67(10):660-71.

14. Hewett L, Lewis M, Collins H, Gordon L. Gender Bias in Diagnostic Radiology Resident Selection, Does it Exist? Academic Radiology. 2016;23(1):101-7.

15. de Oliveira Gildàsio S, Akikwala T, Kendall Mark C, Fitzgerald Paul C, Sullivan John T, Zell C, et al. Factors Affecting Admission to Anesthesiology Residency in the United StatesChoosing the Future of Our Specialty. Anesthesiology. 2012;117(2):243-51.

16. Unwin E, Woolf K, Wadlow C, Potts HWW, Dacre J. Sex differences in medico-legal action against doctors: a systematic review and meta-analysis. BMC Medicine. 2015;13(1):172.

17. Paton LW, Tiffin PA, Smith D, Dowell JS, Mwandigha LM. Predictors of fitness to practise declarations in UK medical undergraduates. BMC Medical Education. 2018;18(1):68.

18. Santen SA, Petrusa E, Gruppen LD. The relationship between promotions committees' identification of problem medical students and subsequent state medical board actions. Advances in Health Sciences Education. 2015;20(2):421-30.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

19. Yates J, James D. Risk factors at medical school for subsequent professional misconduct: multicentre retrospective case-control study. BMJ. 2010;340.

20. Papadakis MA, Hodgson CS, Teherani A, Kohatsu N. Unprofessional Behavior in Medical School Is Associated with Subsequent Disciplinary Action by a State Medical Board. Academic Medicine. 2004;79(3):244-9.

21. Unwin E, Woolf K, Wadlow C, Dacre J. 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. BMJ Open. 2014;4(8).

22. UKMED Data Dictionary. 2018.

23. Twigg V, Aldridge K, McNally S, Eardley I. Does choice of medical school affect a student's likelihood of becoming a surgeon? The Bulletin of the Royal College of Surgeons of England. 2018;100(2):90-5.

24. Gale TCE, Lambe PJ, Roberts MJ. Factors associated with junior doctors' decisions to apply for general practice training programmes in the UK: secondary analysis of data from the UKMED project. BMC Medicine. 2017;15(1):220.

25. McManus I, Elder AT, de Champlain A, Dacre JE, Mollon J, Chis L. Graduates of different UK medical schools show substantial differences in performance on MRCP(UK) Part 1, Part 2 and PACES examinations. BMC Medicine. 2008;6(1):5.

26. Woolf K, Potts HWW, McManus IC. Ethnicity and academic performance in UK trained doctors and medical students: systematic review and meta-analysis. BMJ. 2011;342.

27. Kumwenda B, Cleland JA, Walker K, Lee AJ, Greatrix R. The relationship between school type and academic performance at medical school: a national, multi-cohort study. BMJ Open. 2017;7(8).

28. Baerlocher MO, Walker M. Does Gender Impact Upon Application Rejection Rate Among Canadian Radiology Residency Applicants? Canadian Association of Radiologists Journal. 2005;56(4):232-7.

29. Buddeberg-Fischer B, Stamm M, Buddeberg C, Bauer G, Hämmig O, Knecht M, et al. The impact of gender and parenthood on physicians' careers - professional and personal situation seven years after graduation. BMC Health Services Research. 2010;10(1):40.

30. Scanlan GM, Cleland J, Johnston P, Walker K, Krucien N, Skåtun D. What factors are critical to attracting NHS foundation doctors into specialty or core training? A discrete choice experiment. BMJ Open. 2018;8(3).

31. Lambert TW, Smith F, Goldacre MJ. Career specialty choices of UK medical graduates of 2015 compared with earlier cohorts: questionnaire surveys. Postgraduate Medical Journal. 2018;94(1110):191-7.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

32. Lambert T, Goldacre R, Smith F, Goldacre MJ. Reasons why doctors choose or reject careers in general practice: national surveys. British Journal of General Practice. 2012;62(605):e851-e8.

33. Cleland J, Johnston PW, French FH, Needham G. Associations between medical school and career preferences in Year 1 medical students in Scotland. Medical Education. 2012;46(5):473-84.

34. Woolf K, Elton C, Newport M. The specialty choices of graduates from Brighton and Sussex Medical School: a longitudinal cohort study. BMC Medical Education. 2015;15(1):46.

35. Esmail A, Roberts C. Academic performance of ethnic minority candidates and discrimination in the MRCGP examinations between 2010 and 2012: analysis of data. BMJ : British Medical Journal. 2013;347.

36. Siriwardena AN, Irish B, Asghar ZB, Dixon H, Milne P, Neden C, et al. Comparing performance among male and female candidates in sex-specific clinical knowledge in the MRCGP. The British Journal of General Practice. 2012;62(599):e446-e50.

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UKMED Research Application Form

UKMED
UK Medical Education Database

Scoring guide
0 – Unacceptable.
1 – Uncertain; may be acceptable with further clarification.
2 – Acceptable.

Title

Please note that should this application be approved, its title, summary, lead contact name and email address will be published on the UKMED website.

The role of academic attainment in understanding sex differences in specialty choice and fitness to practise.

Summary

Please outline your proposed research covering all aspects. Maximum 250 words.

The proportions of men and women in different medical specialties varies greatly [1]. Understanding how and why is important for effective workforce planning and the provision of future healthcare, and to reduce sex segregation in some specialties. It may also help us understand other areas of stark sex differences, such as disciplinary action, where male doctors have nearly 2.5 times the odds of facing medico-legal action [2], and doctors from certain specialties are at higher risk of receiving sanctions [3].
Sex differences in specialty choice are partly explained by features such as how plannable, technical, and intellectual a specialty is [1]; but success in obtaining a training place depends on competition ratios, selection methods, and candidates' previous academic attainment – also potentially associated with sex. Academic performance is also important to help us understand how sanctions relate to sex and specialty, because past academic performance predicts future academic performance [4], and poor academic performance is associated with increased odds of sanctions [5].

References

Please reference up to five key papers from your literature review with a sentence explaining the relevance of the paper to the proposed study.

1. Elston MA. Women and medicine: the future. London: Royal College of Physicians, 2009.
2. Unwin E, Woolf K, Wadlow C, et al. Sex differences in medico-legal action against doctors: a systematic review and meta-analysis. BMC Medicine 2015; 13:172.
3. Unwin E, Woolf K, Wadlow C, et al. Disciplined doctors: does the sex of a doctors matter? A cross-sectional study examining the association between a doctor's sex and receiving sanctions against their medical registration. BMJ Open 2014; 4:8.
4. McManus IC, Woolf K, Dacre J, et al. The Academic Backbone: longitudinal continuities in educational achievement from secondary school and medical school to MRCP(UK) and the specialist register in UK medical students and doctors. BMC Medicine 2013; 11:242.
5. Papadakis MA, Arnold GK, Blank LL, Holmboe ES, Lipner RS. Performance during Internal Medicine Residency Training and Subsequent Disciplinary Action by State Licensing Boards. Ann Intern Med 2008; 148(11):869-876

Research Questions

A) Setting the scene and confirming what is already known:
1. Is there a sex difference in the measures of academic attainment used for selection into medical school?
2. Is there a sex difference in the measures of attainment used for selection into the Foundation Programme?
3. Is there a sex difference in the specialties foundation doctors apply to, receive offers from, and ultimately accept offers from?
4. Is there a sex difference between those who did and did not apply for specialty training when eligible?
5. Is prior academic attainment related to a choice not to apply for specialty training when eligible?
6. Is there a sex difference in those doctors with and without Fitness to Practise declarations?
7. Is there an association between academic attainment and having a Fitness to Practise declaration?

B) The main research questions:
8. Is the sex difference in specialty choice (application, offer and acceptance) mediated by previous academic attainment, taking into account the potential confounders of demographics and medical school attended?
9. Is specialty choice associated with Fitness to Practise declarations, taking into account sex and prior academic attainment?

Scoring guide
0 – Aims or question not clear. Question appears irrelevant to policy or practice.
1 – Question is poorly defined or uncertain as to whether it is likely to impact on policy or practice if answered. More information or clarification may be required.
2 – Question if answered has significant implications for policy or practice in medical education.

Data Required from UKMED

Please specify data items and any filters that should be applied, for example date range. The tables below are as per the UKMED data dictionary http://www.ukmed.ac.uk/documents/UKMED_data_dictionary.pdf. For data type and descriptions please refer to the dictionary.

Scoring guide
0 – The data requested is not contained in the UKMED.
1 – The data requested is within the database but does not appear capable of answering the research question identified.
2 – The data requested is contained within the UKMED and is well linked to the research question.

ARCP_OUTCOMES

SELECT	NAME
◯	PERSON_UID
◯	ARCP_EVENT_ID
◯	ARCP_SUBMITTING_DEANERY
◯	ARCP_DATA_YEAR
◯	ARCP_REVIEW_DATE
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◯	ARCP_PERIOD_END_DATE
◯	ARCP_LEVEL_ASSESSED
◯	ARCP_POST_TYPE
◯	ARCP_MILITARY_IND
◯	ARCP_ACADEMIC_IND
◯	ARCP_REMAIN_ON_ACADEMIC_PROG
◯	ARCP_SPECIALTY
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◯	ARCP_OUTCOME_TYPE
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◯	ARCP_OUTCOME_ORDERED
◯	ARCP_OUTCOME_ORDERED_DES

Comments about requested ARCP_OUTCOMES data (Optional)

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Comments about requested ARCP_REASON data (Optional)

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✓	FPAS_EPM_DEGREE_SCORE
✓	FPAS_EPM_PUB_SCORE
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✓	FPAS_DATE_OTHER_QUAL
○	FPAS_OTHER_QUALINSTITUTION
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Comments about requested FPAS data (Optional)

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Comments about requested GAMSAT data (Optional)

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Comments about requested HEE_RECRUIT_OUTCOMES data (Optional)

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☐	HESA_OLD_HUSID
☐	HESA_DEDUP_SCRIPT

Comments about requested HESA_ACAD_YEARS data (Optional)

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☑	HESA_INC_TARIFF
☑	HESA_POINTS

Comments about requested HESA_QUALIFICATION data (Optional)

NTS_TRAINEE

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☐	PROGRAMME_SPECIALTY_2
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☐	POST_END_DATE
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☐	BOARD_TRUST_NAME
☐	SITE_CODE
☐	SITE_NAME
☐	IN_TRAINING_IND
☐	NIT_REASON
☑	TRAINEE_TYPE
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☐	NTN_PROGRAMME_CODE
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☑	EXCLUSION_REASON
☐	SURVEY_COMPLETION_CODE
☐	GEOGRAPHIC_LETB
☐	GEOGRAPHIC_DEANERY
☐	NTS_CURRICULA

Comments about requested NTS_TRAINEE data (Optional)

NTS_TRAINEE_IND_SCORES

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☐	NTS_YEAR
☐	INDICATOR_TYPE
☐	INDICATOR_SCORE

Comments about requested NTS_TRAINEE_IND_SCORES data (Optional)

PERSON_STUDENT

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☑	HESA_OWNSTU
☑	HESA_UCAS_APP_ID
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☑	HESA_PREV_INST
☑	HESA_PREV_INST_NAME
☑	HESA_DOMICILE_COUNTRY
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☑	PARENTAL_POSTCODE_SRC
☑	HESA_TARIFF
☑	HESA_QUALENT
☑	HESA_HIGHQUAL_OBTAIN
☑	UKCAT_PARTICIPANT_ID
☑	UKCAT_NATIONAL_IDENTITY
☑	UKCAT_REGIONAL_IDENTITY
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☑	UKCAT_PARENT1OCCUPATION
☑	UKCAT_PARENT1EMPLOYMENTSTATUS
☑	UKCAT_PARENT1EMPLOYERSIZE
☑	UKCAT_PARENT1SUPERVISOR
☑	UKCAT_PARENT2GENDER
☑	UKCAT_PARENT2OCCUPATION
☑	UKCAT_PARENT2EMPLOYMENTSTATUS
☑	UKCAT_PARENT2EMPLOYERSIZE
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☐	UKCAT_DOMICILE
☐	UKCAT_NATIONALITY1
☐	UKCAT_NATIONALITY2

Comments about requested PERSON_STUDENT data (Optional)

We also need HESA_UKPRN_FIRST and HESA_UKPRN_LAST please

UKCAT

SELECT	NAME
◯	HUSID
◯	PERSON_UID
◯	UKCAT_MATCH_SCRIPT
◯	UKCAT_REGISTRATION_ID
◯	UKCAT_ATTEMPT_NUMBER
◯	UKCAT_TEST
◯	UKCAT_DATE_TEST
◯	UKCAT_ATTENDED
◯	UKCAT_HIGHEST_QUALIFICATION
◯	UKCAT_UCAS_APPLICATION_ID
◯	UKCAT_ID
◯	UKCAT_YEAR_APPLICATION
◯	UKCAT_YEAR_ENTRY
◯	UKCAT_SCHOOL

Comments about requested UKCAT data (Optional)

UKCAT_APPLICATIONQUALIFICATIONS

SELECT	NAME
◯	UKCAT_UCASAPPID
◯	UKCAT_QUALIFICATIONNUMBER
◯	UKCAT_STANDARD
◯	UKCAT_SUBJECT
◯	UKCAT_SCORE

Comments about requested UKCAT_ APPLICATIONQUALIFICATIONS data (Optional)

UKCAT_CR_IMDPOSTCODES

SELECT	NAME
◯	POSTCODE
◯	POSTZONE

Comments about requested UKCAT_CR_ IMDPOSTCODES data (Optional)

UKCAT_CR_IMDZONES

SELECT	NAME
○	CODE
○	CLASS
○	NAME
○	LOCALAUTHORITY
○	COUNTRY
○	RANK
✓	QUINTILE

Comments about requested UKCAT_CR_IMDZONES data (Optional)

UKCAT_CR_UCASSCHOOLCATGLIST

SELECT	NAME
○	CATEGORYID
✓	CATEGORYDESCRIPTION

Comments about requested UKCAT_CR_UCASSCHOOLCATGLIST data (Optional)

UKCAT_CR_UCASSCHOOLLIST

SELECT	NAME
○	SCHOOLID
○	NAME
○	ADDRESS1
○	ADDRESS2
○	ADDRESS3
○	ADDRESS4
✓	POSTCODE
✓	COUNTRY
✓	DFEID
✓	CATEGORYID
✓	SUBCATEGORYID
✓	STATUS

Comments about requested UKCAT_CR_UCASSCHOOLLIST data (Optional)

UKCAT_CR_UCASSCHOOLSUBCATEGORYGROUPLIST

SELECT	NAME
○	SCHOOLGROUPID
○	SCHOOLGROUPDESCRIPTION

Comments about requested UKCAT_CR_UCASSCHOOLSUBCATEGORYGROUPLIST data (Optional)

UKCAT_CR_UCASSCHOOLSUBCATEGORYLIST

SELECT	NAME
○	SUBCATEGORYID
✓	SUBCATEGORYDESCRIPTION
○	SCHOOLGROUPID

Comments about requested UKCAT_CR_UCASSCHOOLSUBCATEGORYLIST data (Optional)

UKCAT_RESPONSES_NONCOG

SELECT	NAME
☐	UKCAT_TESTREGID
☐	UKCAT_ITEM
☐	UKCAT_RESPONSE

Comments about requested UKCAT_RESPONSES_NONCOG data (Optional)

UKCAT_RESULTS

SELECT	NAME
☑	UKCAT_TESTREG_ID
☑	UKCAT_SECTION
☑	UKCAT_SCORE

Comments about requested UKCAT_RESULTS data (Optional)

UKCAT_UCASAPPLICATIONCOURSES

SELECT	NAME
☐	UKCAT_UCASAPPID
☐	UKCAT_CHOICENUMBER
☑	UKCAT_DATEAPPLICATION
☐	UKCAT_UNIVERSITY
☐	UKCAT_COURSE
☐	UKCAT_UNIVERSITYDECISION
☐	UKCAT_APPLICANTREPLY
☐	UKCAT_APPLICANTDECISION

Comments about requested UKCAT_UCASAPPLICATIONCOURSES data (Optional)

UKCAT_UCASAPPLICATIONGCSES

SELECT	NAME
☑	UKCAT_UCASAPPID
☑	UKCAT_GCSENUMBER
☑	UKCAT_SUBJECT
☑	UKCAT_SCORE

Comments about requested UKCAT_UCASAPPLICATIONGCSES data (Optional)

VW_UKCAT_RESULTS_NONCOG

SELECT	NAME
☐	UKCATREGID
☐	TEST
☐	SECTION
☐	SCORE

Comments about requested VW_UKCAT_RESULTS_NONCOG data (Optional)

VW_UKMED_ALLEGATIONS

SELECT	NAME
☐	PERSON_UID
☐	CASE_NUMBER
☐	GMP_DOMAIN
☐	ALLEG_TYPE
☐	ALLEG_SUB_TYPE

Comments about requested VW_UKMED_ALLEGATIONS data (Optional)

VW_UKMED_FTPCHARDECLARATIONS

SELECT	NAME
☑	AGORA_ID
☑	PERSON_UID
☑	DECLARATION_TYPE
☑	DECLARATION_DATE
☑	APPLICATION_TYPE
☑	APPLICATION_STATUS
☑	APPLICATION_STATUS_REASON

Comments about requested VW_UKMED_FTPCHARDECLARATIONS data (Optional)

VW_UKMED_FTP_SUMMARY

SELECT	NAME
☐	PERSON_UID
☐	ENQUIRY_RECEIVED
☐	CASE_OUTCOME
☐	CASE_NUMBER
☐	ENQUIRY_INCIDENT_DATE
☐	ENQUIRY_INCIDENT_LOCATION_L2
☐	ENQUIRY_INCIDENT_LOCATION_L3
☐	ENQUIRY_TYPE
☐	ENQUIRY_SOURCE_TYPE

Comments about requested VW_UKMED_FTP_SUMMARY data (Optional)

VW_UKMED_PERSON

SELECT	NAME
☑	PERSON_UID
☑	HUSID
☑	BIRTH_DT
☑	GENDER
☑	PRIMARY_PMQ
☑	PRIMARY_PMQ_YEAR
☑	PRIMARY_PMQ_PLACE
☑	PRIMARY_PMQ_WORLD_REGION
☐	PRIMARY_PMQ_SHORTCODE
☐	CURR_REG_ADD_POSTCODE
☑	CURR_REG_ADD_POSTCODE_OUTCODE

Comments about requested VW_UKMED_PERSON data (Optional)

For peer review only

VW_UKMED_PROTECTEDCHARS

SELECT	NAME
☑	AGORA_ID
☑	PERSON_UID
☑	ETHNICITY_L1
☑	ETHNICITY_L2
☑	ETHNICITY_SRC
☑	DISABILITY
☐	DISABILITY_SRC
☐	LIMITED_ACTIVITIES
☐	LIMITED_ACTIVITIES_SRC
☐	ADJUSTMENTS
☐	ADJUSTMENTS_SRC
☐	UK_EDUCATED
☐	UK_EDUCATED_SRC
☑	SCHOOL_TYPE
☑	SCHOOL_TYPE_SRC
☑	INCOME_SUPPORT
☑	INCOME_SUPPORT_SRC
☑	FREE_SCHOOL_MEALS
☑	FREE_SCHOOL_MEALS_SRC
☑	PARENT_DEGREE
☑	PARENT_DEGREE_SRC
☑	GROWING_UP_POSTCODE
☑	GROWING_UP_POSTCODE_SRC
☑	POLAR2
☑	POLAR2_SRC
☑	POLAR3
☐	POLAR3_SRC
☑	SEC
☐	SEC_SRC
☑	NSSEC
☐	NSSEC_SRC
☐	SOC2000
☐	SOC2000_SRC
☐	PARED
☐	PARED_SRC

Comments about requested VW_UKMED_PROTECTEDCHARS data (Optional)

Methodology

Study design, setting and source of data:
This will be a longitudinal study using UK-wide data. The data and permission to use the data for research purposes will be obtained from the GMC.

Population:
All doctors who entered a UK medical school in 2007 or in 2008, and who were eligible to apply for a Specialty Training Programme after completion of the Foundation Programme.

Primary outcome and exposure:
The outcome of interest is the Specialty Training Programme(s) the doctor applied to, received an offer from, and accepted the offer, after completion of their Foundation Programme.

The variable, Specialty Training Programme, may be collapsed into fewer categories, to ensure there is sufficient power to perform the statistical analyses. This is dependent on the number of doctors in each category. If we feel that fewer categories are required, two researchers will independently allocate each Specialty Training Programme into a collapsed specialty category, and any disagreements about the specialty allocation will be resolved through discussion. A Kappa statistic will be calculated to report the level of agreement between the two researchers.

The exposure of interest is the doctor's sex.

Background variables:
We are interested in whether previous academic attainment mediates the relationship between doctors' sex and specialty choice. The variables we will explore to measure academic attainment prior to medical school are GCSE grades and UKCAT performance, and for graduate students GAMSAT. The EPM ranking will provide a measure of undergraduate performance. The FPAS SJT score is not strictly a measure of academic attainment, but it will provide a measure of potential postgraduate performance. Other potential confounders we will include in our analysis are ethnicity, prior degree, school type, socioeconomic status, progress through medical school, and medical school.

We are also interested in whether the specialty choice of doctors with a history of Fitness to Practise declarations differs to that of doctors who do not have a history of Fitness to Practise declarations.

The STROBE statement will be used to guide our study.

Scoring guide
0 – Methods not appropriate to addressing research aims or question.
1 – Methods may seem outdated, over simplistic or not well adapted to nature of data.
2 – Methodology takes into account the nature of and type of data available and is suitable to address the research question.

Analysis proposed

We will commence with preliminary data analyses, providing descriptive statistics on the variables we have requested, and performing bivariate analyses to confirm and explore associations in the data. If necessary we will perform multiple imputation to account for missingness. This will enable us to answer research questions 1-7.

We will proceed by completing multivariate analyses using multi-level multiple regression modelling to answer research questions 8 and 9. Multinomial regression will be used to examine the predictors of which specialties participants applied to, and logistic regression to examine the predictors of being offered vs not being offered a place, and accepting vs not accepting a place, respectively. The models will include the background variables that modify the strength of association between the exposure and outcome variables. The final regression models will enable the calculation of an adjusted measure of effect and will be assessed for the presence of effect modifiers.

Scoring guide
0 – Analysis not appropriate to addressing research aims or question.
1 – Analysis may seem outdated, over simplistic or not well adapted to nature of data.
2 – Analysis takes into account the nature of and type of data available and is suitable to address the research question.

Proposed start date			Duration
01	08	2016	13
DD	MM	YYYY	months

Timeline (key milestones)

August 2016: Complete administration to enable access to UKMED data.
August-October 2016: Data management (preparing data for analysis).
October 2016-January 2017: Data analysis.
November 2016: Initial findings shared with the research subgroup.
February-April 2017: Preparation of research manuscript for dissemination, and for PhD thesis.
May 2017 onwards: Research manuscript submitted for publication in peer-reviewed journal.
September 2017: Research manuscript submitted as part of PhD thesis.

Proposal for dissemination of research (E.g. proposed conference submission, proposed journal):

We plan to prepare our research outputs as an original research article for publication in a peer-reviewed journal. We would aim to submit our research manuscript to a peer-reviewed journal that attracts an audience across medical disciplines.

The research project will also be prepared and submitted as part of a PhD thesis. Emily Unwin's PhD is examining the gender difference in the professional performance of doctors, and this research project will be a part of this work.

Scoring guide
0 – No statement of intended use.
1 – Intended uses unclear.
2 – There is a clear statement on the intended outputs which may include publication in a peer-reviewed journal, publication on an organisation's website, reports that are evaluations of a service rather than research, or publication as a PhD thesis.

Researchers

Please provide details of all researchers who will be involved in the study.

Scoring guide
0 – Team is not plausible with little evidence of relevant skills or track record. There is no governance structure defined or there is indication that it may not be accountable.
1 – Team may have obvious skills gaps or limited relevant research track record. Governance structure is outlined, but is not very clear.
2 – Proposed team members have a good track record in related research and are likely to have the skills to employ the proposed methodology and manage data issues. Governance structure is described in a clear and accountable way.

Lead researcher's title and name

Dr Emily Unwin

Organisation

UCL

Address

UCL Medical School
Room GF/664
Royal Free Hospital
Hampstead
NW3 2PF

Email address

emily.unwin.12@ucl.ac.uk

Telephone number

n/a

For peer review

Partners – those who will have access to the data

Please list name, role, organisation, address, email and telephone details.

	Partner 1
Name	Dr Katherine Woolf
Role	Researcher and PhD supervisor
Organisation	UCL
Address	UCL Medical School Room GF/664 Royal Free Hospital Hampstead NW3 2PF
Email	k.woolf@ucl.ac.uk
Telephone	020 3108 9216

	Partner 2
Name	Dr Karim Keshwani
Role	Co-researcher
Organisation	UCL
Address	UCL Medical School Room GF/664 Royal Free Hospital Hampstead NW3 2PF
Email	k.keshwani@ucl.ac.uk
Telephone	n/a

	Partner 3
Name	Dr Chris Valerio
Role	Co-researcher
Organisation	UCL
Address	UCL Medical School Room GF/664 Royal Free Hospital Hampstead NW3 2PF
Email	christopher.valerio.09@ucl.ac.uk
Telephone	n/a

Additional contact details

If you wish to make a note of contact details of other researchers involved in this project who do not require access to the safe haven but do need to be included in communication, please list their name(s) and email(s) here.

1) Professor Jane Dacre
PhD supervisor
Royal College of Physicians
11 St Andrews Place
London
NW1 4LE
jane.dacre@rcplondon.ac.uk

2) Dr. Henry Potts
PhD supervisor
University College London
Institute of Health Informatics
401 222 Euston Road
London
NW1 2DA
h.potts@ucl.ac.uk

Outline each researcher's proposed role and the working time that will be committed to the research project (e.g. 0.5 FTE)

We (EU, KW, KK and CV) have conceived and designed the study. The original idea for the study was KK's and CV's. EU reviewed and modified the original idea and prepared the research proposal with support from KW.

1. Dr. Emily Unwin (EU)
EU will lead on this research project. She will work with KW to manage and organise the datasets in preparation for data analysis. She will work with KW to perform the data analysis and data interpretation. She will also write and prepare the first draft of the manuscript for publication. She will take responsibility for submitting any research manuscripts for publication.
October 2016-September 2017 0.5 FTE

2. Dr. Katherine Woolf (KW)
As EU's PhD supervisor, KW, will be involved in preparing the data for analysis, performing and reviewing the data analysis and data interpretation. She will critically review the manuscript prior to publication. KW will be responsible for reviewing EU's progress with this project and will meet with EU on a regular basis to discuss the project (1-2 times/month).

3. Dr. Karim Keshwani (KK)
KK will support EU with any data management required. He will assist EU in writing the first draft of the manuscript by supporting her in reviewing the literature. He will critically review the manuscript prior to publication.

4. Dr. Christopher Valerio (CV)
CV will support EU with any data management required. He will assist EU in writing the first draft of the manuscript by supporting her in reviewing the literature. He will critically review the manuscript prior to publication.

All authors will contribute to the final version of the manuscript and the revisions.

Scoring guide
0 – Team is not plausible with little evidence of relevant skills or track record. There is no governance structure defined or there is indication that it may not be accountable.
1 – Team may have obvious skills gaps or limited relevant research track record. Governance structure is outlined, but is not very clear.
2 – Proposed team members have a good track record in related research and are likely to have the skills to employ the proposed methodology and manage data issues. Governance structure is described in a clear and accountable way.

CVs

Please provide brief CVs of the lead researcher and other researchers with a significant role.

1) Dr Emily Unwin

Current role
PhD candidate at UCL Medical School

Research summary
My research attempts to explore the gender difference in the professional performance of doctors, by using epidemiological techniques and examining large datasets. I aim to identify the possible areas that we, as researchers in medical education, can focus upon to bridge the gender gap and improve doctors' professional performance as a whole. I also hope to demonstrate how the quantitative techniques usually reserved for the discipline of epidemiology can be applied to medical education research.

Academic background
2012-current date: PhD candidate – Medical Education, University College London
2011-2012: Master of Science – Epidemiology, London School of Hygiene and Tropical Medicine
2000-2006: Bachelor of Medicine and Bachelor of Surgery – University College London
2003: Bachelor of Science – Psychology with Basic Medical Sciences, University College London.

Journal article publications – original research articles (first author only)
Unwin, E., Woolf, K., Wadlow, C., Potts, H.W.W., & Dacre, J. (2015). Sex differences in medico-legal actions against doctors: A systematic review and meta-analysis. BMC Medicine, 13 (1).
Unwin, E., Woolf, K., Wadlow, C., & Dacre, J. (2014). 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. BMJ Open, 4(8).

2) Dr Katherine Woolf

Current role
Senior Lecturer at UCL Medical School

Research summary
My research explores the factors influencing medical students' and doctors' performance, in particular the influence of ethnicity and sex. The aim of my research is to better understand how to improve doctors' performance, improve fairness in medical education, and ultimately improve patient care.

Academic background
2005-2008: PhD in Medical Education and Psychology, University College London
2000-2003: Bachelor of Science (first class honours) – Psychology, Goldsmiths College

Journal article publications – original research articles (first author only)
Woolf, K., Elton, C., & Newport, M. (2015). The specialty choices of graduates from Brighton and Sussex Medical School: a longitudinal cohort study. BMC Medical Education, 15 (1), 46.
Woolf, K., Potts, H., Patel, S., & McManus, C. (2012). The hidden medical school: A longitudinal study of how social networks form, and how they relate to academic performance. Medical Teacher, 34 (7), 577-586.
Woolf, K.V.M., McManus, I.C., Potts, H.W.W., & Dacre, J. (2011). The mediators of minority ethnic underperformance in final medical school examinations. British Journal of Educational Psychology.
Woolf, K., Potts, H.W.W., & McManus, I.C. (2011). The relationship between ethnicity and academic performance in UK-trained doctors and medical students: a systematic review and meta-analysis. BMJ, 342, d901.
Woolf, K., Potts, H.W.W., & McManus, I.C. (2011). The relationship between ethnicity and academic performance in UK-trained doctors and medical students: a systematic review and meta-analysis. BMJ, 342, d901.

Is the research funded, and/or does your organisation support the work? Please outline the status of any funding application and whether it is essential for the work to proceed. When submitting the form, please attach evidence of the funding organisation's support for the proposed work (e.g. meeting minutes).

This research project will form part of EU's PhD research. EU has a fully-funded PhD studentship at UCL Medical School. KW is EU's PhD supervisor. The costs of this research project will be covered by EU's existing studentship. KK and CV will work on this research project on a voluntary basis, with the aim of furthering their research experience. No additional funding is being sought.

Scoring guide
0 – No explicit plan for how staff time or other resources will be made available to complete the analysis in a timely manner.
1 – Plan for obtaining funding outlined but not guaranteed. Internal institutional support for staff time may be available.
2 – A source of funding has been identified and obtained. This is likely to be sufficient to cover the costs of the work.

Have you received ethical approval, or an exemption from the requirement to obtain ethical approval?
When submitting the form, please attach the relevant correspondence.

We have applied to the UCL Research Ethics Committee to extend the ethical approval for EU's PhD research to include this research project.
We believe that the amendment to the existing ethical approval should have no impact on any ethical considerations.
We will notify the UKMED team when we have received confirmation of ethical approval.

Successful applicants will access data via a safe haven. In order to manage this process, please detail the software you will need to use to complete your research.

Please include details of the version number and the terms of your license. Depending on the software required you may need to bring your own license. Note that some of the licenses held by some UK universities will permit you to use the given software in the safe haven upon provision of a valid license key provided by your institution.

Data management and analysis software:
STATA/SE 12.1

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3,4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	4
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4-6
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	*6*
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	4-7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7
		(*b*) Describe any methods used to examine subgroups and interactions	7
		(*c*) Explain how missing data were addressed	7
		(*d*) If applicable, explain how loss to follow-up was addressed	n/a
		(*e*) Describe any sensitivity analyses	n/a
Results			

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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	4 & 7
		(b) Give reasons for non-participation at each stage	4 & 7
		(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	7,8
		(b) Indicate number of participants with missing data for each variable of interest	6
		(c) Summarise follow-up time (eg, average and total amount)	n/a
Outcome data	15*	Report numbers of outcome events or summary measures over time	6
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	7-10
		(*b*) Report category boundaries when continuous variables were categorized	6
		(*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	n/a
Discussion			
Key results	18	Summarise key results with reference to study objectives	11
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12,13
Generalisability	21	Discuss the generalisability (external validity) of the study results	12
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	13

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

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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BMJ Open

The effect of sex on specialty training application outcomes: a longitudinal administrative data study of United Kingdom medical graduates

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2018-025004.R1
Article Type:	Research
Date Submitted by the Author:	04-Jan-2019
Complete List of Authors:	Woolf, Katherine; University College London, Research Department for Medical Education; University College London, Jayaweera, Hirosha; University College London Medical School, Research Department of Medical Education ; University of Western Australia, Centre for Clinical Research in Neuropsychiatry Unwin, Emily; University College London, UCL Medical School Keshwani, Karim; University College London Medical School - Royal Free Campus, Research Department of Medical Education Valerio, Christopher; North Middlesex University Hospital NHS Trust Potts, Henry; UCL, Centre for Health Informatics and Multiprofessional Education
Primary Subject Heading:	Medical education and training
Secondary Subject Heading:	Medical education and training
Keywords:	MEDICAL EDUCATION & TRAINING, Human resource management < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, EDUCATION & TRAINING (see Medical Education & Training)

SCHOLARONE™
Manuscripts

The effect of sex on specialty training application outcomes: a longitudinal administrative data study of United Kingdom medical graduates

Katherine Woolf[1]*

Hirosha Jayaweera[1,2]

Emily Unwin[1]

Karim Keshwani[1]

Christopher Valerio[3]

Henry W. W. Potts[4]

[1] Research Department of Medical Education, University College London Medical School, GF/664, Royal Free Hospital, London NW3 2PF, United Kingdom (UK).

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Abstract

Objectives

To examine sex differences in the specialty training recruitment outcomes of United Kingdom (UK) medical graduates; and whether sex differences were explained by prior academic attainment and previous fitness to practise (FtP) declarations.

Design

Retrospective longitudinal cohort study.

Setting

Administrative data on entrants to all UK medical schools from the UK Medical Education Database.

Participants

10 559 doctors (6 155; 58% female) who entered a UK medical school in 2007 or 2008 and were eligible to apply for Specialty Training by 2015.

Primary outcome measure

Odds of application, offer, and acceptance to any specialty training programme, and on to each of the nine largest training programmes, adjusting for sex, other demographics, prior academic attainment, FtP declaration, and medical school.

Results

Across all specialties, there were no sex differences in applications for specialty training, but women had increased odds of getting an offer (odds ratio=1.40; 95% CI=1.25-1.57; p<.001) and accepting one (OR=1.43; 95% CI=1.19-1.71; p<.001). Seven of the nine largest specialties showed significant sex differences in applications, which remained after adjusting for other factors. In the adjusted models, Paediatrics (OR=1.57; 95% CI=1.01-2.46; p=0.046) and General Practice (OR=1.23; 95% CI=1.03-1.46; p=0.017) were the only specialties to show sex differences in offers, both favouring women. GP alone showed sex differences in acceptances, with women being more likely to accept (OR=1.34; 95% CI=1.03-1.76; p=0.03). Doctors with an FtP declaration were slightly less likely to apply to specialty training overall (OR=0.84; 95%CI=0.71-1.00; p=0.048) and less likely to accept an offer to any programme (OR=0.71; 95% CI=0.52-0.98; p=0.036), after adjusting for confounders.

Conclusions

Sex segregation between medical specialties is due to differential application, although research is needed to understand why men are less likely to be offered a place on to GP and Paediatrics training, and if offered GP are less likely to accept.

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Strengths and limitations of the study

- First study to assess sex differences in the likelihood of receiving and accepting an offer to UK specialty training overall and within nine specialties.
- Sex differences controlled for confounders including prior attainment.
- Large sample size and longitudinal data obtained from the UK Medical Education Database.
- Did not consider the impact of multiple applications or acceptances from multiple offers, and did not formally compare specialties.
- Large number of tests increased the likelihood of type I error.

Background

The proportion of men and women in different medical specialties varies greatly, with relatively more women in General Practice (GP), Paediatrics, and Obstetrics and Gynaecology (O&G), and more men in Surgery and Radiology. This so-called sex segregation is the result of preferences and constraints, themselves influenced by experiences and gendered societal norms and expectations.(1-6)(7, 8)

Less is known about whether selection processes influence sex ratios in different specialties, either directly - if the methods used to select applicants show sex differences - or indirectly - if selection methods rely on other measures such as previous academic attainment that themselves show sex differences. For example, it is known that women generally do better on Situational Judgement Tests (SJTs),(9) which are used in some specialty selection programmes in the UK, and they also have slightly higher medical school performance as judged by the Educational Performance Measure (EPM) used to select newly qualified doctors to UK Foundation Training.(10) Understanding whether selection processes contribute to differences in the proportions of men and women in different specialties is important for effective workforce planning and the provision of future healthcare, and could influence efforts to reduce sex segregation in some specialties.

Relatively little published research addresses the potential influence of selection processes on outcomes. Studies and data tend to show either no sex differences, or women doing slightly better than men. In the UK, a 2013 evaluation of selection in five English regions into five specialties (Core Medical Training, Core Surgical Training, Psychiatry, O&G, and Paediatrics), found women in the sample achieved higher scores in selection into Core Surgical Training and Psychiatry after adjusting for other demographic factors, with no significant sex differences in the other specialties.(11) A 2016 evaluation of GP selection found women were more likely to be successful.(12) A 2017 study of selection into general and vascular surgery found no effect of sex on selection scores.(13) Publically available Canadian Resident Matching Service data from 2017 showed female Canadian medical graduates were slightly more likely to be successfully matched to a surgical specialty, with no differences in other specialties.(14) Similar data for the US are not publically available,

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but an historic analysis of data from 1987 found women were more likely to get their first choice of specialty and less likely not to be matched.(15) More recent studies of Radiology and Anaesthesia residency selection found female applicants outperformed men.(16, 17)

Research in this area may also help us understand other areas of stark sex differences in medicine, such as disciplinary action, where male doctors have nearly 2.5 times the odds of facing medico-legal action.(18) Recent research has shown male UK medical graduates have increased odds of a Fitness to Practise issue at medical school,(19) and professionalism problems at medical school are known to predict later sanctions.(20-22) It is also known that doctors from certain specialties are at higher risk of receiving sanctions.(23) It is unknown however whether graduates with an FtP declaration may favour certain specialties.

The aims of this study are:

1. To measure sex differences in specialty applications, offers and acceptances.
2. To examine whether sex differences are present in specialty applications, offers and acceptances after controlling for previous academic attainment, and other potential confounders.
3. To examine whether medical school Fitness to Practise declarations predict specialty choice, taking into account sex and prior academic attainment.

Methods

Design and setting

Longitudinal study using data from the UK Medical Education Database (UKMED). UKMED contains administrative data on UK medical students. The data and permission to use the data for research purposes was obtained from the General Medical Council (GMC). The study protocol can be found in the Supplementary Material (file name "UKMED_Application_April_2016.pdf").

Participants

At the time this study was undertaken, UKMED contained data on 13 763 people - 5 913 (43%) men and 7 850 (57%) women - who entered medical school in 2007 and 2008. Our study population comprised 10 559 doctors who entered a UK medical school in 2007 or 2008 and who had completed Foundation training and thus were eligible to apply for Specialty Training by 2015. Compared to the full dataset, there were slightly fewer men (n=4 404; 42%) in this sample.

Study variables

A summary of all variables included in the analysis is given in Table 1. Further details can be found in the UKMED data dictionary.(24)

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The primary exposure of interest was a doctor's sex (male or female). The secondary exposure of interest was having a Fitness to Practise declaration at application to the Foundation Programme vs having none. The primary outcomes of interest were:

- Specialty Training Programme(s) applied to.
- Specialty Training Programme offered (of those applied to).
- Specialty Training Programme accepted (of those offered).
- Application to a Specialty Training Programme vs no application.

We only included first applications. We did not analyse the number of applications made, and analysed data for each specialty separately e.g. if a doctor applied to two specialties, we included them in both specialties. Men and women did not differ significantly in the number of multiple applications they made (p=0.77). We combined applications from all years for the analysis for everyone who entered medical school in 2007 or 2008.

Prior attainment included both medical school and pre-medical school academic attainment. Pre-medical school attainment consisted of Higher Education Statistics Agency (HESA) tariff points, which is a measure of qualifications on entry to medical school (typically A-levels), and first attempt aptitude test score, either UK Clinical Aptitude Test (UKCAT) or Graduate Medical School Admissions Test (GAMSAT). We also looked at whether or not a doctor had a university degree before entering medical school. Medical school attainment consisted of Foundation Programme Application System (FPAS) scores, available from 2012 to 2015. This included the Educational Performance Measure or EPM, which is a quartile (2012) or decile (2013 onwards) ranking of an applicant compared to others within their medical school, Situational Judgement Test (SJT) score (2013 onwards), degree points (awarded for university degrees other than the primary medical degree), and publication points (awarded for peer reviewed research publications). We recoded degree points into a three level variable (0=no additional degrees; 1=additional undergraduate degree 3rd class, lower second class or upper second class; 2=additional undergraduate degree 1st class, Master's degree or doctorate). We also recoded publication points into a binary variable (0=none, 1=one or more).

We controlled for the medical school doctors graduated from since it is known that graduates of different medical schools differ significantly in terms of the specialties they apply to and their academic performance (e.g. (25-27)). We also controlled for ethnicity, socio-economic status, and pre-medical school country of domicile, since these are known to influence academic performance.(28, 29) Ethnicity was a binary variable (black and minority ethnic or BME vs white) created by collapsing all 'non-white' groups, including mixed, into the BME category, and all white groups into the white category. We included four socioeconomic measures, each of which we collapsed into binary variables: socioeconomic class (SEC, based on parental occupation: higher managerial vs all others), school type (fee-paying vs non-fee-paying), POLAR3 (low neighbourhood higher education participation vs all other; non-UK missing), and free school meals (no free school meals vs free school meals). We chose those variables because they measure slightly different things:

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POLAR3 is the only area level variable, SEC is a measure of parental occupation, school type is measure of the student's educational background (and students from poor backgrounds can receive scholarships to attend private schools), and free school meals is a marker of parental income.

Table 1: Description of variables

Variable group	*Factor*	*Level*	*Details*	*Missing (N, %)*
Demographics				
	Free school meals	Binary	Free School Meals vs No Free School Meals	N=1 722, 16.3%
	Parental socioeconomic class	Binary	Categories 1 to 4 vs Category 5	N=914, 8.7%
	School type	Binary	Non fee-paying vs fee paying	N=920, 8.7%
	Participation of Local Areas (POLAR) 3	Binary	Low participation neighbourhood vs all other neighbourhoods	N=1 020, 9.7%
	Ethnicity	Binary	Black and Minority Ethnic (BME) vs white	N=55, 0.5%
	Gender	Binary	Male vs female	N=0.
	Year of birth	Continuous	Min=1959 Max=1991. Median=1988.	N=0.
	Pre-medical school domicile	Binary	UK vs non-UK domicile	N=0.
Pre-medical school academic attainment	HESA tariff points	Continuous	Tariff points Min=20, Max=1036. Mean=473, SD=109.	N=2 743, 26%
	University degree prior to medical school	Binary	Prior degree vs no prior degree	N=0
	First attempt score UK Clinical Aptitude Test (UKCAT)	Continuous	UKCAT points Min=1600, Max=3340 Mean=2504, SD=222	N=1 524, 14.4%
Medical school	Medical School	Categorical	Last recorded medical school name n= 30	N=0
	FPAS Educational Progress Measure	Continuous	Min=34, Max=43 Mean=38.7, SD=2.8	N=1 035, 9.8%
	FPAS Situational Judgement Test (SJT) score	Continuous	Min=4.50, Max=50 Mean=40.8, SD=3.2	N=4 588, 43.5%
	FPAS degree points	Continuous	Min=0, Max=2, Mean=.094, SD=0.73	N=3 541, 33.6%
	FPAS publication points	Binary	None vs One or more	N=1035, 9.8%
	Fitness to Practise declaration	Binary	Declaration vs no declaration	N=0
Specialty application	Applied to at least one of 22 specialties	Binary	Applied vs not applied	N=0
	Applied to each specialty	Binary	Applied vs not applied 9 largest specialties	N=0
	Offered at least one of 22 specialties	Binary	Offered vs not offered	N=0. Excludes non-applicants

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	Offered each specialty	Binary	Offered vs not offered 9 largest specialties	N=0. Excludes non-applicants
	Accepted at least one of 22 specialties	Binary	Accepted vs not accepted	N=0. Excludes not offered
	Accepted each specialty	Binary	Accepted vs not accepted 9 largest specialties	N=0. Excludes not offered

Statistical analysis

Univariate tests (t-tests, Mann-Whitney tests, χ^2-tests) were conducted in SPSS v22. Multilevel binomial logistic regressions with a random effect of medical school and fixed effects of background variables were conducted using lme4 in R. We considered medical school a random effect because the medical schools are a sample of all medical schools in the world.

The multilevel models were fitted to predict applications, offers, and acceptances overall and for each of the nine larger specialties that showed a univariate effect of sex on outcome. Predictor variables were sex, pre-medical school attainment (HESA tariff points. UKCAT score, GAMSAT score), and Foundation Programme Application Scores which were used as a measure of medical school attainment (EPM, SJT, degree points, publication points). The following confounders were also included in the models: ethnicity, year of birth, pre-medical school domicile, parental socio-economic class, free school meals, school type, POLAR3, prior undergraduate degree, and medical school fitness to practise declaration.

For each regression model, missing values were multiply imputed for the following variables: UKCAT score, HESA tariff score, FPAS SJT scores, FPAS EPM scores, FPAS degree points, FPAS publication points, and the four socio-economic variables, using 25 iterations of the Multiple Imputation function in SPSS, with indicators being: regression model outcome (e.g. whether applied for specialty training or not), birth year, gender, ethnicity, medical school, year entered medical school, HESA tariff score, UKCAT total score (min=1600, max 3360), GAMSAT total score, FPAS SJT score (min 0, max=50), FPAS EPM score (min=34, max=43), FPAS degree points, FPAS publication points. Imputed scores were used in the models.

Patient involvement

No patients were involved in this study.

Results

Nearly three quarters of doctors (7 634/10 559; 72.2%) had applied for specialty training. Of 22 specialties recorded, nine had 250+ applicants and 90+ acceptances: Acute Care Common Stem Emergency Medicine (ACCS EM), Clinical Radiology, Core Anaesthetics Training, Core Medical Training, Core Psychiatry Training, Core Surgical Training, General

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Practice (GP), Obstetrics and Gynaecology (O&G), and Paediatrics. 173 doctors had only applied to smaller specialties and were excluded from the analyses on the larger specialties.

Univariate results

Across all specialties, sex was not related to whether any application versus none was made (p=0.25), but women were more likely to get at least one offer versus none (odds ratio=1.40; 95% CI=1.25-1.58; p<.001) and to accept an offer versus none (OR=1.54; 95%CI=1.30-1.84; p<.001). There were significant sex differences in applications to seven of the nine largest specialties (women favouring GP, O&G, Paediatrics, and men favouring ACCS EM, Clinical Radiology, Core Anaesthetics Training, and Core Surgical Training), sex differences in offers to two (GP and Paediatrics, both favouring women), and sex differences in acceptances to two (GP and ACCS EM, both with more women accepting). See Table 2 for details. GP was the only specialty that showed a significant sex difference in applications (unadjusted OR= 1.51; 95% CI=1.37-1.66; p<.001), offers (unadjusted OR = 1.42; 95% CI=1.21-1.66; p<.001) and acceptances (unadjusted OR= 1.34; 95% CI=1.05-1.70; p=0.03), with all favouring women.

There were various sex differences in prior attainment. At application to medical school, men in the sample had on average 36 more UKCAT points than women (p<0.001), but their HESA tariff points were not statistically different, and they were no more likely to have a degree at entry to medical school. At application to Foundation Training, women had higher EPM (p<.001) and SJT scores (p<.001), whereas men had more publications (p=0.007) and degree points (p<0.001). Men were significantly more likely to have a Fitness to Practise declaration (OR=2.12; 95%CI=1.82-2.45; p<0.001).

Doctors who had not applied for specialty training had lower HESA tariff points (p<0.001), UKCAT score (p<0.001), and FPAS degree points (p<0.001) than those who had. There was no difference in EPM (p=0.23) or SJT scores (p=0.13).

There were significant differences by medical school on all predictor variables, including the proportion of women (range: 44.7 to 67.0; p<.001), average prior attainment (all measures significant at p<.001), and the proportion with an FtP declaration (range: 3.5% to 16.7%; p<.001). Medical schools also differed in the proportion of their graduates who applied to specialty training (range: 62.5% to 87.4%; p<.001), received an offer (range: 65.0% to 92.9%; p<.001) and accepted an offer (range: 83.5 to 95.7%; p<.001). All the nine largest specialties except Core Anaesthetics, O&G, and Paediatrics showed significant medical school differences in applications. By contrast, only Core Medical Training, Core Surgical Training, and GP showed medical school differences in offers, and only ACCS EM, Core Surgical Training, and GP showed medical school differences in acceptances. Only GP and Core Surgical Training showed medical school differences in applications, offers, and acceptances.

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Multivariate results

Sex differences in applications remained in the same seven specialties with similar magnitudes after controlling for medical school attended, prior attainment, and demographics. The only specialties showing sex differences in offers were GP and Paediatrics, both favouring women. In the fully adjusted models, the only specialty to show sex differences beyond offers was GP, women being more likely to apply (odds= 1.51; 95% CI=1.37 to 1.67; p<.001), to be offered a place (odds = 1.29; 95% CI=1.03 to 1.11; p=0.004) and to accept an offer (odds= 1.34; 95% CI=1.05 to 1.70; p<.05) to GP training. See Table 2.

Doctors with a medical school FtP declaration were slightly less likely to apply to specialty training overall (OR=0.84; 95%CI=0.71-1.00; p=0.048). Of those who did apply, having an FtP declaration was a small predictor of applying to ACCS Emergency Medicine (odds= 1.39; 95% CI=1.01 to 1.92; p=0.046). Of those who received an offer to any specialty, those with an FtP declaration were slightly less likely to accept (odds= 0.71; 95% CI=0.52 to 0.98; p=0.036), after adjusting for all other factors. It is important to bear in mind in interpreting these findings that we performed a large number of tests, with analyses done for all specialties and then repeated for each of nine specialties separately, increasing the probability of getting a statistically significant result by chance alone (i.e. increasing the chance of type I error). Significant independent predictors of applying, being offered a place, and accepting a place on any specialty are shown in Tables 3 to 5.

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Table 2: Sex differences in applications, offers, and acceptances across all specialties and in the nine largest specialties (32% of doctors applied to multiple specialties). Odds adjusted for year of birth, socioeconomic status, ethnicity, pre-medical school attainment, graduate status, pre-medical school country of domicile, medical school attended, Foundation Programme Application Scores, and medical school Fitness to Practise declaration. Statistically significant values in bold: *p<.05 **p<0.001.

	% applied (Women, Men)	*Unadjusted odds woman applied (95%CI)*	*Adjusted odds woman applied (95%CI)*	*% offered (Women, Men)*	*Unadjusted odds woman offered (95%CI)*	*Adjusted odds woman offered (95%CI)*	*% accepted (Women, Men)*	*Unadjusted odds woman accepted (95%CI)*	*Adjusted odds woman accepted (95%CI)*
All Specialties	72.3 (72.0, 72.7)	0.97 (0.40,2.30)	0.94 (0.85,1.03)	81.3 (83.5, 78.3)	**1.40 (1.25,1.58)****	**1.31 (1.16,1.48)****	90.8 (92.1, 88.7)	**1.54 (1.30,1.84)****	**1.47 (1.23,1.77)****
ACCS EM	5.8 (5.0, 6.9)	**0.71 (0.68,0.74)****	**0.69 (0.57,0.85)****	72.2 (74.8, 69.7)	1.29 (0.85,1.96)	1.50 (0.94,2.39)	67.4 (73.5, 60.8)	**1.79 (1.11,2.87)***	1.57 (0.92,2.70)
Clinical Radiology	3.8 (3.0, 5.0)	**0.58 (0.46,0.73)****	**0.63 (0.49,0.85)****	49.5 (46.6, 51.9)	0.81 (0.51,1.28)	0.71 (0.41,1.21)	63.2 (67.2, 60.2)	1.35 (0.68,2.70)	1.77 (0.77,4.09)
Core Anaesthetics	12.0 (10.1, 14.7)	**0.65 (0.57,0.75)****	**0.57 (0.49,0.85)****	66.5 (69.2, 64.0)	1.27 (0.96,1.67)	1.06 (0.81,1.50)	76.1 (75.2, 77.0)	0.90 (0.62,1.31)	0.90 (0.60,1.35)
Core Medical	29.9 (29.9, 29.8)	1.00 (0.91,1.11)	1.01 (0.91,1.12)	72.9 (73.5, 72.1)	1.07 (0.89,1.29)	1.08 (0.89,1.32)	75.5 (75.2, 76.0)	0.95 (0.76,1.29)	1.01 (0.80,1.28)
Core Psychiatry	5.3 (4.9, 5.8)	0.85 (0.69,1.04)	1.00 (0.819,1.24)	77.7 (80.4, 74.6)	1.39 (0.87,2.23)	1.70 (0.99,2.95)	75.7 (73.3. 78.3)	0.76 (0.45,1.29)	0.97 (0.54,1.73)
Core Surgical	13.8 (8.8, 20.8)	**0.37 (0.32,0.42)****	**0.38 (0.33,0.44)****	64.9 (64.8, 65.1)	0.99 (0.76,1.28)	1.05 (0.78,1.40)	77.1 (80.3, 75.3)	1.34 (0.92,1.96)	1.25 (0.82,1.87)
GP	43.4 (47.5, 37.5)	**1.51 (1.38,1.66)****	**1.53 (1.39,1.69)****	74.5 (76.9, 70.2)	**1.42 (1.21,1.66)****	**1.23 (1.03,1.46)***	87.1 (88.3, 84.9)	**1.34 (1.05,1.70)***	**1.37 (1.05,1.79)***
O&G	4.8 (7.0, 1.7)	**4.33 (3.24,5.79)****	**4.28 (3.18,5.76)****	59.7 (59.9, 58.2)	1.08 (0.60,1.92)	1.00 (0.51,1.95)	77.6 (77.0, 81.3)	1.77 (0.29,1.99)	0.88 (0.30,2.60)

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Paediatrics	8.3 (10.7, 4.9)**	**2.34 (1.94,2.82)****	**2.22 (1.82,2.71)****	76.2 (78.3, 69.9)	**1.56 (1.04,2.34)***	**1.57 (1.01,2.46)***	76.5 (75.8, 78.9)	0.84 (0.49,1.40)	0.72 (0.40,1.27)

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Table 3: Mixed effects logistic regression of medical school (random effect), demographics, prior attainment, and fitness to practise declaration (fixed effects) on the probability of applying to specialty training versus not applying (n=10 559). Statistically significant fixed effects in bold: *p<.05 **p<0.001. The random effect of medical school was highly statistically significant (p<.0001)

	Estimate	*SE*	*Odds ratio*	*Lower 95% CI*	*Upper 95% CI*	*P value*
Female	-0.0633	0.0477	0.9387	0.8549	1.0307	0.1847
HESA tariff	**0.0008**	**0.0003**	**1.0008**	**1.0003**	**1.0013**	**0.0009**
UKCAT score*	**-0.0003**	**0.0001**	**1.0008**	**1.0003**	**1.0013**	**0.0009**
EPM score**	**0.0495**	**0.0095**	**1.0508**	**1.0313**	**1.0705**	**0.0001**
SJT score*	**-0.0295**	**0.0096**	**0.9709**	**0.9528**	**0.9894**	**0.0021**
Degree points**	**-0.7255**	**0.0417**	**0.4841**	**0.4461**	**0.5253**	**<0.0001**
Publication points**	**0.3047**	**0.0573**	**1.3562**	**1.2122**	**1.5174**	**<0.0001**
UK domicile**	**0.3104**	**0.0862**	**1.1610**	**0.9372**	**1.4382**	**0.0003**
Graduate entry**	**0.7103**	**0.0785**	**2.0346**	**1.7445**	**2.3729**	**<0.0001**
Birth Year**	**-0.0750**	**0.0044**	**0.9278**	**0.9198**	**0.9358**	**<0.0001**
BME	-0.0056	0.0031	0.9944	0.9883	1.0004	0.0689
High SEC*	**-0.1126**	**0.0561**	**0.8935**	**0.8005**	**0.9973**	**0.0446**
Fee paying school	-0.0678	0.0538	0.9345	0.8410	1.0384	0.2078
No Free School Meals	0.0412	0.0946	0.9597	0.7972	1.1552	0.6633
High local participation (POLAR)*	**-0.2866**	**0.1284**	**0.7508**	**0.5838**	**0.9657**	**0.0256**
FtP declaration*	**-0.1715**	**0.0871**	**0.8424**	**0.7102**	**0.9992**	**0.0489**

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Table 4: Mixed effects logistic regression of medical school (random effect), demographics, prior attainment, and fitness to practise declaration (fixed effects) on the probability of being offered a place on any specialty training programme or not (n=7 634). Statistically significant fixed effects in bold: *p<.05 **p<0.001. The random effect of medical school was highly statistically significant (p<.0001)

	Estimate	*SE*	*Odds ratio*	*Lower 95% CI*	*Upper 95% CI*	*P value*
Female	**0.2750**	**0.0627**	**1.3165**	**1.1643**	**1.4887**	**<0.0001**
HESA tariff*	**0.0010**	**0.0004**	**1.0010**	**1.0003**	**1.0017**	**0.00585**
UKCAT score	-0.0001	0.0002	0.9999	0.9996	1.0003	0.74034
EPM score	**0.1040**	**0.0131**	**1.1096**	**1.0815**	**1.1385**	**<0.0001**
SJT score	0.0231	0.0141	1.0234	0.9955	1.0520	0.10185
Degree points	**0.2890**	**0.0558**	**1.3351**	**1.1968**	**1.4894**	**<0.0001**
Publication points	0.0457	0.0814	1.0468	0.8924	1.2278	0.57474
Non UK domicile	**-0.4240**	**0.0948**	**0.6544**	**0.5435**	**0.7881**	**<0.0001**
Graduate entry*	**-0.2070**	**0.0980**	**0.8130**	**0.6709**	**0.9852**	**0.03498**
Birth year	-0.0027	0.0137	0.9973	0.9709	1.0244	0.84156
BME	0.0005	0.0054	1.0005	0.9936	1.0093	0.7314
High SEC	0.0563	0.0728	1.0579	0.9172	1.2202	0.4391
Fee paying school	-0.0520	0.0757	0.9493	0.8184	1.1012	0.4926
No Free School Meals	-0.0578	0.1200	0.9438	0.7460	1.1941	0.6289
High local participation (POLAR)	0.1070	0.1510	1.1129	0.8278	1.4962	0.4806
FtP declaration	-0.0471	0.1141	0.9540	0.7927	1.2394	0.9383

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Table 5: Mixed effects logistic regression of medical school (random effect), demographics, prior attainment, and fitness to practise declaration (fixed effects) on the probability of accepting an offer to specialty training or not (n=6 208). Statistically significant fixed effects in bold: *p<.05 **p<0.001. The effect of medical school was statistically significant at p<.007

	Estimate	*SE*	*Odds ratio*	*Lower 95% CI*	*Upper 95% CI*	*P value*
Female **	**0.3868**	**0.0935**	**1.4723**	**1.2259**	**1.7682**	**<0.0001**
HESA tariff	-0.0004	0.0005	0.9996	0.9987	1.0005	0.3316
UKCAT score	-0.0001	0.0002	0.9999	0.9994	1.0003	0.5447
EPM score	0.0476	0.0189	1.0487	1.0106	1.0883	0.0117
SJT score	-0.0264	0.0194	0.9740	0.9377	1.0117	0.1739
Degree points **	**-0.4350**	**0.0798**	**0.6472**	**0.5535**	**0.7569**	**<0.0001**
Publication points*	**-0.2472**	**0.1068**	**0.7810**	**0.6335**	**0.9628**	**0.0206**
Non UK domicile*	**-0.3161**	**0.1451**	**0.7290**	**0.5486**	**0.9687**	**0.0293**
Graduate entry	0.2617	0.1433	1.2991	0.9810	1.7204	0.0678
Birth year**	**-0.0344**	**0.0007**	**0.9662**	**0.9649**	**0.9675**	**<0.0001**
BME	0.0115	0.0095	1.0116	0.9930	1.0306	0.2244
High SEC	-0.1424	0.1141	0.8673	0.6934	1.0846	0.2120
Fee paying school	-0.1802	0.1067	0.8351	0.6775	1.0294	0.0913
No Free School Meals	0.1407	0.1771	1.1511	0.8135	1.6287	0.4270
High local participation (POLAR)	0.0170	0.2402	1.0172	0.6352	1.6288	0.9436
FtP declaration*	**-0.3379**	**0.1608**	**0.7133**	**0.5205**	**0.9775**	**0.0356**

Discussion

There were significant sex differences in the specialty applications of this sample of 10 559 UK medical graduates. Women were more likely to apply to GP, O&G and Paediatrics, and men were more likely to apply to Core Surgical Training, ACCS EM, and Clinical Radiology. Women were more likely to receive an offer versus none, and to receive an offer in GP and Paediatrics specifically. Women were more likely to accept an offer if they received one, and to accept an offer in GP specifically. Sex differences largely remained after controlling for prior academic attainment and having a fitness to practise (FtP) declaration, as well as medical school attended and other demographics. In the fully adjusted models, GP was the only specialty with significant sex differences at all three stages: applications, offers, and acceptances; women being more likely to apply and to accept an offer, and also being more likely to be offered a place. Having an FtP declaration was a small predictor of not applying to specialty training, and of rejecting an offer across all specialties, although the large number of tests performed increases the possibility that this was due to type I error.

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The raw sex differences in applications are consistent with previous research from the UK and other countries.(2, 3, 15, 26, 30) Our finding that women were more likely than men to get an offer in GP selection, but not in selection for Core Surgical Training reflects Davison and colleagues' analysis of national data (12) but differs from Thomas and colleagues' analysis of a smaller subsample.(11) To our knowledge this is the first study to assess sex differences in the likelihood of receiving and accepting an offer to specialty training after controlling for prior attainment, as well as controlling for medical school, other demographics, and a measure of medical school professionalism. It is also the first that we know of to assess whether Fitness to Practise issues at medical school predict specialty preferences and selection outcomes.

A considerable strength of the study is the large sample size (three quarters of all entrants to medical school from 2007 to 2008) and the longitudinal nature of the data, obtained from the UK Medical Education Database (UKMED). This made it possible to examine recruitment to nine different specialties in the UK. It also meant we could conduct multivariate analyses to understand whether sex segregation in some specialties is due to sex differences on the potential confounder of academic attainment, both prior to and during medical school. Because UKMED data are collected by the GMC as part of their statutory duty to regulate medical education in the UK, we did not have to rely on voluntary completion of surveys for data, unlike previous analyses.(11)

The study has some methodological weaknesses. We did not consider multiple applications, or acceptances from multiple offers. 70% of doctors in our sample applied to one specialty only, and this did not differ by sex (p=0.77); however it is likely that the number of multiple applications varies by specialty. For example, a previous study using the same dataset but looking only at GP applicants found that only 59% (vs 70%) made a single specialty training application; however, women were more likely to apply to GP after controlling for prior attainment and other demographics regardless of whether they had applied to multiple specialties or not.(26) We also did not formally compare sex differences between specialties taking into account competition ratios, and we only analysed data from first applications. Since women were more likely to receive and accept and offer first time around, it is possible that men are more likely to apply a second time around, which may then influence the final proportions of men and women in different specialties. We combined applications across years, which meant we could not account for the possibility that different selection processes occurred during different application cycles. We did not look at potential interactions, for example between age and sex, or medical school and sex, which have been shown in other studies to influence specialty choice.(25, 31) Using administrative data rather than data collected for research purposes limited our ability to infer reasons for the sex differences observed. There were also considerable amounts of missing data on some variables, in particular because some of the cohorts within the sample had not taken a test, with multiple imputation used to avoid excluding large amounts of data. Our dataset was

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truncated because we could only include graduates who were eligible to apply to specialty training by 2015. The study findings are not generalizable outside of the UK.

This study suggests that sex differences in specialty applications and outcomes are driven largely by factors unmeasured in this study, and not by academic, other demographic, or medical school differences. In terms of differential applications, previous research has shown that these factors are likely to include how plannable, technical, and people-oriented a specialty is,(2) the career prospects a specialty offers, a trainee's domestic circumstances, and their perceptions of their own ability and interests.(32) There is also evidence that, while some specialties such as Surgery and Paediatrics show sex differences very early in medical school training,(33) experiences during medical school and postgraduate training can influence specialty choices.(12, 34) This suggests that efforts to reduce sex segregation should focus on understanding and addressing medical career choice early on, as well as on understanding whether men and women have different experiences during training, and on removing any perceived or real barriers to career progression and enjoyment within sex-segregated specialties.

It is unclear why women were more likely to receive an offer, and to accept an offer compared to men. The sex differences in GP were the most striking of any of the nine largest specialties, and this itself requires more research to understand. It is important to note that sex differences in applications and acceptances are the result of doctors' choices, which themselves are underpinned by sociological and educational factors; whereas sex differences in offers reflect the specialty selection processes. GP selection comprises written and face-to-face assessments, and potential sex differences on those assessments were not taken into account in our analysis of offers. Performance in GP selection has been found to predict subsequent performance in the Membership of the Royal College of General Practitioners exit examinations,(35) in which women outperform men.(36, 37) As such, the relationship between sex differences in offers and sex differences within General Practice training also merits further exploration.

Conclusions

Sex differences in specialty applications, offers, and acceptances result from factors other than prior academic attainment, medical school Fitness to Practise declarations, medical school, and other demographics. General Practice was the only specialty with significant sex differences in applications, offers, and acceptances: women were more likely to apply; of those who applied, women were more likely to be offered a place; and of those offered a place, women were more likely to accept. Further research exploring the reasons underlying sex differences in applications and acceptances, as well as the differences in offers within GP and Paediatrics, is important for future work place planning and equity.

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Keywords

Medical workforce, academic attainment, sex differences, fitness to practise, professionalism

Original protocol for the study

See Supplementary file "UKMED_Application_April_2016.pdf".

Funding statement

This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Author contributions

KK, CV, and EU conceived of the study and EU wrote the first draft of the original protocol. KK, CV, HWWP, KW and HJ designed the data analysis, with KW and HJ conducting the data analysis. KW wrote the first draft of the report. All authors read and approved the final version of the article. KW is the article guarantor.

Competing interests

KW reports grants, personal fees and non-financial support from General Medical Council, personal fees and non-financial support from Membership of the Royal Colleges of Physicians (United Kingdom), personal fees from University of Dundee School of Medicine, non-financial support from UK Medical Education Database, other from Higher Education Funding Council England, non-financial support from Medical Schools Council, grants from National Institute for Health Research, outside the submitted work.

CV reports non-financial support from Actelion, outside the submitted work.

HWWP reports grants from General Medical Council, outside the submitted work.

EU reports non-financial support from the General Medical Council and financial support from University College London outside the submitted work.

The other authors declare no competing interests.

Data sharing statement

Data files used in the study are securely held by the UK Medical Education Database and cannot be shared by the authors, but are available via application - see www.ukmed.ac.uk.

Acknowledgements

The UK Medical Education Database (UKMED) UKMEDP20 provided the data via an extract generated on 01/08/2016, and it was approved for publication by the UKMED Advisory

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Board on 25/09/2017. We are grateful to UKMED for the use of these data; however UKMED bears no responsibility for our analysis or interpretation. The data includes information derived from that collected by the Higher Education Statistics Agency Limited (HESA) and provided to the General Medical Council (GMC). Source: HESA Student Record 2007/2008 and 2008/2009 Copyright Higher Education Statistics Agency Limited. The Higher Education Statistics Agency Limited makes no warranty as to the accuracy of the HESA Data, and cannot accept responsibility for any inferences or conclusions derived by third parties from data or other information supplied by it. We thank Daniel Smith from GMC for his advice on our application for data and support with data linkage.

Ethics approval and consent to participate

The UK Medical Schools Council agreed that all approved applications for research projects using data exclusively held by UKMED would meet the criteria for a blanket exemption from the need to apply for ethics approval that would be recognised by ethics committees relevant to the UK medical schools. Queen Mary University of London Research Ethics Committee, on behalf of all UK medical schools, confirms ethics exemption, noting that NHS review is not required and that only de-identified data accessed under safe haven conditions is used.

Consent for publication

Not applicable.

References

1. Lambert EM, Holmboe ES. The Relationship between Specialty Choice and Gender of U.S. Medical Students, 1990-2003. Academic Medicine. 2005;80(9):797-802.

2. Elston M. Women and Medicine: The Future. London: Royal College of Physicians; 2009.

3. Buddeberg-Fischer B, Klaghofer R, Abel T, Buddeberg C. Swiss residents' speciality choices – impact of gender, personality traits, career motivation and life goals. BMC Health Services Research. 2006;6(1):137.

4. McManus IC, Sproston KA. Women in hospital medicine in the United Kingdom: glass ceiling, preference, prejudice or cohort effect? Journal of Epidemiology and Community Health. 2000;54(1):10-6.

5. Ku MC. When Does Gender Matter?:Gender Differences in Specialty Choice Among Physicians. Work and Occupations. 2011;38(2):221-62.

6. Rodriguez Santana I, Chalkley M. Getting the right balance? A mixed logit analysis of the relationship between UK training doctors' characteristics and their specialties using the 2013 National Training Survey. BMJ Open. 2017;7(8).

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

7. Scanlan GM, Cleland J, Johnston P, Walker K, Krucien N, Skåtun D. What factors are critical to attracting NHS foundation doctors into specialty or core training? A discrete choice experiment. BMJ Open. 2018;8(3).

8. Buddeberg-Fischer B, Stamm M, Buddeberg C, Bauer G, Hämmig O, Knecht M, et al. The impact of gender and parenthood on physicians' careers - professional and personal situation seven years after graduation. BMC Health Services Research. 2010;10(1):40.

9. Patterson F, Ashworth V, Zibarras L, Coan P, Kerrin M, O'Neill P. Evaluations of situational judgement tests to assess non-academic attributes in selection. Medical Education. 2012;46(9):850-68.

10. MacKenzie RK, Dowell J, Ayansina D, Cleland JA. Do personality traits assessed on medical school admission predict exit performance? A UK-wide longitudinal cohort study. Adv Health Sci Educ. 2017;22(2):365-85.

11. Thomas H, Davison I, Gee H, Grant J, Taylor C. The fairness, effectiveness and acceptability of selection for specialty training in the UK. British Journal of Hospital Medicine. 2013;74(1):47-51.

12. Davison I, McManus IC, Taylor C. Evaluation of GP Specialty Selection. 2016.

13. Scrimgeour DSG, Cleland J, Lee AJ, Griffiths G, McKinley AJ, Marx C, et al. Impact of performance in a mandatory postgraduate surgical examination on selection into specialty training. BJS Open. 2017;1(3):67-74.

14. Canadian Resident Matching Service: CARMS; 2018 [Available from: https://www.carms.ca/en/data-and-reports/r-1/r-1-match-reports-2017/.

15. Colquitt WL, Smith IP, Killian CD. Specialty selection and success in obtaining choice of residency training among 1987 U.S. medical graduates by race-ethnicity and gender. Acad Med. 1992;67(10):660-71.

16. Hewett L, Lewis M, Collins H, Gordon L. Gender Bias in Diagnostic Radiology Resident Selection, Does it Exist? Academic Radiology. 2016;23(1):101-7.

17. de Oliveira Gildàsio S, Akikwala T, Kendall Mark C, Fitzgerald Paul C, Sullivan John T, Zell C, et al. Factors Affecting Admission to Anesthesiology Residency in the United StatesChoosing the Future of Our Specialty. Anesthesiology. 2012;117(2):243-51.

18. Unwin E, Woolf K, Wadlow C, Potts HWW, Dacre J. Sex differences in medico-legal action against doctors: a systematic review and meta-analysis. BMC Medicine. 2015;13(1):172.

19. Paton LW, Tiffin PA, Smith D, Dowell JS, Mwandigha LM. Predictors of fitness to practise declarations in UK medical undergraduates. BMC Medical Education. 2018;18(1):68.

20. Santen SA, Petrusa E, Gruppen LD. The relationship between promotions committees' identification of problem medical students and subsequent state medical board actions. Advances in Health Sciences Education. 2015;20(2):421-30.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

21. Yates J, James D. Risk factors at medical school for subsequent professional misconduct: multicentre retrospective case-control study. BMJ. 2010;340.

22. Papadakis MA, Hodgson CS, Teherani A, Kohatsu N. Unprofessional Behavior in Medical School Is Associated with Subsequent Disciplinary Action by a State Medical Board. Academic Medicine. 2004;79(3):244-9.

23. Unwin E, Woolf K, Wadlow C, Dacre J. 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. BMJ Open. 2014;4(8).

24. UKMED Data Dictionary. 2018.

25. Twigg V, Aldridge K, McNally S, Eardley I. Does choice of medical school affect a student's likelihood of becoming a surgeon? The Bulletin of the Royal College of Surgeons of England. 2018;100(2):90-5.

26. Gale TCE, Lambe PJ, Roberts MJ. Factors associated with junior doctors' decisions to apply for general practice training programmes in the UK: secondary analysis of data from the UKMED project. BMC Medicine. 2017;15(1):220.

27. McManus I, Elder AT, de Champlain A, Dacre JE, Mollon J, Chis L. Graduates of different UK medical schools show substantial differences in performance on MRCP(UK) Part 1, Part 2 and PACES examinations. BMC Medicine. 2008;6(1):5.

28. Woolf K, Potts HWW, McManus IC. Ethnicity and academic performance in UK trained doctors and medical students: systematic review and meta-analysis. BMJ. 2011;342.

29. Kumwenda B, Cleland JA, Walker K, Lee AJ, Greatrix R. The relationship between school type and academic performance at medical school: a national, multi-cohort study. BMJ Open. 2017;7(8).

30. Baerlocher MO, Walker M. Does Gender Impact Upon Application Rejection Rate Among Canadian Radiology Residency Applicants? Canadian Association of Radiologists Journal. 2005;56(4):232-7.

31. Lambert TW, Smith F, Goldacre MJ. Career specialty choices of UK medical graduates of 2015 compared with earlier cohorts: questionnaire surveys. Postgraduate Medical Journal. 2018;94(1110):191-7.

32. Lambert T, Goldacre R, Smith F, Goldacre MJ. Reasons why doctors choose or reject careers in general practice: national surveys. British Journal of General Practice. 2012;62(605):e851-e8.

33. Cleland J, Johnston PW, French FH, Needham G. Associations between medical school and career preferences in Year 1 medical students in Scotland. Medical Education. 2012;46(5):473-84.

34. Woolf K, Elton C, Newport M. The specialty choices of graduates from Brighton and Sussex Medical School: a longitudinal cohort study. BMC Medical Education. 2015;15(1):46.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

35. Patterson F, Lievens F, Kerrin M, Munro N, Irish B. The predictive validity of selection for entry into postgraduate training in general practice: evidence from three longitudinal studies. British Journal of General Practice. 2013;63(616):e734-e41.

36. Esmail A, Roberts C. Academic performance of ethnic minority candidates and discrimination in the MRCGP examinations between 2010 and 2012: analysis of data. BMJ : British Medical Journal. 2013;347.

37. Siriwardena AN, Irish B, Asghar ZB, Dixon H, Milne P, Neden C, et al. Comparing performance among male and female candidates in sex-specific clinical knowledge in the MRCGP. The British Journal of General Practice. 2012;62(599):e446-e50.

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UKMED
UK Medical Education Database

Scoring guide
0 – Unacceptable.
1 – Uncertain; may be acceptable with further clarification.
2 – Acceptable.

Title

Please note that should this application be approved, its title, summary, lead contact name and email address will be published on the UKMED website.

The role of academic attainment in understanding sex differences in specialty choice and fitness to practise.

Summary

Please outline your proposed research covering all aspects. Maximum 250 words.

The proportions of men and women in different medical specialties varies greatly [1]. Understanding how and why is important for effective workforce planning and the provision of future healthcare, and to reduce sex segregation in some specialties. It may also help us understand other areas of stark sex differences, such as disciplinary action, where male doctors have nearly 2.5 times the odds of facing medico-legal action [2], and doctors from certain specialties are at higher risk of receiving sanctions [3].
Sex differences in specialty choice are partly explained by features such as how plannable, technical, and intellectual a specialty is [1]; but success in obtaining a training place depends on competition ratios, selection methods, and candidates' previous academic attainment – also potentially associated with sex. Academic performance is also important to help us understand how sanctions relate to sex and specialty, because past academic performance predicts future academic performance [4], and poor academic performance is associated with increased odds of sanctions [5].

References

Please reference up to five key papers from your literature review with a sentence explaining the relevance of the paper to the proposed study.

1. Elston MA. Women and medicine: the future. London: Royal College of Physicians, 2009.
2. Unwin E, Woolf K, Wadlow C, et al. Sex differences in medico-legal action against doctors: a systematic review and meta-analysis. BMC Medicine 2015; 13:172.
3. Unwin E, Woolf K, Wadlow C, et al. Disciplined doctors: does the sex of a doctors matter? A cross-sectional study examining the association between a doctor's sex and receiving sanctions against their medical registration. BMJ Open 2014; 4:8.
4. McManus IC, Woolf K, Dacre J, et al. The Academic Backbone: longitudinal continuities in educational achievement from secondary school and medical school to MRCP(UK) and the specialist register in UK medical students and doctors. BMC Medicine 2013; 11:242.
5. Papadakis MA, Arnold GK, Blank LL, Holmboe ES, Lipner RS. Performance during Internal Medicine Residency Training and Subsequent Disciplinary Action by State Licensing Boards. Ann Intern Med 2008; 148(11):869-876

Research Questions

A) Setting the scene and confirming what is already known:
1. Is there a sex difference in the measures of academic attainment used for selection into medical school?
2. Is there a sex difference in the measures of attainment used for selection into the Foundation Programme?
3. Is there a sex difference in the specialties foundation doctors apply to, receive offers from, and ultimately accept offers from?
4. Is there a sex difference between those who did and did not apply for specialty training when eligible?
5. Is prior academic attainment related to a choice not to apply for specialty training when eligible?
6. Is there a sex difference in those doctors with and without Fitness to Practise declarations?
7. Is there an association between academic attainment and having a Fitness to Practise declaration?

B) The main research questions:
8. Is the sex difference in specialty choice (application, offer and acceptance) mediated by previous academic attainment, taking into account the potential confounders of demographics and medical school attended?
9. Is specialty choice associated with Fitness to Practise declarations, taking into account sex and prior academic attainment?

Scoring guide
0 – Aims or question not clear. Question appears irrelevant to policy or practice.
1 – Question is poorly defined or uncertain as to whether it is likely to impact on policy or practice if answered. More information or clarification may be required.
2 – Question if answered has significant implications for policy or practice in medical education.

Data Required from UKMED

Please specify data items and any filters that should be applied, for example date range. The tables below are as per the UKMED data dictionary http://www.ukmed.ac.uk/documents/UKMED_data_dictionary.pdf. For data type and descriptions please refer to the dictionary.

Scoring guide
0 – The data requested is not contained in the UKMED.
1 – The data requested is within the database but does not appear capable of answering the research question identified.
2 – The data requested is contained within the UKMED and is well linked to the research question.

ARCP_OUTCOMES

SELECT	NAME
◯	PERSON_UID
◯	ARCP_EVENT_ID
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Comments about requested ARCP_OUTCOMES data (Optional)

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Comments about requested ARCP_REASON data (Optional)

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Comments about requested FPAS data (Optional)

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Comments about requested GAMSAT data (Optional)

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Comments about requested HEE_RECRUIT_OUTCOMES data (Optional)

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☐	HESA_DEDUP_SCRIPT

Comments about requested HESA_ACAD_YEARS data (Optional)

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☑	HESA_POINTS

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☐	POST_END_DATE
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☐	NTN_PROGRAMME_CODE
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☑	EXCLUSION_REASON
☐	SURVEY_COMPLETION_CODE
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☐	GEOGRAPHIC_DEANERY
☐	NTS_CURRICULA

Comments about requested NTS_TRAINEE data (Optional)

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☐	INDICATOR_SCORE

Comments about requested NTS_TRAINEE_IND_SCORES data (Optional)

PERSON_STUDENT

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☑	HESA_QUALENT
☑	HESA_HIGHQUAL_OBTAIN
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☑	UKCAT_PARENT1EMPLOYERSIZE
☑	UKCAT_PARENT1SUPERVISOR
☑	UKCAT_PARENT2GENDER
☑	UKCAT_PARENT2OCCUPATION
☑	UKCAT_PARENT2EMPLOYMENTSTATUS
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☐	UKCAT_NATIONALITY2

Comments about requested PERSON_STUDENT data (Optional)

We also need HESA_UKPRN_FIRST and HESA_UKPRN_LAST please

UKCAT

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◯	UKCAT_REGISTRATION_ID
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◯	UKCAT_TEST
◯	UKCAT_DATE_TEST
◯	UKCAT_ATTENDED
◯	UKCAT_HIGHEST_QUALIFICATION
◯	UKCAT_UCAS_APPLICATION_ID
◯	UKCAT_ID
◯	UKCAT_YEAR_APPLICATION
◯	UKCAT_YEAR_ENTRY
◯	UKCAT_SCHOOL

Comments about requested UKCAT data (Optional)

UKCAT_APPLICATIONQUALIFICATIONS

SELECT	NAME
◯	UKCAT_UCASAPPID
◯	UKCAT_QUALIFICATIONNUMBER
◯	UKCAT_STANDARD
◯	UKCAT_SUBJECT
◯	UKCAT_SCORE

Comments about requested UKCAT_ APPLICATIONQUALIFICATIONS data (Optional)

UKCAT_CR_IMDPOSTCODES

SELECT	NAME
◯	POSTCODE
◯	POSTZONE

Comments about requested UKCAT_CR_ IMDPOSTCODES data (Optional)

UKCAT_CR_IMDZONES

SELECT	NAME
○	CODE
○	CLASS
○	NAME
○	LOCALAUTHORITY
○	COUNTRY
○	RANK
✓	QUINTILE

Comments about requested UKCAT_CR_IMDZONES data (Optional)

UKCAT_CR_UCASSCHOOLCATGLIST

SELECT	NAME
○	CATEGORYID
✓	CATEGORYDESCRIPTION

Comments about requested UKCAT_CR_UCASSCHOOLCATGLIST data (Optional)

UKCAT_CR_UCASSCHOOLLIST

SELECT	NAME
○	SCHOOLID
○	NAME
○	ADDRESS1
○	ADDRESS2
○	ADDRESS3
○	ADDRESS4
✓	POSTCODE
✓	COUNTRY
✓	DFEID
✓	CATEGORYID
✓	SUBCATEGORYID
✓	STATUS

Comments about requested UKCAT_CR_UCASSCHOOLLIST data (Optional)

UKCAT_CR_UCASSCHOOLSUBCATEGORYGROUPLIST

SELECT	NAME
○	SCHOOLGROUPID
○	SCHOOLGROUPDESCRIPTION

Comments about requested UKCAT_CR_UCASSCHOOLSUBCATEGORYGROUPLIST data (Optional)

UKCAT_CR_UCASSCHOOLSUBCATEGORYLIST

SELECT	NAME
○	SUBCATEGORYID
✓	SUBCATEGORYDESCRIPTION
○	SCHOOLGROUPID

Comments about requested UKCAT_CR_UCASSCHOOLSUBCATEGORYLIST data (Optional)

UKCAT_RESPONSES_NONCOG

SELECT	NAME
☐	UKCAT_TESTREGID
☐	UKCAT_ITEM
☐	UKCAT_RESPONSE

Comments about requested UKCAT_RESPONSES_NONCOG data (Optional)

UKCAT_RESULTS

SELECT	NAME
☑	UKCAT_TESTREG_ID
☑	UKCAT_SECTION
☑	UKCAT_SCORE

Comments about requested UKCAT_RESULTS data (Optional)

UKCAT_UCASAPPLICATIONCOURSES

SELECT	NAME
☐	UKCAT_UCASAPPID
☐	UKCAT_CHOICENUMBER
☑	UKCAT_DATEAPPLICATION
☐	UKCAT_UNIVERSITY
☐	UKCAT_COURSE
☐	UKCAT_UNIVERSITYDECISION
☐	UKCAT_APPLICANTREPLY
☐	UKCAT_APPLICANTDECISION

Comments about requested UKCAT_UCASAPPLICATIONCOURSES data (Optional)

UKCAT_UCASAPPLICATIONGCSES

SELECT	NAME
☑	UKCAT_UCASAPPID
☑	UKCAT_GCSENUMBER
☑	UKCAT_SUBJECT
☑	UKCAT_SCORE

Comments about requested UKCAT_UCASAPPLICATIONGCSES data (Optional)

VW_UKCAT_RESULTS_NONCOG

SELECT	NAME
☐	UKCATREGID
☐	TEST
☐	SECTION
☐	SCORE

Comments about requested VW_UKCAT_RESULTS_NONCOG data (Optional)

VW_UKMED_ALLEGATIONS

SELECT	NAME
☐	PERSON_UID
☐	CASE_NUMBER
☐	GMP_DOMAIN
☐	ALLEG_TYPE
☐	ALLEG_SUB_TYPE

Comments about requested VW_UKMED_ALLEGATIONS data (Optional)

VW_UKMED_FTPCHARDECLARATIONS

SELECT	NAME
☑	AGORA_ID
☑	PERSON_UID
☑	DECLARATION_TYPE
☑	DECLARATION_DATE
☑	APPLICATION_TYPE
☑	APPLICATION_STATUS
☑	APPLICATION_STATUS_REASON

Comments about requested VW_UKMED_FTPCHARDECLARATIONS data (Optional)

VW_UKMED_FTP_SUMMARY

SELECT	NAME
☐	PERSON_UID
☐	ENQUIRY_RECEIVED
☐	CASE_OUTCOME
☐	CASE_NUMBER
☐	ENQUIRY_INCIDENT_DATE
☐	ENQUIRY_INCIDENT_LOCATION_L2
☐	ENQUIRY_INCIDENT_LOCATION_L3
☐	ENQUIRY_TYPE
☐	ENQUIRY_SOURCE_TYPE

Comments about requested VW_UKMED_FTP_SUMMARY data (Optional)

VW_UKMED_PERSON

SELECT	NAME
☑	PERSON_UID
☑	HUSID
☑	BIRTH_DT
☑	GENDER
☑	PRIMARY_PMQ
☑	PRIMARY_PMQ_YEAR
☑	PRIMARY_PMQ_PLACE
☑	PRIMARY_PMQ_WORLD_REGION
☐	PRIMARY_PMQ_SHORTCODE
☐	CURR_REG_ADD_POSTCODE
☑	CURR_REG_ADD_POSTCODE_OUTCODE

Comments about requested VW_UKMED_PERSON data (Optional)

For peer review only

VW_UKMED_PROTECTEDCHARS

SELECT	NAME
☑	AGORA_ID
☑	PERSON_UID
☑	ETHNICITY_L1
☑	ETHNICITY_L2
☑	ETHNICITY_SRC
☑	DISABILITY
☐	DISABILITY_SRC
☐	LIMITED_ACTIVITIES
☐	LIMITED_ACTIVITIES_SRC
☐	ADJUSTMENTS
☐	ADJUSTMENTS_SRC
☐	UK_EDUCATED
☐	UK_EDUCATED_SRC
☑	SCHOOL_TYPE
☑	SCHOOL_TYPE_SRC
☑	INCOME_SUPPORT
☑	INCOME_SUPPORT_SRC
☑	FREE_SCHOOL_MEALS
☑	FREE_SCHOOL_MEALS_SRC
☑	PARENT_DEGREE
☑	PARENT_DEGREE_SRC
☑	GROWING_UP_POSTCODE
☑	GROWING_UP_POSTCODE_SRC
☑	POLAR2
☑	POLAR2_SRC
☑	POLAR3
☐	POLAR3_SRC
☑	SEC
☐	SEC_SRC
☑	NSSEC
☐	NSSEC_SRC
☐	SOC2000
☐	SOC2000_SRC
☐	PARED
☐	PARED_SRC

Comments about requested VW_UKMED_PROTECTEDCHARS data (Optional)

Methodology

Study design, setting and source of data:
This will be a longitudinal study using UK-wide data. The data and permission to use the data for research purposes will be obtained from the GMC.

Population:
All doctors who entered a UK medical school in 2007 or in 2008, and who were eligible to apply for a Specialty Training Programme after completion of the Foundation Programme.

Primary outcome and exposure:
The outcome of interest is the Specialty Training Programme(s) the doctor applied to, received an offer from, and accepted the offer, after completion of their Foundation Programme.

The variable, Specialty Training Programme, may be collapsed into fewer categories, to ensure there is sufficient power to perform the statistical analyses. This is dependent on the number of doctors in each category. If we feel that fewer categories are required, two researchers will independently allocate each Specialty Training Programme into a collapsed specialty category, and any disagreements about the specialty allocation will be resolved through discussion. A Kappa statistic will be calculated to report the level of agreement between the two researchers.

The exposure of interest is the doctor's sex.

Background variables:
We are interested in whether previous academic attainment mediates the relationship between doctors' sex and specialty choice. The variables we will explore to measure academic attainment prior to medical school are GCSE grades and UKCAT performance, and for graduate students GAMSAT. The EPM ranking will provide a measure of undergraduate performance. The FPAS SJT score is not strictly a measure of academic attainment, but it will provide a measure of potential postgraduate performance. Other potential confounders we will include in our analysis are ethnicity, prior degree, school type, socioeconomic status, progress through medical school, and medical school.

We are also interested in whether the specialty choice of doctors with a history of Fitness to Practise declarations differs to that of doctors who do not have a history of Fitness to Practise declarations.

The STROBE statement will be used to guide our study.

Scoring guide
0 – Methods not appropriate to addressing research aims or question.
1 – Methods may seem outdated, over simplistic or not well adapted to nature of data.
2 – Methodology takes into account the nature of and type of data available and is suitable to address the research question.

Analysis proposed

We will commence with preliminary data analyses, providing descriptive statistics on the variables we have requested, and performing bivariate analyses to confirm and explore associations in the data. If necessary we will perform multiple imputation to account for missingness. This will enable us to answer research questions 1-7.

We will proceed by completing multivariate analyses using multi-level multiple regression modelling to answer research questions 8 and 9. Multinomial regression will be used to examine the predictors of which specialties participants applied to, and logistic regression to examine the predictors of being offered vs not being offered a place, and accepting vs not accepting a place, respectively. The models will include the background variables that modify the strength of association between the exposure and outcome variables. The final regression models will enable the calculation of an adjusted measure of effect and will be assessed for the presence of effect modifiers.

Scoring guide
0 – Analysis not appropriate to addressing research aims or question.
1 – Analysis may seem outdated, over simplistic or not well adapted to nature of data.
2 – Analysis takes into account the nature of and type of data available and is suitable to address the research question.

Proposed start date			Duration
01	08	2016	13
DD	MM	YYYY	months

Timeline (key milestones)

August 2016: Complete administration to enable access to UKMED data.
August-October 2016: Data management (preparing data for analysis).
October 2016-January 2017: Data analysis.
November 2016: Initial findings shared with the research subgroup.
February-April 2017: Preparation of research manuscript for dissemination, and for PhD thesis.
May 2017 onwards: Research manuscript submitted for publication in peer-reviewed journal.
September 2017: Research manuscript submitted as part of PhD thesis.

Proposal for dissemination of research (E.g. proposed conference submission, proposed journal):

We plan to prepare our research outputs as an original research article for publication in a peer-reviewed journal. We would aim to submit our research manuscript to a peer-reviewed journal that attracts an audience across medical disciplines.

The research project will also be prepared and submitted as part of a PhD thesis. Emily Unwin's PhD is examining the gender difference in the professional performance of doctors, and this research project will be a part of this work.

Scoring guide
0 – No statement of intended use.
1 – Intended uses unclear.
2 – There is a clear statement on the intended outputs which may include publication in a peer-reviewed journal, publication on an organisation's website, reports that are evaluations of a service rather than research, or publication as a PhD thesis.

Researchers

Please provide details of all researchers who will be involved in the study.

Scoring guide
0 – Team is not plausible with little evidence of relevant skills or track record. There is no governance structure defined or there is indication that it may not be accountable.
1 – Team may have obvious skills gaps or limited relevant research track record. Governance structure is outlined, but is not very clear.
2 – Proposed team members have a good track record in related research and are likely to have the skills to employ the proposed methodology and manage data issues. Governance structure is described in a clear and accountable way.

Lead researcher's title and name

Dr Emily Unwin

Organisation

UCL

Address

UCL Medical School
Room GF/664
Royal Free Hospital
Hampstead
NW3 2PF

Email address

emily.unwin.12@ucl.ac.uk

Telephone number

n/a

For peer review

Partners – those who will have access to the data

Please list name, role, organisation, address, email and telephone details.

	Partner 1
Name	Dr Katherine Woolf
Role	Researcher and PhD supervisor
Organisation	UCL
Address	UCL Medical School Room GF/664 Royal Free Hospital Hampstead NW3 2PF
Email	k.woolf@ucl.ac.uk
Telephone	020 3108 9216

	Partner 2
Name	Dr Karim Keshwani
Role	Co-researcher
Organisation	UCL
Address	UCL Medical School Room GF/664 Royal Free Hospital Hampstead NW3 2PF
Email	k.keshwani@ucl.ac.uk
Telephone	n/a

	Partner 3
Name	Dr Chris Valerio
Role	Co-researcher
Organisation	UCL
Address	UCL Medical School Room GF/664 Royal Free Hospital Hampstead NW3 2PF
Email	christopher.valerio.09@ucl.ac.uk
Telephone	n/a

Additional contact details

If you wish to make a note of contact details of other researchers involved in this project who do not require access to the safe haven but do need to be included in communication, please list their name(s) and email(s) here.

1) Professor Jane Dacre
PhD supervisor
Royal College of Physicians
11 St Andrews Place
London
NW1 4LE
jane.dacre@rcplondon.ac.uk

2) Dr. Henry Potts
PhD supervisor
University College London
Institute of Health Informatics
401 222 Euston Road
London
NW1 2DA
h.potts@ucl.ac.uk

Outline each researcher's proposed role and the working time that will be committed to the research project (e.g. 0.5 FTE)

We (EU, KW, KK and CV) have conceived and designed the study. The original idea for the study was KK's and CV's. EU reviewed and modified the original idea and prepared the research proposal with support from KW.

1. Dr. Emily Unwin (EU)
EU will lead on this research project. She will work with KW to manage and organise the datasets in preparation for data analysis. She will work with KW to perform the data analysis and data interpretation. She will also write and prepare the first draft of the manuscript for publication. She will take responsibility for submitting any research manuscripts for publication.
October 2016-September 2017 0.5 FTE

2. Dr. Katherine Woolf (KW)
As EU's PhD supervisor, KW, will be involved in preparing the data for analysis, performing and reviewing the data analysis and data interpretation. She will critically review the manuscript prior to publication. KW will be responsible for reviewing EU's progress with this project and will meet with EU on a regular basis to discuss the project (1-2 times/month).

3. Dr. Karim Keshwani (KK)
KK will support EU with any data management required. He will assist EU in writing the first draft of the manuscript by supporting her in reviewing the literature. He will critically review the manuscript prior to publication.

4. Dr. Christopher Valerio (CV)
CV will support EU with any data management required. He will assist EU in writing the first draft of the manuscript by supporting her in reviewing the literature. He will critically review the manuscript prior to publication.

All authors will contribute to the final version of the manuscript and the revisions.

Scoring guide
0 – Team is not plausible with little evidence of relevant skills or track record. There is no governance structure defined or there is indication that it may not be accountable.
1 – Team may have obvious skills gaps or limited relevant research track record. Governance structure is outlined, but is not very clear.
2 – Proposed team members have a good track record in related research and are likely to have the skills to employ the proposed methodology and manage data issues. Governance structure is described in a clear and accountable way.

CVs

Please provide brief CVs of the lead researcher and other researchers with a significant role.

1) Dr Emily Unwin

Current role
PhD candidate at UCL Medical School

Research summary
My research attempts to explore the gender difference in the professional performance of doctors, by using epidemiological techniques and examining large datasets. I aim to identify the possible areas that we, as researchers in medical education, can focus upon to bridge the gender gap and improve doctors' professional performance as a whole. I also hope to demonstrate how the quantitative techniques usually reserved for the discipline of epidemiology can be applied to medical education research.

Academic background
2012-current date: PhD candidate – Medical Education, University College London
2011-2012: Master of Science – Epidemiology, London School of Hygiene and Tropical Medicine
2000-2006: Bachelor of Medicine and Bachelor of Surgery – University College London
2003: Bachelor of Science – Psychology with Basic Medical Sciences, University College London.

Journal article publications – original research articles (first author only)
Unwin, E., Woolf, K., Wadlow, C., Potts, H.W.W., & Dacre, J. (2015). Sex differences in medico-legal actions against doctors: A systematic review and meta-analysis. BMC Medicine, 13 (1).
Unwin, E., Woolf, K., Wadlow, C., & Dacre, J. (2014). 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. BMJ Open, 4(8).

2) Dr Katherine Woolf

Current role
Senior Lecturer at UCL Medical School

Research summary
My research explores the factors influencing medical students' and doctors' performance, in particular the influence of ethnicity and sex. The aim of my research is to better understand how to improve doctors' performance, improve fairness in medical education, and ultimately improve patient care.

Academic background
2005-2008: PhD in Medical Education and Psychology, University College London
2000-2003: Bachelor of Science (first class honours) – Psychology, Goldsmiths College

Journal article publications – original research articles (first author only)
Woolf, K., Elton, C., & Newport, M. (2015). The specialty choices of graduates from Brighton and Sussex Medical School: a longitudinal cohort study. BMC Medical Education, 15 (1), 46.
Woolf, K., Potts, H., Patel, S., & McManus, C. (2012). The hidden medical school: A longitudinal study of how social networks form, and how they relate to academic performance. Medical Teacher, 34 (7), 577-586.
Woolf, K.V.M., McManus, I.C., Potts, H.W.W., & Dacre, J. (2011). The mediators of minority ethnic underperformance in final medical school examinations. British Journal of Educational Psychology.
Woolf, K., Potts, H.W.W., & McManus, I.C. (2011). The relationship between ethnicity and academic performance in UK-trained doctors and medical students: a systematic review and meta-analysis. BMJ, 342, d901.
Woolf, K., Potts, H.W.W., & McManus, I.C. (2011). The relationship between ethnicity and academic performance in UK-trained doctors and medical students: a systematic review and meta-analysis. BMJ, 342, d901.

Is the research funded, and/or does your organisation support the work? Please outline the status of any funding application and whether it is essential for the work to proceed. When submitting the form, please attach evidence of the funding organisation's support for the proposed work (e.g. meeting minutes).

This research project will form part of EU's PhD research. EU has a fully-funded PhD studentship at UCL Medical School. KW is EU's PhD supervisor. The costs of this research project will be covered by EU's existing studentship. KK and CV will work on this research project on a voluntary basis, with the aim of furthering their research experience. No additional funding is being sought.

Scoring guide
0 – No explicit plan for how staff time or other resources will be made available to complete the analysis in a timely manner.
1 – Plan for obtaining funding outlined but not guaranteed. Internal institutional support for staff time may be available.
2 – A source of funding has been identified and obtained. This is likely to be sufficient to cover the costs of the work.

Have you received ethical approval, or an exemption from the requirement to obtain ethical approval?
When submitting the form, please attach the relevant correspondence.

We have applied to the UCL Research Ethics Committee to extend the ethical approval for EU's PhD research to include this research project.
We believe that the amendment to the existing ethical approval should have no impact on any ethical considerations.
We will notify the UKMED team when we have received confirmation of ethical approval.

Successful applicants will access data via a safe haven. In order to manage this process, please detail the software you will need to use to complete your research.

Please include details of the version number and the terms of your license. Depending on the software required you may need to bring your own license. Note that some of the licenses held by some UK universities will permit you to use the given software in the safe haven upon provision of a valid license key provided by your institution.

Data management and analysis software:
STATA/SE 12.1

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3,4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	4
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4-6
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	*6*
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	4-7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7
		(*b*) Describe any methods used to examine subgroups and interactions	7
		(*c*) Explain how missing data were addressed	7
		(*d*) If applicable, explain how loss to follow-up was addressed	n/a
		(*e*) Describe any sensitivity analyses	n/a
Results			

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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	4 & 7
		(b) Give reasons for non-participation at each stage	4 & 7
		(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	7,8
		(b) Indicate number of participants with missing data for each variable of interest	6
		(c) Summarise follow-up time (eg, average and total amount)	n/a
Outcome data	15*	Report numbers of outcome events or summary measures over time	6
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	7-10
		(*b*) Report category boundaries when continuous variables were categorized	6
		(*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	n/a
Discussion			
Key results	18	Summarise key results with reference to study objectives	11
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12,13
Generalisability	21	Discuss the generalisability (external validity) of the study results	12
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	13

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

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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