



Gender Disparities and Their Impact on the Professional Experiences of Female Neurosurgery Residents in Germany: A Cross-Sectional Survey

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■ **BACKGROUND:** Despite advancements in gender equality within neurosurgery, the field continues to encounter challenges related to the under-representation of women and reports of gender-based disparities. This study examines the impact of these disparities on the experiences, professional development, and well-being of female neurosurgery residents in Germany, identifying specific challenges within the neurosurgical community.

■ **METHODS:** An anonymous, questionnaire-based survey was conducted among female neurosurgery residents from various German training hospitals nationwide, using a quantitative approach. Data were collected from June 2021 to January 2023.

■ **RESULTS:** A total of 63 female neurosurgery residents participated, representing about 19% of all female neurosurgery residents in Germany. Seventy percent reported experiencing incidents of discrimination during training, with 39% encountering “sometimes” emotional abuse, 20% physical abuse, and 17% “rarely” experiencing sexual harassment. Eighty-six percent did not report these incidents, primarily due to doubts about reporting effectiveness (24%) and the belief that reporting would not lead to change (24%). Discrimination significantly impacted job satisfaction (56%) and career progression (71%). Additionally, 60% reported frequent frustration, 52% experienced occasional depression, and burnout was common.

■ **CONCLUSIONS:** The survey highlights gender disparities affecting female neurosurgery residents in Germany, negatively influencing job satisfaction and career advancement. Tackling gender discrimination and harassment requires a multifaceted approach, and further studies are warranted to assess these methods. The neurosurgical community must ensure a supportive environment by adopting no-tolerance policies against discrimination for all residents, paving the way for a future where professional excellence and patient care are free from gender inequalities.

INTRODUCTION

In 1993, almost 70 years after Alice Rosenstein (1898–1991) practiced medicine as the first female neurosurgeon in Germany in the 1920s, the academic medical field welcomed its first female neurosurgery department director, Gabriele Schackert.^{1,2} Despite this significant milestone, gender disparities remain evident in some neurosurgery departments more than 3 decades later.^{3–5} According to recent research by Foster et al., female neurosurgeons comprised 28% of the 2324 neurosurgeons working across 140 German neurosurgical departments.⁵ This percentage places neurosurgery relatively in the upper range of female representation compared to other surgical specialties in Germany, such as vascular surgery (17%), general surgery (18%),

Key words

- Female residents
- Gender discrimination
- Germany
- Mentorship
- Neurosurgical training
- Workplace environment

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and plastic surgery (23%).⁶ Current data also indicate that, as of 2021, there are 338 female neurosurgery trainees in Germany, representing 35% of neurosurgery residents.⁵ Although the literature shows that female applying for residency possess the same academic qualifications as their male counterparts,⁷ they still face disparities in their training, which extend beyond mere representation in neurosurgery, affecting the quality of their training experiences, professional development, and overall well-being.⁸ Factors such as mentorship opportunities, daily interactions with colleagues, and the general training environment play critical roles in shaping these experiences. Mentorship is a cornerstone of medical training, offering guidance, support, and opportunities for professional growth. However, the scarcity of female mentors in neurosurgery poses a significant barrier for female residents,⁹ limiting their access to role models who have navigated similar challenges. This gap not only affects their professional trajectory but also impacts their sense of belonging within the neurosurgical community.^{10–14} Furthermore, interactions within the neurosurgical department, from daily consultations to operative teamwork, are critical in shaping a resident's competence and confidence. Yet, female residents may sometimes encounter biases in these interactions, ranging from subtle doubts about their capabilities to overt discrimination.^{15–18} Such an environment could potentially impede their professional growth and contribute to a less diverse and innovative culture. The influence of gender-based challenges in neurosurgery extends beyond individual experiences, potentially impacting career development and sense of belonging within the field. This is reflected in the persistent gender gap in leadership positions, where only 7.8% of a director-level position in Neurosurgery in Germany are females.¹⁹ Consistently, in the United States, the proportion of women with a full professorship in neurosurgery was only 4% in 2018.^{9,20} Additionally, the pressures associated with navigating such environments could also affect the psychological well-being of female residents and potentially impact the quality of patient care.²¹ Although no data are currently available from Germany, the literature indicates that female surgical residents face a notably higher dropout rate than their male counterparts.^{22,23} In the United States, for example, the dropout rate for women in surgical training is 24%, compared to only 17% for men.²⁴ This study aims to fill a gap in the research on the experiences of female neurosurgery residents in Germany, with a particular focus on gender disparities, the importance of mentorship, interactions with colleagues, and the impact of these factors on their career and well-being.

METHODS

Study Design, Data Collection, and Statistical Analysis

This cross-sectional survey study used an anonymous questionnaire to collect data from female neurosurgery residents across Germany. The distribution of the questionnaire was facilitated by the German Society of Neurosurgery, leveraging their community network. The questionnaire was also distributed via e-mail links to female neurosurgery residents who were not members of the German Society of Neurosurgery. This sample size was calculated to achieve a 90% confidence level, with a margin of error of plus or

minus 9%. The survey was piloted with 10 residents (about 15% of the total interview) to identify and address issues related to question clarity, survey length, and overall design. The participants represented a diverse range of hospital settings, including university hospitals, private hospitals, and community hospitals. Using a questionnaire, we gathered comprehensive data spanning demographic information, types of discrimination encountered, the impact of these experiences, and challenges related to reporting incidents (Supplement Content 1). The data collection period spanned from June 2021 to January 2023. This study was conducted according to the Checklist for Reporting of Survey Studies (Supplement Content 2). Verbal or emotional abuse included any behavior that caused psychological distress, such as insults or intimidation. Sexual harassment included unwanted sexual advances, comments, or behaviors creating a hostile work environment. Physical abuse was defined as any intentional physical force causing harm. We selected frustration, depression, and burnout as psychological outcomes due to their prominence in existing literature on resident well-being as well as their clinical relevance and as they allow comparability of our findings with existing research in the field.

For the statistical analysis, R Studio (version 4.3.2) was employed to process the collected data. The analysis focused on comparing patterns and correlations between the reported experiences of discrimination and their impacts on the respondents' professional development and well-being by using a combination of χ^2 test to assess the significance of differences between groups and percentage comparisons for a straightforward representation of the data. Statistical significance was set at $P < 0.05$.

ETHICAL CONSIDERATIONS

In compliance with the anonymous design of the study, where no personal or sensitive data were collected, this study was exempted from ethical review as per paragraph 15 of the Professional Code for Physicians in Thuringia, Germany. This exemption is in line with ethical guidelines for research involving human subjects. The guidelines stipulate that due to the anonymity of the data collected in this study, obtaining consent from participants is not requisite. Documentation confirming the exemption is available and can be provided upon request. All methods were carried out in accordance with relevant guidelines and regulations.

RESULTS

The total number of female residents surveyed was 63. Among them, 33% were in years 1–2 of training, 22% in years 3–4, 26% in years 5–6, and 19% had been in training for more than 6 years (Table 1). Regarding relationship status, 62% were married or in a relationship, and 81% did not have children. The majority (59%) worked in university hospitals, followed by 28% in community hospitals and 12% in private hospitals. Most respondents identified as White, with other ethnicities represented as Asian, Arab, Hispanic, and Black (Table 1). The program locations varied, with 40% in the South of Germany, 27% in the West, 17% in the North, and 16% in the East. Overall, 70% of the residents reported experiencing discrimination due to gender at some point in their training.

Table 1. Demographic and Professional Characteristics of the Group

Characteristics	N (%)
Total number	63 (100%)
Training year	
1–2	21 (33%)
3–4	14 (22%)
5–6	16 (26%)
>6	12 (19%)
Relationship status	
Married or in a relationship	39 (62%)
Not in a relationship	21 (33%)
Divorced or widowed	3 (5%)
Type of the hospital	
University hospital	37 (59%)
Community hospital	18 (28.5%)
Private hospital	8 (12.5%)
Children	
No children	51 (81%)
One child	8 (12.5%)
More than 1 child	4 (6.5%)
Ethnicity	
White	43 (68%)
Black	3 (5%)
Asian	9 (14%)
Arabic	4 (6.5%)
Hispanic	4 (6.5%)
Program location*	
North	11 (17%)
South	25 (40%)
East	10 (16%)
West	17 (27%)
Do you experience gender discrimination	
Yes	44 (70%)
No	19 (30%)

*North = Schleswig-Holstein, Hamburg, Lower Saxony, Bremen; South = Thuringia, Baden-Württemberg, Bavaria; West = North Rhine-Westphalia, Hessen, Rhineland Palatinate; East = Mecklenburg Western Pomerania, Brandenburg, Saxony-Anhalt, Berlin.

Regarding the perceived subjective frequency of fewer opportunities compared to male colleagues among female neurosurgery residents by ethnicity, the data show that a proportion of residents, particularly those from minority ethnic groups, perceive

frequent inequities (Figure 1). Hispanic residents notably report “often” feeling they have fewer opportunities, while a substantial number of White, Asian, and Black residents perceive this disparity as occurring “sometimes”.

Furthermore, 39% of respondents “sometimes” experienced verbal or emotional abuse during training, while 9% experienced it “often” (Table 2). Regarding physical abuse, most respondents stated they rarely experienced it. Concerning sexual harassment, the majority reported never experiencing it, although 5% stated they sometimes did. The most frequently felt emotions following abuse incidents were frustration and embarrassment.

The highest percentage of verbal or emotional abuse came from patients or their families (35%), followed by co-residents (26%). Physical abuse was also most frequently reported from patients or their families (50%), as was sexual harassment (50%) (Table 3).

Concerning frequency and types of sexual misconduct faced by neurosurgery residents, nearly half of the respondents reported they “never” experienced sexual comments, while 63% stated they never encountered sexual gestures (Table 4). A minority experienced unwanted sexual contact or physical touch “sometimes.” Most respondents never experienced unwanted exposure to pornographic material, although 12% reported “rarely” encountering it. Consistently, most never faced subtle sexual bribery.

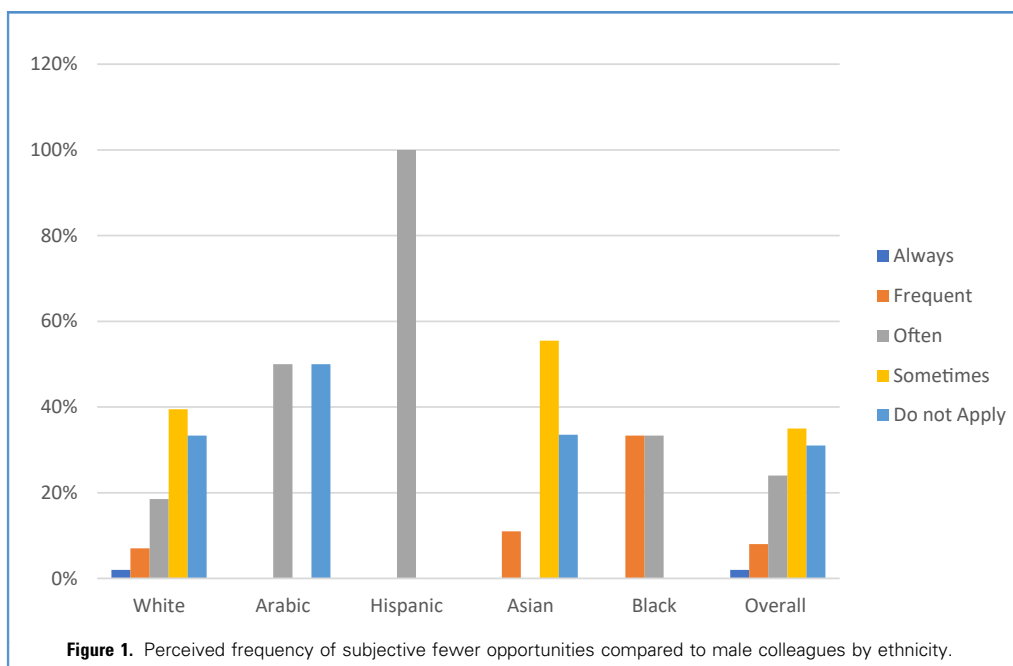
60% of respondents “frequently” feel frustration, 27% experience depression, and another 27% feel frequent burnout, although some respondents reported never experiencing these feelings (Table 5).

Regarding the negative impact of discrimination on various aspects of female neurosurgery residents’ careers, more than half of the respondents reported discrimination affected respect/value in the surgical team, job satisfaction, and operation opportunities according to level, while 30% indicated it impacted the quality of patient care (Figure 2). Notably, 71% reported that discrimination affected their access to leadership positions, and 61% reported an impact on the selection of subspecialty.

Most female neurosurgery residents did not report incidents of maltreatment or discrimination; 86% (54 residents) responded “No” when asked if they reported such incidents, while only 14% (9 residents) stated that they had reported them. The main reasons for female neurosurgery residents to not report maltreatment or discrimination include feeling it wasn’t worth reporting (53%), believing that reporting would make no difference (24%), and concerns about fair treatment (5%). Other reasons include uncertainty about reporting channels (5%), personal preference for coping (8%), and fear of jeopardizing their career (2%) (Figure 3).

DISCUSSION

Our study sheds light on the experiences of female neurosurgery residents in Germany, revealing issues related to gender disparities. Key challenges identified include limited mentorship opportunities, a difficult working environment, and a notable lack of incident reporting. These findings suggest that there is a need for targeted measures to support female residents during their training, ensuring equitable opportunities and an improved working environment.



Despite significant advancements in academic and professional fields over the past 2 decades, suggesting that women have shattered the proverbial glass ceiling,²⁵ challenges remain within surgical training, including neurosurgery. Our findings reveal a persistent challenge: approximately 70% of female respondents reported experiencing gender-based disparities during their training. This figure is high and aligns with the global context, as evidenced by the work of Bruce et al., which uncovered that 88% of female surgical residents in United States faced gender-based discrimination.²⁶ Consistently, a recent study by Choi et al. in Korea reported that women are significantly more likely to experience discrimination during their surgical training period.²⁷ Discrimination manifests in several facets of the training period, notably in reduced opportunities for surgical hands-on experience, teaching, and academic advancement for female neurosurgery residents.¹

Despite the prohibition of gender discrimination under German law, the issue remains complex and pervasive. This challenge can be seen also in the field of neurosurgical training, where there is already a marked gender imbalance in recruitment. Data from the German Society of Neurosurgery show that

between 65% and 75% of residency positions are filled by men, highlighting the disparity.¹ Although disparities can affect all genders, the literature in surgery shows that females are significantly more likely than males to encounter such disparities throughout their careers.^{28,29} Despite the demanding nature of neurosurgery and concerns about work-life balance may discourage women from entering the field, prejudices against female neurosurgeons—whether conscious or unconscious—further exacerbate the situation.³⁰ The hiring process is sometimes influenced by the assumption that motherhood will interfere with professional responsibilities, or doubts about women's physical endurance.³¹ Additionally, the scarcity of female mentorship, essential for supporting and empowering young female trainees, plays a significant role in maintaining gender imbalance. Scerrati et al.'s recent survey in Italy highlighted this issue, finding that only 11% of their 98 female respondents in neurosurgery had a female mentor at any point in their career.³² Furthermore, literature indicates that a challenging work environment can exacerbate gender disparities, contributing to an unwelcoming atmosphere for women in neurosurgery.³³

Table 2. Frequency of Experiencing Different Types of Discrimination During the Training Program and the Most Commonly Reported Emotions Following These Experiences

Type of Discrimination	Never	Rarely	Sometimes	Often	Frequently	Most Common Emotion
Verbal or emotional abuse	5 (7.9%)	23 (36.5%)	25 (39.6%)	6 (9.5%)	4 (6.3%)	Frustration: 56.8% Embarrassment: 19.6%
Physical abuse	17 (28.5%)	25 (69.4%)	13 (20.6%)	7 (19.4%)	0	
Sexual harassment	49 (77.7%)	11 (17.4%)	3 (4.9%)	0	0	

Table 3. Sources of Harassment During the Training Period*

Source of Harassment	Verbal or Emotional Abuse (%)	Physical Abuse (%)	Sexual Harassment (%)
Patient or patient's family	20 (35%)	23 (50%)	7 (50%)
Senior colleague/supervisor	9 (17%)	10 (21.4%)	4 (28.5%)
Co-resident	15 (26%)	0	3 (21.4%)
Nurses or other staff	11 (20%)	0	0
Unidentified source	3 (2%)	13 (28.5%)	0

*P value = 0.026, indicates the statistical difference in the occurrence of harassment between incidents involving 'Patient or patient's family' compared to all other categories combined.

Our collected data indicate that the primary sources of reported harassment stem from patients and their families, followed closely by senior colleagues. This finding aligns with a survey by Phillips et al. among female physicians in the United States, where more than three quarters of respondents reported experiencing sexual harassment from patients at least once, making patients the most common source of harassment.³⁴ Similarly, a recent survey among women in US neurosurgery by Benzil et al. found that two thirds of respondents had witnessed sexual harassment, with individuals in superior positions most often cited as the offenders.¹¹ The literature on gender discrimination in neurosurgery from a European perspective, particularly among residents, is limited. However, the survey by Scerrati et al. in Italy showed that 45% of female respondents rarely experienced harassment.³² Several factors contribute to harassment of female doctors by patients or co-patients, including gender stereotypes, which may lead some patients to believe men are more competent in scientific and leadership role.^{35,36} Perceived power imbalances can embolden patients to behave inappropriately toward female healthcare providers. The situation is worsened by inadequate training on maintaining professional boundaries and addressing harassment, coupled

Table 4. Frequency and Types of Sexual Misconduct Experienced During Residency Training

Type of Sexual Misconduct	Never	Rarely	Sometimes	Often
Sexual comments	26 (41.2%)	21 (33.3%)	14 (22.2%)	2 (3.2%)
Sexual gestures	40 (63.4%)	20 (31.8%)	2 (3%)	1 (2%)
Unwanted sexual contact/physical touch	47 (75%)	11 (18%)	2 (3%)	1 (2%)
Unwanted exposure to pornographic material	55 (88%)	8 (12%)	0	0
Subtle sexual bribery	51 (90%)	11 (16.6%)	1 (2.3%)	0

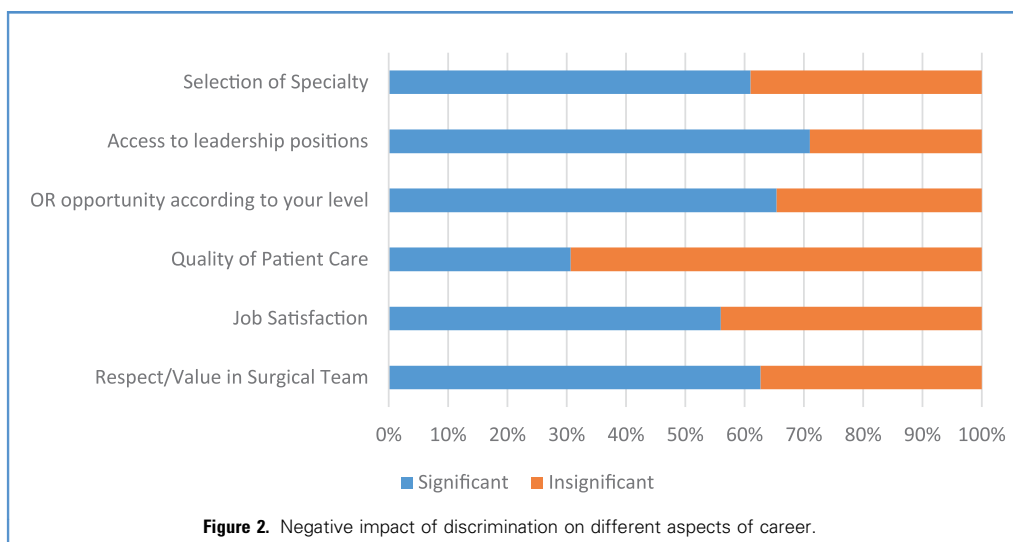
Table 5. How Often do the Female Neurosurgery Residents Experience the Following Feelings "Frustration, Depression, and Burnout" During Their Residency Period*

Psychological Response	Frequent	Occasional	Never
Frustration	38 (60.3%)	19 (30.1%)	6 (9.5%)
Depression	17 (27%)	33 (52.3%)	13 (20.6%)
Burnout	17 (27%)	25 (39.6%)	21 (33.3%)

*P value: 0.00001 indicates the statistical association between the types of psychological responses (Frustration, Depression, and Burnout) and their occurrence frequencies.

with insufficient administrative support.^{36,37} Additionally, patients under stress, fear, or suffering from mental health issues may inappropriately direct their frustrations at healthcare providers, which can lead to harassment or abuse.³⁷ Harassment by colleagues in the medical field often stems from a broader culture of sexism and misogyny, where outdated attitudes toward women persist.³⁸ A major obstacle to combating this issue is the fear of retaliation, as many victims choose not to report harassment due to concerns over inaction or negative repercussions for speaking up. Our survey indicates that 80% of interviewed residents choose not to report harassment, attributing their silence to a belief that reporting is futile and a preference to manage the issue on their own. This reluctance is rooted in an absence of coaching, alongside the absence of clear reporting protocols and concerns over potential stigmatization.³⁹

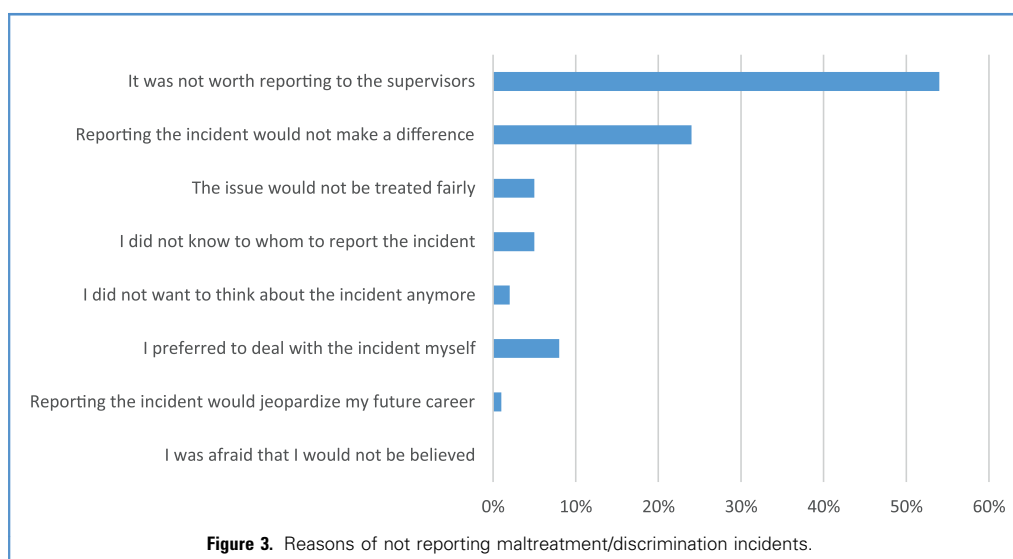
Discrimination against female residents in neurosurgery not only renders the specialty less appealing to them but also potentially contributes to some dropouts during the training period. According to our data, 60% of respondents reported frequent frustration due to discrimination, while nearly half experienced occasional depression and burnout. The study by Hu et al. showed that in the United States, female surgical residents often face emotional exhaustion, with increased incidents of mistreatment directly linked to higher burnout rates, escalating from rare to frequent episodes.⁴⁰ Gender disparities not only undermine the respect of female doctors within their teams but also hamper their future access to leadership roles.^{5,20,21} In Germany, the disparity in leadership roles within neurosurgery is pronounced, with data from the German Society of Neurosurgery from 2021 showing that only 9 (6.3%) of 143 department heads were women.⁵ Our findings suggest that discrimination and harassment could lead to reduced job satisfaction among female neurosurgery residents, which may also have implications—according to the literature—for the quality of patient care.^{21,41} Workplace challenges of this nature may undermine the authority of female doctors, potentially affecting patient trust and communication. These factors contribute to burnout and can impact the mental health and well-being of female residents, which may ultimately influence the standard of patient care. Therefore, addressing gender equality is not only important to ensure fairness but also to foster an environment that supports high-quality research and patient care.⁴²



Eliminating gender disparities in neurosurgery requires the implementation of comprehensive strategies. These include raising awareness about both unconscious and conscious biases among staff, and ensuring transparency in hiring and promotion processes. A commitment to promoting women's careers through active support and encouragement for leadership roles is also important.¹⁶ Additionally, providing professional coaching, establishing clear standards for addressing discrimination, and implementing straightforward reporting mechanisms can effectively support female neurosurgery residents. An example of such mentorship programs is the German organization (Die Chiruginnen e.V. "the female surgeons"), which provides mentorship programs for female residents across all surgical specialties, offering a model that could be adapted for

neurosurgery. Ensuring equal access to surgical and research opportunities, along with establishing mentorship programs that include senior female mentors, are critical steps toward fostering a more inclusive and supportive environment.^{26,43}

This study, as the first survey of female neurosurgery residents in Germany, has both strengths and limitations. The cross-sectional design limits the ability to monitor changes over time, crucial for understanding evolving trends in residency experiences. The relatively small sample size, coupled with decentralized data collection and a low response rate, may introduce response and sampling biases, affecting representativeness and generalizability. The survey recruitment methods could have introduced selection bias. The 1.5-year data collection period, extended by reminders, and reliance on self-reported data could further introduce biases.



The absence of qualitative data, such as in-depth interviews, limits the depth of insight into personal experiences. Additionally, cultural differences in interpreting terms like discrimination and harassment were not accounted for, potentially influencing responses. The overlap with the COVID-19 pandemic might have also skewed results, particularly regarding work hours, stress levels, and burnout. Despite its scope, the study may not fully capture the diverse experiences of all female neurosurgery residents in Germany and may overlook some objective measures, such as the number of operations performed and publications authored by female trainees compared to their male counterparts. Furthermore, our study lacks a direct comparison between genders, limiting our ability to fully understand gender-specific experiences in neurosurgery. To gain a clearer picture, larger-scale studies with larger samples are needed to explore the potential disparities in harassment and psychological distress across different demographic groups and to determine the extent to which these issues may uniquely affect under-represented populations.

CONCLUSION

This study highlights the ongoing disparities and challenges faced by female neurosurgery residents in Germany, indicating that

despite progress, obstacles remain. There is a need for changes to address gender disparities and ensure equitable opportunities within neurosurgery. Prioritizing an inclusive culture, implementing transparent mechanisms to eliminate bias and harassment, and providing equal access to mentor and career support are essential steps. Embracing these changes will help foster a more diverse, inclusive, and equitable future in neurosurgery, where excellence in patient care and professional success are accessible to all regardless of gender.

CRediT AUTHORSHIP CONTRIBUTION STATEMENT

Mazin Omer: Writing – original draft, Methodology, Data curation, Conceptualization. **Thuy Linh Nguyen:** Data curation. **Akram A. Alhamdan:** Investigation, Data curation. **Kathrin Machetanz:** Writing – review & editing, Investigation, Data curation. **Dorothea Nistor-Gallo:** Data curation. **Ina Moritz:** Data curation. **Tatiana Rivera Ramirez:** Formal analysis. **Da Bin Kim:** Writing – original draft, Data curation. **Anna C. Lawson McLean:** Writing – review & editing, Data curation. **Stefanie Maurer:** Investigation, Data curation. **Jussi P. Posti:** Writing – review & editing, Supervision, Data curation.

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