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Gender diversity in the National Joint Registry

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Aims

Our primary aim was to establish the proportion of female orthopaedic consultants who perform arthroplasty via cases submitted to the National Joint Registry (NJR), which covers England, Wales, Northern Ireland, the Isle of Man, and Guernsey. Secondary aims included comparing time since specialist registration, private practice participation, and number of hospitals worked in between male and female surgeons.

Methods

Publicly available data from the NJR was extracted on the types of arthroplasty performed by each surgeon, and the number of procedures of each type undertaken. Each surgeon was cross-referenced with the General Medical Council (GMC) website, using GMC number to extract surgeon demographic data. These included sex, region of practice, and dates of full and specialist registration.

Results

Of 2,895 surgeons contributing to the NJR in 2023, 102 (4%) were female. The highest proportions of female surgeons were among those who performed elbow (n = 25; 5%), shoulder (n = 24; 4%), and ankle (n = 8; 4%) arthroplasty. Hip (n = 66; 3%) and knee arthroplasty (n = 39; 2%) had the lowest female representation. Female surgeons had been practising for a median of 10.4 years since specialist registration compared to 13.7 years for males ($p < 0.001$). Northern Ireland was the region with the highest proportion of female arthroplasty surgeons (8%). A greater proportion of male surgeons worked in private practice (63% vs 24%; $p < 0.001$) and in multiple hospitals (74% vs 40%; $p < 0.001$).

Conclusion

Only 4% of surgeons currently contributing cases to the NJR are female, with the highest proportion performing elbow arthroplasty (5%). Female orthopaedic surgeons in the NJR are earlier in their careers than male surgeons, and are less involved in private practice. There is a wide geographical variation in the proportion of female arthroplasty surgeons.

Take home message

- There were 102 (4%) female orthopaedic surgeons contributing to the National Joint Registry, out of 2,895 surgeons.
- The highest proportion of female surgeons were among those who performed elbow (5%), shoulder (4%), and ankle (4%) arthroplasty.
- A greater proportion of male surgeons worked in private practice (63% vs 24%; $p < 0.001$) and in multiple trusts (74% vs 40%; $p < 0.001$).

Introduction

Issues of gender bias and sexual discrimination have been brought to the forefront of public discourse owing to increasing coverage in entertainment, politics, and sport.[1] Such issues include prejudice towards one gender or discrimination on the grounds of gender,[2] with these being highly prevalent

in the medical sector.[3,4] Those identifying as female surgeons face multiple sources of implicit bias and epistemic injustice,[5] including limited access to parental leave and role models, stereotyped expectations pertaining to adopting surgery's care working roles, and objectification.[4]

Since 1996, females have comprised 55% of medical students in the UK.[6] However, orthopaedic surgery is the surgical speciality with the lowest proportion of female surgeons, with women comprising 19% of registrars and 6% of consultants.[7] Organizations in the UK such as the British Orthopaedic Trainees Association and the British Orthopaedic Association have carried out campaigns to help rectify this imbalance.[8]

Studies pertaining to various surgical specialities have demonstrated that patient-surgeon gender concordance leads to improved surgical outcomes and patient satisfaction.[9-11] However, there is a paucity of literature on the effect of surgeon gender on patient outcomes in orthopaedic surgery. A recent register-based cohort study carried out in Sweden explored outcomes following primary total hip arthroplasty according to gender concordance between patients and surgeons.[12] A total of 11,993 procedures were included in the study, which were categorized into gender-concordant (n = 5,318) and gender-discordant (n = 6,675) groups. The former had a lower likelihood of developing adverse events (odds ratio (OR) 0.82; 95% CI 0.71 to 0.95) and surgical adverse events (OR 0.86; 95% CI 0.72 to 0.99). However, no association was detected between gender concordance and patient-reported satisfaction.[12] Evidence suggests patient-surgeon gender concordance leads to improved outcomes, rather than surgeon gender alone, considering the latter was not found to impact outcomes of arthroplasty.[13]

The National Joint Registry (NJR) is a publicly available register which records, monitors, and analyses outcomes in arthroplasty in England, Wales, Northern Ireland, the Isle of Man, and Guernsey.[14] Information on hip, knee, ankle, elbow, and shoulder arthroplasty surgery is collected, with the aim of improving patient safety and clinical outcomes. It accurately represents orthopaedic workforce, with a total of 3.7 million records, and 250,000 submitted annually.[14] The General Medical Council (GMC) register provides a list of doctors in the UK, including their registration and training status.[15] Given the importance of patient-surgeon gender concordance and the need to evaluate the gender composition of orthopaedic surgeons, our primary aim was to establish the proportion of female consultants who perform arthroplasty via cases submitted to the NJR. Secondary aims included comparing time since specialist registration, private practice participation, and number of hospitals worked in between male and female surgeons.

Methods

We extracted publicly available data from the NJR[14] and GMC websites.[15] Ethical approval was therefore not required.

Data extraction

Data were extracted in April 2023. Types of arthroplasty performed by each surgeon, the number of procedures of each type undertaken, patient demographic data, location, and trust were collected from the NJR. We extracted the total number of each procedure that the surgeon performed in the last 12 and 36 months. We categorized hospitals into NHS and independent hospitals. We cross-referenced each surgeon by GMC number with the GMC website in order to extract surgeon gender and dates of full and specialist registration. If a surgeon was recorded in the NJR as working in hospitals in different regions, they were assigned to a single region for the purposes of analysis; this was the site registered as their designated body with the GMC.

Statistical analysis

The percentage of female orthopaedic surgeons in different regions was calculated, as well as the percentage of female surgeons performing knee, hip, ankle, elbow, and shoulder arthroplasty. We calculated time since full and specialist registration, taking 1 January 2023 as reference. The Kolmogorov-Smirnov test and visual assessment of histograms were used to establish whether data were normally distributed. Accordingly, difference in time since registration and time in training between male and female surgeons was compared using the Mann-Whitney U test. The categorical values of female and male surgeons carrying out each procedure more or less than five times in the previous 12 and 36 months, the number of female and male surgeons working in multiple hospitals, and those working in independent or NHS hospitals were compared using the chi-squared test (test statistic denoted by χ^2). Degrees of freedom for each test were denoted by df. Significance was set at the 5% level. All statistical analyses were carried out using SPSS v. 29 (SPSS, USA).

Results

Out of 2,895 surgeons in the NJR, there were 2,793 male consultant orthopaedic surgeons (96%), and 102 female consultant orthopaedic surgeons (4%).

Distribution of female surgeons according to joint

The highest proportion of female surgeons were among those who performed elbow arthroplasty (25 (5%) vs 535 (95%) males), followed by ankle (eight (4%) vs 210 (96%) males), shoulder (24 (4%) vs 639 (96%) males), and hip arthroplasty (66 (3%) vs 2,192 (97%) males). The joint with the lowest proportion of female arthroplasty surgeons was the knee (39 (2%) vs 1,947 (98%) males). Of 102 total female surgeons, 52 (50%) had not performed a single hip arthroplasty within 12 months, 26 (26%) had performed fewer than five, and 24 (24%) had performed five or more within 12 months. Conversely, of 2,793 total male surgeons, 1,108 (40%) had not performed a single hip arthroplasty within 12 months, 342 (12%) had performed fewer than five, and 1,343 (48%) had performed five or more within 12 months ($p < 0.001$) (Table I). Overall, males performed a statistically significant higher volume of operations than females pertaining to primary and revision hip arthroplasty, primary patellofemoral arthroplasty, primary total knee arthroplasty, primary unicompartmental knee arthroplasty, revision knee arthroplasty within 12 and 36 months, and primary elbow arthroplasty within 12 months. This was not the case for the remaining procedures (Table I).

Distribution of female surgeons according to region

Northern Ireland was the region with the highest proportion of female arthroplasty surgeons (6 (8%) vs 66 (92%) males),

Table I. Volume of operations performed by male and female orthopaedic surgeons.

		Number of procedures within 12 months, n (%)				Number of procedures within 36 months, n (%)			
Procedure	**Gender**	**None**	**< 5**	**≥ 5**	**χ^2**	**None**	**< 5**	**≥ 5**	**χ^2**
Hip primary	Female	52 (50)	26 (26)	24 (24)	$p < 0.001$	37 (36)	29 (29)	36 (35)	$p < 0.001$
	Male	1,108 (40)	342 (12)	1,343 (48)	$\chi^2 = 29.289$	692 (25)	510 (18)	1,591 (57)	$\chi^2 = 152.440$
Hip revision	Female	87 (85)	10 (10)	5 (5)	$p = 0.002$	78 (77)	14 (13)	10 (10)	$p = 0.001$
	Male	1,957 (70)	375 (13)	461 (17)	$\chi^2 = 12.434$	1,665 (60)	459 (16)	669 (24)	$\chi^2 = 13.519$
Knee primary - patellofemoral	Female	102 (100)	0 (0)	0 (0)	$p = 0.006$	100 (98)	2 (2)	0 (0)	$p = 0.004$
	Male	2,538 (91)	190 (7)	65 (2)	$\chi^2 = 10.212$	2,430 (87)	216 (8)	147 (5)	$\chi^2 = 11.138$
Knee primary – medial compartment	Female	102 (100)	0 (0)	0 (0)	$p = 0.619$	102 (100)	0 (0)	0 (0)	$p = 0.426$
	Male	2,767 (99)	24 (0.9)	2 (0.1)	$\chi^2 = 0.958$	2,748 (98)	39 (1.4)	6 (0.2)	$\chi^2 = 1.707$
Knee primary – total knee arthroplasty	Female	75 (74)	3 (3)	24 (23)	$p < 0.001$	68 (67)	3 (3)	31 (30)	$p < 0.001$
	Male	1,162 (42)	133 (5)	1,498 (53)	$\chi^2 = 41.467$	962 (34)	155 (6)	1,676 (60)	$\chi^2 = 44.701$
Knee primary – unicompartmental knee arthroplasty	Female	95 (93)	3 (3)	4 (4)	$p < 0.001$	92 (90)	4 (4)	6 (6)	$p < 0.001$
	Male	2,089 (75)	201 (7)	503 (18)	$\chi^2 = 18.070$	1,977 (71)	180 (6)	636 (23)	$\chi^2 = 18.876$
Knee revision	Female	88 (86)	11 (11)	3 (3)	$p < 0.001$	78 (76)	16 (16)	8 (8)	$p < 0.001$
	Male	1,874 (67)	530 (19)	389 (14)	$\chi^2 = 17.646$	1,517 (54)	565 (20)	711 (26)	$\chi^2 = 22.120$
Ankle primary	Female	96 (94)	6 (6)	0 (0)	$p = 0.087$	95 (93)	4 (4)	3 (3)	$p = 0.739$
	Male	2,640 (95)	86 (3)	67 (2)	$\chi^2 = 4.882$	2,600 (93)	81 (3)	112 (4)	$\chi^2 = 0.605$
Ankle revision	Female	99 (97)	3 (3)	0 (0)	$p = 0.454$	99 (97)	3 (3)	0 (0)	$p = 0.665$
	Male	2,744 (98)	42 (1.5)	7 (0.3)	$\chi^2 = 1.578$	2,711 (97)	64 (2)	18 (1)	$\chi^2 = 0.815$
Elbow primary	Female	84 (82)	17 (17)	1 (1)	$p = 0.019$	79 (77)	17 (17)	6 (6)	$p = 0.203$
	Male	2,492 (89)	244 (9)	57 (2)	$\chi^2 = 7.939$	2,294 (82)	307 (11)	192 (7)	$\chi^2 = 3.189$
Elbow revision	Female	99 (97)	3 (3)	0	$p = 0.769$	96 (94)	4 (4)	2 (2)	$p = 0.643$
	Male	2,712 (97)	69 (2.5)	12 (0.4)	$\chi^2 = 0.526$	2,653 (95)	112 (4)	28 (1)	$\chi^2 = 0.883$
Shoulder primary	Female	81 (79)	10 (10)	11 (11)	$p = 0.07$	78 (76)	7 (7)	17 (17)	$p = 0.715$
	Male	2,295 (82)	135 (5)	363 (13)	$\chi^2 = 5.318$	2183 (78)	140 (5)	470 (17)	$\chi^2 = 0.670$
Shoulder revision	Female	97 (95)	4 (4)	1 (1)	$p = 0.462$	93 (91)	7 (7)	2 (2)	$p = 0.424$
	Male	2,560 (91)	188 (7)	45 (2)	$\chi^2 = 1.545$	2,445 (88)	224 (8)	124 (4)	$\chi^2 = 1.716$

χ^2 = chi-squared test statistic.
All tests had degrees of freedom (df) of 2.

followed by the South East (20 (5%) vs 409 (95%)), South West England (13 (4%) vs 282 (96%)), and North West England (17 (4%) vs 376 (96%)). North Wales, the Isle of Man, and the Channel Islands had no female arthroplasty surgeons (Figure 1 and Table II).

Distribution of female surgeons according to hospital

Female orthopaedic surgeons were distributed across 147 NHS hospitals and 26 independent hospitals. Male orthopaedic surgeons were distributed across 283 NHS hospitals and 175 independent hospitals. Of 102 female surgeons, 80 (78%) worked in the NHS exclusively, whereas the remaining 22 (22%) worked in an independent hospital. Of 2,793 male surgeons, 1,031 worked in the NHS exclusively (37%), and 1,762 (63%) worked in an independent hospital. The proportion of arthroplasty consultants working in private practice was significantly greater among males than in females ($p < 0.001$, $\chi^2 = 71.726$; df = 1). The proportion of surgeons working in more than one hospital was higher in males than in females (74% vs 40%, $p < 0.001$, $\chi^2 = 56.830$; df = 1). Overall, males worked in a greater number of hospitals than females ($p < 0.001$) (Table III).

Time since registration

The median time since full registration was 24.4 years (2.9 to 55.8) for males and 32.1 years (range 12.3 to 45.5) for females ($p < 0.001$). A total of 179 males and one female were not on the specialist register; these could be consultants who retired. Among those on the specialist register, the median time since specialist registration was 13.7 years (11 days to 30 years) for males and 10.4 years (2.0 to 26.6) for females ($p < 0.001$). There were 43 males and one female who received their full and specialist registration concomitantly. In the remaining, the median time from full to specialist registration was 10.9 years for males (5 days to 36.8 years) and 11.5 years (128 days to 24.6 years) for females ($p < 0.001$).

Fig. 1
Percentage of female orthopaedic surgeons according to region.

Table II. Number of male and female orthopaedic surgeons according to region.

Surgeon gender	Channel Islands, n (%)	East of England, n (%)	Isle of Man, n (%)	London, n (%)	Mid and Central Wales, n (%)	Midlands, n (%)	North East & Yorkshire, n (%)	North Wales, n (%)	North West, n (%)	Northern Ireland, n (%)	South East, n (%)	South East Wales, n (%)	South West, n (%)
Female	0 (0)	10 (4)	0 (0)	14 (3)	2 (4)	8 (2)	10 (3)	0 (0)	17 (4)	6 (8)	20 (5)	2 (3)	13 (4)
Male	2 (100)	251 (96)	4 (100)	410 (97)	48 (96)	481 (98)	367 (97)	31 (100)	376 (96)	66 (92)	409 (95)	66 (97)	282 (96)

Discussion

There is a low proportion of female arthroplasty surgeons within the NJR, with females comprising only 4% of arthroplasty consultants. This is the lowest proportion among all surgical specialties.[16] The highest proportion of female surgeons were among those who performed elbow, shoulder, and ankle arthroplasty. Hip and knee arthroplasty had the lowest female representation. The proportion of female surgeons performing arthroplasty varied by geographical region and was highest in Northern Ireland. Males were more likely to be participating in private practice and to be performing arthroplasty surgery at a greater number of hospitals.

Female orthopaedic surgeons had a longer time from full GMC registration to specialist registration than their male counterparts, and were on average earlier in their careers with less time spent on the specialist register. The shorter time from full to specialist registration observed for some surgeons may be explained by consultants carrying out their training abroad, and registering with the GMC directly on

Table III. Distribution of male and female orthopaedic surgeons according to number of hospitals worked in.

Number of hospitals worked in	Female surgeons, n (%)	Male surgeons, n (%)	Test statistic
1	61 (60)	726 (26)	
2	24 (24)	762 (27)	
3	8 (8)	642 (23)	
4	6 (6)	396 (14)	$p < 0.001$
5	2 (2)	171 (6)	$\chi^2 = 61.630$
6	1 (1)	59 (2)	$df = 8$
7	0 (0)	24 (1)	
8	0 (0)	7 (0.3)	
9	0 (0)	6 (0.2)	

χ^2= chi-squared-squared test statistic.
All tests had degrees of freedom (df) of 2.

the specialist register, yielding a very short gap from full to specialist registration. This also applies to consultants who may have done part of their training abroad. Surgeons may spend a longer time in training due to undertaking fellowships, working in other specialties, taking career breaks or maternity leave, and choosing less than full time training.

The longer time from full to specialist registration among female consultants may be attributed to a greater tendency to have time out of training or working less than full time than their male counterparts. Lachish et al[17] found that at ten years post-graduation, there was a six-fold higher proportion of female doctors working less than full-time compared to male doctors. Female doctors working in surgery were less likely to work full-time than those in other specialties.

These imbalances could be attributed to multiple reasons affecting all stages of professional development. Contemporary research consistently shows that medical students perceive orthopaedic surgery to be an unwelcoming career for women, with both physical and social burdens impairing the development of equality between male and female surgeons.[18,19] In addition, literature from the USA suggests female residency applicants are more likely to be asked inappropriate questions during interviews than males.[2] Women who have completed their training take longer to receive a job offer, and enjoy less success than men in academia.[2] This leads to orthopaedics being less popular among females compared to males during training,[20] and results in women earning less and being under-represented in leadership positions.[21–23] In our study, males were more likely to be participating in private practice than females. This could be a factor contributing to the existing pay gap.[24]

Effective inclusion campaigns are required to increase the proportion of female orthopaedic surgeons. For instance, Mason et al[25] reported on 118 students who completed an orthopaedic summer internship programme. This lasted eight weeks, and consisted of lectures, workshops, presentation of a completed research project, counselling, and ongoing mentoring. Completion of this programme was associated with increased odds of applying to orthopaedic surgery residency (OR 51.3, 95% CI 21.1 to 122.0; $p < 0.001$). However, it could be argued that those taking part in the programme had an initial interest in orthopaedic surgery, rendering a self-selecting group of a disproportionately high number of orthopaedic surgery residency applicants. Therefore, it is unclear whether this scheme is able to recruit women into orthopaedics who otherwise would have not considered it as a career.

Coffin et al[26] presented a survey to 18 high school and 18 medical students before and after the delivery of simulated orthopaedic procedures and speaker sessions. Average interest score before the event was 6 out of 10, with all respondents believing that women faced more barriers than men in orthopaedics. Respondents stated that upholding the expectations and perceptions of orthopaedic surgeons in the view of peers and patients could be an impediment to women seeking a career in orthopaedic surgery. After the simulated procedures and lectures, average interest increased to 7.67 out of 10 ($p = 0.003$). In addition, participants perceived fewer barriers to entry in terms of balancing a career and family life.[26] However, other studies have demonstrated that women in surgery events alone are not enough to alter the perception of sex bias in orthopaedic surgery.[27]

Publications on inclusion campaigns are dominated by the USA, with the results of many UK initiatives yet to realized or published.[8] Many are local initiatives and hence are limited in scope, with their effectiveness at regional or national level remaining unclear.[2] Strategies must target all levels of training, from medical school to senior faculties and editorial boards.[2] Misconceptions, such as women not being suited for a career in orthopaedics due to physical requirements, must be dispelled, considering that the evidence does not support this.[28] Further, equality during job applications must be promoted, and initiatives to improve work-life balance must be instated. Though there are schemes in place in the UK for less than full-time training, participants of such schemes may experience undermining behaviour due to their choice of working flexibly.[29] Addressing this is necessary, with current evidence suggesting that concerns regarding family life deter women from choosing a surgical career.[30]

Such initiatives should be implemented across the UK, with particular emphasis on regions which had the lowest proportion of female orthopaedic surgeons. These were the Midlands, North Wales, the Channel Islands, and the Isle of Man, with the latter three having no female consultant orthopaedic surgeons. The geographical variation in female surgeons may require further investigation to identify and help alleviate any potential barriers to increasing representation in these regions. Okike et al[31] found that increased orthopaedic faculty and resident ethnic diversity was associated with a greater orthopaedic application rate among under-represented minority medical students. Similar benefits may be expected with an increased female representation, particularly in hip and knee arthroplasty, which had the lowest proportion of female orthopaedic surgeons among all subspecialties. In order to reflect the population we serve, and to have the possibility of gender concordance between patient and surgeon, active efforts should be made to increase the proportion of female surgeons undertaking

hip and knee arthroplasty. The British Hip Society have a very active programme to increase diversity among its members and among hip surgeons within the UK, which has included workshops for school age children, in addition to an actively managed mentorship scheme.[32] Such efforts have not yet been replicated across all other adult orthopaedic subspecialty societies.

The limitations of this study must be taken into account when interpreting the findings. The main limitation of our dataset from the NJR is that it only represents those surgeons who perform arthroplasty as part of their practice. Orthopaedic subspecialties performing exclusively non-arthroplasty surgery, such as paediatrics and hand surgery, could not be explored. However, it is increasingly unusual for adult shoulder, foot and ankle, knee, or hip surgeons not to perform any arthroplasty. In addition, arthroplasty is typically employed in oncology, which captures many of the orthopaedic subspecialties. Therefore, although our study cannot provide insights into the proportion of female surgeons among the entire orthopaedic profession with certainty, it may serve as a proxy. The quantitative nature of the data limits the ability to analyze the root causes of gender imbalance in orthopaedic surgery. An understanding of baseline representation and stage of training can help guide future qualitative research exploring the reasons behind the gender disparity, and inform efforts to address it. We evaluated the orthopaedic workforce composition at a single timepoint, rather than carrying out a historical analysis. Further work should explore time trends to garner a better understanding of changes over time and areas for improvement. The NJR does not include Scotland, and therefore cannot be quoted as UK-wide.[14] The NJR does not report absolute numbers of procedures when fewer than five are performed, therefore the mean number of procedures performed per surgeon could not be calculated. Moreover, the NJR and GMC do not provide information on changes in job plans that can affect hospital sites represented in the NJR, which may impact the results. Finally, the gender quoted on the GMC website is self-identified, but there are only male and female options presented when searching for doctors, and further gender diversity is absent.

In conclusion, there is a very low proportion of female consultant orthopaedic surgeons performing arthroplasty surgery within the NJR of England, Wales, Northern Ireland, the Isle of Man, and Guernsey. This was lowest among lower limb arthroplasty. Female orthopaedic surgeons in the NJR are earlier in their careers than male surgeons and are less likely to engage with private practice performing arthroplasty. There is a wide variation in the proportion of female arthroplasty surgeons across different geographical regions. The ongoing support of inclusion campaigns is required to increase the proportion of female orthopaedic surgeons in the long term.

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Data sharing

The data for this study are publicly available at https://www.njrcentre.org.uk/about-the-njr/ and https://www.gmc-uk.org/registration-and-licensing/the-medical-register.

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