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# The path towards achieving gender equity for surgeons: The role of individuals, their professional organizations along with the associated healthcare systems

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# The path towards achieving gender equity for surgeons: The role of individuals, their professional organizations along with the associated healthcare systems

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# Table of contents

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# Editorial: The path towards achieving gender equity for surgeons: The role of individuals, their professional organizations along with the associated healthcare systems

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Editorial on the Research Topic
The path towards achieving gender equity for surgeons: The role of individuals, their professional organizations along with the associated healthcare systems

When the editorial support team at Frontiers in Surgery were looking for a research topic with a focus on gender equity within and across the various surgical disciplines, some of us answered the initial call. This was followed by us working out which of the 14 sections of the journal would be the best fit for this particular research topic, with Visceral Surgery subsequently being decided upon. A collective decision was also made early on in the process to deliberately target a full range of all of the relevant sub-topics for potential manuscripts with the aim of facilitating the publication of as much in the way of relevant research along with perspectives from around the world. Plus, it was anticipated at an early stage that there would be additional challenges related to the COVID-19 pandemic which may also be a focus for some authors (1).

What led to this decision being made by the team at Frontiers in Surgery? It had not gone unnoticed that over the last 5 years there had been a steady increase in the number of published manuscripts with a focus on gender equity appearing not only in high-profile medical journals (2) but also in surgical journals (3). This is of relevance not only to individual surgeons but also to the institutions within which they practice along with the relevant professional surgical societies (4, 5). In addition, it is now understood that having a surgical workforce made up of individuals who reflect the demographics of the community which it serves (6) is also important in ensuring that health equity can be achieved (7).

The secondary impacts of the ongoing COVID-19 pandemic on healthcare systems created challenges for everyone involved in this research topic whether it be the editors, the reviewers, or the authors. We received feedback on multiple occasions attesting to this. Nevertheless, of the close to 30 groups of authors who initially showed an interest in the research topic, 10 manuscripts were eventually able to be published.

Medical and surgical education emerged as a sub-topic of significant ongoing interest, with 5 manuscripts being published. Some of the factors which contribute to medical students having negative perceptions when it comes to considering a career in surgery are examined both for Orthopedics (Hull et al.) and Urology (Reale et al.). Then there is the data on the relatively high prevalence and impact of microaggressions on medical and surgical trainees in the Gulf regions (Al Rashed et al.), regardless of gender. The challenges being wrought by the COVID-19 pandemic were the focus of one manuscript (Cimen et al.), on how the continuing professional development of surgeons needed to be shifted to an online/virtual format. The small numbers in this particular study meant that no differences were able to be detected according to gender for the outcomes of interest. Surgical education was also a focus of one manuscript from Mexico (Mejia Fernandez et al.), on the rates of female participation in the annual scientific meeting of their national General Surgical association. They detect some differences, some of which are related to the proportion of women who are undertaking surgical training. The authors make a number of interesting recommendations that will be of particular interest to surgeons involved in the running of scientific meetings.

The working environment was the predominant focus of the remaining 5 manuscripts. The subgroup analysis of the surgeons who responded to a survey on doctors' experiences including with infertility and pregnancy in Australia (Kevric et al.) was both interesting and revealing. Anyone with an interest in family leave entitlements should look up this manuscript. Fewer female surgeons being involved in academic research, particularly in clinical trials formed the basis of another manuscript from Australia (Thao Luong et al.) along with one from the United States (Venkatesh et al.). The implications of this were explored in detail in each case, with the data from the United States also revealing a lack of diversity of the researchers in the sub-group of trials focusing on traumatic brain injury. This also appeared to be associated with the demographics of the patients being recruited into these particular trials, with the ensuing implications for achieving health equity. Finally, there was a focus on the extent of either bullying and/or harassment being encountered by female surgeons in the workplace whether it be in Gynecological Oncology in the United States (Hong et al.), or in Surgical Oncology in India (Pandrowala S). In each case, the authors make a series of system-level recommendations on how to both address and deal with these undesirable behaviours.

As can be seen, many of these manuscripts are potentially of interest to medical educators, researchers, clinicians who hold leadership positions within organizations, and of course all of the surgeons who are involved in any of the aforementioned activities. The most important common theme which is apparent from all of this is the real need to both develop and implement systemic type measures to deal with the issues, depending on where they lie, whether it be within an organization and/or professional societies. Finally, we would like to thank the authors who kindly submitted their work, the reviewers who so graciously gave their time, and the team in the Frontiers in Surgery support office. We hope that this research topic stimulates ongoing interest such that other related manuscripts continue to be submitted to Frontiers in Surgery.

## Author contributions

The manuscript was conceived by DV, IMB and KR in equal proportions. DV undertook the first draft which was amended by IMB. All authors contributed to the article and approved the submitted version.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher's note

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# Gynecologic Oncology and Inclusion of Women Into the Surgical Workforce: The Canary in This Coal Mine

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**Objective:** Women make up a majority of the gynecologic oncology workforce. Increasing the numbers of women in leadership has been proposed as a path towards professional gender equity. This study examined whether leadership gender and departmental infrastructure impact the work environment for women gynecologic oncologists.

**Methods:** Members of a 472-member private Facebook group "Women of Gynecologic Oncology" (WGO) who self-identified as women gynecologic oncologists provided demographics, practice infrastructure, personal experience with workplace bullying, gender discrimination, microaggressions using a REDcap survey platform.

**Results:** Of 250 (53%) respondents to this survey, most were younger than age 50 years (93.6%); White (82.2%) and non-Hispanic (94.3%); married (84.7%); and parenting (75.2%). Practice environments included academic (n=152, 61.0%), hospital employed (n=57, 22.9%), and private practice (n=31, 12.4%), and 89.9% supervised trainees. A significant percent of respondents had experienced bullying (52.8%), gender discrimination (57%) and microaggressions (83%). Age, race, ethnicity, practice setting, or mentorship were not statistically significantly associated with these experiences. Reported perpetrators were varied and included colleagues (84%), patients (44%), staff (41%), administrators (18%), and trainees (16%). Prevalence of bullying (55.0 vs 47.7%, p=0.33), gender discrimination (59.1 vs 52.3%, p=0.33) and microaggressions (83.3 vs 83.0%, p=1.00) were similar irrespective of departmental leadership gender.

**Conclusions:** Women gynecologic oncologists report a high prevalence of workplace bullying, gender discrimination and microaggressions regardless of the gender of their immediate leadership. Proactive and deliberate structural interventions to improve the work environment for surgeons who are women are urgently needed.

**Keywords: gender discrimination, women in medicine (WIM), women in surgery, gynecologic oncologists, inclusion, microaggressions, bullying**

## INTRODUCTION

Gender equity remains a critical issue for physicians who are surgeons (1). Although women have comprised more than half of medical students since 2003, women have remained less likely to enter and remain within surgical specialties (1, 2). Gynecology is a notable exception. By the 1990's half of trainees in obstetrics and gynecology were women. More than half of physicians practicing obstetrics and gynecology have been women since 2012; currently 59% of practicing gynecologists are women and 83% of trainees are women (3–5). Gynecologic oncology is a unique gynecologic subspecialty that requires competency in radical pelvic surgery including upper abdominal, bowel and bladder procedures. Similar to obstetrics and gynecology as a whole, increasing numbers of women have entered this field. In 2020, more than half of gynecologic oncologists and 70% of trainees self-identified as female (6).

Despite the majority of gynecologic oncologists identifying as women, recent literature supports the persistence of significant gender disparities in attaining leadership (7), a gender wage gap that is unexplained by experience or skill (6, 8), and high rates of perceived discrimination (9, 10). In a recent survey of gynecologic oncologists, 64% of female respondents endorsed gender discrimination in training or practice (10). Women remain under-represented in leadership relevant to gynecologic oncology including division director and department chair, but the presence of women in leadership roles has been previously associated with positive work environments within the subspecialty (7).

The objective of this study was to assess whether leadership gender and practice infrastructure are associated with the prevalence of bullying, gender discrimination, and microaggressions among surgeons who are women.

## METHODS

A sample of women gynecologic oncologists was recruited from the Facebook group, the "Women of Gynecologic Oncology" (WGO), an online Facebook community established August 18, 2017. At the time of the study, there were 472 members of this group of an estimated 1126 gynecologic oncologists in the United States (77.6% of the women workforce in gynecologic oncology) (6). The group is active with 453 members who signed on the month of the survey with 98 new posts, 972 comments, and 1,956 reactions from members during this time period. A link to an anonymous, secure survey administered *via* Research Electronic Data Capture (REDCap) (11) was posted on the WGO Facebook page and remained active between 7/20/2020 and 8/19/2020. The survey was optimized for use on computers as well as mobile devices. Written informed consent was included in the survey. The study was granted exemption status by the Institutional Review Boards at Loma Linda University Health.

The survey included 69 multiple choice items with branching logic. Demographic data collected included age, race/ethnicity, marital status, parenting status, geographic location, and years in practice. Practice setting was categorized as academic, hospital employed, private practice, HMO, military or other. Respondents were asked whether they oversee trainees, the department to which they report, their leadership gender and sub-specialty and whether they have a formal assigned mentor. Satisfaction with parental leave and whether breast-feeding goals had been met were queried to assess work-life balance.

Bullying was defined within the survey for respondents as "the use of negative and aggressive interpersonal behaviors to intimidate and dominate others. Bullying behaviors often are persistent and repeated. Examples include humiliation, insults, threats, coercion, isolation, and overwork—sometimes involving repetitive or meaningless tasks. Discrimination was defined as "negatively charged, differential treatment based on one's personal characteristics or attributes, including, but not limited to, gender, race, religion, sexual orientation, culture, ethnicity, disability, or age." Microaggressions were evaluated using questions felt to be most relevant to a surgical practice from the validated survey the "sexist mess" (12, 13) and defined as "everyday verbal, nonverbal, and environmental slights, snubs, or insults, whether intentional or unintentional, which communicate hostile, derogatory, or negative messages to target persons".

Data regarding bullying, harassment, and microaggression including perpetrators and effects on the respondent's career were captured. Missing values were excluded by line. Descriptive statistics were compiled. Univariate analysis was performed using $\chi^2$ tests. A multivariate logistic regression model was created to study the association of partner occupation with the respondents' desire to switch to a less demanding career or specialty while controlling for potential confounders. Variables were chosen based on contextual plausibility and statistical significance on initial univariate analysis. All $p$ values were from 2-sided tests, and results were deemed statistically significant at $p \leq .05$. All analyses were performed using JMP®, Version 15. SAS Institute Inc., Cary, NC, 1989-2019.

## RESULTS

Four hundred and fifty three of 472 WGO members logged onto the Facebook group while the survey was active. Of these members 250 (55%) submitted survey responses. Demographics of those respondents are detailed in **Table 1**. Most respondents were younger than age 50 years (93.6%), white (82.2%) and non-Hispanic (94.3%). A majority were married (84.7%) and had children (75.2%). Practice environments are described in **Table 2** and included academic (n=152, 61.0%), private practice (n=31, 12.4%), and hospital employed (n=57, 22.9%), and 89.9% supervised trainees. Most respondents reported within a department of obstetrics and gynecology (77.5%) to male division directors (56.7%) and male department chairs (60%). Only 16.1% of respondents had a formal, assigned mentor.

**TABLE 1** | Demographics of survey respondents.

| Characteristic | N (%) |
|---|---|
| Age | |
| 30-40 years old | 160 (64.0) |
| 41-50 years old | 74 (29.6) |
| >50 years old | 16 (6.4) |
| Race | |
| Asian | 25 (10.1) |
| Black | 5 (2.0) |
| Native American | 1 (0.4) |
| White | 203 (82.2) |
| Two or more races/Other | 13 (5.2) |
| Ethnicity | |
| Hispanic/Latina | 14 (5.7) |
| Partner Status | |
| Married or in a long-term relationship | 223 (89.6) |
| Separated/Divorced or Single | 26 (10.4) |
| Parenting | 188 (75.2) |
| Geographic Region | |
| Northeast | 60 (24.2) |
| Midwest | 52 (21.0) |
| South | 82 (33.1) |
| West | 50 (20.2) |
| Canada | 4 (1.6) |
| Years in Practice | |
| Fellow in training | 47 (18.7) |
| 1-10 | 162 (65.1) |
| 11+ | 40 (16.1) |

**TABLE 2** | Practice characteristics of survey respondents.

| Practice Type | |
|---|---|
| Academic | 152 (61.0) |
| Hospital Employed | 57 (22.9) |
| Private Practice | 31 (12.4) |
| HMO, Military, Other | 9 (3.6) |
| Oversee Trainees | 221 (89.1) |
| Reporting Structure | |
| OBGYN | 193 (77.5) |
| OBGYN Chair specialty | |
| General OBGYN | 54 (28.4) |
| Maternal Fetal Medicine | 53 (27.9) |
| Gynecologic Oncology | 34 (17.9) |
| Urogynecology (FPMRS) | 30 (15.8) |
| Reproductive Endocrinology | 16 (8.4) |
| Surgery | 20 (8.0) |
| Other | 36 (14.5) |
| Female Department Chair | 88 (40) |
| Female Division Director | 87 (43.3%) |
| Formal Mentor | 40 (16.1%) |

The experience of bullying was endorsed by 131 of 248 (52.8%) of respondents, 100 (76.3%) in training and 81 (61.8%) in practice. Gender discrimination was endorsed by 142 of 249 respondents, 112 (78.9%) in training and 92 (64%) in practice. Two hundred and eight (83.5%) respondents endorsed being the target of any microaggression. Experiences included the following: (1) hiding personal life or changed personality to adapt to a work environment (56.6%); (2) pretending to be interested in an activity to feel included in a conversation (41.9%); (3) being told to smile more (30.9%); (4) being told at work to dress a certain way (19.7%); and being told to act more female, nurturing and/or motherly (16.1%). No demographic or practice characteristics, including having an assigned mentor were statistically associated with experiences of bullying, discrimination, and microaggressions.

Division director gender, specialty or department reporting structure were not statistically significantly associated with the experience of bullying, gender discrimination or microaggressions (**Table 3**). Compared to respondents with a male chair, those with a female chair experienced similar rates of bullying (55.0 vs 47.7%, p=0.33); gender discrimination (59.1 vs 52.3%, p=0.33); and microaggressions (83.3 vs 83.0%, p=1.00). Women with male department chairs were more likely to meet breast-feeding goals (81 vs 60.4%, p-0.02). No other significant associations were identified between chair gender and perceived work environment for respondents.

Formal institutional reporting of bullying and discrimination was uncommon (24.4 and 19% respectively). When reported, bullying and discrimination was most commonly reported to a chief or chair (78.1 and 77.8%, respectively) and human resources (18.8% and 29.6%, respectively). The frequency of reporting was not associated with practice environment. Respondents who worked for a woman department chair were more likely to report experiences of bullying (33.3% vs 16.7%, p= 0.04) but not discrimination.

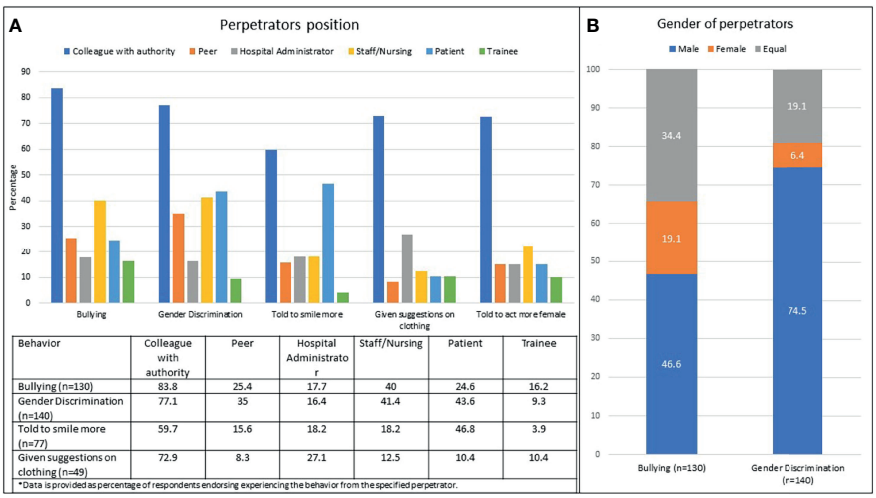
Multiple and varied perpetrators of bullying, gender discrimination and microaggression were reported (**Figure 1**). Individuals instigating these behaviors were identified as colleagues with authority (84%), patients (44%), staff (41%), administrators (18%), and trainees (16%). Perpetrators of bullying and discrimination were more commonly male, but significant numbers of respondents reported female instigators and/or an equal amount of bullying and discrimination from men and women.

Survey respondents endorsed that gender had impacted their careers and advancement (**Table 4**). Bullying and gender discrimination led to job changes for 18.3 and 13.6%, respectively, of participants. Nearly half of respondents endorsed exclusion from networking opportunities and over a third reported exclusion from leadership that was perceived to be related to gender. A woman in a leadership role was perceived as having been a barrier to advancement for 32.1% of respondents.

**TABLE 3 |** Association between leadership gender and workplace experience.

| | Female GO Division Chair n = 87 (43.3%) | Male GO Division Chair n = 114 (56.7%) | *p* value | Female Department Chair n = 88 (40%) | Male Department Chair n = 132 (60%) | *p* value |
|---|---|---|---|---|---|---|
| Experienced bullying? | 47 (54%) | 60 (52.6%) | 0.84 | 42 (47.7%) | 72 (45%) | 0.64 |
| Experienced gender discrimination? | 49 (56.3%) | 68 (59.7%) | 0.64 | 46 (52.3%) | 78 (59.1%) | 0.32 |
| Experienced microaggression? | 74 (85%) | 96 (84.2%) | 0.94 | 73 (83%) | 110 (83.3%) | 0.94 |
| Insufficient parental leave? | 34 (64.2%) | 44 (68.8%) | 0.6 | 36 (64.3%) | 48 (69.6%) | 0.53 |
| Met personal breastfeeding goals? | 38 (74.5%) | 36 (65.5%) | 0.31 | 29 (60.4%) | 51 (81%) | **0.02** |
| Adequate departmental support? | 59 (68.6%) | 71 (65.1%) | 0.61 | 52 (61.2%) | 87 (69.6%) | 0.21 |
| Adequate division support? | 71 (84.5%) | 82 (74.6%) | 0.09 | 66 (79.5%) | 96 (76.8%) | 0.64 |
| Excluded from leadership role due to gender? | 26 (29.9%) | 46 (40.3%) | 0.12 | 27 (30.7%) | 52 (39.4%) | 0.19 |

*OBG, Obstetrics and Gynecology; GO, Gynecologic Oncology. Bold values statistically significant at p < 0.05 values.*




| Behavior | Colleague with authority | Peer | Hospital Administrator | Staff/Nursing | Patient | Trainee |
|---|---|---|---|---|---|---|
| Bullying (n=130) | 83.8 | 25.4 | 17.7 | 40 | 24.6 | 16.2 |
| Gender Discrimination (n=140) | 77.1 | 35 | 16.4 | 41.4 | 43.6 | 9.3 |
| Told to smile more (n=77) | 59.7 | 15.6 | 18.2 | 18.2 | 46.8 | 3.9 |
| Given suggestions on clothing (n=49) | 72.9 | 8.3 | 27.1 | 12.5 | 10.4 | 10.4 |

*Data is provided as percentage of respondents endorsing experiencing the behavior from the specified perpetrator.

**FIGURE 1** | Perpetrators of bullying and discrimination were multiple and varied. **(A)** Positions of the perpetrators; **(B)** Gender of the perpetrators.

**TABLE 4 |** Perceived influence of gender on the careers of women gynecologic oncologists.

| Outcome | Response n (%) |
|---|---|
| Excluded from networking opportunities due to gender | 106/249 (42.6) |
| Excluded from a leadership position due to gender | 90/249 (36.1) |
| Written up for speaking your mind in a way that would have been tolerated from a male colleague | 82/249 (32.9) |
| Had a woman be a barrier to advancement | 80/249 (32.1) |
| Changed jobs because of bullying | 24/131 (18.3) |
| Changed jobs because of gender discrimination | 19/141 (13.6) |
| Been involved in a sham peer review, defined as the abuse of a medical peer review process to attack a doctor for personal or other non-medical reasons? | 24/249 (9.6) |
| Observed gender negatively impacting the careers of your male colleagues | 30/249 (12.0) |

Being written up for speaking one's mind that was perceived to have been tolerated from male colleagues was common. Ten percent of respondents had been the subject of a sham peer review (defined as the abuse of a medical peer review process to attack a doctor for personal or other non-medical reasons). Few respondents (12%) felt that gender negatively impacts their male colleagues.

## DISCUSSION

The findings of the current study confirm that gender-based discrimination remains a common experience for gynecologic oncologists who are women; that reporting of these experiences is uncommon; and provides evidence that this environment negatively impacts the career trajectories of women, leading to lost opportunities and job changes. By capturing perceived bullying and microaggressions, this study demonstrates the pervasiveness of hostility related to gender for women, despite the large numbers of women practicing within this surgical specialty. A previous, recent survey of gynecologic oncologists demonstrated that 71% of women and 51% of men reported experiencing sexual harassment in training or in practice. Few targets (14.5%) reported their experience. Female respondents

were more likely to have had the experience impact their career advancement or compensation (10). Prior reports have linked experiences of gender discrimination and sexual harassment to increased reports of burnout, job changes and career dissatisfaction (9, 10, 14–17).

"Critical mass" theory of the 1970's proposed that once women represented a third of a professional group, the culture of the group would shift such that they would no longer be perceived as a minority or subordinate (18). However, increasing proportions of women in a surgical work environment does not necessarily correlate to decreased prevalence of gender discrimination or sexual harassment. In a survey of general surgery training programs, increasing proportions of female residents was correlated with program-level rates of gender discrimination (r=0.64; 95% CI, 0.56-0,70) and sexual harassment (r=0.17; 95% CI, 0.06-0.28) (19). In gynecologic oncology experiences of bullying and discrimination persists despite large numbers of women – most recently in the "2020 Society of Gynecologic Oncology State of the Specialty" report, 54% of gynecologic oncologists self-identified as female (6), at rates remarkably similar to those reported in surgical specialties that remain predominated by men. A survey of the members of the American College of Surgeons and Association of Women Surgeons, found that 58% of women and 25% of men experienced sexual harassment in the preceding 12 months (20). In a survey of 927 practicing orthopedic surgeons 81% of women reported having experienced harassment, discrimination or bullying (21).

The professional roles and genders of the perpetrators of bullying and harassment reported in this study were multiple and varied. Significant numbers of respondents identified peers, staff/nursing, administrators, patients and trainees as the source of unprofessional behaviors. Nurses were the most commonly identified perpetrators of harassment in a recent survey of 270 general surgery trainees in which 48% percent of female and 22% of male respondents reported being harassed by nursing staff (22). Another recent survey of trainees identified the most common sources of discrimination as patients and nurses and that events occurred more often in the emergency and operating rooms (23). A qualitative study of 30 women surgeons described frequent workplace conflict with a non-physician and those interactions frequently resulting in formal reporting of the surgeon. Common impact themes, including personal (emotional and physical), professional, and patient safety were identified (24).

Promoting more women into leadership has often been proposed as a means with to reduce gender inequities in medicine and surgery (7, 25, 26). Yet despite large numbers of women in divisions and departments led by women, our study did not find an association between leadership gender and the experiences of bullying, gender discrimination or microaggressions. The only significant associations with women whose department chairs were men were more likely to reach breast feeding goals, while women were more likely to report bullying when working for a female department chair. These findings support the concept that organizational and institutional acknowledgement, accountability and education for leaders is necessary in order for culture change to be successful in traditionally hierarchical academic medical centers (27).

Our study confirmed that reporting of bullying and discrimination is uncommon among targets of sexual harassment (1, 10, 15, 22). Organizational prioritization of reporting and investigating harassment is necessary to create the transparency required to address the culture that allows bullying, harassment and microaggressions. In 2017 an anonymous reporting system was developed and implemented at the Mayo Clinic demonstrating the feasibility of institutional accountability. All allegations of sexual harassment are duly investigated by an HR representative in conjunction with the legal department. Over the first 2 years, 153 allegations were made and 88 (57.5%) substantiated. Of these, 71 (80.7%) included inappropriate comments and/or unwelcome sexual advances, 22 (25%) unwanted touch or physical contact, and 16 (18.2%) virtual or electronic harassment (e.g., email, messenger, text). Investigations resulted in 31 employees receiving formal coaching, 22 receiving written warnings, and 35 terminations or resignations (28). An improved culture has not yet been documented; however, the perception of fairness and justice are important foundations for eliminating cultures that allow harassment (1, 29, 30).

The negative effects of bullying and harassment in the workplace extend to surgeons of any gender. Observing discriminatory behavior is detrimental to the well-being of those exposed (15, 17, 31). Engaging bystanders may also be a key component to changing the culture of surgery as bystanders interventions are an effective evidence-based tool that can be used to combat discrimination (32, 33).

This study was designed to provide information about the effect of gender on work environment among women who are surgeons in a specialty with a majority women workforce. As such the prevalence and impact of bullying, discrimination and microaggressions among men were not captured. The results presented in this manuscript are limited by the biases inherent in a survey design and the convenience sample used to obtain responses. Gender bias in medicine is often insidious (34, 35) and our results may reflect recall bias. Gynecologic oncologists who experience a negative work environment may be more likely to actively participate in a social media support group. Our results may have undercounted the experiences of bullying and harassment across a woman's career as our survey respondents were primarily young, therefor may not yet have experienced the accumulation of events reported by midcareer and senior surgeons who are women (36). Similarly, most participants were White, and may not have experienced the amplified experiences bullying and harassment reported by physicians from historically underrepresented in medicine communities who are also women (21, 37, 38). In addition, we were unable to assess the leadership gender within the broader context of the organization which may have contributed to our findings. The strengths of this study, however, include the large proportion of gynecologic oncologists who are women who participate actively

in this social media group, the WGO and the high response rate (over half of active participants).

An urgent need to correct gender-based hostility within the surgical work environments exists. Inclusion of women into a specialty and into leadership positions is insufficient to create belong within surgical workplaces. Department and institutional leaders and mentors need to actively help women navigate unprofessional behavior, gender bias, and exclusion at work. Although gynecology was the first surgical specialty to attract a majority women workforce, increasing numbers of women are entering all surgical specialties (1, 39). With an increasing number of women in the surgical workforce, attention to creating spaces where all surgeons can thrive should be prioritized by all healthcare systems. Further studies are needed to address how the systemic change can occur and be standardized in institutions.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Loma Linda University Institutional Review Board. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

## AUTHOR CONTRIBUTIONS

LH, ST, MB, and LR contributed to conception and design of the study. LH, DT, MB, and ST designed the survey. LR organized the database. LR performed the statistical analysis. ST wrote the first draft of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

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# Role of Female Research at the Asociacion Mexicana de Cirugia General Annual Meeting: A Retrospective Analysis From 2013 to 2019

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**Background:** Academic surgery has been a traditionally male-dominated field. Female contribution remains challenging. In Mexico, there is no published evidence regarding gender disparity in academic surgery. We aimed to analyze the female role in clinical research submitted to the Asociación Mexicana de Cirugía General (AMCG).

**Methods:** Retrospective study evaluating abstracts submitted to AMCG annual meetings from 2013 to 2019. Categorical variables were compared using $\chi^2$ test. Univariate logistic regression was performed to calculate odds ratios (OR) followed by a log-binomial logistic regression model to obtain the adjusted relative risk (aRR) for acceptance as an oral presentation.

**Results:** Overall, 7,439 abstracts were analyzed of which 24.2% were submitted by females. Female-submitted abstracts increased from 22.5% to 25.3% during 2013–2019 ($p = 0.15$). The proportion of 47 abstracts submitted by females was higher in the resident group (27.7% vs. 18.8%; $p < 0.001$). The percentage of females' abstracts selected for oral presentation was less than the percentage of males' 49 abstracts selected for presentation (9% vs. 11.5%; $p = 0.002$). Females' abstracts submitted have a 50 23.5% decreased chance of being selected for oral presentation (OR = 0.765, CI 95%, 0.639–0.917, 51 $p = 0.003$). However, after adjusting for research type and trainee status, the gender of the oral 52 presenting author showed no association (aRR = 0.95, CI 95%, 0.8–1.1, $p = 0.56$).

**Conclusion:** In Mexico, the female role in academic surgery is still limited. These results should 55 encourage professors and program directors to identify and address factors contributing to gender 56 disparities.

**Keywords: gender role, academic surgery, surgical training, general surgery, inclusion, surgeon, leadership, bias**

## INTRODUCTION

In the last half-century, female enrollment in medicine has increased significantly. In 2016, females accounted for 47% of medical school graduates worldwide (1, 2). In Mexico, 53% of medical graduates were females during the last decade (3). Despite this increase, gender disparity remains a constant issue in the areas of promotions, remunerations, evaluations, and scientific publications (4–6).

Females have gained positions in traditionally male-dominated specialties such as general surgery (7). However, there is still a wide disparity favoring males. In general surgery, females represent only 43% of residents in the United States and only 22% are active physicians (8, 9). In Mexico, only 22% of general surgery residents are females (3). Furthermore, females represent 16% of active members of the Asociación Mexicana de Cirugía General (AMCG).

The enrollment of women in academic surgery continues to be a challenge as well. According to the AAMC, women represent 38% of full-time academic faculty, 21% of full professors and 15% of department chairs. However, women represent less than 20% of full-time surgical faculty, less than 10% of full professors of surgery and only 5.7% of surgical chairs (7, 10). In the Surgery Department of the National Autonomous University of Mexico (UNAM), only 22% of the professors are women (11). The first female did not get a seat on the Executive Board in the AMCG until 1990. After 19 years, the first female President of the AMCG was elected and the first Executive President in 2017 (11). Likewise, the National Medical Academy in Mexico elected its first female President in 2019. As a result, it is not a surprise that the number of females in surgery research is considerably lower than males.

Currently, there is no published data regarding female role in surgical research in Mexico. Annually, the AMCG organizes scientific meetings and encourages research in surgery by calling for abstract submission. The information provided by submitted abstracts to this meeting can be an indirect measure of the scientific activity among surgical residency programs and academia in Mexico. The aim of this study was to evaluate the female role in surgical clinical research performed in Mexico by analyzing submitted abstracts to the AMCG.

## MATERIALS AND METHODS

Submitted abstracts to AMCG annual meetings were retrospectively analyzed from 2013 to 2019. Databases were provided by the AMCG and included information regarding presenting author, acceptance status, type of presentation, design of the study, topic classification according to surgical subspecialty, and trainee status. Submitted abstracts went through a blinded peer-reviewed process. The author's name, trainee status, and institution were not available during the acceptance/rejection decision making. For this reason, any differences observed in female representation were unlikely to have been caused by potential biases in abstracts reviewers. Submitted abstracts during the study period were screened for inclusion in the study. Multiple abstracts ($n$) submitted by the same individual were included as $n$ observations. Abstracts accepted for video sessions and those submitted as "Video/surgical technique" were excluded from the analysis.

Sex of presenting author was assigned independently by four authors (FRH, ALR, LMF, and JSG) using a binary system (i.e., female or male), as previously reported (12, 13). A three-tiered approach was used: (1) determination of sex using traditional naming conventions; (2) search of presenting authors using the association's members directory; (3) internet search of presenting author's name and institution. Cases in which the presenting author's sex could not be determined by the above-mentioned steps were excluded from the analysis.

Confidentiality of authors was respected according to the terms and conditions signed and consent provided at the moment of abstract submission.

### Statistical analysis

Descriptive results are reported as percentages. Categorical variables were compared using $\chi 2$ test to determine differences between groups. Univariate logistic regression was performed to calculate odds ratios (OR) and identify any associations among analyzed variables. Statistically significant variables in univariate analysis were included in a log-binomial logistic regression model to calculate adjusted relative risks (aRR). All statistical tests were two-tailed, and $p$ values <0.05 were considered significant. Statistical analysis was performed using R software version 3.6.2 (R Core Team, 2019; **Supplementary file**).

## RESULTS

A total of 8,428 abstracts were submitted between 2013 and 2019, and 7,439 were ultimately included in this analysis (**Figure 1**). A total of 6,017 abstracts were accepted for presentation (809 for oral presentation and 5,208 for poster presentation) while 1,422 were rejected. Overall, 24.2% ($n = 1,806$) were submitted by females. Abstract submissions by gender were accepted at a similar rate (female 82% vs. male 80.5%; $p = 0.174$). The percentage of abstracts submitted by females increased from 22.5% in 2013 to 25.3% in 2019 (**Figure 2**), although this increase was not statistically significant ($p = 0.15$).

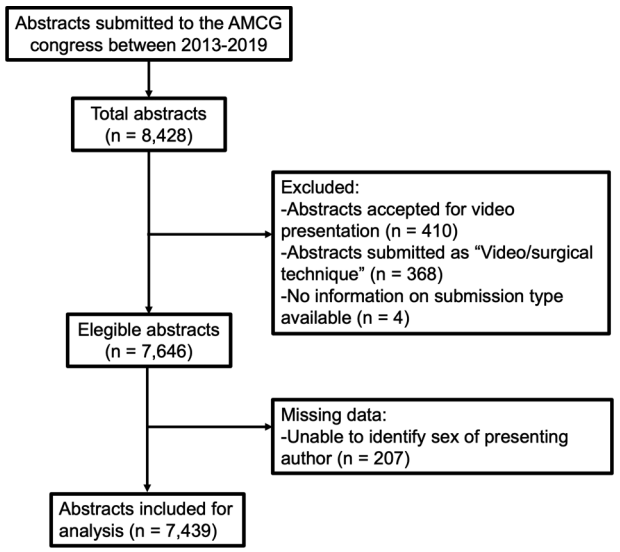


**FIGURE 1** | Flow diagram showing data obtained for this study.

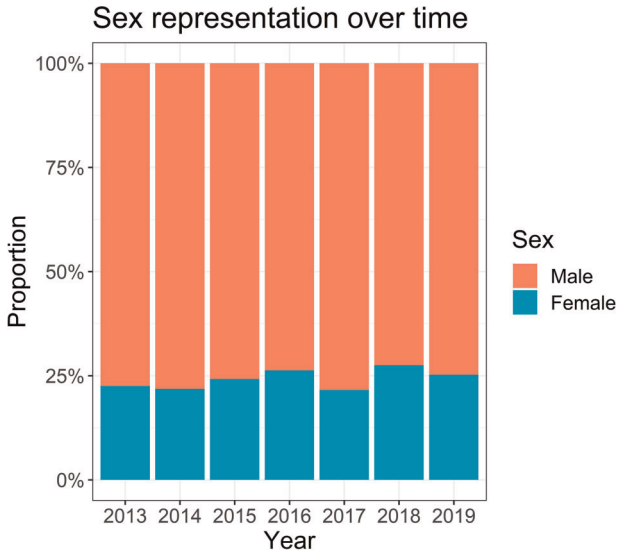


**FIGURE 2** | Abstracts submitted to AMCG annual meetings from 2013 to 2019 compared by sex. The year with the highest proportion of accepted abstracts from females was 2018, while 2017 showed the lowest proportion.

## Trainee status

When comparing males and females by trainee status, the percentage of abstracts submitted by females in the resident group was 27.7%, while the non-resident group was 18.8%. This difference between the resident and non-resident group compared by sex was statistically significant ($p < 0.001$). We did not have enough information about trainee status to trace a progression during the analyzed period.

## Topic

The proportion of females varied across the different surgical topics (**Figure 3**). Among the top 20 most frequent abstract topics, females had the highest representation in pediatric surgery, followed by transplant surgery and urology. The lowest representations were found in cardiothoracic surgery, minimally invasive surgery, and experimental surgery/surgical research. However, the only topics in which females were significantly over and underrepresented were miscellaneous and infectious diseases, respectively.

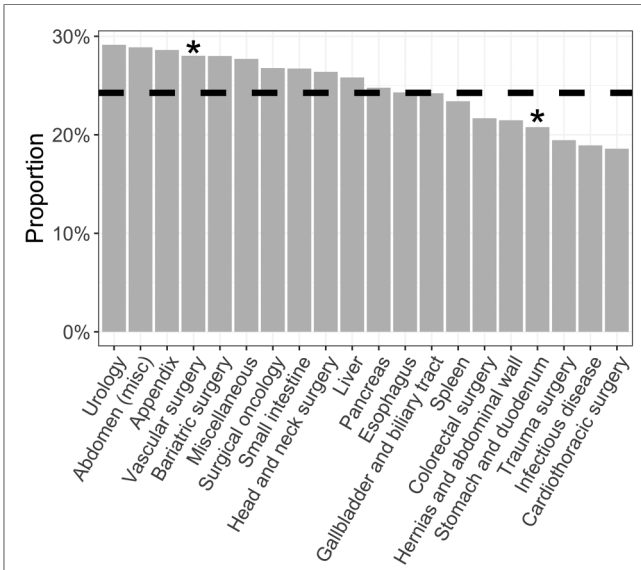


**FIGURE 3** | Abstracts submitted by females stratified by topic/subspecialty. The dashed line represents the mean female proportion (24.2%). * $p < 0.05$

## Analysis per Study Design, Trainee Status, Author's Sex and Status of Acceptance

Throughout the study period, the percentage of original research abstracts submitted by females increased from 16.9% in 2013 to 27.3% in 2019 ($p < 0.01$). A smaller percentage of abstracts submitted by females was selected for oral presentation compared to those by males (9% vs. 11.5%; $p = 0.002$, **Figure 4**). Overall, abstracts submitted by females that were classified as original research represented 22.4%, compared to 26.3% of those by males ($p = 0.001$, **Figure 5**).

In a subgroup analysis, females in the resident group had fewer original abstracts (23.1% vs. 34.9%, $p = 0.0001$), fewer abstracts selected for oral presentations (8.6% vs. 13.7%, $p = 0.02$) but similar abstracts rejected (14.5% vs. 12.9%, $p = 0.6$) when compared to females in the non-resident group. Similarly, when comparing males in the resident group *versus* the non-resident group, the former had fewer original abstracts (22.9% vs. 35.4%, $p < 0.0001$), fewer abstracts selected for oral presentations (8.6% vs. 15.4%, $p < 0.0001$) and fewer abstracts rejected (15.8% vs. 19.7%, $p = 0.004$)

Compared to males, unadjusted logistic regression showed that abstracts submitted by females had a 23.5% decreased

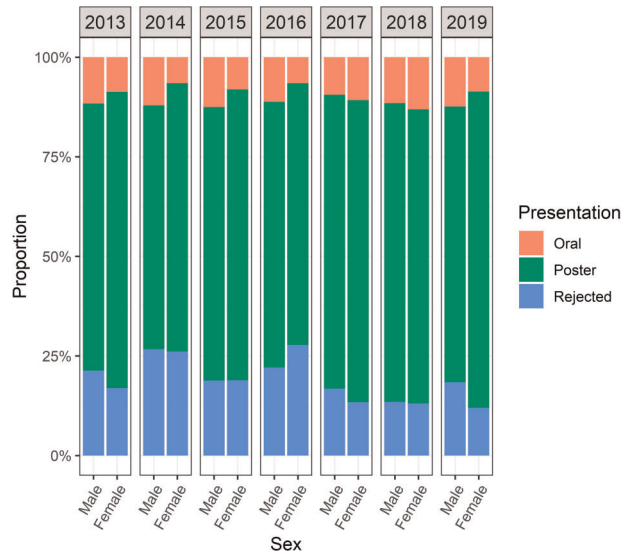


**FIGURE 4** | Comparison of abstracts submitted to AMCG annual meeting from 2013 to 2019 by sex and status of acceptance (oral, poster, or rejection).

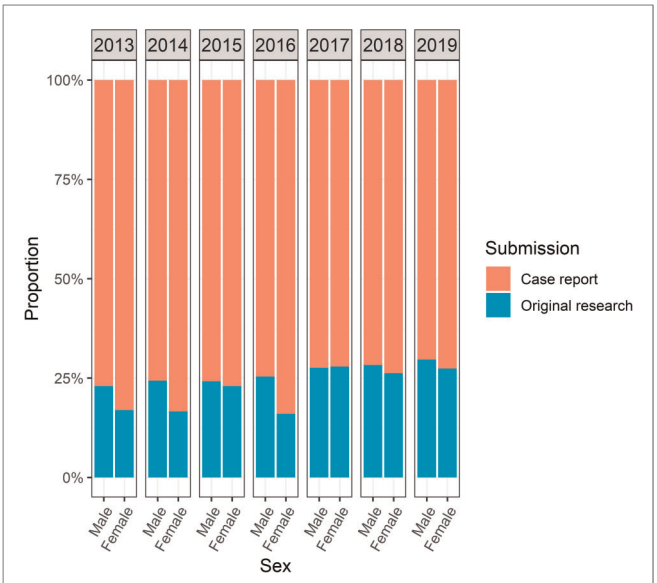


**FIGURE 5** | Comparison of abstracts accepted to AMCG annual meeting from 2013 to 2019 by sex and study design (case report, original research).

chance of being selected for oral presentation (OR = 0.765, CI 95%, 0.639–0.917, $p = 0.003$). However, this association was no longer statistically significant when adjusted for the type of research and trainee status (aRR = 0.95, CI 95%, 0.8–1.1, $p = 0.056$, **Supplementary Table S1**).

Original research studies were more likely to be accepted for oral presentations (aRR = 136.7, CI 95%: 70.9–263.5, $p < 0.001$), while abstracts submitted by surgery residents had a decreased tendency of being accepted as oral presentations (aRR = 0.87, CI 95%: 0.75–1, $p = 0.058$). In the adjusted logistic regression, oral presentations and resident status remained statistically significant after excluding the rejected abstracts (**Supplementary Table S2**).

## DISCUSSION

Gender disparity among surgical specialties is a current concern that negatively impacts the professional development of females. Overall, submitted abstracts that had a female as a first-author accounted for 24.2%. Females' participation in surgical clinical research showed a 2.8% increase in seven years but did not reach statistical significance. Jagsi *et al.* reported a 5-fold increase of females participating as first or senior authors among original high-quality medical research publications in a 35-year period (14). It is important to notice that surgical journals had the lowest increase in female participation compared to journals related to other medical disciplines such as obstetrics & gynecology and pediatrics. More recently, Mueller *et al.* reported that females in academic surgery had significantly lower H-index and publications compared to males (15). Our data indirectly indicates gender disparity in academic surgery research in Mexico similar to these reports.

Several factors may be contributing to the differences shown in this study regarding abstract submission rates by females enrolled in a surgical residency program. Surgery residency admission in Mexico is complex, demanding, and limited with an acceptance rate of 20% per year (16, 17). In the last 7-years, from all applicants accepted for surgery residency, the proportion of females has been 22 ± 1% (3). (**Supplementary Figure S1**). In the United States, the female percentage in surgical training programs was nearly 40% in 2013 (18). Despite the fact that about half of Mexican medical school graduates are females, there has not been an equitable increase in the proportion of females enrolling in surgery specialty programs in Mexico (16, 19). This limited enrollment directly impacts the proportion of females actively participating in surgical research. Therefore, there is a need to address the factors leading to the low enrollment of females in surgical residency programs after graduation from medical school. In Mexico, medical students have reported that their specialty choice is highly dependent on their experience during medical school, and 24% apply to general surgery programs (17). In Latin America, only 8.6% of females intend to pursue general surgery training and are 22% less likely to choose this field compared to males (19). Globally, male medical students are more likely to choose surgery or orthopedics residencies compared to females (4). This decision is mainly driven by the potential for work-life balance and, particularly in females, by the presence of hostility and sexism within the residency environment (20). It has been reported that medical students perceive surgical residency programs to be discriminatory and prone to abuse and burnout (21–23). Mistreatment perceptions have also been reported by general surgery residents (24).

While sparse, our results are similar to previous studies in other countries of Latin America. In a recent study, Bueno

Motter et al. investigated women's representativeness across surgical departments of Brazilian universities, Brazilian surgical societies, and speakers in surgical events (25). They found that of university departments, only 11.2%were women and only three universities had women as department chairs. Also, in surgical societies, only 8.6% of positions were held by women. When analyzing speakers' participation in surgical events, only 13.3% of 6686 speakers were women. Similarly, Sarmiento Altamirano et al. surveyed a total of 105 women surgeons to evaluate the current representation of women surgeons in Ecuador (26). Of the female surgeons surveyed, 67% reported that leadership in their workplace, both departmental and hospital levels tended to be led by males, and only 6.7% were occupied by females. These results should serve as an overall status of gender disparities in Latin America to promote changes towards a more equal representation.

## Trainee Status

Abelson *et al.* reported that female participation in General Surgery has increased from 20% to 40% during the last 20 years in the United States (27). Despite the fact that only 22% of Mexican surgery residents are females, our study showed an overrepresentation of female residents submitting abstracts (27%) (28). Although the factors contributing to greater participation of female residents remain to be elucidated, this might suggest that, once, outside the residency program, women encounter more obstacles that hinder their continued participation in research. Alternatively, this might suggest a higher interest in female residents to participate in surgical research. It's important to consider that women face additional challenges during residency, such as pregnancy and motherhood, exacerbating the research gap. While no research on the number of women who get pregnant during general surgery residency is available, from the author's experience we can say that pregnancy is not common during surgery residency in Mexico. This could be related to several factors including limited monetary compensation to raise a family, fear of losing their residency status, and lack of appropriate and supporting maternity leave policies. Definitely, this should be a significant area of opportunity for future research to approach gender disparities, modify current policies and improve current residency programs.

The non-resident group may involve board-eligible female surgeons, medical students, and/or other healthcare professionals. From the authors' personal experiences, the number of medical students participating as presenting authors in the AMCG meeting is very low due to the lack of research curriculum, tutoring and funding in the majority of medical schools. Thus, we think that this group is mostly represented by senior academic surgeons, which may be supported by the fact that the non-resident group had more original abstracts and a greater number of their abstracts selected for oral presentation compared to the resident group. Even though it is difficult to analyze this group, we can hypothesize that multiple factors influence the decreased research participation by non-residents, including the low representation of female surgeons, family and personal commitments, or academic requirements (8). Further research is imperative to determine the cause for lower abstract submission by female non-residents.

## Topic and Specialties

Females had higher participation in urology, followed by abdominal, appendix, and bariatric surgery (**Figure 3**). Contrary to what previous studies have shown, our data display more female participation in traditionally male-dominated surgical subspecialties (29, 30). Furthermore, our study showed that the lowest female representation accounted for cardiothoracic surgery and infectious diseases related abstracts, supporting previously published data (27, 31). Valsangkar et al. showed the highest gender disparity in publications related to surgical subspecialties, such as in acute care surgery, surgical oncology, vascular surgery, plastic surgery, and cardiac surgery (32). Differences observed within different topics should be interpreted cautiously, as the AMCG is a general surgery meeting. It is well known that gender impacts the choice of subspecialty, in that males are more likely to enter a fellowship (70% vs. 43%), and females tend to select fellowships that are less time-demanding and provide more lifestyle flexibility (29). Overall, there is a tendency for females to choose specialties that favor an optimal work-life balance. For instance, an increased female enrollment has been reported in subspecialties, such as critical care surgery and colorectal surgery (27).

## Study Design and Acceptance Status

Even though the rate of abstract acceptance between females and males is similar, we describe a significantly smaller proportion of female abstracts being selected for oral presentation. Adjusted multivariable analysis revealed that the design of study and trainee status, rather than gender, are the most important factors for an abstract to be accepted for oral presentation.

Similarly, the 2018 Annual Meeting of the Society of Thoracic Surgeons in the United States reported that only 12.9% of oral abstracts were presented by females (31). In addition, females represented 19.4% of plenary speakers, 29% of plenary and keynote speakers, and 28.5% of speakers in American Surgical Conferences, United States Medical Education Conferences and Canadian Anesthesiologists' annual meetings, respectively (12, 13, 33).

Research quality is strongly related to research funding. In the United States, male faculty receive greater proportions of larger NIH grants (32). In Mexico, females comprise only 15% of surgery scientists registered at the National System of Researchers (SNI). SNI is commonly considered the cornerstone of scientific promotion and funding support in the country (34). This could be one of the factors contributing to the low number of original research abstracts submitted by females. However, there is limited data on research funding in Mexico.

Factors contributing to the professional gender gap have been described elsewhere (4, 10). Academic factors include early exposure to positive role models, effective mentorship, rough training environments, harassment, remuneration gap, and inclusion in high-quality research studies. Female surgery

residents tend to receive less mentorship compared to males (35). Heath *et al.* reported that female trainees' evaluations are more likely to include emotive terms (e.g., empathetic, delight, warm), as opposed to their male counterparts who are often described with ability (e.g., master, complexity) and research (e.g., trials, studies, data) terms in their evaluations (36).

Personal and social factors such as professional satisfaction, time commitment, lifestyle, and family planning can influence the development of a female resident or medical student (2, 4, 10, 21–23). For instance, Seemann *et al.* found up to 56% gender discrimination rates in female surgeons; however, the mean score of career satisfaction in these women was 8.6 (scale 1–10) (2). Schwarz et al. reported similar mean work satisfaction scores between female (69.5%) and male (75.7%) surgeons (37). Despite the fact that females have more opportunities nowadays than in the past, much remains to be done. The so-called "leaky pipeline" phenomenon demonstrates that females are less likely to have a full-professor status, even after accounting for scientific productivity (38–40). If this trend is allowed to continue its course, gender parity in academic ranks would not be achieved until 2136 (27).

It seems that social role expectations keep playing a role in achieving balance between professional and personal life. Implicit and explicit gender biases exist in healthcare professionals, who often associate males with professional development, whereas females are more likely to be associated with family and family medicine (41). Gender bias and stereotypes affect career engagement and technical performance among those pursuing a career in academic surgery (42). Indeed, academic and social factors impact academic surgery in Mexico. However, there is not enough data from Mexico describing the different factors that affect or influence a female's decision to engage in research projects during or after residency. This could be an area of opportunity for future research.

Several associations have already developed tools and resources to identify detrimental factors, such as sexual discrimination. For instance, The National Academies of Sciences, Engineering, and Medicine developed a consensus to evaluate sexual harassment in females (43). Furthermore, the University of Louisville has also implemented changes to ensure teamwork and non-discriminatory environments (29). These tools, among others, could help point out specific factors that can be acted upon to enhance the scientific development of females.

## Limitations

This study has some limitations, aside from those inherent in its retrospective nature. First, overall female participation could not be assessed as we analyzed only the sex of the presenting authors, and the role of co-authors could disclose additional findings, especially when looking at senior authors. We decided to focus on presenting authors because we felt it to be a reliable marker of research participation, as presenting authorship is usually granted to the greatest contributor. In Mexico, it is not a universal practice to place the senior author as the last co-author; this prevented us from assessing gender disparities in this group. It should be noted that only abstracts submitted to the AMCG meetings were analyzed, which limits the generalizability of our results. However, as the largest academic surgery platform in Mexico, AMCG meetings represent an overall picture of the status of academic surgery in our country.

As a social phenomenon, analysis of longer periods of time may be needed to better identify changes in gender discrimination. However, due to data availability, this study only included the last seven years. Although sex and gender are used interchangeably, these represent different dimensions. Due to the retrospective nature of the study, the gender identity of presenting authors could not be collected. As gender is a social construct based on expected roles and behaviors in society, differences in gender identity in academic surgery could uncover results that may have been overlooked by our sex-based analysis.

# CONCLUSION

This study showed that in Mexico, the female role in academic surgery is still limited, with only a quarter of submitted abstracts to the last AMCG meetings having a female as the first author. This might be related to the lower number of females in surgery, but further research is needed. Increasing female participation in original and high-quality surgical research is crucial to start changing the *status quo* and reducing the gender gap. The low increase in females' abstract submissions during the study period should encourage surgical educators and general surgery leadership to identify and address factors contributing to gender disparities, beginning in the early stages of medical school and continuing throughout the entire professional careers.

# DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author/s.

# AUTHOR CONTRIBUTIONS

LM-F: Writing – Original Draft, Writing – Review and Editing. FR-H: Writing – Original Draft, Writing – Review and Editing. AL-R: Writing – Original Draft, Writing – Review and Editing. FL-V: Conceptualization, Formal analysis, Writing – Review and Editing. JS-G: Conceptualization, Writing – Review and Editing. JL MaO: Writing – Original Draft, Writing – Review and Editing. EM-P: Writing – Original Draft, Writing – Review and Editing. EL-G: Conceptualization, Writing – Review and Editing. All authors contributed to the article and approved the submitted version.

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## SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/article/10.3389/fsurg.2022.900076/full#supplementary-material.

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BRIEF RESEARCH REPORT
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# Women in Surgery Events Alone do not Change Medical Student Perceptions of Gender Bias and Discrimination in Orthopaedic Surgery

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**Aims:** This study investigated the perceptions of medical students regarding the barriers to pursuing a career in trauma and orthopaedics (T&O); and whether these perceptions were altered by attending an event promoting women in T&O.

**Methods:** An event consisting of presentations and interactive sessions from two female T&O trainees was hosted online. Attendees completed pre and post-event questionnaires. Students were asked about their previous exposure to T&O, perceptions of gender imbalances in T&O and what barriers they perceived prevented women from entering T&O. Univariate analysis was performed to identify changes in perceptions following the event.

**Results:** Pre-event questionnaires were completed by 102 people; and post-event by 52. Although 64/102 respondents were considering a career in T&O, 26/102 were dissuaded by perceived gender disparities. Perceptions of gender disparities were significantly higher in UK based attendees compared to other nationalities ($p = 0.047$). Attendees were more likely to want to pursue a career in T&O if they had been directly exposed at medical school ($p = 0.044$), but exposure did not alter perceptions of women in T&O. The most common perceived barrier was the orthopaedic stereotype followed by male dominated workplace culture, and lack of female role models. Pre and post-event responses did not differ significantly for any areas examined.

**Conclusion:** There are significant concerns amongst medical students regarding gender based discrimination within T&O, and these perceptions were not altered by attending a one-off women in T&O event. Early exposure to T&O appears important to improve interest in orthopaedics, whereas negative stereotyping is a barrier.

**Keywords: gender, women in surgery, diversity & inclusion, medical students, discrimination, bias, orthopaedic surgery**

## INTRODUCTION

Since 1996 medical school cohorts in the United Kingdom have consistently been made up of more females than males, yet this has not translated to the surgical workforce (1). Over the past 15 years, the percentage of women in surgical training has increased by only 3.9% (2). Currently 14.5% of consultant surgeons within the National Health Service [NHS] are female. Female representation

within trauma and orthopaedics (T&O) is the lowest of any surgical speciality; 6.5% of NHS T&O consultants and 18.7% of speciality registrars identify as female (3). Although the number of women in training is increasing, efforts to both recruit and retain female trainees is required.

A recent systematic review of gender bias and sexual discrimination in orthopaedics found strong evidence that gender based sexual discrimination is unfortunately widespread within the speciality, significantly impacting women at all stages of their careers (4). There has been limited research into whether women are deterred from applying for T&O, and the causes of this. Issues that have been cited include minimal exposure to musculoskeletal topics during medical school, lack of female role models, discriminatory recruitment, male dominance within the speciality, the perception of requiring physical strength, and concerns over the length of training and ability to have a family (5–9).

Experiences during medical school are thought to be the most common reason for choosing a career in a given speciality and therefore medical students are an important population to investigate and potentially target (10). The aims of this study were to investigate the perceptions of medical students' regarding pursuing a career in T&O and whether these perceptions and beliefs were altered by attending an online event promoting women in T&O.

## METHODS

A collaborative online event entitled "Women in Trauma and Orthopaedics" was created and organised by the Association of Women Surgeons (AWS) Edinburgh Chapter and Edinburgh University Trauma and Orthopaedic Society (EUTOS). The event was designed to facilitate discussion about women in T&O and encourage female medical students interested in the profession. It was advertised on Facebook through EUTOS and AWS and was open to anyone. The event was of 1 h duration and included speeches from two Edinburgh based T&O trainees, followed by a question and answer session. The speakers shared their career paths to date, experiences of being a woman in T&O and gave advice for students interested in T&O.

Before and after the event students were asked to complete a survey that was distributed via Facebook and email. Students provided demographic data including year of medical school training, location of medical school and gender identity. Students were asked about their exposure to T&O to date, perceptions of gender imbalances in T&O, whether they were dissuaded from applying because of gender imbalances, and what barriers they identified as preventing women from entering T&O. The majority of questions were asked on a five point Likert scale. The pre and post-event surveys may be found in appendix A.

Statistical analysis was performed using SPSS Version 25.0. Categorical variables were compared using Chi squares or Fisher's exact test. Continuous variables were examined for normality: parametric data was compared between groups using an unpaired students T-test. A $p$ value of $<0.05$ was considered statistically significant.

## RESULTS

Pre-event questionnaires were completed by 102 students; 52 of whom completed the post-event questionnaire. Consent was obtained from individuals to analyse their anonymised data.

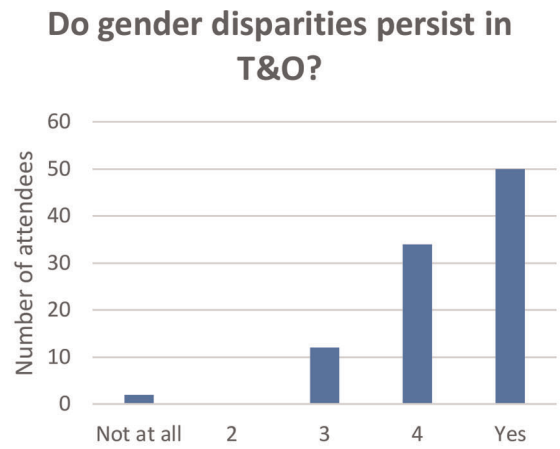
### Pre-Event Questionnaire

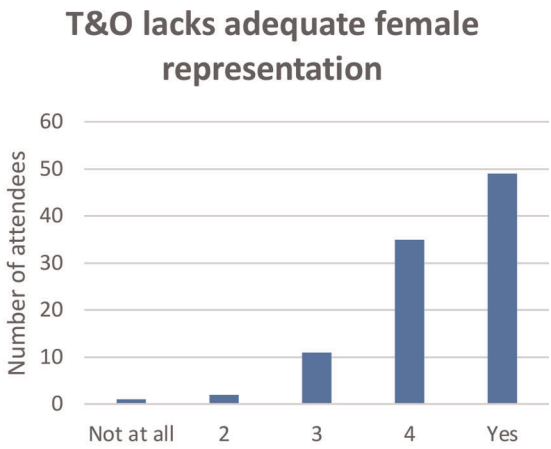
Pre-event questionnaires identified that 98/102 (96%) of respondents identified as female and 89/102 (87%) were current medical students. The remainder had already graduated but were in the early years of postgraduate medical training before specialty training. Almost two thirds (64/102, 63%) were strongly considering a career in orthopaedics. One third of attendees (33/102, 32%) reported little or no exposure to T&O as part of their medical education or training to date. Thirty percent (30/99) had undertaken research in T&O. One fifth (20/96) considered that they were at a point where they could apply to T&O training.

Perceptions of T&O as recorded on the pre-event questionnaire are given in **Figure 1**. A quarter of attendees (26/102) reported pre-event that they had been dissuaded from entering T&O by the perceived gender disparities within it.

Responders were international though the majority 68/102 (67%) were based in the United Kingdom. Geographic base did not significantly affect the responses to any of the questions regarding women in T&O: the number strongly considering a career in orthopaedics ($p = 0.415$, Chi square); the proportions who felt that orthopaedics lacks adequate female representation ($p = 0.327$, Chi square); that women face more obstacles and prejudice when pursuing surgery compared to males ($p = 0.130$, Chi square); the amount of sexism experienced by women in the workplace ($p = 0.106$, Chi square); the amount of exposure to T&O as a specialty ($p = 0.600$, Chi square) or the number dissuaded from entering T&O due to gender inequality within the specialty ($p = 0.376$, Chi square). There was a significant difference in the perception of gender disparities within orthopaedics between UK and non-UK attendees ($p = 0.047$, Chi square): UK 59/66 (89%) vs non-UK 25/30 (83%) were strongly aware of gender disparities.

Direct exposure to T&O was significantly associated with a desire to pursue a career in T&O: 47/64 (73%) with direct exposure were considering a career in orthopaedics compared to 18/34 (52%) with little or no exposure ($p = 0.044$, Chi square) (**Figure 2**). Exposure to T&O did not however affect perceptions of gender disparities ($p = 0.766$, Chi square); lack of female representation ($p = 0.340$, Chi square); lack of role models ($p = 0.135$, Fisher's exact); the perception of more obstacles for women ($p = 0.181$, Fisher's exact); or the perception of how much sexism women face at work ($p = 0.645$, Chi square). Importantly, previous direct exposure to T&O did not significantly affect the number of students dissuaded from a career in T&O due to gender disparities within it: 13/45 (29%) with direct exposure had been dissuaded vs 13/27 (48%) with no direct exposure ($p = 0.100$, Chi square).



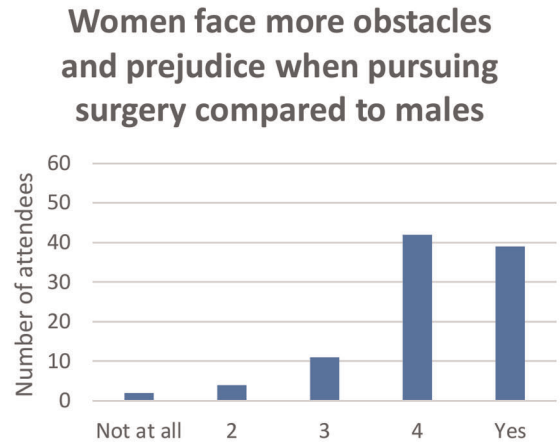






**FIGURE 1** | Pre-event perceptions of T&O.

## Post-Event Questionnaire

Pre and post event responses to the statements regarding women in T&O did not differ significantly for any of the areas examined (**Figure 3**): Orthopaedics lacks adequate female representation ($p = 0.751$, Chi square); Women face more obstacles and prejudice when pursuing surgery compared to males

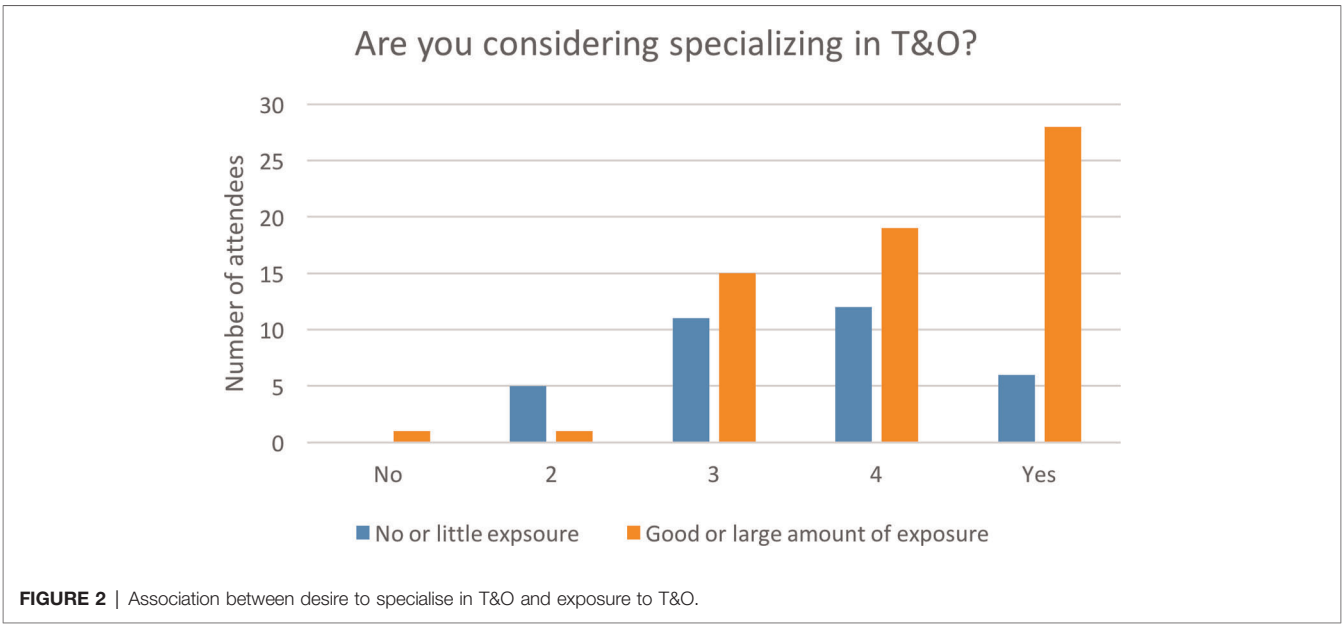



**FIGURE 2** | Association between desire to specialise in T&O and exposure to T&O.

($p = 0.078$, Fisher's exact); Are you dissuaded from specialising in trauma & orthopaedics because of gender inequality within the specialty? ($p = 0.097$, Fisher's exact); Do gender disparities persist in orthopaedic surgery? (0.758, Chi square).

The most common perceived barrier to women entering a career in T&O on post-event questioning was the orthopaedic stereotype followed by concerns regarding male dominated workplace culture and a lack of female role models (**Table 1**). Attendees identified a mean of 4.3 (SD 2.0) barriers to entering a career in T&O from a maximum possible of 8 (**Table 1**). The mean number of perceived barriers was significantly higher in the UK ($n = 34$) compared to non-UK ($n = 14$) attendees: mean difference of 1.60 (0.46 to 2.74 95%CI, $p = 0.007$ Unpaired T-test). Previous exposure to T&O ($n = 30$) did not affect the mean number of perceived barriers compared to no or little previous exposure ($n = 19$): mean difference 0.45 (−0.75 to 1.64, $p = 0.456$, unpaired T-test).

## DISCUSSION

The medical students and early years trainees who attended the web based women in orthopaedic surgery event reported high levels of concerns regarding gender bias and discrimination within T&O both before and after attending the webinar. Perceptions of gender disparities were significantly higher in UK based attendees compared to attendees of other nationalities. Though attendees were significantly more likely to want to pursue a career in T&O if they had been directly exposed to T&O at medical school, this exposure did not alter their perceptions of women in T&O for any of the variables examined. Though all attendees were interested in careers in surgery, and two-thirds were strongly considering a career in T&O, in the pre-event survey 28% of attendees stated that they had been dissuaded from entering T&O by the perceived gender disparities within it.

These concerns are not unfounded. A UK study in 2009 showed 13% of 54 orthopaedic surgeons felt that women are incapable of operating, with 5.6% believing women should purposefully be pressured into leaving surgery, and 21% saying a woman's family responsibilities should not be accommodated in surgery (11). A recent survey of 81 female surgeons in the UK found that 53% perceived orthopaedics to be a sexist speciality, which was 40% more than any other surgical speciality (12). It is unknown if these views were from surgeons with first hand experience of working in T&O. A questionnaire of 96 female medical students and junior doctors in two UK hospitals in 2012 found 15% of medical students and 18% of foundation doctors felt they had been subject to sexual discrimination in the surgical workplace. One example of a comment to a female medical student by an orthopaedic consultant was "6 girls?! That's at least 3 full time doctors between you …" (13).

Compared to other international students and early years trainees, the perception of gender disparities was higher among UK students, who also perceived significantly more barriers to women pursuing careers in T&O. To the authors knowledge there is no published research into differences in perceptions of gender disparity in orthopaedics between countries, however Marks et al. carried out a global survey of 639 medical students from 75 countries on more general perceptions of surgery. They found women from lower income countries and lower middle income countries were 40% less likely to consider a career in surgery than men, when controlling for other factors (14). Our data found geographic location did not significantly affect the number considering a career in orthopaedics, however we did not divide countries according to their income.

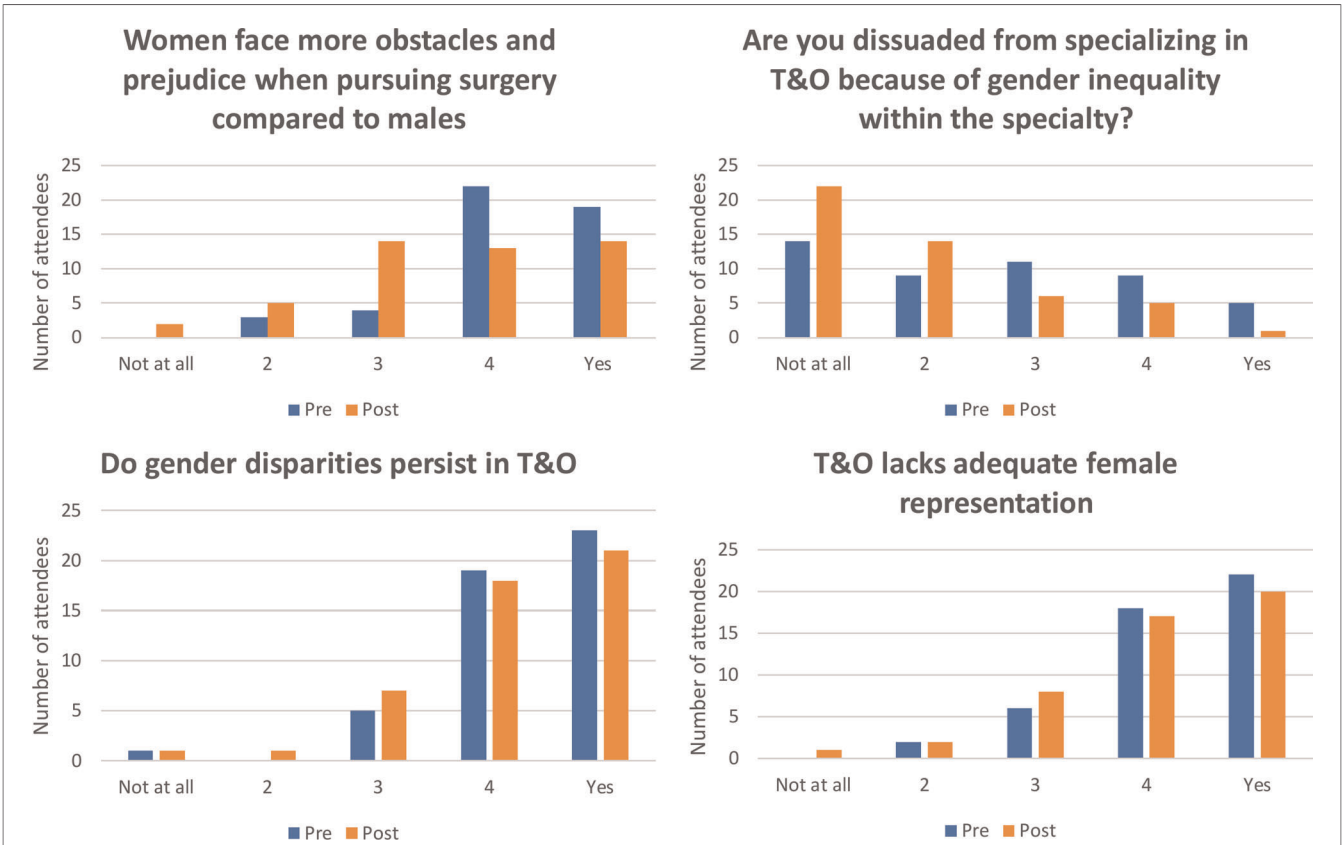



**FIGURE 3** | Pre and post event perceptions of T&O compared.

**TABLE 1** | Perceived barriers to women entering a career in orthopaedics identified in the post-event questionnaire ($n = 52$).

| Perceived Barrier | *N* [%] |
|---|---|
| The orthopaedic stereotype | 36 [69] |
| Male dominated workplace culture | 33 [63] |
| Lack of role models | 32 [62] |
| Concerns about having a family causing a career lag compared to men | 29 [56] |
| Sexist comments at work | 28 [54] |
| Work/life balance | 24 [46] |
| Patriarchy | 17 [33] |
| Poor exposure at medical school | 15 [29] |

This study found direct exposure to T&O was significantly associated with a desire to pursue a career in T&O. This highlights the importance of ensuring female medical students and junior doctors have adequate exposure to the speciality to stimulate interest, a concept which is supported by existing literature. A 2001 survey of 122 US medical schools found compulsory musculoskeletal medicine teaching was associated with a 12% higher rate of application to orthopaedic residency programmes among all students (15). The relative difference was greater among women with a 75% increase in application rates (15).

A review conducted by O'Conner indicated that interest in orthopaedics often begins before medical school and actions to address gender imbalance in T&O needs to be implemented at the earliest stages of training (16). An example of this is the Perry initiative started in the US in 2012, designed to inspire young women to become leaders in orthopaedics by running hands-on outreach programs for female high school, college, and medical school students. A study of 88 first and second year medical students enrolled in the Perry outreach programme had very positive results. The curriculum consisted of 90 min of hands-on mock orthopaedic surgery, and 90 min of lectures from female orthopaedic surgeons addressing the following topics: stereotypes and misconceptions about orthopaedic practice, orthopaedic subspecialties, academic and prior experience expectations for residency application, and work-life balance. The programme positively influenced women to choose T&O as a career and programme participants had a high match rate to orthopaedic residency. Importantly the programme also significantly improved perceptions of lifestyle, workforce diversity, and the physical demands of orthopaedics (17).

The influence of exposure to T&O was investigated further in a prospective study by Baldwin et al. (9). They aimed to report

female medical students' attitudes towards orthopaedic surgery compared to male students, the factors that make orthopaedics more and less appealing to students, and whether educational resources can be used to increase students' interest. A programme of orthopaedic lectures and electronic resources were distributed regularly to 154 medical students throughout the study period. Personal, independent and school exposures were all significantly related to baseline interest among women. Before the programme began men were more likely to be interested in orthopaedics than women, however, following the programme this predisposition was removed. The programme also improved women's perceptions on their ability to succeed in orthopaedic residency interviews. Unlike the Perry initiative, the programme did not change how deterred women felt by the perceived physical demand of operations nor their perceptions of their gender inhibiting career progression or opinions on male domination within the speciality. This is in keeping with our findings. Despite T&O exposure increasing students desire to pursue a career in T&O, exposure did not significantly affect the perceptions of gender bias and discrimination within the speciality in the current study. It also did not reduce the number of students dissuaded from a career in T&O due to gender disparities within it. This suggests exposure to T&O should be focused on reducing misconceptions and stereotypes as well as offering hands-on experience.

The need to dispel stereotyping is further supported by this study, which identified orthopaedic stereotyping as the most common perceived barrier to women entering orthopaedics. Studies show that negative stereotyping of specialities within medical schools has an impact on career choice and often occurs in early years (18). Maidment et al. suggest medical schools should proactively provide information and career advice as part of undergraduate education to combat negative propaganda and encourage students to choose careers that suit them (19). Gender stereotypes are particularly dangerous and discourage a balanced workforce. One study showed that lack of ambition or concern over long working hours and family life were not dissuading factors to women pursuing a surgical career, but rather perceptions about their ability to succeed were. If surgery is consistently stereotyped as a male speciality and this is reinforced by exposure to predominantly male consultants, it is harder for women to see themselves succeeding in the field (20). Therefore, those currently working in the field, in particular leaders, need to make effort to encourage women and challenge any negative stereotyping that they encounter in the workplace. This will help to create an inclusive culture and prevent perpetuation of negative stereotypes.

After stereotypes, the second and third most highly ranked barriers by respondents were a male dominated workplace culture and a lack of role models. It is consistently documented that females value role models of the same sex more than males. In a survey of 205 medical students in the US 33% of female respondents ranked role models of the same sex as an important factor in speciality choice, as opposed to 9% of males (5). A 2013 survey of 529 orthopaedic residents also found significantly more women than men believed having a role model of the same sex or ethnicity was a positive factor to enter orthopaedics (59% vs 25%) (21).

The current study found that a singular event with presentations from two positive female role models did not significantly affect participants' perceptions of women in T&O and the challenges they experience. This implies that female role modelling cannot be delivered simply by one off remote events. Perhaps a more personal experience or longer term exposure to visible female T&O surgeons is required to change such opinions. Some studies have cast doubt on the benefit of female role models. Kerr et al 2016 survey of 96 female medical students and foundation doctors found while 58% had encountered a female surgical role model during their career, only seven of these felt this had strongly influenced their career decision, and approximately 30% stated they had been dissuaded from a career in surgery by the interactions (13). This is potentially due to female surgeons sharing their challenging career experiences and discouraging respondents. Alternatively one student thought female surgeons are "anti-female", and can be unsupportive or inattentive. This highlights the need to ensure not only visibility of same sex role models, but also the availability of positive, supportive, and affirmative counselling for women by surgeons male or female. Furthermore, a study of 101 US medical schools found no correlation between the average number of female orthopaedic faculty at an institution and the total number of female orthopaedic applicants from that institution (22). A US survey of 238 first year medical students' perceptions of surgeons found that females had a less favourable view of surgeons than their male counterparts and concluded recruitment may be improved by surgeon educators using a "communal demeanour" in their interactions with students, regardless of the students gender or interest in surgery (23). This again supports the importance of having encouraging role models either male or female. These studies indicate the complexity of the issue and the need to further investigate ways to encourage female medical students and establish consistent positive female leadership.

Limitations of this study include that it was not limited to medical students, however non-medical student attendees were all in their early post-graduate years. The results may not be generalisable to the medical student population, but reflect those of medics at a stage before they have committed to a specialty. A further limitation is that the survey was written by the authors and was not validated prior to its use.

Only 52/102 of the participants who filled out the pre-event survey filled out the post-event survey, however this was due to 50 people who completed the pre-event survey not attending the event. This study is vulnerable to self-selection bias as those attending the event and filling out the survey may have had more strongly held views regarding women in T&O than the average medical student. This is a common issue in studies of this nature as investigated initiatives are often voluntary and require pre-existing interest. Study of a more representative group of medical students would be a useful future step. A recent survey of 27 US medical schools attempted this by

surveying students before and after their orthopaedic rotation, however the response rate was low at 26%. Compared with before their rotation, after their rotations women believed less that they would have to work harder than others to be valued equally on the rotation and thought orthopaedic surgery friendlier, more diverse and less sexist. However, they were still less likely than men to want to pursue a career in orthopaedic surgery (24). This suggests that, contrary to our study and the study by Baldwin et al., but in keeping with the Perry initiative, orthopaedic exposure may be valuable in improving perceptions of orthopaedics. However, it appears there is still something further than increased exposure which needs to be done to encourage women into the profession.

To the authors knowledge there are currently no UK based studies focusing on medical student perspectives on orthopaedics or how these perspectives might be altered. One small UK study investigating factors increasing the flow of students to vascular surgery found a one day student surgical society conference attended by 36 students, resulted in a 18% decrease in the negative perception that vascular surgery is female-unfriendly and 33% increase in interest in vascular surgery (25). However, the gender of respondents was not available making these results hard to interpret in the context of improving female representation.

T&O must work to achieve a greater level of female representation by further investigating the barriers faced by women, and potential solutions. It is crucial to diversify the T&O workforce not only to allow equal opportunities for men and women but to have a workforce that can generate diverse perspectives, greater degrees of innovation and better understanding of the patient population; and therefore provide the highest level of patient care (26).

In conclusion, this study established that medical students interested in surgery and T&O believe there are a number of barriers preventing women from pursuing a career in T&O surgery, and that these beliefs were not altered by attending a single women in orthopaedics event. Early exposure to T&O appears to be an important factor in increasing interest in orthopaedics whereas negative stereotyping is a barrier. This indicates that work should be targeted early in medical school to prevent such stereotypes from being ingrained in medical students. The culture that has lead to these negative stereotypes must continue to be challenged. A lack of same sex role models was also identified as a barrier and efforts need to be made to provide positive and encouraging support to women in medical school in order to eliminate established negative perceptions and cultivate a more welcoming and supportive work environment. Initiatives that are able to actively challenge negative perceptions and stereotypes whilst also providing exciting hand-on exposure to the specialty may prove to be the most successful in improving female interest in orthopaedics.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the participants was not required to participate in this study in accordance with the national legislation and the institutional requirements.

## AUTHOR CONTRIBUTIONS

BH - organisation, data collection and analysis, literature search, manuscript writing and editing. OP - organisation, data collection and analysis, literature search, manuscript writing and editing. CEHS - data analysis, manuscript writing and editing. CMB delivered the webinar and editted the manuscript; RH delivered the webinar and editted the manuscript. All authors contributed to the article and approved the submitted version.

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# Utilization of Internet Resources by Surgeons for Continuous Professional Development in the Era of Prevailing COVID-19 Pandemic: Trends and Obstacles

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**Background:** To investigate the use of internet resources by surgeons for continuing professional development (CPD).

**Results:** This cross-sectional study was carried out between July 1, 2021, to October 31, 2021, at the Department of Medicine, Health Sciences University Diskapi Yildirim Beyazit Training and Research Hospital, Ankara, Turkey, with participants from nine surgical specialties: General surgery, neurosurgery, orthopedics, urology, plastic surgery, ear-nose-throat surgery, cardiovascular surgery, ophthalmology, and anesthesiology. All study participants were asked to complete a questionnaire comprising 23 questions regarding their age, duration of work experience, appointment status, venue, and time spent on internet resources and preferred online resources for CPD purposes. In addition, participants were divided into two groups according to their appointment status: academic faculty and staff surgeons. Data analysis was performed using IBM SPSS Statistics version 17.0. The target population consisted of 216 specialists. The survey was completed by 204 (94.4%) surgical specialists. The majority of the specialists ($n = 137$, 67.2%) reported using the internet for work-related purposes every day. Daily time spent on internet resources was reported to be 30–60 min by 39.2% ($n = 80$) participants, whereas 52 (25.5%) reported spending less than 30 min. The participants wished to spend more time on internet resources. The majority of surgeons found the hospital and home equally effective in using the internet and preferred to engage alone. The mean age, English language level, usage of online resources, and the attitude score toward the perceived credibility and usefulness of e-resources were significantly higher in the academic faculty group than staff surgeons ($p < 0.005$). On the other hand, the use of Google/Google scholar was similar between the two groups ($p = 0.192$). Technical difficulties such as slow internet, need for website registration, and article fees were considered drawbacks for internet resources among all the participants.

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**Conclusions:** This study showed that most surgeons use internet resources daily for CPD and stated they would like to engage longer despite technical difficulties. Institutions should address these technical difficulties.

**Keywords: internet resources, PubMed, google scholar, surgical education, continuous professional development, digital competence**

## INTRODUCTION

During the coronavirus disease 19 (COVID-19) epidemic, surgical training and continuous professional development (CPD) activities had to evolve to distance education, taking advantage of internet resources (1). CPD is imperative for surgeons to continuously refresh, update and improve their knowledge and skills to perform the best practices. In addition, CPD enables healthcare professionals to keep abreast with advancements in the medical and surgical fields (2). The widespread availability and powerful capabilities of the internet helped increase the incorporation of CPD into the daily routine of surgeons. With COVID-19 and social restrictions, a new era of surgical education began, consisting of online educational meetings, the usage of internet resources for mentoring, skills transfer, and even practical training. However, considering the predictable shortcomings such as lack of physical and personal interactions, the proficiency of surgical training and CPD in this era is yet to be determined (3). Other challenges of surgical education and CPD have been attributed to time constraints, patient safety concerns, and high costs.

Along with other evolving technologies such as artificial intelligence and virtual reality, internet resources hold significant promise for addressing the current challenges in surgical CPD. Furthermore, internet resources remove geographical boundaries, allowing for global sharing of knowledge, research collaboration, and tele-mentoring (4). Additionally, internet resources comprise a range of online platforms that provide anatomical illustrations, case-based learning, clinical examination, procedural skills, comprehensive course curricula, even allowing real-time peer-to-peer interactions. Thus, successful implementation of these internet-based educational tools into CPD can help surgeons keep up to date and improve their overall work-related satisfaction.

This study aimed to analyze how surgeons in a Turkish tertiary care hospital utilize online resources and their perception of these resources. In addition, technical obstacles in using internet sources were also explored. The results may help improve the proficiency of these resources and thus shape the future of surgical CPD for better educational outcomes.

## MATERIALS AND METHODS

A cross-sectional study was carried out with participants from nine surgical specialties (i.e., general surgery, neurosurgery, orthopedics, urology, plastic surgery, ear-nose-throat surgery, cardiovascular surgery, ophthalmology, and anesthesiology) in a tertiary level research and training hospital in Turkey. The participants were asked to complete a questionnaire comprising 23 questions regarding their age, duration of work experience, appointment status, venue, and time spent on internet resources and preferred online resources for CPD purposes. All responses were kept anonymous. The questionnaire used was modified from MacWalter et al.' s study (5). It comprised 23 questions in "tick all that apply", five-point Likert style, and open-ended formats. The Turkish Surgical Association expert committee reviewed the questionnaire regarding feasibility and clarity.

The surgical staff working at the hospital has two different appointment schemes. One group is appointed as academic teaching faculty affiliated with Health Sciences University, while the other group is employed as attending surgical staff with no academic responsibilities. These two groups were compared to find whether differences existed between the faculty and staff surgeons' preference and use of internet resources.

Data analysis was performed using IBM SPSS Statistics version 17.0 software (IBM Corporation, Armonk, NY, USA). The distributions of continuous variables were determined by the Kolmogorov-Smirnov test. The assumption of homogeneity of variances was examined by using the Levene test. As appropriate, descriptive statistics for continuous variables were expressed as means ± standard deviations (SD) or medians ± interquartile ranges (25th–75th). The number of cases and percentages were used for categorical data. The subtitle scores obtained from the questions evaluating perceived credibility and usefulness of online resources for CPD were transformed to a scale of 0 to 100 using the formula: (Subtitle Score-Lowest score) × (Range of raw score)-1 × 100.

The mean differences in ages between the groups were compared using Student's t test. In cases where parametric assumptions were not met, the ordinal data and the continuous variables were analyzed by Mann Whitney U test. Categorical variables were analyzed using Pearson's $\chi^2$ or Continuity corrected $\chi^2$ tests. Wilcoxon Sign Rank test was performed for intra-group comparisons. A $p$ value less than 0.05 was considered statistically significant.

## RESULTS

### Response Rates and Respondent Characteristics

The target population consisted of 216 specialists. The survey was completed by 204 surgical specialists, which comprised 94.4% of the targeted population. The mean age of all respondents was 38.8 ± 10.4 years. Most ($n$ = 116; 56.9%) of the participants were younger than 40 years and male

($n = 159$, 77.9%). Duration of work experience ranged between 1 and 42 years. The participants consisted of 108 (52.9%) staff and 96 (47.1%) academic surgeons. The five most populous specialties were anesthesiology, general surgery, ear-nose-throat (ENT) surgery, orthopedic surgery, and urology (**Table 1**). English proficiency as a second language was self-rated by participants, and most surgeons appraised themselves as having an intermediate command of language ($n = 81$, 39.7%) (**Table 1**).

## Internet usage and reasons for use

The majority of the specialists reported using the internet for work-related purposes every day ($n = 137$, 67.2%) (**Table 2**). Only 6 described themselves as hardly ever using the internet resources ($n = 6$, 2.9%). The three most common reasons for using the internet resources were literature review ($n = 164$, 80.4%), finding the answer to a clinical question ($n = 156$, 76.5%), and attending CPD activities ($n = 115$, 56.4%). The top preference among the internet resources was PubMed ($n = 148$, 72.5%) (**Table 2**). PubMed was followed by Google/Google scholar ($n = 114$, 70.6%). The other frequently used internet resources were official surgical websites ($n = 132$, 64.7%), YouTube ($n = 107$, 52.5%), Up-to-Date ($n = 101$, 49.5%) and online journals websites ($n = 97$, 47.5%). Facebook and Twitter were less frequently used ($n = 28$, 13.7%, and $n = 16$, 7.8% respectively) than the other internet resources for CPD purposes.

Among all, 106 (52%) of the surgical specialists reported accessing internet resources at work and home equally. Fifty-five specialists (27%) reported accessing the internet mostly at hospital grounds, whereas 43 (21.1%) stated accessing primarily at home. The majority ($n = 117$, 57.4%) of the specialists reported that they preferred to be alone during internet use for CPD. The mean attitude score toward the

**TABLE 1** | Demographic characteristics of participants.

| | ***n* = 204** |
|---|---|
| Age (years) | 38.8 ± 10.4 |
| Age Range | 25–65 |
| Age groups | |
| <40 years | 116 (56.9%) |
| ≥40 years | 88 (43.1%) |
| Gender | |
| Female | 45 (22.1%) |
| Male | 159 (77.9%) |
| Professional experience (years) | 13 (6–20) |
| Professional experience range (years) | 1–42 |
| Surgical Staff | |
| Attending surgeon | 108 (52.9%) |
| Academic faculty | 96 (47.1%) |
| Surgical Specialty | |
| General Surgery | 35 (17.2%) |
| Neurosurgery | 16 (7.8%) |
| Orthopedic Surgery | 23 (11.3%) |
| Urology | 23 (11.3%) |
| Ophthalmic Surgery | 22 (10.8%) |
| Plastic and Reconstructive Surgery | 12 (5.9%) |
| ENT | 23 (11.3%) |
| Cardiovascular Surgery | 15 (7.3%) |
| Anesthesia | 35 (17.2%) |
| English language proficiency | |
| Basic | 23 (11.3%) |
| Intermediate | 81 (39.7%) |
| Advanced | 69 (33.8%) |
| Superior | 31 (15.2%) |

**TABLE 2** | Internet resource use and attitude reported by participants and preferred sites for continuous professional development.

| **Frequency of Accessing E-Resources** | ***n* = 204** |
|---|---|
| Everyday | 137 (67.2%) |
| Two-three times a week | 38 (18.6%) |
| Once in a week | 14 (6.9%) |
| Less than once in a week | 9 (4.4%) |
| Hardly ever | 6 (2.9%) |
| Purposes of E-Resource Use | |
| To inform a patient | 111 (54.4%) |
| To answer a clinical question | 156 (76.5%) |
| To answer a non-clinical question | 107 (52.5%) |
| To review literature | 164 (80.4%) |
| Continuous professional development | 115 (56.4%) |
| Other | 22 (10.8%) |
| Preferred E-Resources | |
| Official surgical websites | 132 (64.7%) |
| Google/Google scholar | 144 (70.6%) |
| Online journals | 97 (47.5%) |
| PubMed | 148 (72.5%) |
| Up-to-date | 101 (49.5%) |
| YouTube | 107 (52.5%) |
| Facebook | 28 (13.7%) |
| Twitter | 16 (7.8%) |
| Other resources | 32 (15.7%) |
| Access Venues | |
| In hospital | 55 (27%) |
| At home | 43 (21.1%) |
| Hospital and home equally | 106 (52%) |
| Access Setting | |
| Always alone | 70 (34.3%) |
| Usually alone | 117 (57.4%) |
| Usually with somebody | 16 (7.8%) |
| Always with somebody | 1 (0.5%) |
| Attitude Scores Toward the Perceived Credibility and Usefulness of E-Resources | 76.7 (68.3–91.7) |

perceived credibility and usefulness of internet resources was calculated as 76.7 [68.3–91.7].

Daily time spent on internet resources was reported to be 30–60 min by 39.2% ($n = 80$) of the participants, whereas 52 (25.5%) reported spending less than 30 min. Also, the time spent on internet resources was significantly lower than the time the participants intended to spend ($p < 0.001$). In other words, it was observed that the participants wished to spend more time on internet resources (**Figure 1**).

The perceived obstacles to internet resources' use are shown in **Figure 2**. Our analysis elucidated that 129 (63.2%) participants listed a slow internet connection as the leading problem. The second most frequent obstacle was logging in to CPD websites ($n = 109$; 53.4%). The requirement of downloading a specific software to access CPD content was reported as an obstacle by 79 (38.7%) participants. Additional problems experienced while downloading required software were expressed by 72 (35.3%) subjects. Nearly one-third of surgeons ($n = 66$; 32.4%) reported encountering computer login problems (**Figure 2**).

## Intergroup Comparisons

Participants were divided into two groups according to their appointment status: academic faculty and staff surgeons. There were 96 academic faculties and 108 staff surgeons in the study group. The mean age and duration of professional experience both were significantly higher in the former group than the latter ($p < 0.001$) (**Table 2**). Sixty-two (64.6%) of the academic faculty classified themselves as having advanced or superior command of the English language (**Table 3**). However, 64.8% ($n = 70$) of the staff surgeons defined their command of the English language as basic or intermediate. This difference was statistically significant between the two groups ($p < 0.001$).

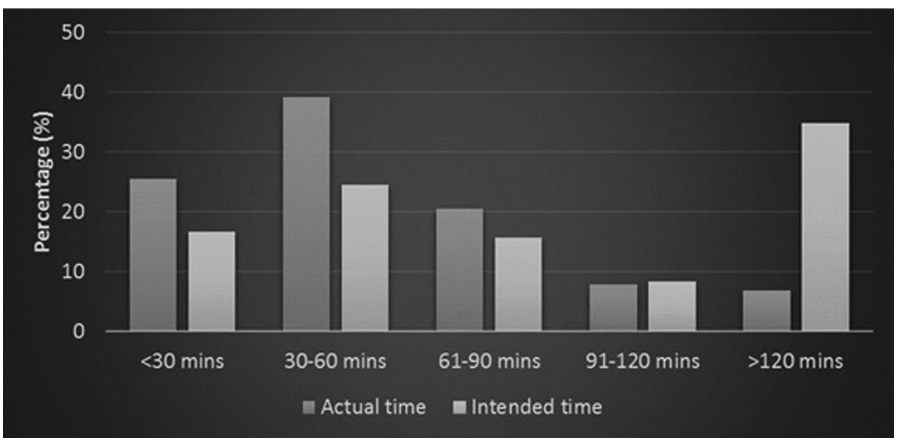


**FIGURE 1** | The distribution of the actual and intended time periods to use continuous professional development resources on the internet.

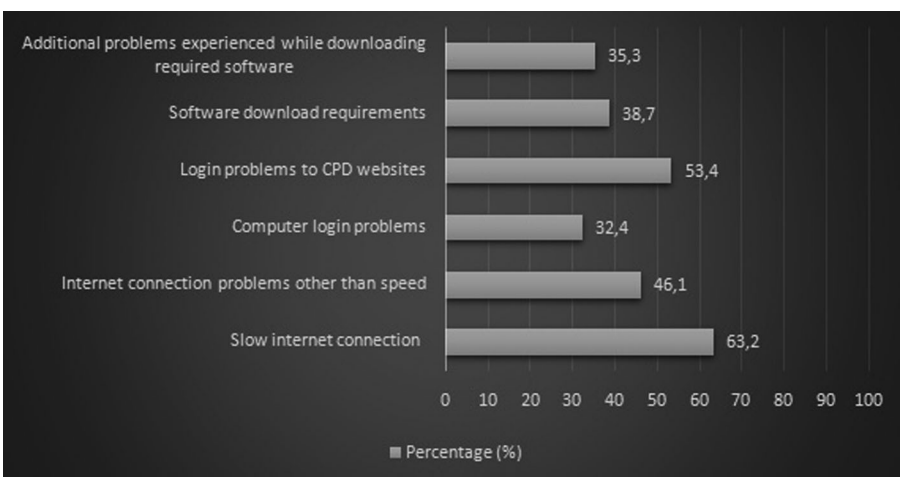


**FIGURE 2** | The perceived obstacles to internet resource use.

**TABLE 3 |** Demographic characteristics of the participants according to their appointment status.

| | Attending Surgeon ($n = 108$) | Academic Faculty ($n = 96$) | $p$ value |
|---|---|---|---|
| Age (years) | 32.4 ± 6.1 | 46.1 ± 9.3 | **<0.001** |
| Age groups | | | **<0.001** |
| <40 years | 92 (85.2%) | 24 (25.0%) | |
| ≥40 years | 16 (14.8%) | 72 (75.0%) | |
| Gender | | | 0.913 |
| Female | 23 (21.3%) | 22 (22.9%) | |
| Male | 85 (78.7%) | 74 (77.1%) | |
| Professional experience (years) | 6 (4–11) | 19.5 (14–30) | **<0.001** |
| English language skills | | | **<0.001** |
| Basic-Intermediate | 70 (64.8%) | 34 (35.4%) | |
| Advanced-Superior | 38 (35.2%) | 62 (64.6%) | |

*Bold p values indicate significant difference.*

Comparative analysis elucidated that the academic participants used online resources more frequently ($p < 0.001$). They were significantly more frequently used to inform a patient, review the literature, and for CPD purposes ($p = 0.014$, $\boldsymbol{p} < 0.001$, $\boldsymbol{p} < 0.001$, respectively). Academic faculty reported using official surgical websites, online journals, PubMed, Up-To-Date, YouTube, Facebook, and Twitter significantly more frequently than the staff surgeons (**Table 4**). Google/Google scholar use was similar between these two groups ($p = 0.192$). The attitude score toward the perceived credibility and usefulness of e-resources was significantly higher in the academic faculty group ($p < 0.001$).

**TABLE 4 |** Comparison of academic and non-academic participants' attitude and use of online continuous professional development resources.

| | Attending Surgeon ($n = 108$) | Academic Faculty ($n = 96$) | $p$ value |
|---|---|---|---|
| Frequency of Accessing E-Resources | | | **<0.001** |
| Everyday | 62 (57.4%) | 75 (78.1%) | |
| Two-three times a week | 21 (19.4%) | 17 (17.7%) | |
| Once a week | 14 (13.0%) | 0 (0.0%) | |
| Less than once a week | 7 (6.5%) | 2 (2.1%) | |
| Hardly ever | 4 (3.7%) | 2 (2.1%) | |
| Purposes of E-Resource Use | | | |
| To inform a patient | 50 (46.3%) | 61 (63.5%) | **0.014** |
| To answer a clinical question | 81 (75.0%) | 75 (78.1%) | 0.719 |
| To answer a non-clinical question | 51 (47.2%) | 56 (58.3%) | 0.113 |
| To review literature | 76 (70.4%) | 88 (91.7%) | **<0.001** |
| *Continuous Professional development* | 48 (44.4%) | 67 (69.8%) | **<0.001** |
| *Other* | 4 (3.7%) | 18 (18.8%) | **<0.001** |
| Preferred E-Resources | | | |
| Official surgical websites | 57 (52.8%) | 75 (78.1%) | **<0.001** |
| Google/ Google scholar | 72 (66.7%) | 72 (75.0%) | 0.192 |
| Online Journals | 34 (31.5%) | 63 (65.6%) | **<0.001** |
| PubMed | 63 (58.3%) | 85 (88.5%) | **<0.001** |
| Up-To-Date | 41 (38.0%) | 60 (62.5%) | **<0.001** |
| Youtube | 46 (42.6%) | 61 (63.5%) | **0.003** |
| Facebook | 7 (6.5%) | 21 (21.9%) | **0.003** |
| Twitter | 2 (1.9%) | 14 (14.6%) | **0.002** |
| Other resources | 13 (12.0%) | 19 (19.8%) | 0.184 |
| Attitude Scores Toward the Perceived Credibility and Usefulness of E-Resources | 73.3 (62.1–80.8) | 85.8 (75.0–97.9) | **<0.001** |

*Bold p values indicate significant difference.*

## DISCUSSION

Successful implementation of internet-based educational tools into CPD requires formal needs assessment, collaborative efforts of educational and professional bodies, and rigorous evaluation of their effectiveness. *Internet* is a widely used technology that may provide a novel learning modality for surgeons (6, 7). During the COVID-19 pandemic, the traditional surgical education and CPD activities were suspended. These were replaced by online discussions, interactions, and training, allowing continuous distribution of knowledge and experience (1, 3, 8). Moreover, social media offers a range of interactive online platforms with users worldwide (9).

Most of the ($n = 116$; 56.9%) surgeons in our study were younger than 40, and their work experience was less than 15 years, representing the new generation of surgeons. They reported internet use for professional development at least 30–60 min daily and desired to spend more time provided they had more time and were free of technical problems.

The most preferred internet resources were PubMed and Google/Google Scholar. The academic faculty responsible for residency and fellowship training used PubMed more frequently than the staff surgeons. This difference may be due to the limited English proficiency in the latter group, as delineated in the questionnaire results. However, this difference was not present with Google/Google Scholar use. Since Google creates content in multiple languages, it may be preferred more by surgeons with limited English proficiency.

The most frequent technical problem reported by the surgeons was the slow internet connection. Improving internet connection and speed institutionally can solve this problem. Another option would be to create wireless hotspots within the hospital grounds where surgeons can access online resources easier and faster. For more comprehensive access and consumption of internet resources, professional development sites should consider reducing the membership and registration fees (10). PubMed and Google/ Google Scholar were able to eliminate these fees and thus are the two most preferred online resources by surgeons (11). A solution to circumvent the membership cost is to provide institutional

registrations for the surgeons (12). In order to obviate the additional software download requirement, which was encountered by 38.7% of participants, the CPD websites should utilize frequently used interfaces while designing online educational content.

Perceived obstacles to internet resource access are in close relationship with digital competence (13, 14). *Digital competence* is a relatively new term used to explain a person's ability to perform digital tasks, read digital data, and apply new knowledge obtained from digital environments (15). Digital competence is a fundamental skill for surgeons' CPD activities. Thus, mentorship or basic skills review may improve the surgeons' attitude towards the credibility of internet resources. Van der Vaart et al. stated that good digital competence was based on academic skills such as reading and writing (14). This finding might explain the academic faculty's more frequent use of internet resources.

Our data showed that 67.2% of the surgeons used the internet resources daily despite all challenges. However, this rate is lower than the frequency of internet resource consumption reported by the general practitioners of Denmark and Scotland (5).

On the other hand, the reasons for internet resource use were parallel to those reported in our study: Mainly to review the literature and answer a clinical question. This finding suggests that internet resource use and demand among different health care systems are similar. These similarities may assist in generalizing the results of our study beyond the surgical community.

Facebook and Twitter were not commonly preferred by surgeons for CPD (13.7% and 7.8%, respectively). However, these platforms may help professionals collaborate with each other, participate in journal clubs and join online discussions. A recent study that included oncologists revealed that social media was especially preferred for networking, research sharing, and leadership development (16). On the other hand, YouTube was frequently used by the surgeons participating in our study. This finding is probably due to the demonstrative surgical videos where one can watch and learn the technical details and pitfalls of a surgical procedure (17, 18). Farag et al. emphasized the increased use of YouTube among surgical trainees, recommending expert surgeons to register to YouTube and share their videos and make comments on others (17).

There are several limitations to this study. First, its results cannot be generalized to the surgical specialists since the survey was undertaken at a single university-affiliated tertiary care center in Ankara, the capital of Turkey. Second, the study was conducted at the beginning of the COVID-19 pandemic and provided cross-sectional data; however, with the extension of the pandemic and restrictions, the use of internet resources might have increased since the time this study was conducted.

This study showed that most surgeons use the internet daily for CPD and wish to engage longer despite technical difficulties. This study determined that most surgeons found the hospital and home equally effective in using internet resources and preferred to engage with the content alone. They reported preferring primarily PubMed, Google/Google Scholar, and official surgical websites as their CPD resource and stated that they would like to engage with the content longer despite the technical difficulties. To improve the efficacy of internet resource use for surgeons, the technical problems defined in this article should be tackled by institutions individually.

## DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/Supplementary Material, further inquiries can be directed to the corresponding author/s.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Health Sciences University Diskapi Training and Research Hospital Ethics Committee. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

## AUTHOR CONTRIBUTIONS

SGC and AK conceived, analyzed and finalized the manuscript. AE and MSY did data collection, transcription, analysis and manuscript writing. FSU and MSY collected and analyzed data, wrote the manuscript. AED and BB analyzed and interpreted data, SC did the literature search and collected data, AE and SC designed the study and revised the manuscript. All authors contributed to the article and approved the submitted version.

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# Microaggressions: Prevalence and Perspectives of Residents and Fellows in Post-Graduate Medical Education in Kuwait

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**Objective:** Microaggression prevalence in post-graduate medical education is unknown in Kuwait. The objective is to determine the prevalence of and capture the perspectives on microaggression among post-graduate trainees in Kuwait.

**Materials and Methods:** This is a cross-sectional study of an anonymous online survey targeting residents and fellows in Kuwait. Data collected included demographics, level of training, country of training, microaggression experience, types, and response. Univariate and multivariate analyses were performed using the Chi-square test and binary logistic regression, respectively.

**Results:** A total of 319 participants (69.1% females) included 52% junior residents, 39.2% senior residents, and 8.78% fellows. Forty-three percent were aware of the microaggression definition. The percentage was significantly higher in respondents from Gulf/Middle East Countries (57.9%) than from Kuwait. Approximately three-quarters experienced microaggressions. Senior residents were more likely to report exposure to microaggressions [Odds ratio (OR) = 2.4, $P < 0.05$] and had higher odds of exposure than juniors (OR = 9.85, $P < 0.05$). Exposure to microaggressions was highest in surgery/surgical specialties. The most common act of microaggression was verbal, followed by invalidation/dismissal of thoughts/ideas, and then acts of discrimination. Of those who experienced microaggressions, two-thirds thought that the experience had a psychological effect on them. Both groups reported low confidence in dealing with microaggressions (Gulf/Middle East Countries 18.8% and Kuwait 30.1%); the difference was not statistically significant.

**Conclusions:** Microaggressions are common among post-graduate medical trainees in Kuwait. Implementation of strategies to manage it is necessary. Further research on its impact on medical-training outcomes is needed.

**Keywords: microaggressions, prevalence, residents, fellows, post-graduate medical education, Kuwait, surgery, training**

## INTRODUCTION

The term microaggression was first coined by American Harvard psychiatrist Chester Pierce to clarify the ambiguity surrounding commonplace non-verbal inequities inflicted by white Americans on African Americans in 1970 (1). Microaggressions are now used as an umbrella term for any derogatory verbal, behavioral, or visual insults directed towards a group of individuals (2, 3). Due to its disguised nature where both the offender and affected individual are usually unaware of the offence, the situation is often overlooked and devalued, leaving the group subject to microaggressions feeling confused and demoralized (2, 4, 5). Studies show that cumulative exposure to microaggressions can have detrimental effects, such as mental exhaustion, depression, hypertension, and suicidal thoughts (6–10). According to Sue et al., microaggressions can occur in the form of (1) micro-invalidations, which are actions of dismissal and invalidation of an individual's feelings or thoughts; (2) micro-assaults, which show close overlap with overt racism and are considered as any derogatory behavior or words towards an individual; and (3) micro-insults, which is unconscious demeaning delivery of words and disregard of a person's identity or heritage (2).

Microaggressions occur in medicine and healthcare as reported in the literature (11–20), and they have been mentioned as one of the factors that negatively impact the workplace environment and medical education in different regions of the world (16–18). There is expanding literature on the prevalence of microaggressions in the healthcare setting. Its occurrence is not exclusive to a specific profession and cases have been documented involving nurses (11, 12), surgeons (15, 21), physicians, medical students, and residents (14–19). Among healthcare professionals, microaggressions have been reported to cause depression, burnout, suicidal thoughts, and even lead to increased medical errors (11, 14, 15). The negative impact of microaggressions is also evident in medical education and can affect a student's academic performance and well-being, as well as being a cause of increased workload and the feeling of not belonging also known as the imposter phenomenon (12, 17).

Unfortunately, there have been no published articles addressing microaggressions in medicine in Kuwait and the Arabian Gulf region to date. Recently, a study from Kuwait looked at the barriers preventing medical students and interns from choosing a surgical career and the solutions to those barriers and identified multiple deterrent factors such as long working hours, quality of life, and maternity and paternity leave policies. However, it also found in its thematic analysis that unprofessional attitudes, especially those of male surgeons, could render a surgery a harsh workplace (22, 23). Therefore, a closer examination of human interactions in the medical and healthcare workplaces in Kuwait and the Gulf region is needed, since demographic differences exist across the world and this can complicate the extrapolation of studies from regions that hold different social and cultural values. The objective of this study is to determine the prevalence of and capture the perspectives on microaggressions in post-graduate medical training programs in Kuwait, and to assess their prevalence in the Arabian Gulf countries considering the similarities in culture and demographics they share with Kuwait.

## MATERIALS AND METHODS

A cross-sectional study was conducted through an online survey, using Google forms, containing 11 questions (see **Appendix 1**: Microaggression Questionnaire). Ethical approval was obtained from the Ministry of Health (MOH) and all participants consented anonymously. The data were collected between 21st and 24th of August 2020, and included information on demographics, level of training, country of training, experiences of microaggression, acts of microaggression, and responses to microaggression by the participants. The inclusion criteria were determined as the place of residency and fellowship training programs located in Kuwait, the Arabian Gulf region (Kingdom of Saudi Arabia, Kingdom of Bahrain, Qatar, Sultanate of Oman, United Arab Emirates), and the Middle East region (Yemen, Iraq, Palestine, Jordan, Lebanon, Syria). Participants who received post-graduate medical training in other countries were excluded. Statistical analysis was performed using R v 3.6.3. Counts and percentages were used to summarize the distribution of categorical variables. The Chi-square test of independence was used to assess the association between categorical variables. Multivariable analysis was performed using binary logistic regression and *post-hoc* analysis. Hypothesis testing was performed at a 5% level of significance.

## RESULTS

### Demographics

The study sample included 319 respondents after exclusion (seven participants). At the time of the study, residency and fellowship programs in Kuwait Institute for Medical Specialization (KIMS) had a total of 801 trainees with 198 who responded, resulting in a response rate of 24.7% for participants from Kuwait. The gender of participants was 30.9% males and 69.1% females. Participants were from various specialties, such as surgery and surgical subspecialties (38.9%), medical (30.1%), dentistry (12.9%), pediatrics (6.27), and others (12%). About half of the respondents (52%) were junior residents and 39.2% were senior residents, while fellows were only 8.78%. **Table 1A** includes descriptive statistics of the study sample stratified by residency location.

### Prevalence and Experience of Microaggressions

Less than half of the respondents were aware of the term microaggressions (43.6%), and the percentage was significantly higher ($P < 0.001$) in Gulf and Middle East region respondents (57.9%) than respondents in Kuwait (34.8%). Approximately three-quarters of the respondents experienced microaggressions (71.5%). The percentage was significantly higher in respondents from the Gulf and Middle East respondents

**TABLE 1A** | Descriptive statistics for the study sample stratified by residency location.

| | [All] N = 319 | Gulf/Middle East regions N = 121 | Kuwait N = 198 | P |
|---|---|---|---|---|
| Gender | | | | 0.016 |
| Female | 163 (69.1%) | 69 (61.1%) | 94 (76.4%) | |
| Male | 73 (30.9%) | 44 (38.9%) | 29 (23.6%) | |
| Specialty | | | | |
| Dentistry | 41 (12.9%) | 14 (11.6%) | 27 (13.6%) | |
| Emergency medicine | 1 (0.31%) | 0 (0.00%) | 1 (0.51%) | |
| Family medicine | 6 (1.88%) | 0 (0.00%) | 6 (3.03%) | |
| Medical field | 96 (30.1%) | 22 (18.2%) | 74 (37.4%) | |
| Neurology | 1 (0.31%) | 0 (0.00%) | 1 (0.51%) | |
| Nuclear medicine | 2 (0.63%) | 0 (0.00%) | 2 (1.01%) | |
| Other | 28 (8.78%) | 7 (5.79%) | 21 (10.6%) | |
| Pediatrics | 20 (6.27%) | 6 (4.96%) | 14 (7.07%) | |
| Surgery and surgical subspecialties (including OBGYN) | 124 (38.9%) | 72 (59.5%) | 52 (26.3%) | |
| Current level of training | | | | 0.003 |
| Junior resident (PGY1–PGY2) | 166 (52.0%) | 52 (43.0%) | 114 (57.6%) | |
| Senior resident (PGY3–PGY5) | 125 (39.2%) | 51 (42.1%) | 74 (37.4%) | |
| Fellow | 28 (8.78%) | 18 (14.9%) | 10 (5.05%) | |

**TABLE 1B** | Descriptive statistics for the study sample stratified by residency location.

| | [All] N = 319 | Gulf/Middle East regions N = 121 | Kuwait N = 198 | P |
|---|---|---|---|---|
| Aware of the term microaggression | | | | <0.001 |
| No | 180 (56.4%) | 51 (42.1%) | 129 (65.2%) | |
| Yes | 139 (43.6%) | 70 (57.9%) | 69 (34.8%) | |
| Ever experienced microaggression | | | | 0.021 |
| No | 91 (28.5%) | 25 (20.7%) | 66 (33.3%) | |
| Yes | 228 (71.5%) | 96 (79.3%) | 132 (66.7%) | |
| Response to microaggression | | | | 0.083 |
| Discuss the matter with a senior in charge | 35 (15.4%) | 17 (17.7%) | 18 (13.6%) | |
| Discuss the matter with the offender | 60 (26.3%) | 18 (18.8%) | 42 (31.8%) | |
| I don't usually do anything about it | 133 (58.3%) | 61 (63.5%) | 72 (54.5%) | |
| Experience had a psychological effect | | | | 0.024 |
| No | 75 (33.0%) | 23 (24.2%) | 52 (39.4%) | |
| Yes | 152 (67.0%) | 72 (75.8%) | 80 (60.6%) | |
| Confidence dealing with microaggressions | | | | 0.125 |
| Maybe | 81 (33.2%) | 35 (34.7%) | 46 (32.2%) | |
| No | 101 (41.4%) | 47 (46.5%) | 54 (37.8%) | |
| Yes | 62 (25.4%) | 19 (18.8%) | 43 (30.1%) | |

(79.3%) than in respondents from Kuwait (66.7%, $P < 0.05$). Regarding the response to microaggression, respondents from Gulf countries and the Middle East were more passive towards reporting microaggressions (63.5% vs. 54.5%). Overall, 15% discussed the matter with a senior in charge (15.4%), while 26.3% discussed the matter with the offender. Of those who experienced microaggressions, two-thirds thought that the experience had a psychological effect on them. When asked about feeling confident in dealing with microaggressions, there was no significant difference between both groups ($P = 0.125$), with 18.8% and 30.1% of respondents from the Gulf/Middle East and Kuwait, respectively, thinking that they had the confidence to deal with it. **Table 1B** includes descriptive statistics stratified by residency location.

## Microaggressions and Training Level

Analysis showed that senior residents were more likely to report exposure to microaggressions (OR = 2.4, $P < 0.05$) than junior residents. When the analysis was stratified by location, no significant association was observed between the training level and exposure to microaggressions among respondents in Kuwait (OR = 1.24, $P > 0.05$). Among residents in the Middle East/Kuwait, the odds of exposure were higher in senior residents than junior residents (OR = 9.85, $P < 0.05$), as shown in **Table 2**.

## Acts of Microaggressions

There were no observed differences between those who were trained in Kuwait compared to those in the Gulf and ME regions regarding the act of microaggressions. The most common act of microaggression was a verbal insult (67.0%), followed by the invalidation of an opinion (62.1%), dismissal of thoughts and opinions (62.1%), and acts of discrimination (56.4%). The least common were passive-aggressive behavior

**TABLE 2** | Multivariate analysis of factors associated with exposure to Microaggressions.

| Predictors | Overall | | | In Kuwait | | | Middle East/GCC | | |
|---|---|---|---|---|---|---|---|---|---|
| | Odds ratios | CI | *P* | Odds ratios | CI | *P* | Odds ratios | CI | *P* |
| (Intercept) | 2.45 | 1.19–5.33 | 0.018 | 1.67 | 1.00 –2.85 | 0.052 | 2.51 | 1.07–6.43 | 0.042 |
| Gender: Male vs. female | 0.91 | 0.47–1.80 | 0.786 | 1.57 | 0.61–4.44 | 0.365 | 0.55 | 0.20–1.50 | 0.239 |
| Nationality: non-Kuwaiti vs. Kuwaiti | 1.33 | 0.56–3.14 | 0.520 | 1.99 | 0.28–40.01 | 0.545 | 1.14 | 0.40–3.15 | 0.796 |
| Location: in Kuwait vs. GCC and ME | 0.66 | 0.30–1.41 | 0.292 | | | | | | |
| Training level: PGY1–PGY 2 | Ref | | | | | | | | |
| Training level: PGY3–PGY 5 | 2.40 | 1.23–4.94 | **0.013** | 1.24 | 0.54–2.93 | 0.612 | 9.85 | 2.54–65.65 | **0.004** |
| Training level: Fellow | 0.91 | 0.38–2.33 | 0.844 | 1.26 | 0.31–6.30 | 0.757 | 1.07 | 0.33–3.71 | 0.916 |

*Analysis was performed using binary logistic regression.*

**TABLE 3** | Incidence of microaggressions stratified by location.

| Microaggression act | [All] *N = 319* | Gulf/Middle East region *N = 121* | Kuwait *N = 198* | *P* overall |
|---|---|---|---|---|
| Acts of discrimination | 128 (56.4%) | 57 (59.4%) | 71 (54.2%) | 0.522 |
| Invalidation of an opinion | 141 (62.1%) | 69 (71.9%) | 72 (55.0%) | 0.014 |
| Dismissal of thoughts and opinions | 141 (62.1%) | 69 (71.9%) | 72 (55.0%) | 0.026 |
| Verbal insult | 152 (67.0%) | 71 (74.0%) | 81 (61.8%) | 0.076 |
| Loss of learning opportunities | 1 (0.44%) | 1 (1.04%) | 0 (0.00%) | 0.423 |
| Gender discrimination | 1 (0.44%) | 1 (1.04%) | 0 (0.00%) | 0.423 |
| Passive aggressive behavior | 3 (1.32%) | 3 (3.12%) | 0 (0.00%) | 0.074 |

(1.32%), followed by gender discrimination (0.44%), and loss of learning opportunities (0.44%). **Table 3** shows the incidence of microaggressions stratified by location.

## Microaggressions and Specialty

**Figure 1** demonstrates exposure to microaggressions according to specialty. As noted, the highest number of microaggressions reported by specialty were in surgery and surgical subspecialties followed by medicine and then dentistry. It is worth mentioning that the numbers of participants from other specialties were very low to consider accurate representation and comparison.

A pairwise comparison of specialties (see **Table 4**) showed that the odds of exposure to microaggression were 80% lower in dentistry residents than those in family medicine residents (OR = 0.21, $P = 0.75$), although the association was not statistically significant at the 0.05 level. The odds of reporting exposure to microaggression were ∼90% lower in dentistry residents than surgery residents (OR = 0.222, $P = 0.0016$). The odds of reporting exposure to microaggressions were also lower in medical field residents than in surgery residents (OR = 0.386, $P = 0.032$). None of the remaining pairwise comparisons were statistically significant at the 0.05 level. The odds of exposure to microaggression were higher in pediatric residents than in dentistry residents (OR = 0.117, $P = 0.08$), although the association was only significant at the 0.1 level.

# DISCUSSION

This is the first study to address microaggressions in post-graduate medical education in Kuwait. The most important finding was the high prevalence of microaggressions that was reported with a rate of 71.5% (Kuwait 66.7%, the Gulf and ME 79.3%) among all participants from post-graduate residency and fellowship programs. Interestingly, more than half of the participants (56.4%) were not aware of the term "microaggressions" at the time they participated in this study, with the lowest awareness among Kuwait's post-graduate trainees comparable to the Gulf/ME (65.2% vs 42.1% $P < 0.001$), which was statistically significant. This indicates the importance of raising awareness about microaggressions and warrants further study to outline interventions and solutions that could decrease the likelihood of microaggressions in medical education in Kuwait and in the Middle East region.

To outline a few limitations of this study, the questionnaire was short and did not address details about the psychological effect and response to microaggressions; however, the goal was to capture a general perspective since the topic is new and the study was conducted over a short period of time (only 3 days).

Although most participants were females (69.1%), which is consistent with the predominance of female medical school graduates in Kuwait and the Gulf region (23). However, there was no difference related to gender in terms of experiencing

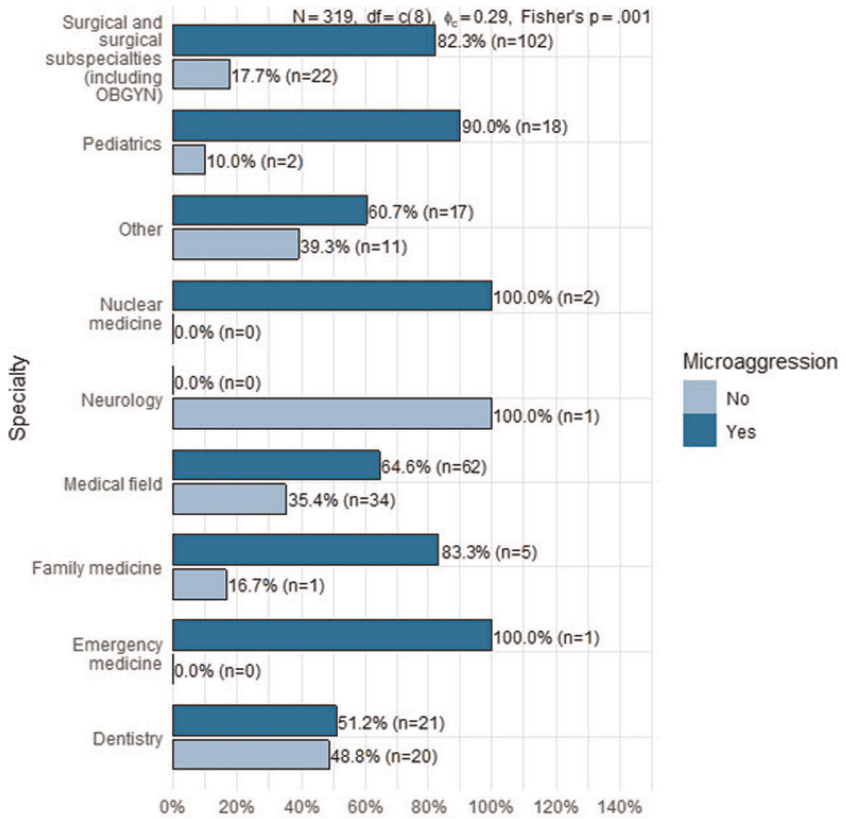


**FIGURE 1** | Exposure to microaggressions by specialty.

**TABLE 4** | Pairwise comparisons of specialties.

| | Dentistry | Family medicine | Medical field | Other | Pediatrics | Surgery and surgical subspecialties (including OBGYN) |
|---|---|---|---|---|---|---|
| Dentistry | **0.512** | 0.7451 | 0.6906 | 0.9714 | 0.0838 | **0.0016** |
| Family medicine | 0.21 | **0.833** | 0.9457 | 0.9146 | 0.9978 | 1 |
| Medical field | 0.576 | 2.742 | **0.646** | 0.999 | 0.3089 | **0.032** |
| Other | 0.679 | 3.235 | 1.18 | **0.607** | 0.2881 | 0.1329 |
| Pediatrics | 0.117 | 0.556 | 0.203 | 0.172 | **0.9** | 0.9632 |
| Surgery and surgical subspecialties (including OBGYN) | 0.222 | 1.058 | 0.386 | 0.327 | 1.904 | **0.825** |

*Diagonals represent the probability of exposure to microaggression. The upper triangle represents the P-values for post-hoc comparisons. The lower triangle represents the odds ratio (column/row). Analysis was performed using logistic regression followed by post-hoc comparisons of estimated marginal probabilities.*

microaggressions (*odds ratios* 0.91 [CI 0.47–1.80], $P$ =0.786). Although gender bias has been documented in the literature (24, 25), being of a minority group regardless of gender was the most common factor for being subjected to microaggressions as reported by a study from North America (26).

Contrary to what is reported in the literature in a study from Iran and a study from the United States (16, 24), that junior residents are more likely than senior residents or attending surgeons to experience microaggression, in our study, senior residents were more likely to be exposed to microaggressions (OR = 9.85, $P < 0.05$) and report exposure to microaggressions (OR = 2.4, $P < 0.05$) than junior residents, regardless of the country of the training program. This could suggest that as residents advance into their training, changes in human interactions and behavior when faced with microaggression may occur. However, the study did not include staff and faculty nor did it identify perpetrators and therefore this should be taken into consideration.

While no differences were observed regarding the acts of microaggression based on the location of training, it was noted that the most common act of microaggressions was the verbal microaggression followed by the invalidation of an opinion, dismissal of thoughts and opinions and then acts of discrimination. Another limitation of this study is that microaggression is influenced by what is deemed socially acceptable. For example, calling a physician by their first name and using the title rather than their last name in the medical field is considered acceptable in the ME (27). However, some may consider this as an act of microaggression by dismissing the person's qualifications. Furthermore, since this study has not explored the exact scenarios of the reported microaggressions, some of the reported microaggressions may also fall into the overt acts of discrimination (macroaggression) category rather than microaggression.

While findings of high rates of microaggressions by specialty were found in surgery and surgical subspecialties (82.3%), followed by medical (30.1%) and dentistry (12.9%), these findings were consistent with reports from regions outside the Gulf/ME region. Microaggression and implicit bias in surgical training has been reported, in an American study by Alimi Yewande et al., in a national survey with a majority (72.2%, $n = 1173$) of respondents reported experiencing microaggressions, most commonly from patients (64.1%), followed by staff (57.5%), faculty (45.3%), and co-residents (38.8%), while only a small proportion ($n = 109$, 7.0%) of residents reported these events to the graduate medical education office/program director, and nearly one-third (30.8%) of residents said they experienced retaliation after reporting a microaggression (20).

The negative impact of microaggression has been documented by many researchers (11, 12, 14, 15, 19). This paper reflects these studies, as two-thirds of those who experienced microaggression thought that these incidents had a psychological effect on them. However, further studies are needed to investigate the characteristics of these psychological effects, and the impact they have on the quality of post-graduate medical education in Kuwait and the ME region.

To conclude, microaggressions are prevalent and common in post-graduate medical education in Kuwait, the Gulf countries, and the Middle East. Implementation of strategies to raise awareness of and to manage them is necessary, along with further research on their impact on medical-training outcomes.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## AUTHOR CONTRIBUTIONS

All authors contributed to the article and approved the submitted version.

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## SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://journal.frontiersin.org/article/10.3389/fsurg.2022.907544/full#supplementary-material.

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# Gender discrimination in surgical oncology: An in-house appraisal

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**Introduction:** Gender discrimination (GD) though rarely blatant, may present indirectly within a surgical department in the form of subtle inequities, differing standards, and bias. GD encompasses a wide spectrum including academic development, surgical opportunities and sexual harassment.
**Methods:** We conducted an online survey to analyse the perceived incidence of GD in the surgical oncology department at a tertiary care cancer centre in India. The questionnaire consisted of 15 questions and was mailed to the entire department including trainees and faculty. Anonymity was maintained while collecting the data only of the participants' gender and whether they were faculty or trainee. Collated responses were analysed using proportions.
**Results:** The questionnaire was sent out to 200 recipients of whom 56% (112/200) responded *via* an online survey. Respondents included 84% of faculty (42/50) and 46.6% of trainees (70/150). GD was perceived by 28% of female trainees (7/25) as compared to 6.6% of male trainees (3/45), whereas amongst faculty, GD was perceived by 26.6% of female faculty (4/15) compared to 14.8% of male faculty (3/27). Approximately 13% of our trainees and 12% of our faculty mentioned that GD affected their professional performance or mental well-being. GD was experienced in terms of work experience and opportunities by a majority of trainees (13%) and faculty (9.5%). There was a significant lack of awareness about recourse to an institutional grievance committee by trainees (47%) compared to faculty (14%). About 7% of trainees and 12% of faculty acknowledged that they may have been responsible for intentional/unintentional GD.
**Conclusion:** Gender discrimination can present in subtle or overt fashion in surgical departments and requires active sustained efforts to allow both genders to feel equally empowered. Establishing a system to objectively evaluate gender equity while avoiding stereotyping for certain roles can help minimize GD.

KEYWORDS
gender, discrimination, surgical oncology, surgery, appraisal

## Introduction

Gender stereotyping is ingrained in society to such an extent that women get subconsciously habituated to gender discrimination (GD). This is especially true in surgical fields, where a masculine, confident and competitive stereotype is considered the norm and celebrated (1, 2). Breaking the glass ceiling requires determination, courage and patience; it took 26 years from the first physician to the first woman surgeon in India (3). Planning a surgical career for women physicians is challenging,

requiring planned sacrifices both professionally and in their personal lives. There is additional pressure to excel in a field in which they are traditionally under-represented (4). In spite of working as much as their male counterparts while balancing professional and family life (5, 6), women face GD at various levels of their surgical careers from residency to academic positions to salaries (7). GD can present as unequal surgical opportunities, lack of respect from co-workers, differences in pay equity, imbalanced leadership roles and fewer academic opportunities (8–10). Although not a direct form of GD, women surgeons get fewer surgical case referrals as compared to their male counterparts (11).

GD is not necessarily restricted to women and can be perpetrated and experienced by both men and women (10). Besides impacting the individual directly affected, GD may also affect others who witness such misconduct. While having long term effects on the individuals concerned, it also creates an undesirable work environment for faculty, trainees and all involved. While not implying that female surgical trainees need to be treated differently or "delicately" (12), the importance of a gender diverse workplace with equal roles and opportunities is increasingly being recognized. Identification of GD is the first step towards changing preconceived notions, thought processes and attitudes. Literature on GD in India is limited and so is our understanding of the situation in the country (13, 14). We initiated an online survey among our surgical trainees and faculty to assess whether GD was prevalent in the surgical oncology department.

## Materials and methods

We conducted a cross-sectional study at the Tata Memorial Hospital, a tertiary level comprehensive cancer centre in Mumbai, to identify if GD was prevalent in the department of surgical oncology. Faculty and trainees were invited to participate in an online survey. Participation was voluntary and anonymized. The survey was created after an online review to identify questions relevant to GD which led to pooling of 30 most relevant questions. A panel comprising of faculty and trainees then distilled these to 11 questions with multiple choice answers, and its perceived impact on the participants' surgical career (**Table 1**). The online survey was sent *via* email in the form of a Google Survey sheet to surgical trainees and faculty. Two reminders *via* individual email were given 10 days apart and once on a common trainees' group. The survey was closed for responses after 2 weeks. To gather insights on perceptions and suggestions for improvement, we provided an option of free text entry for all participants. Besides the responses; gender, age and position at which the respondent was currently employed were also recorded. The department comprises of 50 faculty members (33 males – 66% and 17 females- 34%) and 150 trainees (113 males- 75% and 37 females- 25%).

### Statistics

Responses were entered into a Microsoft Excel v.2016 datasheet, maintaining anonymity and only revealing gender and the position at which the respondent was currently employed. Results were analyzed based on the gender of the respondents with descriptive statistics using percentages as overall. Categorical variables were summarized as numbers with proportions.

## Results

The online questionnaire was sent out to 200 recipients out of whom 112 (56%) responded. Amongst faculty 42/50 (84%) responses were recorded with 27/33 (82%) from male faculty and 15/17 (88%) from female faculty. Amongst trainees 70/150 (46.6%) responses were recorded with 45/113 (48.6%) from male and 25/37 (67.5%) from female trainees. Most trainees (>75%) and faculty (>85%) were in the 30 to 50-year age group in both genders.

### Responses of trainees

The responses of 25 (67.5%) female and 45 (48.6%) male trainees to the survey are shown in **Table 1**. With regards to opportunities to develop and surgical exposure, 6 (24%) women and 3 (6.6%) men felt that they received unequal opportunities as compared to the opposite gender. Nearly one-third female trainees (28%, 7/25) perceived that they had been discriminated on the basis of their gender while only 6.6% (3/45) male trainees felt similarly. Amongst the 10 (14%) respondents perceiving GD, five experienced disturbed professional performance, with mental well-being being affected in three trainees. Four trainees, who had their mental well-being affected due to GD, did not feel it reflected on their professional performance. Unequal work experience and opportunities was the most common reason to perceive GD (13%, 9/70) amongst trainees. Seven trainees perceived that faculty was responsible for GD. There was a lack of awareness about recourse to an institutional grievance committee in 47% of trainees. Five trainees (7%) considered that they themselves might have been responsible for GD intentionally or unintentionally; two of these mentioned experiencing GD during this survey.

### Responses of faculty

Differing developmental opportunities based on gender was perceived by one (6.6%) female faculty as compared to 2 (7.5%) male faculty whereas absence of equal surgical exposure

TABLE 1 Responses of trainees and faculty to the questionnaire.

| Sr. no | Questionnaire | Trainees | | Faculty | |
|---|---|---|---|---|---|
| | | Female trainees ($n = 25$) | Male trainees ($n = 45$) | Female faculty ($n = 15$) | Male faculty ($n = 27$) |
| 1. | Age group | | | | |
| | <30 years | 6 (24%) | 10 (22.3%) | 0 | 1 (3.7%) |
| | 30–50 years | 19 (76%) | 35 (77.7%) | 13 (86.6%) | 24 (88.8%) |
| | >50 years | 0 | 0 | 2 (13.4%) | 2 (7.5%) |
| 2. | Do you receive equal developmental opportunities or responsibilities as compared to your opposite gender? | | | | |
| | No | 6 (24%) | 3 (6.6%) | 1 (6.6%) | 2 (7.5%) |
| | Yes | 19 (76%) | 42 (93.4%) | 14 (93.4%) | 25 (92.5%) |
| 3. | Do you receive equal surgical exposure as compared to your opposite gender? | | | | |
| | No | 6 (24%) | 3 (6.6%) | 2 (13.4%) | 1(3.7%) |
| | Yes | 19 (76%) | 42 (93.4%) | 13 (86.6%) | 26 (96.3%) |
| 4. | Have you faced gender discrimination? | | | | |
| | No | 18 (72%) | 42 (93.4%) | 11 (73.4%) | 23 (85.2%) |
| | Yes | 7 (28%) | 3 (6.6%) | 4 (26.6%) | 4 (14.8%) |
| 5. | If yes, in the form of | | | | |
| | Work experience and opportunities | 9 (13%) | | 4 (9.5%) | |
| | Given clerical jobs only | – | | 1 (2.4%) | |
| | Objectionable behavior | 1 (1.4%) | | 1 (2.4%) | |
| | NA | – | | 2 (4.7%) | |
| 6. | If yes, it was from | | | | |
| | Faculty | 4 (16%) | 3 (6.6%) | 2 (13.3%) | 4 (14.8%) |
| | Trainees | 1 (4%) | – | 2 (13.3%) | – |
| | Patients | 2 (8%) | – | | |
| 7. | Did it affect your professional performance? | | | | |
| | No | 5 (20%) | – | 2 (13.3%) | 3 (11.1%) |
| | Yes | 2 (8%) | 3 (6.6%) | 2 (13.3%) | 1 ((3.7%) |
| 8. | Did it affect your mental well-being? | | | | |
| | No | 1 (4%) | 2 (4.4%) | 1 (6.6%) | 2 (7.4%) |
| | Yes | 6 (24%) | 1 (2.2%) | 3 (20%) | 2 (7.4%) |
| 9. | Are you aware of an institutional grievance/ complaints committee? | | | | |
| | No | 13 (52%) | 20 (44.4%) | 1 (6.6%) | 5 (18.5%) |
| | Yes | 12 (48%) | 25 (55.6%) | 14 (93.4%) | 22 (81.5%) |
| 10. | Have you approached the committee or brought to the notice of the department/hospital authority any issues related to gender discrimination? | | | | |
| | No | 7 (28%) | 3 (6.6%) | 1 (6.6%) | 4 (14.8%) |
| | Yes | – | – | 3 (20%) | – |
| 11. | With the benefit of hindsight, have you been responsible (unintentional/ intentional) at any time for gender discrimination? | | | | |
| | No | 15 (60%) | 37 (82%) | 7 (47%) | 25 (92%) |
| | Yes | 0 | 1 (2%) | 1 (7%) | 0 |
| | Maybe | 3 (12%) | 1 (2%) | 4 (27%) | 0 |
| | Cannot Say | 7 (28%) | 6 (14%) | 3 (19%) | 2 (8%) |

was perceived by 2 (13.4%) female faculty as compared to one (3.7%) male faculty. Overall, GD was perceived by 4 (26.6%) women and 4 (14.8%) men which was mostly in the form of work experience and opportunities ($n = 4$) and was from a co-faculty ($n = 6$). GD affected professional performance of 3 (7.1%) consultants and had an impact on their mental well-being. Two faculty members felt GD had a bearing on their mental well-being without affecting professional performance. There was a lack of awareness about recourse to an institutional grievance committee in 14% of faculty. Five faculty members (12%) thought they might have been responsible for intentional/unintentional GD and these included two of the faculty who mentioned experiencing GD during this survey.

## Discussion

The results of our survey show that GD is perceived by both male and female members in our department, but was clearly higher among female trainees and faculty (28% and 26.6%

female trainees and faculty, compared to 6.6% and 14.8% male trainees and faculty respectively). Trainees across both genders largely equated GD with developmental opportunities or surgical exposure. However, amongst faculty, GD was perceived for reasons besides developmental opportunities or surgical exposure.

Being the largest tertiary cancer center in India, our surgical oncology department is one of the largest in the country with 50 faculty and 150 trainees in 2021. The proportion of female faculty has increased manifold from 7/35 (20%) in 2012 to 17/50 (34%) in 2021, highlighting the fact that an increasing number of women are embarking on a career in surgical oncology and capability and experience, rather than gender are the criterion for selection of faculty. The institute prides itself on nurturing a gender-neutral, bullying-free workspace for our trainees and faculty and we strive to give equal opportunities to all, irrespective of gender, with merit being the yardstick to evaluate and determine capability and efficiency. Recognizing the need to continue to maintain a gender-neutral workspace and help create awareness of this issue, we conducted this anonymous survey to assess the ground situation in our department.

In the United States, women constitute >50% of the current medical school graduates but this is not reflected in surgical residency (15, 16). There are a number of barriers for women seriously considering a surgical career as their first option. Due to the masculine surgeon stereotype and constant stress to overachieve, women surgeons perceive discrimination as high as 89% even in high income countries (10, 17). Based on a survey from the United States, 87% women perceived GD in medical school, 88% in residency, and 91% in practice (10). In low- and middle-income countries more than half of female medical students do not proceed to specialty training (18, 19). Our survey results showed much lower proportions of surgeons who perceived GD. The reasons for this could be many. Surgical oncology in India is typically pursued after post-graduation in the broad surgical specialties. Trainees in our department of surgical oncology have completed three years of a basic surgical training prior to enrolling in surgical oncology, and hence our cohort is different from undergraduate medical students or general surgery trainees in their initial years. Apart from a different cohort of trainees, our department tries to build a gender-neutral workspace with minimal hierarchy which is emphasized from the very first day of joining to all trainees. We have two resident representatives from male and female genders to allow effective communication from trainees to the head of department. They are encouraged to discuss any decision they have a difference of opinion on and provide possible solutions to problems faced.

The factors responsible for gender bias include workplace challenges, assessment of credibility and objectification by patients, colleagues and self (20). GD may also manifest as workplace harassment of female surgeons by staff, patients and colleagues. This can range from inappropriate verbal remarks to physical contact (20, 25–27). The most important issues faced by women surgeons include ineffective mentorship, gender stereotypes, work-family issues and a perceived lack of belonging (18, 21–24). Perceptions also differ based on country of origin. Most reported studies on GD have emanated from high-income countries especially in the last five years. GD combined with lower levels of respect and constant objectification can result in psychological effects of GD leading to low self-esteem and confidence affecting the quality of work performed, which may ultimately culminate in burnout and attrition (20, 26–28). Approximately 13% of our trainees and 12% of our faculty mentioned that GD affected their professional performance or mental well-being. This survey also helped trainees and faculty introspect, as 7% of our trainees and 12% of our faculty thought they might have been responsible for intentional/unintentional GD.

Women face discrimination in the workplace in every field right from hiring to promotions to differences in pay and career opportunities (29). Amongst the Fortune's top 500 companies only 37 of the CEOs were women in 2020 which was an all-time high (30). Women held 38% of managerial positions as compared to 62% for men in 2020 (30). The first female CEO of General Motors, USA was paid less than half compared to her male predecessor (29). Beyond blocked opportunities and reduced wages, the position of a level of authority is also accompanied by an unsupportive environment which makes it difficult to work effectively (31). GD has been recently condemned publicly which is seen in all fields of medicine to be experienced more by women (32, 33), however, surgical fields pose a different challenge due to the male stereotype deeply rooted in the minds of patients, nursing staff and colleagues.

Identifying the presence of GD without recommending solutions is a job "half done". Possible avenues include.

- Basic minimum surgical requirements ensuring equal surgical opportunities

Trainees in surgical specialties allow themselves to be proved "worthy of their operative training". Hence, introducing an objectivity with every rotation requiring a basic minimum surgical requirement to be completed at the end of training period will reduce bias and enable providing equal surgical opportunities. Though this system requiring a minimum number of performed and assisted surgeries per rotation in a surgical sub specialty does exist in our department, it is important to regularly audit and ensure that this system is functional.

- Awareness of institutional grievance/ complaints committee

While most of the faculty were aware of the institutional grievance/ complaints committee, interestingly, almost half of the trainees were not aware of its existence. It is essential to

create awareness and constantly reinforce the existence of an approachable institutional grievance committee with no fear of repercussions. We suggest to do so by enquiring about the trainee's well-being through e mails once in a couple of months from the committee with information on redressal avenues and requesting them to revert back if there is a need to discuss any issue.

- Distributing administrative responsibility equally

Trainees look up to their faculty and/or seniors and try to follow in their path. These role models must actively endorse gender equality and seek to set examples. We have a mentorship program within the department which is voluntary and requires the mentee to regularly interact and connect with their mentor. We have recently modified our mentorship program to involve both, a senior and junior faculty mentor for each trainee opting for a mentor, so as to help establish a more comfortable and approachable platform to the mentee to interact with their mentors.

- Distributing administrative responsibility equally

Women faculty tend to handle interactions more compassionately (34) and are hence often tasked with the responsibility of allocating resident rotation duties and serving as "first responders" when trainees are distressed. It is likely that they could feel overburdened by this added responsibility, creating dissatisfaction and a sense of discrimination. A more gender equitable distribution of such responsibilities may be beneficial.

## Conclusion

Gender discrimination can present in subtle or overt fashion in surgical departments and requires active sustained efforts to allow both genders to feel equally empowered. It is necessary to ensure that the work environment remains conducive for each individual to perform to their optimum capability without deleterious effects on their mental well-being. Establishing a system to objectively evaluate gender equity while avoiding stereotyping for certain roles can help minimize GD.

## Data availability statement

The original contributions presented in the study are included in the article/Supplementary Material, further inquiries can be directed to the corresponding author/s.

## Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

## Author contributions

The authors have contributed equally to drafting and editing of manuscript. All authors contributed to the article and approved the submitted version.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher's note



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# Gender profile of principal investigators in a large academic clinical trials group

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**Introduction:** Gender equity in medicine has become a significant topic of discussion due to consistently low female representation in academia and leadership roles. Gender imbalance directly affects patient care. This study examined the gender and craft group of the Principal Investigators (PI) of clinical trials run by the Australasian Gastro-Intestinal Trials Group (AGITG)
**Methods:** Publicly available data was obtained from the AGITG website. Trials were divided into upper, lower gastrointestinal cancer, miscellaneous (neuroendocrine and gastrointestinal stromal tumours). Where multiple PIs were listed, all were counted. Craft group was assigned as surgical, medical, radiation oncology or other.
**Results:** There were 69 trials with 89 PI, where 52 trials were represented exclusively by male PIs. Of all PIs, 18 were women (20.2%); all were medical oncologists. Prior to 2005, all PIs were male. The craft group distribution of PIs was: 79% medical oncologists, 12% surgical oncologists, 8% radiation oncologist, 1% nuclear medicine physicians. Regarding trials with multiple PI's, there were 19 in total. Of these, 11 had only male PIs, which included 5 surgeons. Females were more likely to be a co-PI (42%) as opposed to sole PI (18%). There was no gender policy publicly available on the AGITG website.
**Conclusions:** There is a low percentage of female PIs in academic oncology trials in the portfolio of this large international trials group. No trial was led by a female surgical or radiation oncologist. There is a need to understand the reasons driving the disparity so that specific strategies can be put in place.

KEYWORDS

gender equity, female surgeon, principal investigator, clinical trials, surgical oncologist, leadership

## Introduction

Gender inequity in medicine remains a global issue, despite many years of policies and initiatives to promote participation and progression to leadership roles. Women constitute the majority of the medical workforce, yet are still grossly under-represented in many specialties and at senior levels (1). Gender bias is proven to impact adversely on patient care (2). Diversity, including in gender, brings broadening of values, opinions and collective contributions and most importantly, reflects the broad community, who are after all the main stakeholder in healthcare provision.

It is widely recognised that females are under-represented in almost every country across the spectrum of surgical subspecialties (1, 3–5). A recent systematic review demonstrated a self-perpetuating cycle, where lack of progression in career development of female surgeons is shown to perpetuate the imbalance (6). Additionally, gender equity statements and policies among professional surgical societies were recently catalogued as deficient (7). To date there is little data available with respect to the surgical oncology craft group. Other oncology disciplines such as medical oncology, haematology and radiation oncology have shown increased female representation over time, although imbalances remain in various proportions (1, 4, 8, 9).

Despite the rise in female presence by numbers, this has not translated to equity at the level of senior positions, such as decision-making or developmental roles, both within clinical care and academia (10–17). The imbalance is even stronger in certain geographical regions, such as Asia-Pacific, and has been exacerbated by the COVID-19 pandemic (18–20). Over the past few years, growing numbers of reports of gender distribution in specific leadership positions and roles have been published, including analysis of first and senior authors in publications; journal editorial boards; presenters at major meetings and even the differences by gender of the use of titles by chairpersons when introducing speakers at international meetings (21–25).

One problem is that researching the topic of gender equity is often met with hostility and researchers can be ostracised (26, 27). By contrast, it is only when this data becomes welcomed that there is likely to be a culture in which positive change can be achieved.

In Australia, data regarding gender equity in the various disciplines of oncology is lacking. As an exemplar, we studied leadership in the field of clinical trials by examining the gender of trial Principal Investigators (PI). The PI plays a pivotal role in establishing, running and reporting a trial, leading the Trial Management Committee and liaising with trial investigators. Most oncology trials have a sole PI, although increasingly the role is shared amongst two or even three individuals. This research presents the distribution and trends in PI gender in the Australasian Gastro-Intestinal Trials Group (AGITG), a large academic, international, not-for-profit, trials consortium.

## Methods

Publicly accessible areas of the AGITG website (https://gicancer.org.au/about-the-agitg/) were viewed on several occasions between July and August 2021. All listed trials were sub-grouped into categories: completed, open, in-development and in follow-up. Trials were further sorted into tumour site as: Upper Gastrointestinal (GI), Lower GI and other (gastrointestinal stromal tumour and neuroendocrine tumours). The year of trial registration and the gender of the PI(s) were recorded. Gender was confirmed from personal knowledge and/or Google® searches for public profile. PIs were counted for every trial they led; where trials had multiple PIs, each was recorded. Data was verified by a second investigator.

## Results

Across 69 clinical trials conducted by the AGITG between 1994 and 2022, there were a total of 89 PIs, with 18 trials led by females (20.2%) comprising nine unique females. All female PIs were medical oncologists; they constituted 25.7% of the total of 70 PIs from this craft group. There were no females amongst the 11 surgical oncology, 7 radiation oncology and 1 nuclear medicine PIs. Women were under-represented as PI when trials were considered according to study status and tumour site (**Table 1**). Trials in the "completed" and "in follow up" categories had 8% of PIs being female (registration year between 1994 and 2018, $n =$

TABLE 1 Distribution of principal investigators for AGITG trials.

| | | Principal investigators ($n = 89$) | | |
|---|---|---|---|---|
| | **All studies ($n = 69$)** | **Total investigators 89** | **Males (%) 71 (79.8)** | **Females (%) 18 (20.2)** |
| Craft groups | Medical oncology | 70 | 52 (74.3) | 18 (25.7) |
| | Radiation oncology | 7 | 7 (100.0) | 0 (0.0) |
| | Surgical oncology | 11 | 11 (100.0) | 0 (0.0) |
| | Nuclear medicine | 1 | 1 (100.0) | 0 (0.0) |
| Study status | Completed ($n = 43$) | 53 | 47 (88.7) | 6 (11.3) |
| | In follow-up ($n = 6$) | 8 | 6 (75.0) | 2 (25.0) |
| | Open ($n = 14$) | 21 | 13 (61.9) | 8 (38.1) |
| | In preparation ($n = 6$) | 7 | 5 (71.4) | 2 (28.6) |
| Types of cancers | Upper GI ($n = 30$) | 42 | 33 (78.6) | 9 (21.4) |
| | Lower GI ($n = 32$) | 39 | 31 (79.5) | 8 (20.5) |
| | Others (NET and GIST) ($n = 7$) | 8 | 7 (87.5) | 1 (12.5) |

*Abbreviation: GI, gastrointestinal, NET, neuroendocrine tumour; GIST, gastro-intestinal stromal tumour.*

49), whereas the newer trials in the "open" and "in preparation" categories (registration year 2016–2022, $n = 20$) had 10% female PIs. Female PIs were less likely to be the sole PI ($n = 9$, 18% of 50 sole PI studies) than to play a role as a co-PIs ($n = 8$, 42% of the 19 co-led trials) (Table 2).

The trend of male and female investigators over a nearly 30-year timeframe is shown in Figure 1. Half of all studies ($n = 33$) were conducted from 1994 to 2010, with only 7% of female investigators in this period; there were none prior to 2005. Between 2011 and 2022, female investigators constituted 34%. Our study estimated a rise of 0.6 PI per 10-year from 2015 onward.

## Discussion

Despite often being poorly received, there is a growing movement to present data about gender disparity to try to stimulate change based on evidence. We have shown a lack of female leadership in GI oncology clinical trials within a large academic organization, with the interesting (and actionable) analysis that it is female PIs particularly from surgical and radiation oncology that should be encouraged. Not only were there many less females, those who had PI roles only comprised only a few different individuals across multiple studies. This suggests that women have difficulty in "penetrating the scene" and that only a few females were offered opportunities, potentially relating to the fact that they have had to recurrently "prove their worth".

Furthermore, significantly fewer studies within AGITG were represented by surgical oncology compared to medical oncology. This can be explained and is consistent with data presented by Wong et al where only 7.6% of surgical oncology trials from 2008 to 2020 involved surgical interventions (28). Is this because academic productivity (number of research publications and grants) as a promotion benchmark is not as highly valued and less commonly sought by employers within surgical oncology, at least in the Australian context and likely in many other countries (29)? It has been suggested that heavy workload and long hours of the surgical career lead to reduce commitment to research (30). In fact, protected research time was one of the challenges to achieving academic success (followed by academic mentorship) (31). This is a call out not only for a revised surgical training program but also increased research support and mentorship for young surgeons.

At the time of our study, publicly available data (June 2021) from the Australian Health Practitioner Regulation Agency (AHPRA) reported that 13.4% of the total of 6,445 registered surgeons were female (4). The number involved in surgical oncology is likely to be much smaller; no data is available. Of the 442 total registered radiation oncologists, 44.1% were female. It is sobering that public data prior to 2019 on surgical and radiation

TABLE 2 Principal investigator gender according to composition of PIs within AGITG.

| | Sole PI (%) Studies ($n = 50$) | 2 PIs (%) Studies ($n = 18$) | 3 PIs (%) Studies ($n = 1$) |
|---|---|---|---|
| Male PI only | 41 (82.0) | 11 (61.1) | 0 (0.0) |
| Female PI only | 9 (18.0) | 0 (0.0) | 0 (0.0) |
| Mixed PIs | Not applicable | 1M:1F = 7 (38.9) | 1M:2F = 1 (100.0) |

*Definition: Sole PI: a study that had only one PI (male or female).*
*Abbreviation: M, Male; F, Female.*

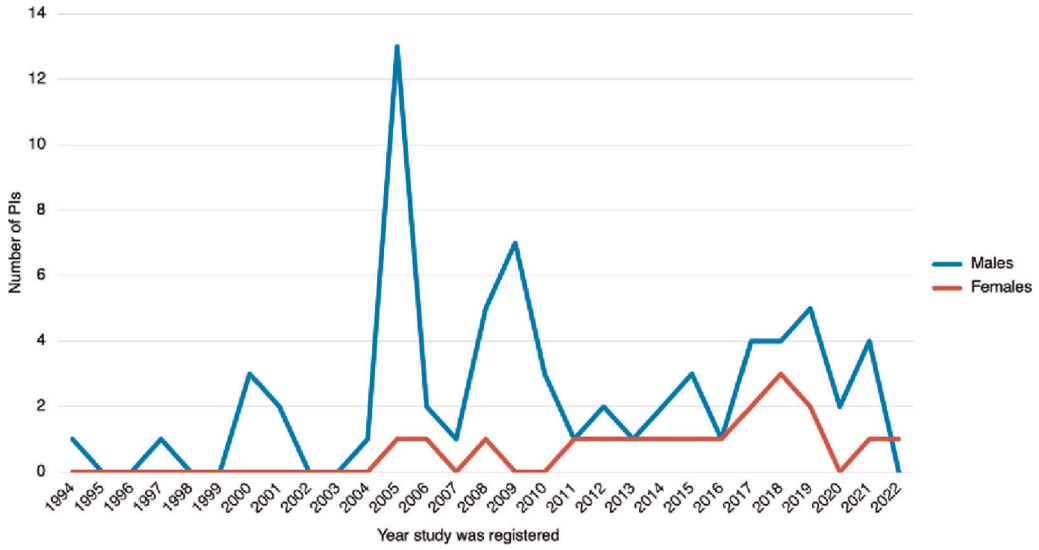


FIGURE 1
Trend over time of principal investigators within AGITG. Each trial is represented once, in the year it was registered.

oncology registration by gender is unavailable; even more surprising is that there is no data even now on the proportion of female medical oncologists. Over the 3 year period from 2019 to 2021, there was only a 1% increase in total numbers of both female surgeons and radiation oncologists registered in Australia, which is roughly consistent with data from the USA (32). This indicates that the ingredients needed for significant increases have not been addressed and it is not simply a matter of time before gender is equalised.

The need to ensure balanced recruitment of patients for trials in all disciplines of medicine (and for that matter laboratory animals for pre-clinical research) has given rise to the Sex and Gender Equity in Research (SAGER) guidelines, amongst others (33–35). The phenomenon of female under-representation as clinical trial PIs and academic leaders similarly cuts across all areas of medicine, surgery and medical research (36–38).

There is scant data available regarding female oncology trial PIs. One study captured data on trials published between 2003 and 2018 with an estimated rise of 1.2% in female authors annually. Their data showed no female corresponding authors for surgical trials and a lower rate of female authors within GI and genitourinary cancer trials (39). There was a higher percentage (still less than 50%) for breast and gynecological cancers (39, 40). Jou et al reported a 3% rise annually in female PIs within phase 3 gynecological clinical trials from 2010 to 2020 internationally and as in our study, women were more likely to be leading trials with multiple co-PIs than with one PI (41).

Data on the constitution of AGITG members by gender is not publicly available and we would encourage transparency in this, so that the "talent pool" from which PIs are nurtured can be understood. Additionally, at the time of the study, AGITG did not have a publicly available policy on gender equity, nor a description of the process by which trial PIs are selected. As a non-governmental organization with a significant fundraising mission and profile, we respectfully suggest that these policies be made available. However, having a policy is just the starting point, although it lays a benchmarking process that can be actively monitored. Translating the ideas and goals of a gender equity policy into significant and sustained change is where the problem lies. In Australia, one of the largest philanthropic funders of cancer research announced this year that it would not support future projects at a major University, until such time as their gender policies were reflected in actual equitable outcomes (42).

A large survey of both male and female members of the European Society of Medical Oncology published in 2018 revealed that it is not simply a matter of proportion, but rather opportunities that encourages female leadership, such as leadership training and mentoring, facilitating work life balance and provision of a flexible working environment (43). Many systematic reviews reported that strategies such as mentoring programs, education and professional development create positive outcomes in improving women's skills, however there is a dearth of appropriate mentors (44–46). Furthermore, it can only be fundamental institutional, cultural reform and perhaps even quotas, rather than individual training, that will bring about gender equality (16, 47–49).

A limitation of our study is that we did not personally contact PIs to confirm their gender. Comparative statistical analysis was not performed because there is no equivalent Australian population of physician or trial investigator according to oncology graft groups. In addition, the number of trials per year within AGITG was small and hence the trend over time of female PI was not strengthened with statistical significance. Nevertheless, the data presented is useful to inform concrete planning for positive change. We hope that the results will be openly and positively received, rather than the defensive response that similar studies internationally often encounter (26, 27). We are currently undertaking a similar review of multiple other Australian cancer trials groups to examine the gender issue in a broader sample (50).

This study shows a lack of female leadership within a large academic clinical trials group, although improvement within one specialty (medical oncology) has been seen over time. For AGITG and most likely, many other oncology trials groups across the globe, the challenges are to rectify the lack of females from surgical and radiation oncology specialties; to expand the number of different women leading trials, to address the imbalance of females being sole lead rather than co-leads; to publish gender equity policies and then enact them, and to make transparent their guidelines for selecting trial PIs.

## Conclusion

Females are under-represented as clinical trial PIs in this large Australian academic clinical trials group. There should be a focus understanding why this discrepancy still exists in 2022 and on concrete steps to ensure a balance of PIs, particularly female surgical and radiation oncologists, as well as for a broader number of individual women.

## Data availability statement

The original contributions presented in the study are included in the article/Suplementary Material, further inquiries can be directed to the corresponding author/s.

## Author contributions

ES and VL contributed to the concept, design of the study. ES performed data collection. VL organised the database. VA cross-checked and ensured integrity of data collection. CH assisted with data analysis. ES revised manuscript and

approved the submitted version. All authors contributed to the article and approved the submitted version,

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher's note



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# A survey of Australian and New Zealand medical parents' experiences of infertility, pregnancy, and parenthood

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**Objective:** To describe the incidence of infertility, pregnancy complications, and breastfeeding practices among Australian and New Zealand doctors and identify factors associated with increased pregnancy complication rates.

**Methods:** A survey of ANZ doctors using an online questionnaire during November 2021.

**Results:** One thousand ninety-nine completed responses were received. The median age of female doctors at the time of their first child was 32.4. Fertility testing was undertaken by 37%, with 27% having *in vitro* fertilization. More than 60% of respondents delayed family planning due to work. Pregnancy loss occurred in 36% of respondents, and 50% suffered a pregnancy complication. There were significant differences between specialists, with surgeons working longer hours before and after pregnancy, but having greater access to maternity leave than general practitioners.

**Conclusion:** Female doctors delay starting and completing their family due to work-related demands and structural biases in career progression, which may result in higher infertility and pregnancy complication rates.

KEYWORDS

**pregnancy, surgeons, breastfeeding, complication, infertility**

## Introduction

The number of female doctors in Australia's and New Zealand's workforce is on the rise (1). Australia's national medical board AHPRA reported that in 2021 44.8% of the registered medical professionals are female compared with only 38.6% in 2012 (2). This trend has followed within speciality practice, with figures showing 40.2% of specialists are women, up from only 35.7% 5 years ago (2). Some specialties that are starting from a low base (male dominated specialties) are also increasing, with The Royal Australasian College of Surgeons 2018 census confirming the increasing numbers of women in surgery from 9 to 12% (3).

Despite these advances in gender equality, combining parenthood and medicine has proven challenging for many female doctors. The current medical training structure is centered around the prime reproductive years of women. Systemic barriers in medicine and strong paternalistic culture have resulted in many doctors delaying pregnancy until after training. However, the longer women choose to postpone starting a family, the rate of complications rises considerably. This is particularly apparent after 35 years old, where there is a significantly higher risk of infertility, pregnancy loss, fertility interventions, and adverse neonatal outcomes (4). Work-related barriers such as working longer than 42 h per week or long and irregular shifts have shown similar outcomes (5). Further issues such as minimal parental leave, poor peer support and scarce breastfeeding spaces may also create many obstacles for female doctors to balance parenthood and their careers.

A recent JAMA article demonstrated a high infertility rate among American female surgeons, more than twice the rate of the general population (6). The authors called for urgent structural reform to support both men and women as our culture continues to prolong pregnancy. Although many studies across the globe have examined these important issues with infertility and motherhood for decades, there is a paucity of data within Australia. This research aims to describe the incidence of infertility, pregnancy complications, and breastfeeding practices among Australian and New Zealand doctors and identify factors associated with increased pregnancy complication rates.

## Methods

To address the aim of the study, a survey methodology was employed as a more thorough prospective generational study of female doctors was not ethically or practically feasible. Social media was chosen for survey distribution due to the heterogeneity of requirements by sub-specialty colleges for approval and distribution of such a survey. Ethical approval was obtained from the Northern Health Ethics and Governance Committee (HREC 79540).

### Definitions

For the purposes of this paper, the terms female and male refer to the gender of the participant, as recorded by the participant themselves. Sex was not recorded. Parenthood was defined as any participant identifying themselves as a parent, regardless of gender.

### Participants

An invitation to participate in a survey to assess experiences with fertility, pregnancy complications, and breastfeeding practices at work was posted on the Medical Parents Facebook Page containing over 11,000 AHPRA registered doctors although it is impossible to know how many of these members were active members (people who viewed the page within the past 3 months). Members of this Facebook group are required to confirm AHPRA registration to join this group, however no other demographic data (including location and employment details) are collected. Inclusion criteria consisted of all female doctors who had attempted and/or succeeded in becoming pregnant and who completed the survey, and all male doctors with a non-doctor female partner who had attempted and/or succeeded in becoming pregnant, and who completed the survey. Completion of the survey was defined as completing at least the gender question and 25% of the relevant questions. The data collection lasted for 4 weeks; with a reminder posted at the 2-week mark.

### Questionnaire

The questionnaire was a combination of 2 established and externally validated surveys: the recent US survey comprising a number of questions addressing fertility, pregnancy experiences and working conditions (6), and the Indiana University School of Medicine survey exploring breastfeeding practices among physicians (7). The REDCap system was used to distribute and store responses (8). Demographic information such as age, gender, relationship status and ethnicity was collected as well as the specialty of the participants and age of the first pregnancy. All data received were anonymous.

### Statistical analysis

Statistical analysis was performed using SPSS (IBM, Armonk, USA). Comparisons of categorical data were compared using Kruskal-Wallis, Chi-Square or Fisher's Exact Test. Continuous data was assessed for normality using the Shapiro-Wilk test for normality, with an alpha of $>0.05$ used to define normality. Student's *t*-tests or Mann-Whitney (rank sum) tests were used to test for differences in normally and non-normally distributed variables, respectively, with one-way ANOVA used for multiple groups. Statistical significance was set at a *p*-value of 0.05 for all analyses.

## Results

One thousand ninety-nine complete responses were received from over 11,000 members of the Medical Parents Facebook Page over the accrual period, of these 1,040 were from female doctors, 44 were from male doctors, and 15 did not disclose their

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TABLE 1 Comparison between female and male participants.

| | Female ($n = 1,040$) | Male ($n = 44$) | $p$-value |
|---|---|---|---|
| Age participant (mean ± sd) | 36.9 ± 5.4 | 36.9 ± 5.3 | 0.991 |
| Age of female partner | – | 36.5 ± 5.2 | |
| Specialty | ($n = 1,039$) | ($n = 44$) | <0.001 |
| Surgery | 154 (14.8%) | 17 (38.6%) | |
| Medicine | 169 (16.3%) | 9 (20.5%) | |
| General practice | 287 (27.6%) | 6 (13.6%) | |
| Pediatrics | 94 (9.0%) | 0 | |
| Radiology | 7 (0.7%) | 0 | |
| Other | 328 (31.6%) | 12 (27.3%) | |
| Age at first child's birth (median, IQR) | 32 (30, 34) | 31 (29, 33) | 0.018 |
| Age of female partner at first child's birth | – | 31 (29, 32) | <0.001* |
| How many biological children? | ($n = 970$) | ($n = 39$) | 0.039 |
| 1 | 419 (43.2%) | 10 (25.6%) | |
| 2 | 400 (41.2%) | 17 (43.6%) | |
| 3 | 124 (12.8%) | 10 (25.6%) | |
| 4 | 22 (2.3%) | 1 (2.6%) | |
| >4 | 5 (0.5%) | 1 (2.6%) | |
| Do you have the number of children you want for your family? | ($n = 971$) | ($n = 39$) | 0.103 |
| Yes | 441 (45.4%) | 23 (59.0%) | |
| Have you had fertility testing? | ($n = 1,038$) | | 0.205 |
| Yes | 384 (37.0%) | 12 (27.3%) | |
| Have you had IVF? | ($n = 975$) | ($n = 39$) | 0.139 |
| Yes | 266 (27.3%) | 6 (15.4%) | |
| Have you had a pregnancy loss? | ($n = 1,036$) | ($n = 43$) | 0.517 |
| Yes | 377 (36.4%) | 13 (30.2%) | |
| Have you delayed having a family due to work? | ($n = 973$) | ($n = 39$) | 0.407 |
| Yes | 591 (60.7%) | 21 (53.8%) | |
| Seniority when you had first child | ($n = 961$) | ($n = 38$) | 0.111 |
| Intern | 24 (2.5%) | 2 (5.3%) | |
| Resident | 106 (11.0%) | 5 (13.2%) | |
| Registrar | 454 (47.2%) | 24 (63.2%) | |
| Fellow | 116 (12.1%) | 3 (7.9%) | |
| Consultant | 261 (27.2%) | 4 (10.5%) | |
| How many hours did you work per week? | ($n = 970$) | | |
| <40 | 376 (38.8%) | – | |
| 40–60 | 498 (51.3%) | – | |
| 60–80 | 83 (8.6%) | – | |
| >80 | 13 (1.3%) | – | |
| Partner work hours | | ($n = 39$) | 0.023** |
| <40 | – | 26 (66.7%) | |
| 40–60 | – | 13 (33.3%) | |
| Did you reduce your work schedule | ($n = 971$) | | |
| Yes | 263 (27.1%) | – | |
| Frequency of on call roster | ($n = 972$) | | |
| None | 393 (40.4%) | – | |
| 2–4/month | 323 (33.2%) | – | |
| 4–6/month | 126 (13.0%) | – | |

*(Continued)*

TABLE 1 Continued

| | Female ($n = 1,040$) | Male ($n = 44$) | $p$-value |
|---|---|---|---|
| >6/month | 130 (13.4%) | – | |
| Shift length in the third trimester | ($n = 968$) | | |
| 0–8 h | 251 (25.9%) | – | |
| 8–12 h | 592 (61.2%) | – | |
| 12–16 h | 82 (8.5%) | – | |
| >16 h | 43 (4.4%) | – | |
| Any pregnancy complications | ($n = 974$) | ($n = 39$) | 0.515 |
| Yes | 486 (49.9%) | 17 (43.6%) | |
| NICU requirement | ($n = 972$) | ($n = 39$) | 0.184 |
| Yes | 157 (16.2%) | 3 (7.7%) | |
| Neonatal complication | ($n = 966$) | ($n = 39$) | 0.564 |
| Yes | 228 (23.6%) | 11 (28.2%) | |

*Comparing age at first child's birth (female group) to Age of female partner at first child's birth (male group).
**Comparing Hours per week (female group) to Partner Work Hours (male group).

gender. As it is not possible to know how many members of the group were active members, it is not possible to ascertain the response rate. The majority of respondents were married or in a domestic partnership, and of Caucasian ethnicity with a mix of specialty interests.

Comparison between female and male participants was performed to assess potential differences between medical and non-medical females. Although the age of participants (and their female partners) was similar, male doctors and their partners were both younger than female doctors at the time of their first child's birth (Table 1). Male doctors were more likely to have 3 children (25.6%) compared to female doctors (12.8%). The partners of male doctors worked less hours and a higher proportion did not return to work after giving birth. No differences were seen in pregnancy outcomes, although this may have been due to the low number of male participants recruited. A large number of female doctors reported to have undergone fertility testing (37.0%), and one in four female doctors required assisted reproductive therapy (ART). Pregnancy loss occurred in 36.4% of female doctors. Of particular note, the rate of pregnancy complications amongst female doctors was 49.9%.

Further comparisons within the female participants were performed, looking at the three commonest specialty subgroups: surgeons, physicians, and general practitioners (Table 2). Despite surgeons being older at the time of their first child's birth, they were more likely to still be registrars, compared to general practitioners who were younger and more likely to be consultants. Over two thirds of surgeons and physicians stated they had delayed having a family due to work. There were significant differences in work schedules, with surgeons registering longer weekly hours, longer shifts and more on call. There were no differences in pregnancy-related complications. Although general practitioners had greater flexibility in returning to work, they also had less access to maternity leave.

When performing an analysis of women who had recorded a pregnancy-related complication, a higher proportion had undergone fertility testing, IVF and had suffered a previous pregnancy loss (Table 3). They were also more likely to report neonatal complications. Factors such as age at first child's birth or shift length in the third trimester were not different between groups. The presence of birth complications was associated with a lower likelihood of successful initiation of breastfeeding (78.6 vs. 85.2%, $p = 0.023$).

87.9% of female participants had initiated breastfeeding successfully, with 81.9% of those breastfeeding exclusively (Table 4). Only 67.8% could express whilst working, with finding a suitable location to express only found "often" by 20.4% of those breastfeeding. Colleagues were deemed usually or always supportive by only 56.6% of respondents. However, 68.9% of women continued breastfeeding at least 6 months and only 24.9% indicated that cessation was due to demands at work.

Breastfeeding practices varied across the different sub-specialities. Surgeons experienced the greatest barriers to flexible rostering to allow the continuation of breastfeeding. Insufficient time to express at work was a common issue raised in our study, and one in four female doctors never had an appropriate place to express at work (Table 5). Overall, the majority (68.9%) of the respondents in this study breastfed more than 6 months, and the majority (75%) were satisfied with their breastfeeding efforts. Workplace demands resulted in discontinuation of breastfeeding in the majority of surgeons (48.7% surgeons vs. 20.5% physicians and 12.6% general practitioners, $p < 0.001$), and an overall decreased rate of satisfaction with the duration of breastfeeding.

TABLE 2 Comparison between surgical, medical, and general practice sub-specialities.

| | Surgery ($n = 154$) | Medicine ($n = 169$) | General practice ($n = 287$) | $p$-value |
|---|---|---|---|---|
| Age participant (mean ± sd) | 37.6 ± 5.4 | 36.8 ± 4.3 | 36.4 ± 5.7 | 0.060 |
| Age at first child's birth (median, IQR) | 32 (31, 35) | 33 (31, 35) | 31 (29, 34) | <0.001 |
| How many biological children? | ($n = 131$) | ($n = 160$) | ($n = 272$) | 0.491 |
| 1 | 61 (46.6%) | 77 (48.1%) | 113 (41.5%) | |
| 2 | 50 (38.2%) | 67 (41.9%) | 110 (40.4%) | |
| 3 | 15 (11.5%) | 15 (9.4%) | 39 (14.3%) | |
| 4 | 4 (3.1%) | 1 (0.6%) | 8 (2.9%) | |
| >4 | 1 (0.8%) | 0 | 2 (0.7%) | |
| Have you had fertility testing? | ($n = 154$) | ($n = 169$) | ($n = 286$) | 0.720 |
| Yes | 60 (39.0%) | 64 (37.9%) | 101 (35.3%) | |
| Have you had IVF? | ($n = 131$) | ($n = 161$) | ($n = 274$) | 0.796 |
| Yes | 37 (28.2%) | 40 (24.8%) | 74 (27.0%) | |
| Total number of reproductive cycles (median, IQR) | 4 (2, 5) | 2 (1, 5) | 3 (2, 6) | 0.023 |
| Have you had a pregnancy loss? | ($n = 153$) | ($n = 169$) | ($n = 285$) | 0.971 |
| Yes | 56 (36.6%) | 63 (37.3%) | 103 (36.1%) | |
| Have you delayed having a family due to work? | ($n = 131$) | ($n = 160$) | ($n = 274$) | 0.002 |
| Yes | 90 (68.7%) | 108 (67.5%) | 146 (53.3%) | |
| Seniority when you had first child | ($n = 130$) | ($n = 160$) | ($n = 268$) | <0.001 |
| Intern | 3 (2.3%) | 2 (1.3%) | 10 (3.7%) | |
| Resident | 10 (7.7%) | 11 (6.9%) | 41 (15.3%) | |
| Registrar | 76 (58.5%) | 86 (53.8%) | 79 (29.5%) | |
| Fellow | 15 (11.5%) | 20 (12.5%) | 50 (18.7%) | |
| Consultant | 26 (20.0%) | 41 (25.6%) | 88 (32.8%) | |
| How many hours did you work per week? | ($n = 131$) | ($n = 159$) | ($n = 273$) | <0.001 |
| <40 | 16 (12.2%) | 42 (26.4%) | 174 (63.7%) | |
| 40–60 | 62 (47.3%) | 107 (67.3%) | 90 (33.0%) | |
| 60–80 | 44 (33.6%) | 10 (6.3%) | 7 (2.6%) | |
| >80 | 9 (6.9%) | 0 | 2 (0.7%) | |
| Did you reduce your work schedule | ($n = 131$) | ($n = 159$) | ($n = 274$) | <0.001 |
| Yes | 32 (24.4%) | 35 (22.0%) | 110 (40.1%) | |
| Shift length in the third trimester | ($n = 131$) | ($n = 158$) | ($n = 274$) | <0.001 |
| 0–8 h | 21 (16.0%) | 33 (20.9%) | 118 (43.1%) | |
| 8–12 h | 67 (51.1%) | 110 (69.6%) | 131 (47.8%) | |
| 12–16 h | 35 (26.7%) | 10 (6.3%) | 9 (3.3%) | |
| >16 h | 8 (6.1%) | 5 (3.2%) | 16 (5.8%) | |
| Any pregnancy complications | ($n = 131$) | ($n = 161$) | ($n = 273$) | 0.968 |
| Yes | 68 (51.9%) | 82 (50.9%) | 138 (50.5%) | |
| Complications leading to time off work | ($n = 67$) | ($n = 81$) | ($n = 138$) | 0.897 |
| Yes | 42 (62.7%) | 53 (65.4%) | 91 (65.9%) | |
| Colleague supportive of extra time off | ($n = 42$) | ($n = 53$) | ($n = 91$) | 0.001 |
| Yes | 25 (59.5%) | 45 (84.9%) | 78 (85.7%) | |
| NICU requirement | ($n = 130$) | ($n = 161$) | ($n = 273$) | 0.866 |
| Yes | 25 (19.2%) | 30 (18.6%) | 47 (17.2%) | |
| Neonatal complication | ($n = 131$) | ($n = 160$) | ($n = 271$) | 0.887 |
| Yes | 31 (23.7%) | 37 (23.1%) | 68 (25.1%) | |

*(Continued)*

TABLE 2 Continued

| | Surgery ($n = 154$) | Medicine ($n = 169$) | General practice ($n = 287$) | $p$-value |
|---|---|---|---|---|
| Recommend medical career to child? | ($n = 153$) | ($n = 166$) | ($n = 284$) | 0.148 |
| Yes | 71 (46.4%) | 82 (49.4%) | 158 (55.6%) | |
| Access to maternity leave | ($n = 154$) | ($n = 168$) | ($n = 266$) | <0.001 |
| Yes | 119 (77.3%) | 138 (82.1%) | 85 (32.0%) | |
| Length of maternity leave in weeks (median, IQR) | 20 (10, 26) | 28 (16, 40) | 26 (18, 48) | <0.001 |
| Return to work | ($n = 131$) | ($n = 160$) | ($n = 274$) | <0.001 |
| Full time | 87 (66.4%) | 61 (38.1%) | 32 (11.7%) | |
| Part time | 44 (33.6%) | 98 (61.3%) | 235 (85.8%) | |
| Did not return | 0 | 1 (0.6%) | 7 (2.6%) | |

TABLE 3 Factors associated with pregnancy complication.

| | Complication | No complication | $p$-value |
|---|---|---|---|
| Age at first child's birth (median, IQR) | 32 (30, 34) | 32 (30, 34) | 0.210 |
| Have you had fertility testing? | ($n = 486$) | ($n = 487$) | <0.001 |
| Yes | 212 (43.6%) | 149 (30.6%) | |
| Have you had IVF? | ($n = 486$) | ($n = 488$) | <0.001 |
| Yes | 162 (33.3%) | 104 (21.3%) | |
| Total number of reproductive cycles (median, IQR) | 3 (1, 5) | 2 (1, 5) | 0.369 |
| Have you had a pregnancy loss? | ($n = 215$) | ($n = 139$) | <0.001 |
| Yes | 215 (44.3%) | 139 (28.6%) | |
| Have you delayed having a family due to work? | ($n = 486$) | ($n = 486$) | <0.001 |
| Yes | 314 (64.6%) | 277 (57.0%) | |
| Did you reduce your Work Schedule | ($n = 484$) | ($n = 486$) | <0.001 |
| Yes | 159 (32.9%) | 103 (21.2%) | |
| Shift length in the third trimester | ($n = 481$) | ($n = 486$) | 0.925 |
| 0–8 h | 129 (26.8%) | 122 (25.1%) | |
| 8–12 h | 292 (60.7%) | 299 (61.5%) | |
| 12–16 h | 39 (8.1%) | 43 (8.8%) | |
| >16 h | 21 (4.4%) | 22 (4.5%) | |
| NICU requirement | ($n = 485$) | ($n = 486$) | <0.001 |
| Yes | 127 (26.2%) | 30 (6.2%) | |
| Neonatal complication | ($n = 481$) | ($n = 484$) | <0.001 |
| Yes | 179 (37.2%) | 49 (10.1%) | |
| Wellbeing this week—scale 1–10 (median, IQR) | 7 (5, 7) | 7 (6, 8) | <0.001 |

## Discussion

The results of this study suggest that female doctors may experience many obstacles in family planning. The strenuous training requirements for many young doctors possibly contribute to these difficulties. Thus, as more women enter medicine and its sub-specialities, and as the age of childbearing advances, it becomes increasingly important to address the culture and issues surrounding parenthood in the medical workforce.

When considering the optimal time to start a family, the perceived negative impacts of childbearing on a woman's career may often be at the forefront of her mind. This may delay starting a family until later in life, with participants in this study recording an average age of first-time mothers of 32.4 years. Although a direct comparison is difficult, due to potential differences in the studied cohort, the Australian national average is 29.4 (9). Surgeons, in particular, were found to be the most likely to postpone pregnancy due to training commitments, compared to other medical backgrounds. Several studies have now highlighted the adverse effects of advancing maternal age, with its increased risks of infertility and adverse pregnancy outcomes (4). This study results support these findings, as one in three women reported having a miscarriage, compared to one in five with the general population (10). Despite the known escalating risk of infertility with advancing maternal age, more than half of doctors in this study's cohort delayed starting their family due to work requirements. The perceived expectation that young women should wait until the end of training to have children may account for the high rate of respondents who needed fertility testing (37%). Moreover, a substantial portion of them went on to require ART, such as IVF (27.3%). The length of medical training, as much as 14 years in some sub-specialties, may well contribute to the older maternal age, and may necessitate a disproportionate number of doctors having to utilize ART.

Regarding the practicality of ART, the considerable expense, frequent appointments, repeated procedures and laboratory tests may become a large burden to already time-poor doctors. It is not surprising that those who require fertility testing and ART are more likely to have worse mental health outcomes (11).

TABLE 4 Breastfeeding practices among ANZ doctors.

| | |
|---|---|
| Infant feeding method at birth | ($n = 972$) |
| Exclusive breastfeeding | 796 (81.9%) |
| Combination breast mild and formula | 156 (16.0%) |
| Not breastfeeding at all | 20 (2.1%) |
| Emotional state during breastfeeding | ($n = 949$) |
| Severely depressed | 42 (4.4%) |
| Mildly depressed | 320 (33.7%) |
| Not depressed at all | 587 (61.9%) |
| Express while working | ($n = 918$) |
| Yes | 622 (67.8%) |
| Sufficient time to express at work | ($n = 619$) |
| Yes | 288 (46.5%) |
| Access to appropriate place to express at work | ($n = 619$) |
| Never | 113 (18.3%) |
| Occasionally | 121 (19.5%) |
| Sometimes | 127 (20.5%) |
| Often | 126 (20.4%) |
| Always | 132 (21.3%) |
| Were colleagues supportive of milk expression at work? | ($n = 618$) |
| Always opposed | 1 (0.2%) |
| Usually opposed | 18 (2.9%) |
| Neither supportive nor oppositional | 161 (26.1%) |
| Usually supportive | 198 (32.0%) |
| Always supportive | 152 (24.6%) |
| Colleagues did not know | 76 (12.3%) |
| Not applicable | 12 (1.9%) |
| Duration of breast feeding | ($n = 910$) |
| <3 months | 109 (12.0%) |
| 3–6 months | 174 (19.1%) |
| 6–12 months | 279 (30.7%) |
| >12 months | 348 (38.2%) |
| Was discontinuation of breastfeeding due to demands at work? | ($n = 906$) |
| Yes | 226 (24.9%) |
| No | 602 (66.4%) |
| Still breastfeeding | 78 (8.6%) |
| Satisfied with duration of breastfeeding? | ($n = 912$) |
| Yes | 684 (75.0%) |
| No | 164 (18.0%) |
| Still breastfeeding | 64 (7.0%) |

Additionally, ART, particularly IVF, is known to contribute to worse pregnancy and neonatal outcomes, which may carry long-term implications for the mental and physical wellbeing of both mother and child (12). For these compelling reasons, training colleges and health services need to work together to implement the necessary strategies and infrastructure for their trainees to have families during training. These practical measures appear to be necessities, but equally important is the need for cultural change. In a largely male dominated profession where full time lengthy training programs are the norm, acceptance of breaks in training, part time training, shortened days and prolonged rest times needs to be commonplace. If registrars feel supported enough to not delay childbearing until the end of a lengthy training program, their younger maternal age may reduce the rates of infertility and need for ART (6).

Pregnancy complications rates for doctors have been found to be between 34 and 48.3% (4), which is consistent with the findings of this study in which half of the surveyed medical mothers experienced a pregnancy complication. Moreover, these pregnancy complications were also more likely to necessitate the need for NICU admissions for their newborns. To explain the potential correlation between the medical profession and reproductive disorders, studies have put forward several potential causative factors. Takeuchi et al. found that long working hours may be hazardous to fetal health, with a three-fold increased risk of experiencing threated abortion (13). Eighty five percentage of the surveyed medical mothers in this study were still working 8–12+ h per shift during their third trimester. Other possible explanations include regular exposure to occupational hazards to doctors at work, such as ionizing radiation, electromagnetic fields, communicable diseases, cytotoxic and other chemical agents, surgical smoke, and physical stress (such heavy lifting, stair climbing, or night shifts) (14, 15). Whilst mothers-to-be will do their best to minimize contact with these exposures, the nature of medical work often makes complete isolation from them impossible.

The World Health Organization strongly advocates for breastfeeding to be an important component of childrearing, as it offers benefits to both the mother and her newborn baby (16). Whilst the right to breastfeeding in public is enshrined in Australian law, the requirements on employers are less clear and are covered by state laws. The Victorian law, for example, says that employers must "reasonably accommodate" employees who wish to continue breastfeeding. Key components of a successful breastfeeding include adequate parental leave (both maternity and paternity), safe space to express, adequate time to express milk at work, and supportive environment for continuation in milk supply (17). However, surgeons as a subgroup were most susceptible to early cessation of breastfeeding, possibly due to the unyielding demands of surgical work. Surgical respondents, of the specialties analyzed, ranked highest for insufficient time and lack of designated private spaces for milk expression. Lack of flexibility in returning to work in a part-time arrangement may further compromise the breastfeeding efforts of surgeon mothers. These workplace limitations may have resulted in earlier discontinuation of breastfeeding in the majority of surgeons compared with their colleagues (48.7% surgeons vs. 20.5% physicians vs. 12.6% GPs $p < 0.001$). These trends are reflected in literature, as authors Sattari et al. showed 43% doctor mothers terminated breastfeeding early due to demands of work (17).

TABLE 5 Breastfeeding practices comparison among sub-specialties.

| | Surgery ($n = 154$) | Medicine ($n = 169$) | General Practice ($n = 287$) | $p$-value |
|---|---|---|---|---|
| Infant feeding method at birth | ($n = 131$) | ($n = 161$) | ($n = 273$) | 0.160 |
| Exclusive breastfeeding | 101 (77.1%) | 131 (81.4%) | 228 (83.5%) | |
| Combination breast mild and formula | 23 (17.6%) | 27 (16.8%) | 41 (15.0%) | |
| Not breastfeeding at all | 7 (5.3%) | 3 (1.9%) | 4 (1.5%) | |
| Emotional state during breastfeeding | ($n = 124$) | ($n = 157$) | ($n = 269$) | 0.079 |
| Severely depressed | 10 (8.1%) | 7 (4.5%) | 10 (3.7%) | |
| Mildly depressed | 44 (35.5%) | 66 (42.0%) | 86 (32.0%) | |
| Not depressed at all | 70 (56.5%) | 84 (53.5%) | 173 (64.3%) | |
| Express while working | ($n = 119$) | ($n = 153$) | ($n = 259$) | 0.048 |
| Yes | 91 (76.5%) | 97 (63.4%) | 169 (65.3%) | |
| Sufficient time to express at work | ($n = 91$) | ($n = 96$) | ($n = 169$) | 0.002 |
| Yes | 32 (35.2%) | 40 (41.7%) | 96 (56.8%) | |
| Access to appropriate place to express at work | ($n = 91$) | ($n = 96$) | ($n = 168$) | <0.001 |
| Never | 30 (33.3%) | 17 (17.7%) | 15 (8.9%) | |
| Occasionally | 17 (18.7%) | 20 (20.8%) | 23 (13.7%) | |
| Sometimes | 22 (24.2%) | 30 (31.3%) | 22 (13.1%) | |
| Often | 10 (11.0%) | 22 (22.9%) | 32 (19.0%) | |
| Always | 12 (13.2%) | 7 (7.3%) | 76 (45.2%) | |
| Were colleagues supportive of milk expression at work? | ($n = 90$) | ($n = 96$) | ($n = 168$) | 0.002 |
| Always opposed | 0 | 0 | 1 (0.6%) | |
| Usually opposed | 8 (8.9%) | 1 (1.0%) | 3 (1.8%) | |
| Neither supportive nor oppositional | 32 (35.6%) | 26 (27.1%) | 38 (22.6%) | |
| Usually supportive | 24 (26.7%) | 32 (33.3%) | 39 (23.2%) | |
| Always supportive | 17 (18.9%) | 18 (18.8%) | 26 (15.5%) | |
| Colleagues did not know | 9 (10.0%) | 18 (18.8%) | 26 (15.5%) | |
| Not applicable | 0 | 1 (1.0%) | 5 (3.0%) | |
| Duration of breast feeding | ($n = 119$) | ($n = 153$) | ($n = 255$) | 0.070 |
| <3 months | 17 (14.3%) | 19 (12.4%) | 24 (9.4%) | |
| 3–6 months | 29 (24.4%) | 29 (19.0%) | 45 (17.6%) | |
| 6–12 months | 39 (32.8%) | 53 (34.6%) | 72 (28.2%) | |
| >12 months | 34 (28.6%) | 52 (34.0%) | 114 (44.7%) | |
| Was discontinuation of breastfeeding due to demands at work? | ($n = 119$) | ($n = 151$) | ($n = 253$) | <0.001 |
| Yes | 58 (48.7%) | 31 (20.5%) | 32 (12.6%) | |
| No | 48 (40.3%) | 107 (70.9%) | 197 (77.9%) | |
| Still breastfeeding | 13 (10.9%) | 13 (8.6%) | 24 (9.5%) | |
| Satisfied with duration of breastfeeding? | ($n = 119$) | ($n = 152$) | ($n = 256$) | 0.001 |
| Yes | 76 (63.9%) | 110 (72.4%) | 207 (80.9%) | |
| No | 33 (27.2%) | 32 (21.1%) | 27 (10.5%) | |
| Still breastfeeding | 10 (8.4%) | 10 (6.6%) | 22 (8.6%) | |

Systemic factors within hospital rostering and infrastructure need to be addressed to reduce the inadequate time and space for working mothers to breastfeed or express. This study's findings suggest that there is a need for simple structural strategies to be implemented, such as setting aside a room for expressing, furnishing the space with a fridge for storing expressed breast milk and allocating a break between clinic patients and operating lists. Awareness of the benefits of a pregnancy-friendly and lactation-friendly workplace is wise. These include retaining highly-skilled staff, reducing absenteeism, and fostering a healthy working culture in the medical work place (18), as well as improved physical and mental wellbeing of the medical mothers and infants, and achievement of their lactation goals.

To address the inflexibility during training, part-time training positions should be incorporated into the training structure to minimize delay in starting a family and be part of accepted as part of a culture change across the profession. Access to parental leave (both males and females) should be prioritized to meet the demands of the rising number of female doctors. Safe access and adequate time to breastfeed or express is not only a legal requirement, but also a fundamental requirement to return to work for working mothers and should be an institution's performance indicator. Crucially, a focus on education around infertility and pregnancy complications, as well as collegiate support through a culture change should be implemented by training bodies.

## Limitations

Due to the recruitment and advertising process, it is not clear whether the results of this study are representative of the Australian and New Zealand medical community. Due to the voluntary participation, there is a considerable risk of selection bias as medical mothers experiencing childbearing issues are more likely to seek support on the Facebook Group and more likely to be involved in such a survey. There was a very low male participation rate, and given the likely participation bias by affected males in the Facebook Group, this is likely to bias the gender comparisons.

## Conclusion

This study underscores the considerably high rates of infertility and pregnancy complications amongst a cohort of Australian and New Zealand medical professionals. Delays in starting a family due to work-related factors, advancing maternal age, and long irregular working hours may contribute to this incidence. Structural barriers to breastfeeding, in the hospital or clinic environment, could impair the efforts of working mothers to continue breastfeeding beyond 6 months. Interventions to provide improved working conditions for doctors are urgently needed to improve the overall risks of pregnancy and childbearing, and warrants further research. Professional training institutions and employers need to address this issue in a proactive and expedient manner.

## Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

## Ethics statement

The studies involving human participants were reviewed and approved by Northern Health Ethics and Governance Committee (HREC 79540). The patients/participants provided their written informed consent to participate in this study.

## Author contributions

JK, RH, and GC: conception and design, development of methodology, acquisition of data (provided animals, acquired and managed patients, provided facilities, etc.), and analysis and interpretation of data (e.g., statistical analysis, biostatistics, computational analysis). JK, KS, RH, and GC: writing, review, and/or revision of the manuscript and administrative, technical, or material support (i.e., reporting or organizing data, constructing databases). RH and GC: study supervision. All authors contributed to the article and approved the submitted version.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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# Is Urology a gender-biased career choice? A survey-based study of the Italian medical students' perception of specialties

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**Background:** Despite the well-established worldwide phenomenon of "the feminisation of medicine," in Italy, Urology remains a male-dominated field.
**Objective:** The aims of our work are to assess data on medical students' choice of surgical specialty in Italy to investigate if a gender-biased trend exists and to find the key points that influence the decision-making process when choosing a specialty, with a focus on Urology.
**Design:** Data about access to residency programs in 2017–2020 were analysed through descriptive statistics. Investigations concerning the decision-making process were carried through distribution of an online anonymous survey to Italian medical students.
**Results:** Urology was among the specialties with the lowest proportion of female residents in Italy in the last 4 years: 37 (29.4%) in 2017, 27 (21.4%) in 2018, 40 (26.7%) in 2019, and 57 (25.2%) in 2020. The total number of participants of the survey was 1409, of which only 341 declared being keen to pursue a career path in surgery. Out of the 942 students not interested in surgery, 46.2% females and 22.5% males indicated a "sexist environment" as one of the reasons. Overall, the main reason for medical students not choosing Urology is the lack of interest in the specialty. Furthermore, there is a different perception of Urology as a sexist environment between female (23.4%) and male (3.2%, $p < 0.001$) medical students, which may influence their decision-making process.
**Conclusions:** In Italy, the prevalence of female medical graduates does not mirror the proportion of female doctors choosing a career in some surgical specialties, including Urology. Our survey results clearly identified that a large proportion of medical graduates are not choosing urology because of the perception of a sexist environment. While the reasons for this phenomenon remain unclear, the presence of a gender-biased perception of a sexist environment represents a possible explanation.

KEYWORDS

Feminisation of medicine, specialty training, urology training, medical students, sexist environment

# Introduction

Over the past century, women have moved from legal exclusion from medical schools to accounting for the majority of medical school applicants and graduates, a trend that has been referred to as "the feminisation of medicine" (1).

In particular, since the beginning of the 21st century, an increasingly high number of women have been choosing a career in medicine, and as a result, the number of female medical students equals or exceeds that of male medical students in several industrialised countries worldwide, including France (2), United Kingdom (3), Spain (4), Germany (5), United States (6), Canada (7), Israel (8), and Italy (9).

Although women are increasingly taking to the medical profession, some skews persist as far as gender distribution among specialties is concerned. In fact, some medical specialties, including General Surgery and Orthopaedics, are significantly male dominated, while others are more female dominated, such as Gynaecology and Paediatrics (10).

Urology has historically been a field dominated by male physicians (11) and, despite the general trend of medical feminisation in the 21st century, it seems to be attracting primarily male applicants, and the search for the reasons of this specialty being rarely chosen by women should explore different domains.

Despite these hindrances, Urology remains a competitive surgical specialty; therefore, understanding the factors affecting students' overall consideration of Urology as a career is an important step to develop strategies aimed at ensuring that this field continues to attract excellent candidates (12).

In Italy, access to residency programs is regulated by a multiple-choice national test. Participants are ranked into one single national ranking that establishes the priority of each candidate to enrol into a residency program of their choice, until all places in every residency program are allocated. The Italian Ministry of Education subdivides residency programs into three areas: medical, surgical (including Urology), and services. For the detailed list of specialties pertaining to each area, refer to **Supplementary Table S2**.

The aims of our work are: (1) to assess data on the choice of surgical specialty in Italy to investigate if a gender-biased trend exists and (2) to identify the key points that influence the decision-making process when choosing the specialty, with a particular focus on Urology.

# Materials and methods

## 2017–2020 Italian trends

Data about access to residency programs in the Year 2017–2020 were analysed from a dedicated database provided by the Associazione Liberi Specializzandi (ALS) Association.

Extracted data pertaining to 2017–2020 were divided by year, gender, and area of specialty chosen (Medical, Surgical, and Services). The surgical area was further analysed and subdivided by each available single surgical specialty: General surgery, Paediatric surgery, Plastic surgery, Obstetrics and Gynaecology, Orthopaedics, Urology, Maxillofacial surgery, Neurosurgery, Ophthalmology, ENT, Cardiac surgery, Thoracic surgery, and Vascular surgery.

Data extraction was done by two authors (AN, SR) and then cross-checked by a lead researcher (RM).

## Survey

A completely anonymous electronic survey was designed on the platform SurveyMonkey and was distributed in 2019 for 30 days through social media platforms.

The survey was targeted at students who were approaching their specialty training and were enrolled into the fourth, fifth, and sixth year of medical school in 2019 in Italy.

The survey consisted of five to nine total questions for each respondent. Content validity and comprehensiveness were verified before commencement of the study by piloting among interns, medical students, and university lecturers. The number of questions varied due to the presence of two multiple-choice questions whose negative response led to the termination of the questionnaire, excluding participants who would not be relevant to the investigation. There were two question types: multiple-choice questions and 1–5 Likert-scale questions (1 = strongly disagree – 5 = strongly agree). The complete survey structure is presented in **Figure 1**.

## Data analysis

Continuous variables were summarised by mean and standard deviation; categorical variables were described by absolute and relative frequencies.

The association between two categorical variables was evaluated by using the Chi-square test; Fisher exact test was preferred in case of sparse tables. Continuous covariates were compared by using the *t*-test or Wilcoxon rank-sum test when a significant departure from normality was detected.

# Results

## 2017–2020 Trends

Between 2017 and 2020, the percentage of females graduating from medical school remained substantially stable (55.5% in 2017, 53.9% in 2018, 55.3% in 2019, and 55.8% in 2020), showing that every year most of the graduates were females.

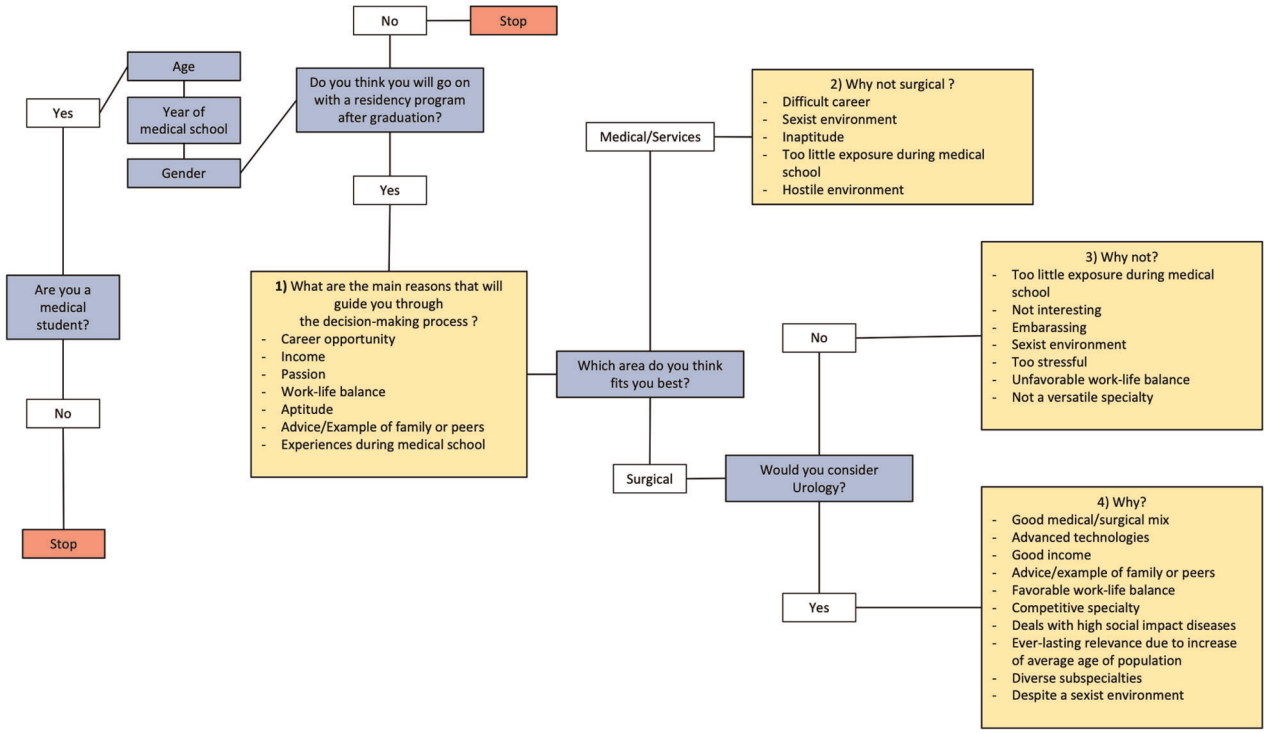



FIGURE 1
Overview of a questionnaire structure, with multiple-choice questions given in blue and Likert-scale questions given in yellow.

This is reflected in the overall gender distribution of matriculants to a specialty program in the same year intervals, where female predominance over male is evident (female matriculants: 57.1% in 2017, 56.2% in 2018, 53.9% in 2019, and 56.3% in 2020).

Gender distributions of matriculants in the three areas (medical, services, and surgical) showed that in 2020, of all female matriculants, 51.0% were in the medical area, 31.4% in the services area, and 17.6% in the surgical area, whereas of all male matriculants, 44.2% were in the medical area, 31.7% in the services area, and 24.1% in the surgical area (Figure 2). Moreover, considering only matriculants in the surgical area, a slight decrease in the number of females from 50.2% in 2017 to 48.4% in 2020 was evidenced (Table 1).

The percentage of female matriculants in all the surgical specialties during the 2017–2020-year interval is shown in (Figure 3). Urology was among the specialities with the lowest proportion of females: 37 (29.4%) in 2017, 27 (21.4%) in 2018, 40 (26.7%) in 2019, and 57 (25.2%) in 2020.

## Survey

The total number of medical student participants in the survey was 1409. Gender distribution of respondents was 62.1% females and 37.9% males. A total of 1363 medical students responded fully to the first set of predefined five-point Likert scale answers about the main motives and reasons guiding the process of choosing a residency program. The overall main reason indicated by both genders was "Passion", with a mean of 4.64 for female and 4.41 male respondents. Meanwhile, the percentage of value ≥4 for female respondents was the highest for "Passion" and "Attitude", while for male respondents, it was the highest for "Career opportunity" (Figure 4).

A total of 942 students, corresponding to 69.1% of all respondents, declared to be keen to choose a specialty pertaining to the Medical or Services groups. These students were then provided with a list of five statements concerning the reasons behind their propensity to avoid surgical specialties, where the main reason indicated was "Too little exposure during studies," accounting for a mean of about four for both genders. The values assigned to each statement were almost equal for both female and male respondents, except for "Sexist environment" with a statistically significant difference in percentage of value ≥4, 22.5% for males and 46.2% for females ($p < 0.0001$) (Figure 5).

A total of 341 students who declared being keen to pursue a career path in surgery were then sorted between 236 (69.2%) who denied considering Urology as a possible specialty and 105 (30.8%) who confirmed including Urology among their specialties of choice.

Among those who declared considering Urology as a choice, the main reasons indicated were "Diverse subspecialties" and

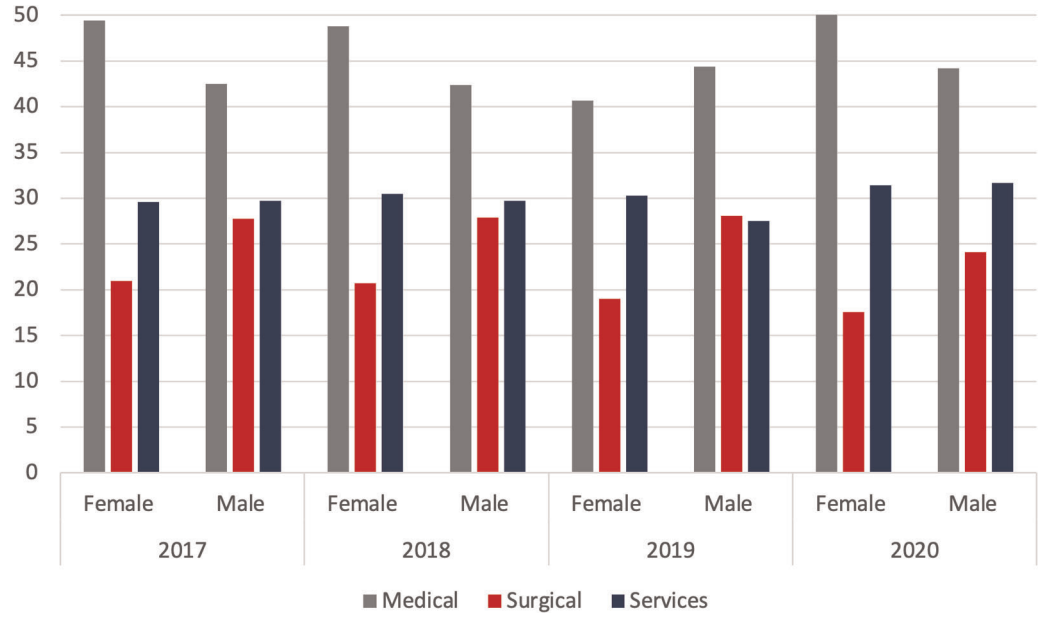



FIGURE 2
Gender distribution among the three areas in percentage: medical, surgical, services.

TABLE 1 Matriculants into the three areas in the years 2017–2020, with the percentage of female matriculants in each area shown in brackets.

| | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|
| Surgical (F%) | 1,635 (50.2) | 1,667 (48.8) | 2,017 (44.2) | 2,977 (48.4) |
| Medical (F%) | 3,165 (60.7) | 3,221 (59.6) | 4,150 (57.2) | 6,999 (59.8) |
| Services (F%) | 2,021 (57.0) | 2,110 (56.8) | 2,517 (56.3) | 4,608 (56.1) |

"Good medical/surgical mix." Surprisingly, male and female respondents attributed a value ≥4 in similar percentages to all the statements, including the one concerning the perception of a sexist environment in Urology: 52.0% for both gender groups (Figure 6).

The main reasons for medical students in general for not choosing Urology is the lack of interest in the specialty. Interestingly, values ≥4 were assigned in similar proportions by the two gender groups for all statements, with an exception for "Sexist environment": 3.2% for males and 23.4% for females ($p < 0.0001$) (Figure 6). The different distributions in value attribution to the statement "Sexist environment" between male and female responders are shown in Figure 7.

## Discussion

Despite a historical general conception of doctors being thought of as masculine entities, in the last 40 years, the figure of women in medicine has been consistently arising until reaching unequivocal numerical predominance (4).

The process of feminisation of medicine (13, 14) has also been evident in Italy, as reported by the higher number of enrolled, matriculated, and graduated female medical students compared with their male counterparts.

What happens after graduation?

Our study showed the tendency of Italian female doctors to prefer medical specialties rather than surgical specialties, with the percentage of female matriculants to surgical specialties decreasing through the years. Moreover, there is a clear uneven gender distribution among the different surgical specialties. In fact, women outnumber males in Gynaecology, Thoracic, and Vascular Surgery, whereas males prefer Plastic Surgery, Orthopaedics, and Urology. It also showed that this tendency is strongly related to the perception of surgical specialties as "Sexist environment."

In Urology, women have always been underrepresented (11), and our study confirms that in Italy, there is still a wide gender gap in this professional field. Therefore, further considerations should be made regarding the tendency of female doctors, who will consider the surgical field of specialisation, not to choose Urology over other surgical specialties.

Choosing a specialty is one of the most important decisions young doctors must face. They undergo an extremely complex decision-making process that involves a variety of factors such as early exposure to the subjects during studies (13), the

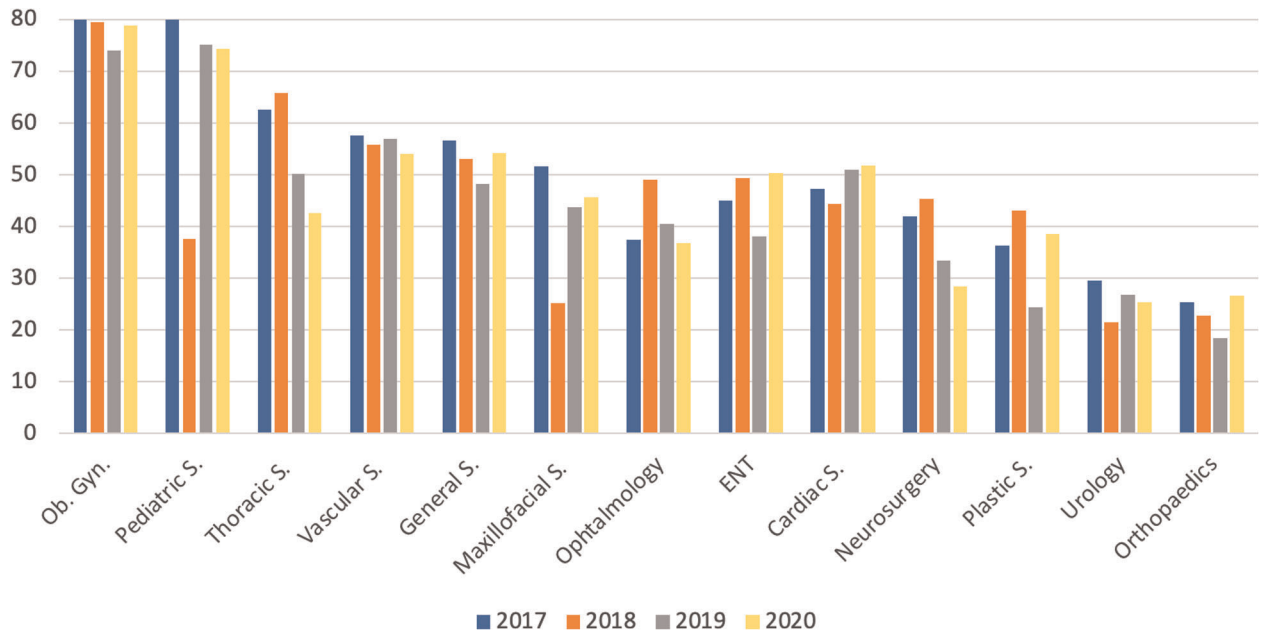



FIGURE 3
Percentage of candidates matriculating into a surgical residency program that were female, in the 2017–2020 period.

perspective of a good work–life balance (14, 15), the possible room for a maternity leave (16), and the possibility of being inspired by same sex mentors (17). Gender bias exists among men and women, and female physicians may be subject to negative stereotyping in male-dominated fields, which are more likely to be surgical in nature, thus avoiding specialties like Orthopaedics and Urology (12).

Our survey has investigated the importance that Italian medical students attribute to personal aptitude towards a subject, the perspective of a favourable work-life balance, personal experience during medical school, and the opportunity of a good career and income. The results demonstrate that the main discriminant is passion and, therefore, the personal interest that a specialty sparks in them during classes or internships.

Interestingly, the main reason why medical students do not consider surgery and in particular Urology as a career appears to be related to the little consideration and space that surgical subjects are accorded during medical school, and the subsequent lack of interest into these subjects. This highlights the crucial role of an early exposure of students to surgery and suggesting an implementation of practical and theoretical surgical experiences in the core curriculum of the medical school.

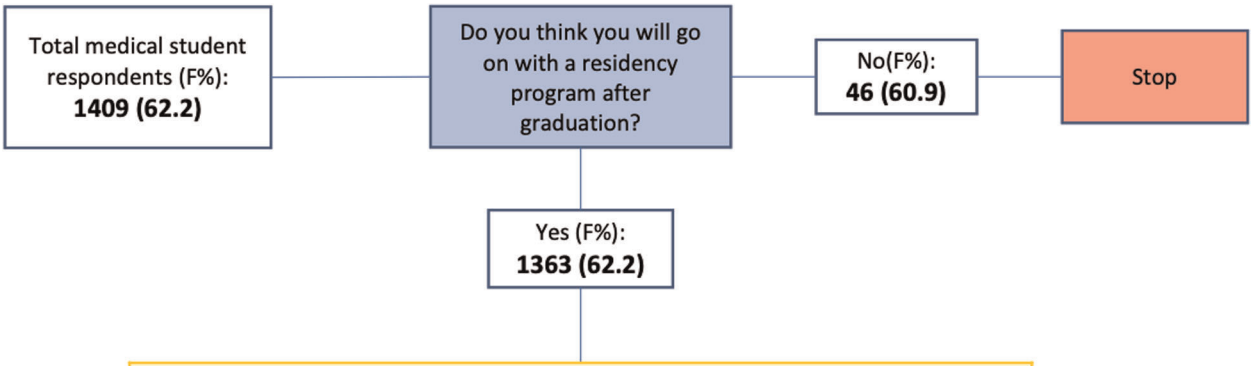
The literature shows the importance of early exposure for medical students to consider Urology as a future specialty (12). In fact, inadequate exposure to Urology and poor staff and resident involvement in undergraduate education were identified as potential causes for misperception of the specialty (12). The roots of male prevalence in Urology may as well arise from the poor knowledge of medical students to this discipline (18), and the consequent misperception of it dealing exclusively with male genitalia (19) instead of encompassing the entire genitourinary system, thus being relevant to both genders. This wrong perception can also give a deeper understanding of the poor attractiveness of the urological field for women.

Moreover, due to the broad spectrum of diseases included under the label of Urology and to the demographic shift that society is facing, leading to a higher prevalence of urological diseases among the elderly population (20), this specialty will be affected negatively by an increase in workload, and the current trend of medical students drifting away from surgery could significantly affect the delivery of urological services.

Our survey has demonstrated that Urology, as all surgical specialties overall, is perceived as a sexist environment, and this impression of it may affect the decision-making process of female medical students more than it affects male students.

Interestingly, while a significant difference between female and male was found regarding “sexist environment” when “Why would you not consider Urology as a career?” was questioned, the same difference did not result when “Why would you consider Urology as a career?” was asked.

The straightforward explanation of this phenomenon might be the existence of a different mindset between women who




**1)What are the main reasons that will guide you through the decision-making process ? *(Likert scale):***

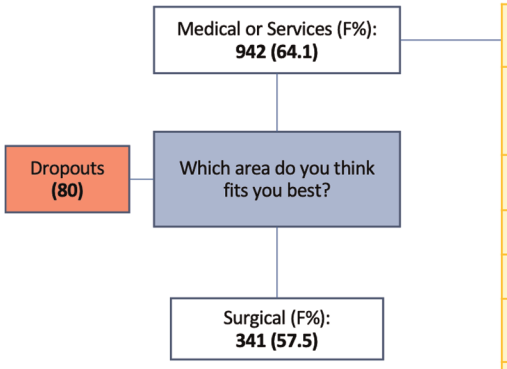
| | Males: Mean (SD) | Females: Mean (SD) | Males: Value ≥ 4 | Females: Value ≥ 4 |
|---|---|---|---|---|
| **Career opportunity** | 3.96 (0.85) | 3.69 (0.87) | **71.8%** | **60%** |
| Income | 3.88 (0.88) | 3.55 (0.95) | 68.5% | 56% |
| **Passion** | 4.41 (0.73) | 4.64 (0.57) | **83.5%** | **91.8%** |
| Work-life balance | 4.01 (0.99) | 4.10 (0.97) | 67.8% | 73.5% |
| **Aptitude** | 4.12 (0.77) | 4.32 (0.69) | **76.7%** | **85.6%** |
| Advice/Example of family or peers | 2.36 (1.07) | 2.42 (1.05) | 11.7% | 14.2% |
| Experiences during medical school | 3.59 (0.99) | 3.72 (0.90) | 57.7% | 62.5% |

FIGURE 4
Reasons guiding the decision-making process of a program, with male and female respondents expressed as mean, standard deviation (SD), and values ≥4.

dismiss Urology because they perceive it as a sexist environment and women who, despite acknowledging the stereotype of the Urological field being a sexist environment, do not discard Urology as an option for their future.

Unconscious gender-based assumptions and stereotypes are deeply embedded in the patterns of thinking of both men and women. This consideration has been extensively proven by the results of the implicit association test (IAT), a measure within social psychology designed to detect a person's subconscious association between mental representations of concepts in memory. It is frequently used to estimate implicit stereotypes retained by test subjects (21).

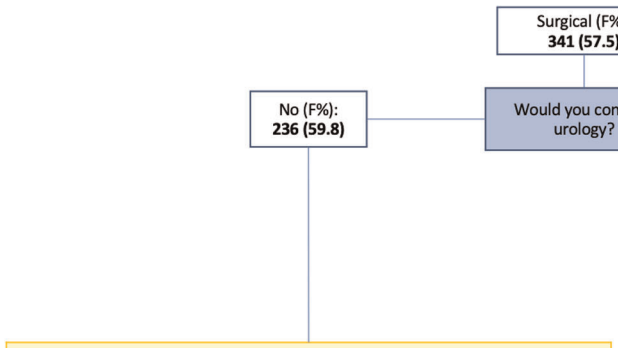
The IAT was proven to apply especially to healthcare professionals. In fact, this group shows more relevant implicit associations linking men with career and women with family than professionals from other fields (22). Therefore, men might be viewed as having more "agentic" traits, which include being strong, action oriented, ambitious, and competitive, whereas




**2)Why not surgical ? *(Likert scale)***

| | Males: Mean (SD) | Females: Mean (SD) | Males: Value ≥ 4 | Females: Value ≥ 4 |
|---|---|---|---|---|
| Difficult career | 3.06 (1.22) | 3.07 (1.13) | 34.9% | 36.3% |
| **Sexist environment** | 2.67 (1.15) | 3.25 (1.23) | **22.5%** | **46.2%** |
| Inaptitude | 3.53 (1.21) | 3.57 (1.20) | 53% | 57.3% |
| Too little exposure during medical school | 4.00 (1.16) | 3.98 (1.01) | 73.4% | 73.8% |
| Hostile environment | 2.83 (1.08) | 2.93 (1.02) | 32.5% | 33.8% |

FIGURE 5
Reasons for not choosing a surgical program, with male and female respondents expressed as mean, standard deviation (SD), and values ≥4. Dropouts were respondents who did not answer all the questions of the survey.




**3) Why not? *(Likert scale)***

| | Males: Mean (SD) | Females: Mean (SD) | Males: Value ≥ 4 | Females: Value ≥ 4 |
|---|---|---|---|---|
| Too little exposure during medical school | 2.47 (1.05) | 2.44 (1.06) | 17.9% | 14.2% |
| **Not interesting** | 4.15 (0.77) | 4.10 (0.79) | **81.1%** | **80.9%** |
| Embarassing | 1.55 (0.80) | 1.79 (0.94) | 2.1% | 5.7% |
| **Sexist environment** | 1.77 (0.93) | 2.67 (1.17) | **3.2%** | **23.4%** |
| Too stressful | 1.96 (0.91) | 2.38 (0.84) | 2.1% | 4.3% |
| Unfavorable work-life balance | 2.43 (0.90) | 2.57 (0.75) | 3.6% | 7.4% |
| Not a versatile specialty | 2.78 (0.99) | 2.87 (0.95) | 22.7% | 25.3% |

**4) Why? *(Likert scale)***

| | Males: Mean (SD) | Females: Mean (SD) | Males: Value ≥ 4 | Females: Value ≥ 4 |
|---|---|---|---|---|
| **Good medical/surgical mix** | 4.28 (0.62) | 4.25 (0.70) | **88%** | **89.1%** |
| Advanced technologies | 4.09 (0.69) | 4.04 (0.82) | 74% | 72.7% |
| Good income | 3.83 (0.85) | 3.71 (0.79) | 64% | 63.6% |
| Advice/example of family or peers | 2.04 (0.89) | 1.91 (0.89) | 6% | 3.6% |
| Favorable work-life balance | 3.33 (0.79) | 3.40 (0.74) | 34% | 41.8% |
| Competitive specialty | 3.20 (0.58) | 3.33 (0.84) | 22% | 36.4% |
| Deals with high social impact diseases | 4.13 (0.72) | 3.98 (0.80) | 78% | 74.6% |
| Ever-lasting relevance due to increase of average age of population | 4.22 (0.63) | 4.18 (0.61) | 82% | 89.1% |
| **Diverse subspecialties** | 4.30 (0.59) | 4.58 (0.63) | **86%** | **96.4%** |
| **Despite a sexist environment** | 3.41 (1.20) | 3.47 (0.98) | **52.7%** | **52.4%** |

FIGURE 6
Reasons for not choosing vs. choosing Urology, with male and female respondents expressed as mean, standard deviation (SD), and values ≥4.

women might be viewed as having more "communal" traits, which include being gentle, sympathetic, and submissive (13).

The same idea is also used to categorise the different medical specialties: "agentic" specialties are mostly Neurosurgery, Orthopaedics, and Urology, while "communal" specialties are Paediatrics, family medicine, primary care internal medicine specialties, including Geriatrics (23). Such categorisation might underlie a

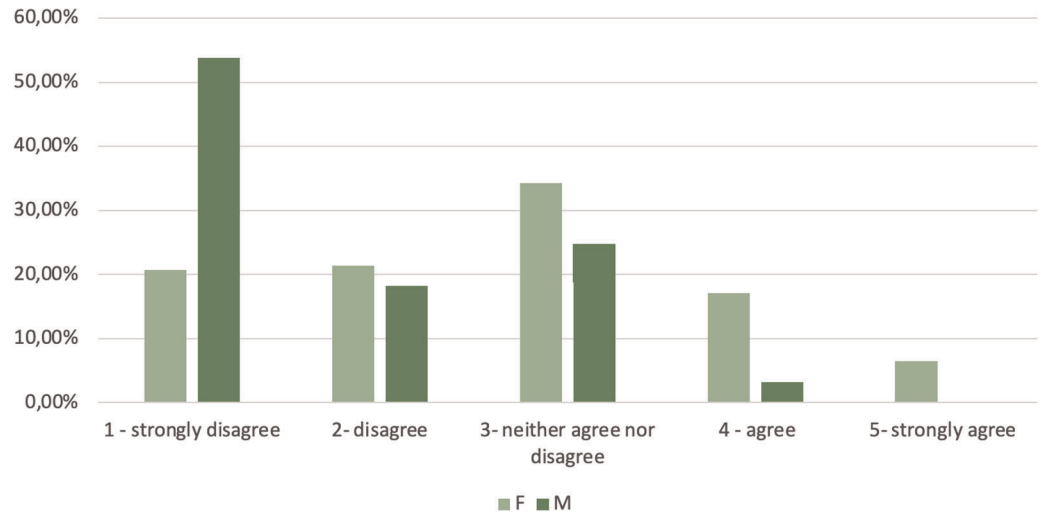



FIGURE 7
Percentage of Likert value attribution to the statement "Sexist environment" among male and female respondents in the group of respondents not choosing Urology.

gender-specialty bias as shown in a study enrolling 131 surgeons (in practice and in training) who were administered a modified IAT, the results of which indicated a significant implicit association linking men with surgery and women with family medicine (22).

Moreover, the IAT also represents a useful mean for surgical educators to self-assess personal gender-related biases and was, in fact, included in a list of guidelines proposed by Hemphill et al. (24) to address this issue.

Furthermore, females working in male-dominated surgical fields like Urology may be affected by the risk of "microaggressions" (25) or worse, sexual harrassement, and discrimination (26). The sexist environment that medical students may perceive in this regard could then negatively influence their choices.

In consideration of the results of our survey, suggesting the existence of two groups of women with a different attitude towards male-dominated specialties, and towards Urology, the next research objective would be to study the psychological mechanisms that might determine this different attitude, to understand whether it is related to the distinction between communal and agentic women, and lastly how their characteristics are perceived and judged in Urology.

In conclusion, the tendency to avoid Urology as the specialty of choice might determine an uneven distribution of human resources, skewed towards a very specific subset of gender or mindset, possibly causing a qualitative decline of the provided services. Therefore, it is important to develop strategies to improve medical student intake into Urology to match the projected demand in future and to attract not only an adequate number of doctors, but also the best and most brilliant ones.

## Conclusion

Our study has proven that in Italy the prevalence of female medical graduates does not mirror the proportion of female doctors choosing a career in some surgical specialties, including Urology. While the reasons for this phenomenon remain unclear and influenced by multiple factors, the presence of a gender-biased perception of a sexist environment represents a possible explanation.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Author contributions

Conception and design was done by MR; acquisition of data was done by RS, PS, PS, and MR; analysis and interpretation of data was performed by NA, RS, and MR; drafting of the manuscript was done by RS; critical revision of the manuscript for important intellectual content was performed by MR, OL, GS, and IS; statistical analysis was performed by

NA; supervision was done by MR. All authors contributed to the article and approved the submitted version.

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## Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fsurg.2022.962824/full#supplementary-material.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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# Consequences of inequity in the neurosurgical workforce: Lessons from traumatic brain injury

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Women and minorities leave or fail to advance in the neurosurgical workforce more frequently than white men at all levels from residency to academia. The consequences of this inequity are most profound in fields such as traumatic brain injury (TBI), which lacks objective measures. We evaluated published articles on TBI clinical research and found that TBI primary investigators or corresponding authors were 86·5% White and 59·5% male. First authors from the resulting publications were 92.6% white. Most study participants were male (68%). 64·4% of NIH-funded TBI clinical trials did not report or recruit any black subjects and this number was even higher for other races and the Hispanic ethnicity. We propose several measures for mitigation of the consequences of the inequitable workforce in traumatic brain injury that could potentially contribute to more equitable outcomes. The most immediately feasible of these is validation and establishment of objective measures for triage and prognostication that are less susceptible to bias than current protocols. We call for incorporation of gender and race neutral metrics for TBI evaluation to standardize classification of injury. We offer insights into how socioeconomic factors contribute to increased death rates from women and minority groups. We propose the need to study how these disparities are caused by unfair health insurance reimbursement practices. Surgical and clinical research inequities have dire consequences, and until those inequities can be corrected, mitigation of those consequences requires system wide change.

KEYWORDS

sex, race, mortality, concussion, clinical research, machine learning traumatic brain injury, inequity

## Introduction

Neurosurgery is the discipline of medicine that is most acutely involved in the care of brain injured patients, and it is among the least diverse of all medical specialties, rivaled most closely by orthopedics and cardiac surgery. Women represent approximately 6% ($n = 259/4,178$) (1) and black neurosurgeons represent approximately 4% ($n = 183/4,178$) (2) of all board-certified neurosurgeons in the United States (3). Lack of mentorship for junior female and minority surgeons remains an issue as there are

only 33 female full professors of neurosurgery in the United States (1) (4% of the field), and an unknown number of black full professors of neurosurgery. Retention of both female and minority talent in neurosurgery remains a significant problem. Women achieve board certification at a rate between 63% and 70% (4, 5) while men are certified at a rate of 81% (4) which effectively prevents the number of female mentors from increasing commensurately with the number of female residents in training. Data on minority attrition in neurosurgery is not currently available. These workforce inequities have grave consequences for patients.

This paper examines gender and racial disparities in the field of traumatic brain injury (TBI) as a model for understanding the consequences of an inequitable workforce. Women and people of color are more likely to sustain a violent TBI (6, 7) but less likely to seek care (8). They are more likely to receive less aggressive care than others (9) and be assessed by a trainee rather than a credentialed physician (10). They are less likely to participate in post-injury rehabilitation (11) or enter a clinical trial (7, 12–14), perhaps due to reasons ranging from historical abuse, socioeconomic and education status, along with reluctance to trust a medical research system that does not treat even its own minority members equitably (15–19). People of color are up to twice as unlikely to survive their brain injury than people who are white (10, 20–23). Those who do survive an initial brain injury are more likely to commit suicide after "recovery" (21, 24) than their white counterparts.

How studies are constructed and whether they specifically analyze factors such as sex or race in outcomes is known to significantly impact the validity and applicability of the data. When studies fail at this, there is less chance for systemic improvement and improved patient outcomes. We present an analysis of TBI studies to identify opportunities for equitable improvements in the care of brain injured people. This approach was chosen to identify problems that collectively reflect deficits present in large systems rather than at a single institution or hospital center.

# Methods

## Identifying NIH funded TBI clinical trials

While ClinicalTrials.gov included NIH funding as a data point, NIH funding was also cross checked using the NIH RePORTER database. Within this module, a query was executed for TBI clinical studies using the Text Search filter and Fiscal Year filter. The following logic statement was used for the text search: "TBI" OR "traumatic brain injury" OR "head injury" OR "concussion" OR "brain injury". All fiscal years, from Active Projects through 1985, were selected under the fiscal year project. The NIH RePORTER query resulted in 24,580 projects and 659 clinical studies. After manual review of all the clinical studies, only 69 of the trials were determined to be true TBI clinical trials. Gender and race was assigned to TBI primary investigators and authors using publicly available information provided by the author and/or investigator based on their employers websites and relevant public databases.

## Determining publication status

Publication status and publication date was determined by manually searching ClinicalTrials.Gov and PubMed. Each trial was reviewed on ClinicalTrials.gov by querying ClinicalTrials.gov with the NCT number of the trial. If there was a publication of results listed for the trial, the study was considered to be positive for having a publication. If a publication of results was not listed in the trial, the NCT number was then queried on PubMed. If the query resulted in publications, the publications listed were then reviewed to ensure they were publishing results of the clinical trial, rather than just referencing it. For example, a published paper may reference an ongoing study whose results may be interesting to the authors of the paper. In this case, the publication would not be considered as a positive publication of that study. If no publications resulted from the NCT trial number query, PubMed was queried with each investigator name listed on ClinicalTrials.gov. The following query was used on PubMed: "investigator first name and last name [au]". All papers of the investigator from the most recent back to the clinical trial start date being searched was reviewed to determine if there was a publication of the trial results.

## Analysis

The following variables listed in ClinicalTrials.gov were analyzed: trial status, if study results were posted, intervention category, trial phase, NIH funding, and age of trial participants. The following variables extracted from ACCT database were also used in the analysis: months from primary completion date to results first posted on ClinicalTrials.gov and result reference posting. Continuous results were reported as mean ± standard deviation. Discrete results were reported as numbers and % of total. Means from 2 samples were compared by *t*-test. Proportions for discrete variables were analyzed by $\chi^2$ tests.

Probability of publication was modeled with a logistic regression using variables that were found to be significant

per the *t*-test or the chi-squared test. A second logistic regression with less explanatory variables was subsequently used. In the second regression, only the enrollment variable and the variables noted as being significant in the first regression model were used. For all analyses, missing values were dropped. Twelve observations had extreme outliers, values greater than the 99th percentile, in the enrollment variable. In cases where the enrollment variable was analyzed, those seven observations were dropped.

# Results

## Identified racial and gender disparities in studies

The National Institute of Health (NIH)-funded TBI clinical trials are predominantly conducted by white men and disproportionately enroll white and male populations (**Table 1**) (14). TBI primary investigators or corresponding authors were 86·5% White and 59·5% male. Based on associations and available data, we estimate that the first authors from the resulting publications were 92.6% White, with gender undetermined due to lack of publicly available information.

A majority of the TBI studies did not include racial or ethnic demographics. Most studies did report gender and overwhelmingly male participants (68%). 64·4% of NIH-funded TBI clinical trials did not report or recruit any black subjects and this number was even higher for other races and the Hispanic ethnicity. We analyzed demographic statistics from all reporting TBI clinical trials, determined the number of participants by race, ethnicity, and gender, and calculated the percent from the total number of participants. Our analysis shows that 9.9% of enrolled TBI clinical trial subjects were black people but 19% of mortalities occur among that racial group (14). White people represented 65·3% of study participants but only 52.0% of mortalities.

## Factors potentially impacting study enrollment

Our analysis found that participants of TBI clinical trials require on average 12 days of commitment. Many TBI clinical trials also required phone calls for follow up visits and specifically excluded non-English speakers. Clinical trials that require significant time (12 days) and numerous follow up sessions may exacerbate systemic inequities (transportation issues, pregnancy, childcare, access to healthcare) found by women and people of color.

# Discussion

## Inequities in clinical trial participants and surgical workforce diversities contribute to two-fold increase in the death rate of minorities

Despite advances by women and people of color in the medical field, and the increasing attention to how these factors impact the quality of healthcare, significant disparities persist with regards to brain injury. The consequences of these inequities are grave. The status quo is that people of color are approximately twice as likely as white people to die from brain injury. Our analysis suggests that current hierarchies for funding and conducting research in brain injury are not mitigating the problem. They reveal the stark need to rethink many aspects of how we conduct research and how this translates into the everyday care we provide for our patients.

While the bias toward white males recruited and enrolled in TBI clinical trials may be partially accounted for by subjects' willingness to engage with the healthcare system and attend follow-up appointments, other factors must also be addressed.

Many of the problems contributing to inequity for brain injury are common to other conditions in healthcare but are exacerbated by a field that has uniquely fewer objective measures, greater opportunity for financial inequity to impact outcome, and far less diversity.

## Healthcare inequities are caused by lack of objective measures despite numerous on-going clinical trials

Our review of all clinical trials in traumatic brain injury revealed inclusion of patients in clinical trials is often predicated on classification of injury severity with the Glasgow Coma (GCS) Scale score. A recent NASEM report focused on the GCS as an important classifier for brain injury (25). One potential point at which bias in the quality of care is introduced is pre- hospital and at the level of triage, which is prior to being seen by neurosurgery. Minority individuals presenting with impaired mental status or documented decreased GCS might more often have their altered examination falsely attributed to intoxication or cultural differences rather than brain injury, leading to delays in recognition of brain injury. **To mitigate this inequity, one might contemplate incorporation of a triage system that incorporates more objective measures, rather than GCS.** Patients that are not awake might undergo pupillometry, which is currently under investigation as a triage tool, and an immediate serum marker analysis as numerous studies now

TABLE 1 Demographic reporting from NIH funded TBI clinical trials.

| Race/Ethnicity/ Gender | Black | American Indian or Alaska Native | Asian | Native Hawaiian | Two or more races | His panic | White | Other or Minority group | Male | Female |
|---|---|---|---|---|---|---|---|---|---|---|
| Count (*n*) from NIH-funded TBI trials | 638 | 24 | 51 | 22 | 44 | 688 | 4190 | 1452 | 7913 | 3731 |
| % Race/Ethnicity/ Gender | 9·9 | 0·4 | 0·8 | 0·3 | 0·7 | 10·7 | 65·3 | 22·6 | 68·0 | 32·0 |
| % Demographics of TBI patients seen in trauma center | 12·3 | 0·0 | 0·0 | 0·0 | 0·0 | 11·3 | 63·1 | 8·0 | 63·9 | 36·1 |
| % Demographics of TBI mortality | 19·0 | 0·0 | 0·0 | 0·0 | 0·0 | 13·0 | 52·0 | 5·0 | 73·0 | 27·0 |
| % Census Data | 13·4 | 1·3 | 5·9 | 0·2 | 2·8 | 18·5 | 76·3 | | 49·2 | 50·8 |
| % of NIH-funded TBI trials not reporting demographics | 64·4 | 84·4 | 84·4 | 88·9 | 84·4 | 80·0 | 42·2 | 62·2 | 17·8 | 17·8 |

Race, ethnicity, and gender demographics are reported as percentage. STD is the standard deviation. General population and TBI statistics are from the Census or CDC, respectively.

demonstrate this to be an accurate means of identifying vascular injury in the brain though it has not been validated for triage (20–22). Patients who are awake could undergo a rapid automated digital neurological examination (26–29). Patients who are awake could undergo a rapid automated digital neurological examination including assessment of the cranial nerves, such as afforded by an eye tracking system that assesses cranial nerves 2 through 7, their nuclei and inputs *via* pupillometry, ocular motility and blink (30–33). Regardless of the mental status of the patient, standard criteria for obtaining a CT scan should be reassessed to ensure lack of bias (34, 35). Clinical trials to ensure the efficacy and objectivity of objective screening measures in a diverse population are warranted prior to wide utilization as it is critical to avoid introduction of objective measures that still perpetuate systemic inequalities. We do not yet know if serum markers, pupillometry or eye tracking are as accurate in people of color as they are in white people.

Incorporation of objective measures for brain injury has the potential to alter the status quo. Imagine the hypothetical scenario of a patient arriving in an emergency department with brain trauma. The perfect scenario is clairvoyant prognostication: a surgeon is able to predict who will have a wretched prognosis regardless of intervention and therefore they do not operate on those destined to be futile. The surgeon will also be able to predict who will benefit from an operation and thus does not risk morbidity/mortality by doing an operation that is theoretically unnecessary. In reality, prognostication can be difficult. A surgeon may overestimate the likelihood of inevitable death, and in predicting a poor outcome ultimately causes it to become inevitable by failing to intervene. Conversely, a surgeon may fail to predict a poor outcome and offer a surgery that ultimately results in survival with a persistent disabling deficit. Another undesirable scenario is that a surgeon may subject a patient who ultimately might have survived without surgery to an unnecessary procedure to avoid missing any of the patients who would benefit from surgery, risking unnecessary morbidity or mortality in that patient. Imposition of physician biases and expectations about patient outcomes on this rubric exacerbates inequity.

Uncomfortable as it may be to acknowledge, the "aggressiveness" of some healthcare personnel in evaluating these patients might be a function of how they perceive that patient will do - their expected mortality, their quality of life, their likelihood of being a burden on society, and their capacity to contribute if disabled by a potentially highly morbid brain injury. It has been established that people with lower education level/ socioeconomic status and non-white race are more likely to have poor outcomes after brain injury. **Thus, implicit bias and "ableism" may render surgeons less likely to operate on people who are perceived to be less educated, disabled, poor, or minorities, as they will be more likely to have a poor outcome.** Such factors may be difficult to assess in a trauma situation, and sadly, poor prognostication of brain injury becomes a self-fulfilling prophecy. These implicit biases may be more likely to be perpetuated by a workforce that is culturally dissonant with the patients they are treating. The subconsciously racist, sexist, ableist and classist surgeon may be particularly susceptible to bias.

## Can artificial intelligence or advanced automation correct these inequities?

How can this inequity be corrected? We would argue that a necessary first step to correct the problem is by building

accurate prognostication algorithms that are objective and agnostic to language, race, wealth, disability, or education. Such algorithms will likely require a combination of physiologic, molecular, and radiographic measures. Further development of these algorithms could potentially reduce implicit biases in the management of brain injury and improve outcomes for all patients, although great care must be taken to make sure that the algorithms are themselves not biased. Examples of assessors to include in these prognosticating algorithms include measures of brainstem function such as pupillometry, eye tracking or other quantitative cranial nerve function (30–33), serum markers (26), and image analysis (36–39). These are measures that should potentially be able to be confirmed as "colorblind." Volitional assessments that rely on physician bias, level of patient education, cooperation, absence of cultural dissonance and language skills will likely contribute to inequity.

The utilization of objective measures with machine learning (artificial intelligence) has the potential to reduce inequities in the neurosurgical field through automation, improved accuracy, speed, accessibility, and reduced costs (34–36). A major caveat is that we need to ensure that data elements incorporated into future algorithms do not perpetuate inequity (40–42). Yet, we find the implicit bias currently found in healthcare is further propagated by machine learning due to systemic inequities. An example is that current pulse-oximeters are less accurate in people with dark skin and regulation does not exist to ensure equitable manufacturing of medical devices (43). Gender inequalities in TBI research are multiple such as a standard exclusion factor of pregnancy, nearly all studies focused on males due to increase frequency of head injuries, and overall lack of female-focused therapies. The use of machine learning should eliminate bias and standardize research outcomes (44–46), however, the aforementioned inequities that exist in medical technological and the overwhelming gender and racial bias that currently exists in TBI clinical research datasets (47, 48), produces a perpetual cycle of healthcare improving outcomes for white men but not necessarily for women and people of color.

The National Institutes of Health and other funding agencies with a vested interest in more equitable care should make the funding of research investigating unbiased objective measures for triage and prognostication algorithms a priority to promote equitable outcomes in brain injury.

## Insurance reimbursements for brain injuries causes surgeon burnout and bias toward white males' patient recruitment

The structure of the American healthcare system is such that insurance companies, Medicare and Medicaid currently reimburse at higher levels for human pathologies that can be objectively measured and are treated with surgery or technologies that rely on device or pharmaceutical intervention. Because brain injury may not always be apparent on conventional imaging, and the lack of objective measures makes it difficult to evaluate and validate therapeutics, financial reimbursement is poor. The ramifications of poor reimbursement include de-prioritization by clinical healthcare systems and increased out-of-pocket costs that ultimately lead to better outcomes in people who can afford to pay for care beyond what insurance will provide. Increased validation of objective measures for injury begins with reimbursement, and eventually will result in effective therapeutics.

Despite the extraordinarily high volume and cost to society of morbidity and mortality from TBI in the U.S., neurotrauma as a specialty is underserved and often not considered as desirable as many of the other neurosurgical specialties. Some of this relates to compensation and some relates to the emergency nature of the work that can impact career satisfaction and burnout. These are challenging economic issues that will likely require legislative intervention to solve.

## Correcting the lack of diversity in the neurosurgical workforce requires systemic change

Women and minorities are under-represented in medicine at progressively disproportionate levels, while white men from wealthy backgrounds are most likely to matriculate into medical school (49). Efforts must be made to correct this inequity. Linkage of national neurosurgical program ranking (48), residency accreditation or ACGME (American College of Graduate Medical Education) (49) funding to hiring, retention and promotion of female and minority residents and faculty might improve these percentages. In addition, since a majority of women and minorities who leave academia likely do so without addressing the problems that drove them out due to fear of retaliation or other adverse consequences (50), organized neurosurgery might consider developing a confidential and anonymous "exit interview" mechanism to identify problems that might be corrected in the future. Finally, the National Institutes of Health should execute its proposed strategy (51) for improving minority participation in research, ensuring that projects proposed by minorities are mentored into funding, and that women and people of color are studied at ratios representative of their likelihood of injury.

Reduction of clinical trial burden (time, number of visits) might make participation for minorities more viable. At a minimum, all NIH funded studies should be disclosing the racial and gender distribution of their research subjects. In addition, the NIH should alter their methods for classifying race and gender as many people have mixed race or binary gender and may be unsure which box to check. Racial and gender inequities in healthcare need to be scrutinized and

studied, yet limited research exists on the connections between health insurance reimbursement, socio-economic status and patient outcomes after injury. Research funding must be made available to understand the current state of health care inequities and overcome the bias caused by unfair health insurance practices.

The exodus of women and minorities from healthcare has been described as burnout (52), as moral injury (53), and as death by 1,000 papercuts (54). We would argue that the reason some women or minorities might leave is that they see the status quo, they try to change it and develop the sensation of screaming into a void as the obstacles they encounter are rooted in hierarchical structures and financial hurdles that are insurmountable. Women and minorities in healthcare may work harder and engage in status leveling (55) but are paid less than white men for the same work (56), are harassed more (50), and experience entitling (57), and role incredulity (58). The combination of these injustices along with being asked to be complicit in a system that gaslights and does not provide the same standard of care for all members of society (59) may be morally unconscionable to some women and minorities and potentially impact their decision to leave healthcare.

## Conclusions

The neurosurgical workforce is overwhelmingly white and male. The consequences of this workforce inequity is felt most strongly in a field such as brain injury, which lacks objective measures and classification schemes. Lack of diversity in clinical research teams from leadership to medical students continually perpetuates the inequities engrained into healthcare. It is much harder for minorities to be promoted or receive recognition due to this. Further, the lack of diversity creates implicit bias in clinical research because the demographics of patients recruited into a clinical trial do not represent the real world. As out analysis shows, this results in unfavorable healthcare for minorities. Outcomes after brain injury are worse for minority and female populations due to systemic inequities in healthcare leadership, research participation and every aspect of patient care from triage to rehabilitation. Multiple strategies are needed to correct these inequities including validation of objective measures for the triage and prognostication of brain injured patients. Development of machine learning and artificial intelligence algorithms may reduce inequity if precautions are taken against the incorporation of measures influenced by race, gender or other factors creating bias. Aspects of the inequities associated with brain injury are common to most of the healthcare system and require fundamental shifts in how healthcare is conducted.

## Author contributions

US led the study. SV, MB, TS, and KS performed literature searches, collected data, analyzed, data, and interpreted results. All authors contributed to the article and approved the submitted version.

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## Publisher's note



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