



## African Women in Neurosurgery: An Exploration of Historical Perspectives, Current Realities, and Future Prospects

Naa Adzoa Adzeley Boi-Dsane<sup>1</sup>, Pooja Venkatesh<sup>2</sup>, Pearl Tenkorang<sup>3</sup>, Oluwaseun Omoba<sup>4</sup>, Bernice Limann<sup>3</sup>, Amoge Opara<sup>2</sup>, Adurape A. Osunjimi<sup>2</sup>, Umaru Barrie<sup>2</sup>, Teddy Totimeh<sup>5</sup>, Ibiwonke Emmanuel<sup>2</sup>, Mabel Banson<sup>6</sup>

■ **BACKGROUND:** Gender disparities remain a significant issue, particularly impacting African women in the field of neurosurgery.

■ **METHODS:** Databases, articles, and perspectives were reviewed to identify challenges faced by African Women in Neurosurgery (AWIN), and explore solutions for recruitment, retention, and career advancement of AWIN.

■ **RESULTS:** In 1982, Africa saw its first female neurosurgeon, with the first female president of the World Federation of Neurosurgical Societies appointed 4 null decades later. Presently, the continent hosts 245 female neurosurgeons, with North Africa comprising the majority at 76.3%, with Algeria notably contributing 72.2% of this total. Southern Africa contributes 7.8%, while West Africa, East Africa, and Central Africa contribute 6.5%, 6.1%, and 3.3%, respectively. Thirteen countries lack neurosurgeons entirely and 30 out of the 54 African nations face shortages of female neurosurgeons, with distributions as follows: North Africa (1-country), Southern Africa (6-countries), West Africa (8-countries), East Africa (9-countries), and Central Africa (6-countries). Our analysis mapped the distribution of 245 AWIN across the African regions and examined the professional trajectories and achievements of 17 pioneering AWIN. Additionally, we compiled registries for: 1) 76 neurosurgical training programs across 26 African countries, 2) organizations tackling gender

disparities in neurosurgery, and 3) recommendations to promote AWIN across governmental, community, and academic spheres.

■ **CONCLUSIONS:** To boost AWIN representation in neurosurgery, concerted and comprehensive efforts are vital. Collaboration among medical schools, training programs, and governments is key to fostering diversity and inclusivity in African neurosurgical settings.

### INTRODUCTION TO WOMEN IN NEUROSURGERY: A GLOBAL PERSPECTIVE

Throughout the 20th century, the field of neurosurgery was primarily shaped by male leaders, with Dr. Harvey Cushing earning recognition as the “father of neurosurgery” for his groundbreaking work on brain tumors at Johns Hopkins Hospital.<sup>1</sup> Historical epithets such as this have consequently contributed to the prevailing perception that the field is predominantly male dominated. This perspective began to change in 1943, when Dr. Sofia Ionescu-Ogrezeanu became the first female neurosurgeon.<sup>2</sup> In 2005, Dr. Ionescu-Ogrezeanu received an official nomination from the World Federation of Neurosurgical Societies Congress for her achievements in the field.<sup>3</sup> Her accomplishments served as a powerful demonstration to women throughout the world, showing them that they possessed the capability not only to pursue careers in medicine

#### Key words

- Africa
- African women
- Global neurosurgery
- Neurosurgery
- WINS
- Women in neurosurgery

#### Abbreviations and Acronyms

**AWIN:** African Women in Neurosurgery  
**WINS:** Women in Neurosurgery

From the <sup>1</sup>Department of Obstetrics and Gynecology, University of Ghana Hospital, Legon, Ghana; <sup>2</sup>University of Texas Southwestern Medical Center Department of Neurological Surgery, Dallas, Texas, USA; <sup>3</sup>University of Ghana Medical School, Korle Bu, Ghana; <sup>4</sup>Long

School of Medicine, University of Texas Health Science Center San Antonio, San Antonio, Texas, USA; <sup>5</sup>Accra Medical Centre, Accra, Ghana; and <sup>6</sup>Department of Neurosurgery, Korle Bu Teaching Hospital, Accra, Ghana

Naa Adzoa Adzeley Boi-Dsane and Pooja Venkatesh are co-first authors.

To whom correspondence should be addressed: Pooja Venkatesh, B.S.  
[E-mail: [Pooja.Venkatesh@UTSouthwestern.edu](mailto:Pooja.Venkatesh@UTSouthwestern.edu)]

Citation: *World Neurosurg.* (2024) 191:10-22.  
<https://doi.org/10.1016/j.wneu.2024.07.136>

Journal homepage: [www.journals.elsevier.com/world-neurosurgery](http://www.journals.elsevier.com/world-neurosurgery)

Available online: [www.sciencedirect.com](http://www.sciencedirect.com)

1878-8750/\$ - see front matter © 2024 Elsevier Inc. All rights are reserved, including those for text and data mining, AI training, and similar technologies.

but also to fearlessly explore traditionally male-dominated fields, such as neurosurgery, side by side with their male colleagues. While there are some historical accounts touting Dr. Diana Beck as the first female neurosurgeon, it is worth noting that the existing literature suggests Dr. Ionescu had already established a presence in the field before Dr. Beck's achievements became widely known.<sup>2</sup> Both women, however, deserve recognition for their inspiring impact on young girls and women worldwide.

The accomplishments of Dr. Ionescu-Ogrezeanu and Dr. Beck were soon followed by that of Dr. Alexa Irene Canady, the first African American woman to become a board-certified neurosurgeon in the year 1984.<sup>3-6</sup> Dr. Canady graduated residency with distinction from the University of Minnesota in 1981.<sup>5,6</sup> She was also the first black woman to have her practice approved by the American Board of Neurological Surgery.<sup>6</sup> She disclosed that the most formidable hurdle during her neurosurgery training was convincing herself of her own capability to succeed. This perspective is not surprising, considering the pervasive racial discrimination against black individuals during her training period.<sup>7</sup> Her perseverance in overcoming these obstacles as a woman, in addition to the extra barriers imposed by her race, was a demonstration of her unwavering determination and resilience.

These women, who were pioneers in neurosurgery, demonstrated admirable tenacity. Their experiences and achievements opened doors for other women, including those of color, to follow in their footsteps. After providing a broad introduction to female pioneers in neurosurgery, the subsequent sections of this paper focus specifically on the unique challenges encountered by African Women in Neurosurgery (AWIN). Furthermore, we put forth recommendations aimed at fostering greater participation of this population, thereby promoting diversity, equity, and inclusivity in neurosurgery.

## INTRODUCTION TO AWIN: PAST AND PRESENT

The objectives in this section begin with a comprehensive description of the distribution of female neurosurgeons across the African continent (Table 1, Table 2, Table 3). We conducted a regional analysis, comparing countries with a high number of women in the field to those with minimal or no representation. Then, we selected pioneering AWIN past (Table 4) and present (Table 5) who have made notable and impactful contributions to the field of neurosurgery within their respective countries.

### Breaking Gender Barriers in African Neurosurgery: Exploring North Africa's Leadership in Female Representation Among African Regions

The distribution of female neurosurgeons across the African continent is highly disproportionate (Table 1). Currently, there are approximately 245 African women practicing neurosurgery, and out of them, a remarkable 187 (76.3%) are based in the North African region.<sup>8</sup> This region comprises 6 countries, namely Algeria, Morocco, Egypt, Tunisia, Libya, and Sudan. The concentration of AWIN in North Africa may be attributed to the region's proximity to Europe, the Mediterranean, and Asia, which has likely facilitated early educational opportunities and expertise development. However, despite these factors, these

figures remain insufficient in accounting for the discrepancies observed between countries in this region.

When compared to other nations in Northern Africa, Algeria stands out with the highest count of women neurosurgeons, estimated to be 135 in total.<sup>8,9</sup> Thus, while North Africa possesses 76.3% of the continent's female neurosurgeons, Algeria alone comprises 72% of that number. Predictably, Algeria produced the first female neurosurgeon in Africa, Professor Faiza Lalam. Her achievement earned her the coveted title, "Dean of Women Neurosurgeons".<sup>8,10</sup> In 1982, she held a position as a neurosurgeon at the surgical unit of Tizi Ouzou's University Hospital. In 2011, she was promoted to the rank of professor and assumed the role of departmental head.<sup>8</sup> Dr. Lalam's impact is believed to be a significant factor in the notable presence of female neurosurgeons in the Northern region of Africa. On a larger scale, her influence has served as a catalyst, inspiring African women from various regions to aspire to become neurosurgeons and encouraging them to believe in the possibility of their dreams becoming reality.

In comparison to the United States, Algeria has 37% more women in neurosurgical training programs.<sup>11</sup> In fact, according to the Algerian Society of Neurosurgery, 23% of female neurosurgeons worldwide live in Algeria. The country's commendable results are largely attributed to the intentional and coordinated efforts made towards permeating fields not traditionally dominated by women, such as medicine. Following Algeria, Morocco, Tunisia, and Sudan, account for the most women in neurosurgery (WINS) in the North African region, at 25, 12, and 12 female neurosurgeons, respectively.<sup>8</sup> It is noteworthy that Egypt, also a North African nation, has 1 of the lowest representations of WINS in the continent. The country houses only 3 female neurosurgeons, constituting 1.6% of the North African region's female neurosurgeon population.<sup>9</sup> Nevertheless, it maintains the distinction of being the African nation with the largest count of male neurosurgeons, reaching approximately 500.<sup>8</sup> This figure highlights a notable gender disparity. Additionally, it is noteworthy that Egypt's pioneering female neurosurgeon, Dr. Djamila Kafoufi Benderbous, received her training in Algeria. This underscores Algeria's significant contribution to fostering the increasing representation of female neurosurgeons throughout Africa.

### Central Africa's Neurosurgical Disparity: Examining the Absence of Female Representation and Overall Representation

On the contrary, Central Africa, a region comprised of 9 countries, reports some of the lowest numbers of AWIN in the field of neurosurgery. Notably, 3 countries in this region—the Central African Republic, Equatorial Guinea, and São Tomé and Príncipe—report zero practicing neurosurgeons, male or female, to date,<sup>8-10</sup> as highlighted in (Table 2). In half of the remaining 6 countries in Central Africa, there are no female neurosurgeons reported (Table 3). These countries include Chad, with 3 male neurosurgeons, the Republic of Congo, with 5 male neurosurgeons, and Angola, with fourteen male neurosurgeons. In contrast, Cameroon, another country located in Central Africa, records the highest number of female neurosurgeons in the region, totaling 5. Following Cameroon is Gabon, which has 2 female neurosurgeons. In comparison, the Democratic

**Table 1.** Distribution and Proportion of Female Neurosurgeons Across African Regions

Region of Africa	Countries within the Region	Number of Female Neurosurgeons in Region	Percentage of Female Neurosurgeons within the Entire Continent
North	Algeria, Egypt, Libya, Morocco, Sudan, Tunisia	187	76.3%
South	Botswana, Lesotho, Mozambique, Namibia, Republic of South Africa, Swaziland, Zambia, Zimbabwe	19	7.8%
West	Benin, Burkina Faso, Cape Verde, Gambia, Ghana, Guinea, Guinea-Bissau, Ivory Coast, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo	16	6.5%
East	Burundi, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Rwanda, Seychelles, Somalia, South Sudan, Tanzania, Uganda	15	6.1%
Central	Angola, Cameroon, Central Africa Republic, Chad, Democratic Republic of Congo, São Tomé and Príncipe	8	3.3%
Total		245	100

Information presented was adapted from World Federation of Neurosurgical Studies (WFNS) and WFNS Women in Neurosurgery.<sup>1,2</sup>

This table does not include counts on female neurosurgical residents, only on female neurosurgeons who have completed all training.

It is important to note that this list may not be completely up-to-date, and the situation may have changed since the report was published. Additionally, some of these countries may have visiting or expatriate neurosurgeons, even if they do not have local neurosurgeons.

Republic of Congo, despite being the largest country in the region, has only 1 female neurosurgeon.

#### Advancing Women's Participation in West African Neurosurgery: Career Guidance and Training Programs in Senegal and Nigeria, and Celebrating the Region's Newest Female Neurosurgeons

West Africa hosts 6.5% of the continent's female neurosurgeons (Table 1). Senegal is credited with having trained the highest number of female neurosurgeons, at a total of 10. At present, thirteen of their thirty-seven neurosurgical residents are women. Currently, the country has 4 practicing female neurosurgeons.<sup>8</sup>

**Table 2.** Regional Overview of African Countries Lacking Fellows in Neurosurgery (Male or Female)

Region of Africa	*Countries With Zero Neurosurgeons
North	N/A
South	Lesotho
West	Sierra Leone, Liberia, Guinea-Bissau, Cape Verde, Mauritania
East	Comoros, Djibouti, Eritrea, Seychelles
Central	Central African Republic, Equatorial Guinea, Sao Tome and Principe
Total	13

Information obtained was adapted from World Federation of Neurosurgical Studies (WFNS).<sup>2,3</sup>

\*It is important to note that this list may not be completely up-to-date, and the situation may have changed since the report was published. Additionally, some of these countries may have visiting or expatriate neurosurgeons, even if they do not have local neurosurgeons.

These numbers may be attributed to the existence of adequate levels of career counseling and guidance in the country. In 2015, Nigeria achieved a significant milestone by producing its first female neurosurgeon, Dr. Salamat Ahuozia Aliu-Ibrahim, who received her training in Nigeria. Since then, 4 additional female Nigerian neurosurgeons have emulated her success, with 3 of them currently holding academic positions as faculty members in teaching hospitals within the country.<sup>8</sup> In 2021, Ghana celebrated the graduation of its first female neurosurgeon, Dr. Mabel Banson, who trained at Korle-Bu Teaching Hospital under the West African College of Surgeons.<sup>12</sup> In 2023, Gambia also achieved this milestone, welcoming its first female neurosurgeon trained in Senegal.

#### Disparities and Milestones in Female Representation within Neurosurgical Services in East Africa

Several nations within the East African Region lack the services of a neurosurgeon, including Comoros, Djibouti, Eritrea, and Seychelles (Table 2). Furthermore, Burundi, Malawi, and Somalia do not possess any female neurosurgeons within their respective medical communities. In the region, Kenya has the highest count of female neurosurgeons, totaling 6, while Tanzania closely follows with 4 and Ethiopia with 2.<sup>8-13</sup> On the other hand, Uganda and Rwanda currently have only a single female neurosurgeon each.<sup>8</sup>

#### Female Neurosurgeons in Southern Africa: A Brief Overview

In the South African region, made up of Botswana, Lesotho, Mozambique, Namibia, the Republic of South Africa, Swaziland, Zambia, and Zimbabwe (Table 1), the Republic of South Africa stands out with the highest number of female neurosurgeons, at an estimated 18 women.<sup>8,10</sup> This positions the country as the third-most prominent in terms of the prevalence of female neurosurgeons in Africa. Moreover, the Republic of South Africa holds

**Table 3.** Overview of African Regions and Countries without Female Neurosurgeon Fellows

Region of Africa	*Countries With Zero Female Neurosurgeon Fellows
North	Libya
South	Botswana, Lesotho, Mozambique, Namibia, Swaziland, Zambia,
West	Benin, Burkina Faso, Guinea-Bissau, Liberia, Mali, Mauritania, Sierra Leone, Togo
East	Burundi, Comoros, Djibouti, Eritrea, Malawi, Mauritius, Seychelles, Somalia, South Sudan
Central	Angola, Central African Republic, Chad, Equatorial Guinea, Republic of Congo, Sao Tome and Principe
Total	30

It is important to note that this list may not be completely up-to-date, and the situation may have changed since the report was published. Additionally, some of these countries may have visiting or expatriate neurosurgeons, even if they do not have local neurosurgeons.

Information present was adapted from World Federation of Neurosurgical Studies (WFNS) and WFNS Women in Neurosurgery.<sup>1,2</sup>

\*This does not include counts on female neurosurgical residents, only on female neurosurgeons who have completed all training.

the distinction of producing the youngest ever female African neurosurgeon, Dr. Ncumisa Jilata. She achieved this feat in 2017 at the age of twenty-nine.<sup>10</sup>

### BREAKING THE MYTH: A PERSONAL JOURNEY AS A WOMAN PURSUING NEUROSURGERY IN GHANA

#### Told by Naa Adzoa Adzeley Boi-Dsane, MBChB, BSc

I completed my medical training at Korle-Bu Teaching Hospital in Accra, Ghana, affiliated with the University of Ghana Medical School. Coincidentally, this is where Dr. Mustaffah, a renowned figure in neurosurgery, established Ghana's inaugural neurosurgery residency program. During my time as a student there, I had the privilege of meeting Dr. Mabel Banson, Ghana's first female neurosurgeon,<sup>12</sup> who was undergoing her residency at the time. Following graduation, I worked as a junior doctor in Northern Ghana, an area with limited neurosurgical resources. Despite my enthusiasm for neurosurgery, many doubted its feasibility, especially for a woman, given its perceived scarcity and rigorous training requirements.

As with many African women in medicine, my journey into academia was marked by challenges, including encountering sexism and bullying, common barriers for women in male-dominated fields like neurosurgery. The lack of effective protocols to address such issues compounded the difficulties. Furthermore, the extended training period for neurosurgery residency, coupled with societal expectations regarding traditional gender roles, posed additional obstacles for African women pursuing careers in this field. Nevertheless, I am determined to complete my housemanship this year and pursue specialization in Neurosurgery after passing my qualifying exams. Encouraged by the pioneering African women who came before me, I remain undeterred by the notion that neurosurgery is too challenging or unattainable for women. My goal is to become a neurosurgeon who contributes to both clinical practice and academia. Whenever I share my aspirations with senior colleagues at the teaching hospital, they consistently offer me words of encouragement, reinforcing my dedication to achieving my dreams.

### THE SOCIAL, CULTURAL, AND EDUCATIONAL OBSTACLES IN THE RECRUITMENT AND RETENTION OF AFRICA WOMEN IN NEUROSURGERY

#### Early Cultural Barriers to African Women in Education

Women in Africa face significant cultural barriers to obtaining an education in general. Traditional gender roles exemplify a pervasive societal belief that girls belong in the domestic sphere, and should prioritize the care of household responsibilities above their education.<sup>14</sup> In contrast, United States and European countries have made significant strides through societal movements to advocate for equal educational opportunities for women. Child marriage further impedes access to education. Early marriage is promoted by some cultural values, which often result in the child dropping out of school, severely limiting their educational prospects.<sup>15</sup> Each additional year of early child marriage decreases the likelihood of that child attending secondary school by 5.6%.<sup>15</sup> Sub-Saharan Africa dominates the list of countries with the highest prevalence of child marriage, with 6 of the top 10 countries located in West and Central Africa.<sup>16,17</sup> Notably, Niger (76%), Chad (61%), Central African Republic (61%), Mali (54%), and Mozambique (53%).<sup>16,17</sup>

Additionally, while public education in the United States and European countries is free and supported by scholarships, grants, loans, and other financial aid, many African families struggle to afford school fees due to insufficient financial support from local and national governments.<sup>18</sup> In the United States, legislation such as Title IX and the Equal Educational Opportunities Act has helped women make incredible strides toward achieving equality.<sup>19-22</sup> In regions of Africa where education is relatively accessible and free, there are still significant barriers such as the high costs of scholastic materials, uniforms, and transportation, which can prevent women from accessing education.<sup>14</sup> Additionally, in families with limited financial resources, boys are often prioritized for education over girls, who are expected to stay at home and help with family responsibilities.<sup>12,23-25</sup> This financial preference further exacerbates the gender gap in educational opportunities. Consequently, from an early age, girls have had to resiliently pursue their dreams. Concerns surrounding gender roles and family expectations often divert many promising women away from many arduous academic

**Table 4.** Select Profiles of Past Pioneer African Female Neurosurgeons: Training, Subspecialties, Positions, and Achievements

Name	Venue of Residency Training	Neurosurgical Subspecialty	Position Held/Achievement	Place of Achievement	Year of Achievement
Prof. Faiza Lalam	Tizi Ouzou University Hospital (Algeria)	N/A	First female neurosurgeon on the continent of Africa	Algeria and Africa	1982
			Professor and Head of Department (HOD)	Tizi Ouzou University Hospital	2011
			Pioneer neurosurgeon to conduct/perform endonasal surgery endoscopically	Algeria	2014
Prof. Souad Bakhti	Faculty of Medicine, The University of Bilda (Algiers, Algeria)	Pediatric Neurosurgery	Treasurer and 2nd Vice president for North Africa (CAANS)	Only female neurosurgeon in attendance at the creation of CAANS	2012
			First female President of National Neurosurgical Society in Africa and President of the Algerian Society of Neurosurgery (SANC)	Algeria	2014
			President of the Mediterranean Association of Neurological Surgeons (MANS)	MANS	2015
			HOD, Neurosurgery	Specialized Hospital Ali Ait Idir (Algiers)	2017
			Chairperson of the World Federation of Neurosurgical Societies' (WFNS) Women in Neurosurgery Committee	WFNS	2018
			Secretary of the Pan Arab Neurosurgical Society (PANS)	PANS	2018
Dr. Nabila Tighilt	N/A	N/A	President of Algerian Society of Neurosurgery	Algeria	N/A
Prof. Najia El Abbadi	Fellowship education and training was obtained globally	Brainstem, vascular skull base, neuro endoscopy and minimally invasive spine surgeries	First female professor of neurosurgery	Morocco	1990
			Programs Director of the Stereotactic Surgery certificate at Mohammed V University	Morocco	2008
			First African Chairperson of WFNS Women in Neurosurgery Committee	Africa	2013–2017
			HOD at Ibn Sina Hospital	Morocco	2014–2016
			First Female President of the Moroccan Society of Neurosurgery	Morocco	2015
			HOD of neurosurgery at Cheikh Zaid International University Hospital	Morocco	2016
			Chairperson of Surgical Department - Abulcasis International University of Health Sciences	Morocco	2016
			Treasurer of CAANS	Africa	2016
			Assistant Treasurer WFNS	Global	2018
			First woman to step into the Pan Arab Neurosurgical Society presidency position	Arab region/Africa	2018
First female President of the World Federation of Neurosurgical Societies(WFNS)	Global	2023			

Dr. Broalet Maman You Esperance	Abidjan	Pediatric Neurosurgery	First female West African Neurosurgeon	Ivory Coast	2006
			Founder of Esperance's Hope	Ivory Coast	2013
Dr. Mame Salimata Diene	N/A	N/A	Treasurer of the Ivorian Society of Neurosurgery	Ivory Coast	2017–2019
			HOD of St. Joseph Moscati Catholic Hospital- established a department of neurosurgery	Ivory Coast	2019
			First woman to lecture in Anatomy and Neurosurgery as an Associate Lecturer at African and Malagasy Council for Higher Education (CAMES)	Burkina Faso	N/A
			First Senegalese female neurosurgeon	Senegal	2008
Dr. Mireille Moutmi	N/A	N/A	Assistant head of Neurosurgery at Fann Teaching Hospital	Senegal	N/A
			Cameroon's first woman to attain neurosurgeon status	Cameroon	2008
Information presented was adapted from Adeloje 1982, World Federation of Neurosurgical Studies 2016, Karekezi et al. 2021, Banson et al. 2022, Hernandez-Duran et al. 2022. <sup>2,4,6</sup>					

pursuits, including neurosurgery. Understanding these cultural stigmas and how they affect African women underscores the ongoing challenges to improve gender representation in the field.

### Barriers to Recruitment and Advancement of AWIN

Recruitment into neurosurgery exhibits significant bias and discrimination against women. Studies indicate that concerns related to pregnancy contribute to wage disparities and instances of sexual harassment.<sup>26-28</sup> Furthermore, societal expectations and gender roles exert considerable influence. Despite achieving high levels of education, women in Africa frequently encounter barriers to employment, often being confined to domestic roles.<sup>28</sup> Under these circumstances, the presence of women in the field of neurosurgery has been restricted. Coupled with the perception that neurosurgery is a cumbersome and winding path, there is also a pervasive fear one might not be able to start a family or successfully balance family life with the vigorous hours of a neurosurgical residency.<sup>28</sup> Women in academia have historically a lower probability of promotion and are less frequently given the opportunity to present at conference programs, even when they have the same prerequisite qualifications as their male colleagues.<sup>11,26,28</sup> The scarcity of female role models who can encourage these women, assuage their fears, and advocate on their behalf also contributes to the low recruitment of women into the field.

On a broader scale within the African continent, there are challenges faced by all neurosurgical specialists that are compounded for women. These include a shortage of equipment and a scarcity of trained personnel who can assist the physician.<sup>29</sup> This creates an environment that results in a stressful increase in workload.<sup>8,12,18,29,30</sup> A survey of young trainees and neurosurgeons in Africa reports inadequate journal club meetings, an inability to obtain journal materials, and limited opportunities to attend conferences.<sup>13,18,29,30</sup> They also listed a lack of access to skills laboratories, dissection rooms, and career guidance as major problems hindering the progress of neurosurgery.<sup>30</sup> These elements coalesce and exacerbate the situation in a way that further limits the number of AWIN. Despite these limitations, there have been (Table 4) and continue to exist (Table 5) pioneering African women who break the boundaries to become neurosurgeons.

### ADVANCING AWIN THROUGH COLLABORATION AND EDUCATIONAL PROGRAMS

The objective of this section is to explore strategies for the advancement of AWIN. The discussion highlights the vital responsibilities of medical schools, neurosurgical training programs, and local and national governments in advancing the representation and availability of opportunities for AWIN.

### Engaging Local, National, and International Organizations

Several initiatives are currently working to enhance the number of AWIN (Table 6). WINS contributes to this effort by providing educational programs and scholarships for female resident neurosurgeons. AWIN has significantly improved global collaboration by establishing a WhatsApp group to provide support among its members and facilitate communication and

**Table 5.** Select Profiles of Current Pioneer African Female Neurosurgeons: Training, Subspecialties, Positions, and Achievements

Name	Venue of Residency Training	Subspecialty	Position Held/Achievement	Place of Achievement	Year of Achievement
Dr. Faten Abid	Monastir Medical School (Tunisia) and Pitie-Salpetriere University Hospital (Paris, France)	N/A	Tunisia's first woman to become a neurosurgeon	Tunisia	N/A
Dr. Djamila Kafoufi Benderbous	Algeria	Craniofacial surgery	Egypt's first woman to be a neurosurgeon	Egypt	N/A
Dr. Juliet Sekabunga	Mulago National Referral Hospital (Lira, Uganda) Hospital for Sick Children (Canada)	Pediatric neurosurgery	Pioneer female neurosurgeon from Uganda	Uganda	2018
Dr. Sylvia Shitsama	University of Nairobi (Kenya)	General Neurosurgery with focus in spine and skull base surgery	First woman from Kenya to become a neurosurgeon	Kenya	2015
Prof Yordanos Ashagre	Addis Ababa University	N/A	First Ethiopian female neurosurgeon	Ethiopia	2015
Dr. Claire Karekezi	Rabat WFNS Training Centre Toronto Western Hospital (Canada)	Skull base and Neuro-oncology	First woman in neurosurgery from Rwanda	Rwanda	2016
			WFNS/WINS activity facilitator	International	2013–2017
			Winner of the AANS/CNS WINS Greg Wilkins-Barrick Chair Visiting International Surgeon Award	International	2013
			Forbes Women in Africa award alongside other national and institutional awards	International	2022
Dr. Magatte Gaye Sakho	Dakar and La Timone (Marseille, France)	N/A	Senegal's first female associate professor of neurosurgery	Senegal	2010
			HOD - Neurosurgery at General Hospital Idrissa Pouye. Head of clinic - Fann Teaching Hospital Neurosurgery	Senegal	N/A
Dr. Sarah Mutomb	Centre Hospitalier National de Fann (Dakar, Senegal)	N/A	The pioneer and sole woman in neurosurgery from the Democratic Republic of Congo	Democratic Republic of Congo	2019
Dr. Salamat Ahuozia Aliu-Ibrahim	National Hospital (Abuja, Nigeria) and sub specialization at Boston Children's Hospital USA	Pediatric neurosurgery	First Nigerian female neurosurgeon in the country	Nigeria	2015
			N/A	Nigeria and United States of America	2019
Dr. Mabel Banson	Korle-Bu Teaching Hospital	Minimally Invasive neurosurgery	Ghana's first woman to attain neurosurgeon status	Ghana	2021

Information highlighted was adapted from Adeloje 1982, World Federation of Neurosurgical Studies 2016, Karekezi et al. 2021, Banson et al. 2022, Hernandez-Duran et al. 2022).<sup>2-6</sup>  
AANS, American Association of Neurological Surgeons; CNS, Congress of Neurological Surgeons; HOD, head of department; WFNS, World Federation of Neurosurgical Societies; WINS, Women in Neurosurgery.

information-sharing about training programs among female neurosurgeons.<sup>8</sup> Additionally, international organizations such as the Association for Women in Science, Million Women Mentors, and National Girls Collaborative Project<sup>25</sup> aim to improve interest in STEM fields among young girls and women, through original initiatives and support of organizations, such as the Africa Research Academies for Women,<sup>31-33</sup> African University of Science and Technology, and Women in Science Girls STEAM Camp.<sup>34,35</sup>

Africa Research Academies for Women contributes to the field of science in Africa by inspiring young women to consider a career in research. Through its organized research programs, it helps students build essential skills and encourages intersectoral collaboration to develop expertise among its students.<sup>31-33</sup> For nearly 2 null decades, the African University of Science and Technology, based in Nigeria, has been at the forefront of delivering graduate programs in the fields of science and technology.<sup>36</sup> Through rigorous curricula and research, their programs aim to prepare students for impactful careers in these pivotal areas. Furthermore, Women in Science Girls STEAM Camp empowers adolescent girls by offering mentorship opportunities and skills training during its annual camp program, with an estimated 78% of alumni currently involved in STEAM programs.<sup>35</sup> These multifaceted approaches help motivate and support African women in pursuing careers in neurosurgery, ultimately leading to a greater number of female neurosurgeons and ensuring their recognition and remembrance in history.<sup>9,10,37</sup>

While primary health care remains a priority for governments, specialties such as neurosurgery are often under-represented, particularly in regions with limited resources. In developed countries, a wide range of medical specialties are available, but in less affluent areas, the emphasis is on basic health care out of necessity. Although this is understandable, the absence of specialized care can lead to significant health issues going untreated. Private sector organizations and faith-based groups, such as the Pan-African Academy of Christian Surgeons,<sup>38</sup> currently offering a 6-year neurosurgical training program at Tenwek Hospital in Kenya, can play a crucial role in addressing the shortage of specialized medical professionals. By providing resources, facilities, and training sites, these entities help create opportunities for aspiring neurosurgeons to receive the necessary education and experience. They also support ongoing research and professional development, ultimately contributing to the overall advancement of neurosurgery in Africa.

### Engaging the Local Community

Addressing the issue of women being restricted to domestic roles postadvanced education requires a nationwide and continental campaign. This initiative should educate communities on the broader value of women beyond their homes, thereby preventing young women from missing out on careers due to outdated beliefs. Training facilities must enforce mandatory maternity leave with financial compensation and impose strict penalties on authorities who discriminate against neurosurgeons based on gender. By transforming societal perceptions of women, the path to traditionally male-dominated professions, including neurosurgery, will undoubtedly broaden.

Moreover, it is crucial to intensify efforts to provide career guidance and counseling programs to women across different

**Table 6.** Select Organizations That are Committed to Supporting African Women Pursuing Neurosurgery

Programs	African Women in Neurosurgery (AWIN)
	Continental Association of African Neurosurgical Societies (CAANS) <sup>7</sup>
	Ghana Academy of Neurological Surgeons
	Foundation for International Education in Neurological Surgery (FIENS)
	World Federation of Neurosurgical Societies (WFNS) <sup>7</sup>
	Congress of Neurological Surgery (CNS)
	Women in Neurosurgery (WINS) <sup>7</sup>
	Young Neurosurgeons Forum (YNS) <sup>7</sup>
	Pan-African Academy of Christian Surgeons (PAACS) <sup>8</sup>

educational stages. This would stimulate interest in less commonly pursued domains, such as neurosurgery. Offering students the opportunity to engage closely with neurosurgeons would foster a culture of mentorship, which has become increasingly important in the path to neurosurgical careers. Financial support should also be strongly considered for these students. There ought to be an increase in scholarships at national, continental, and international levels, grounded on the principles of diversity, inclusivity, and meritocracy. These efforts encourage and enable a greater number of women, who may not possess the resources, to choose a career in neurosurgery.

### Engaging the Local and National Governments

Governments play a crucial role in driving positive change as well. By sponsoring the education and training of aspiring neurosurgeons, they contribute significantly to the advancement of this specialized field. Governmental support extends to ensuring neurosurgeons have access to adequate equipment, upgraded facilities, and dissection laboratories. These enhancements not only elevate the practice of neurosurgery but also contribute to improved survival rates among patients. The integration of advanced technology streamlines the diagnostic process, rendering it more precise, efficient, and less invasive. As a result, this leads to shorter hospital stays, thereby reducing the strain on the health care system. There should be adequate remuneration for neurosurgeons, regardless of their country of origin and gender. Establishing a universally agreed-upon minimum wage within neurosurgical societies, independent of demographic factors, directly addresses the barriers that have kept countless people, including women, from pursuing neurosurgery.

While championing advancements in facilities, technology, and fair compensation for neurosurgeons is noteworthy, it is essential to recognize that challenges in resources vary across countries. Nevertheless, it is equally vital for African countries to be aware that there are individuals and organizations, willing to support and collaborate on educational initiatives to facilitate a collective effort in overcoming these obstacles (Table 6).

**Table 7.** Select African Countries with at Least One Neurosurgery Residency Training Program

Country	Number of Training Programs	Average Number of Training Locations	Length of Training (years)	Training Hospital Names* (Non-exhaustive)
Algeria	14	35–45	5	Tizi Ouzou University Hospital Specialized Hospital Ali Ait Idir in Algiers
Burkina Faso	1	4	5	N/A
Cameroon	1	8	4	Faculty of Medicine and Biomedical Sciences, Yaounde I University
Côte d'Ivoire	1	Variable	5	Université Felix Houphouët-Boigny School of Medicine Yopougon University Hospital in Abidjan
Egypt	15	>25	6–8	N/A
Ethiopia	1	3	4	Myungung Christian Medical Centre Tikur Anbessa (Black Lion) Hospital
Ghana	2	4	6–7	Komfo Anokye Teaching Hospital Korle-Bu Teaching Hospital Military Hospital Accra*
Kenya	2	8	6	Aga Khan University Hospital Nairobi Coast Provincial General Hospital Kenyatta National Hospital Tenwek Hospital University of Nairobi and KwaZulu-Natal
Libya	1	N/A	N/A	N/A
Malawi	1	2	6	Kamuzu Central Hospital Queen Elizabeth Central Hospital
Morocco	5	5–10	5	Maurice Gaud Hospital in Casablanca Ibn Sina Teaching Hospital WFNS Rabat Training Center
Niger	1	1–2	5	N/A
Nigeria	10	5–10	6	Jos University Teaching Hospital Lagos University Teaching Hospital (LUTH) Lagos State University Teaching Hospital (LASUTH) Ladoke Akintola University of Technology Teaching Hospital* Memphy's Teaching Hospital National Hospital Abuja* Nnamdi Azikiwe University Teaching Hospital* Obafemi Awolowo University Teaching Hospital* University College Hospital Ibadan University of Abuja Teaching Hospital* University of Ilorin Teaching Hospital University of Nigeria Teaching Hospital Usmanu Danfodio University Teaching Hospital
Rwanda	1	1–2	6	King Faisal Hospital, Kigali University Teaching Hospital of Kigali Rwanda Military Hospital
Senegal	1	7–13	5	Grand Yoff General Hospital
South Africa	7	Variable	5	University of Cape Town University of the Free State
Sudan	5	3–6	6	Khartoum Teaching Hospital Omdurman Teaching Hospital
Tanzania	2	6	3	Muhimbili Orthopaedic and Neurological Institute

Continues

Table 7. Continued

Country	Number of Training Programs	Average Number of Training Locations	Length of Training (years)	Training Hospital Names* (Non-exhaustive)
Tunisia	1	6	5	N/A
Uganda	2	7–9	4–6	CURE Children's Hospital of Uganda Mulago Hospital
Zambia	1	2	5	University Teaching Hospital, Lusaka
Zimbabwe	1	2–5	5	N/A

Information presented was adapted from several sources including Adeloje 1982, Kato 2020, Dada 2021, Kanmounye 2021, Dada 2022, Hernandez-Duran 2022).<sup>4,6,9-13</sup>  
 The Hospital Names reported are not exhaustive by any means, and simply serve to provide some basic details regarding teaching hospitals for neurosurgery in the African continent. Information and composite lists are unavailable; we have aimed to best consolidate the information. Furthermore, this information is accompanied by the Average number of neurosurgical training location sites in that country, the approximate length of neurosurgical training, and some examples of teaching hospitals within each country.  
 \*Partial accreditation.

### Engaging the Medical Schools

Medical schools have a role to play when it comes to supporting the pipeline for women into neurosurgery. Universities and institutions should pay for access to journals and other academic work, thereby guaranteeing equal access to useful research articles. Avenues should also be created to gain access to research grant opportunities as well as fee waivers or funding from universities regarding article processing charges. To encourage neurosurgical research and improve the number of neurosurgeons in academia, journal clubs should be introduced as common practice in medical institutions. Academic centers should strive to cultivate a habit of organizing training workshops as well as sponsoring their students, residents, researchers, fellows, and attendings, to attend neurosurgical conferences.<sup>13,18,29</sup> This would advance their neurosurgical skills and knowledge while simultaneously enhancing their network. Institutions such as the Ghana College of Surgeons have worked to augment recruitment by eliminating the mandatory 3-year training preceding residency and establishing a straight neurosurgery residency program that bypasses the prerequisite surgical training.<sup>12</sup> By eliminating the mandatory 3-year training period preceding residency, aspiring female neurosurgeons would have a more streamlined pathway to entering the field, allowing them to focus directly on neurosurgical training and specialization. Other medical schools may be able to take a similar approach. Furthermore, emphasis should be placed on global cooperation among neurosurgeons, as exemplified by the UpSurgeOn Course facilitated by the Ghana Academy of Neurological Surgeons in 2021.<sup>12,39</sup> This would not only serve to enhance the proficiency and expertise of female neurosurgeons but also broaden their professional connections and opportunities for collaboration.

### Engaging the Neurosurgical Training Programs in Africa

Currently, there are 76 neurosurgical training programs spanning across 26 countries, with a total of 106 sites (Table 7).<sup>18,29,40-43</sup> North Africa hosts the majority with 52 sites in 6 countries, followed by West Africa with 23 sites in 7 countries, East Africa with

15 sites in 7 countries, Southern Africa with 14 sites in 5 countries, and Central Africa with 2 sites in a single country. These programs reportedly recruit 168 neurosurgical residents per year.

Across various locations, training activities are coordinated through different organizations. For instance, the College of Surgeons of East, Central and Southern Africa has an established 17 sites across 8 East, Central, and Southern African countries. Likewise, West African College of Surgeons has 24 sites in 7 West African countries. Conversely, training sites in North Africa, numbering 52, operate independently and are overseen by different national universities and ministries of health. South Africa has 8 training sites, which are managed by the College of Neurosurgery of the Colleges of Medicine of South Africa.

National programs are also available. These programs include university-based programs in Burkina Faso, Cameroon, Ethiopia, Kenya, Madagascar, Mozambique, Tanzania, Uganda, Zambia, and Zimbabwe, as well as hospital-based programs in Ghana and Nigeria. Despite the availability of these training programs, there is a lack of consistency in their curriculum, duration, expected competencies, and certification processes. Furthermore, the credentials obtained from these programs are not considered equivalent by the various governing bodies. Hence, a vital requirement exists for the implementation of a uniform neurosurgical residency curriculum throughout Africa, aimed at guaranteeing a consistent quality of health care provision to neurosurgical patients throughout the continent.

Given the need for neurosurgical services across the continent, and the low density of neurosurgeons per country, the number of residency positions is woefully inadequate. At the forefront, are Algeria and Egypt, with 14 and 15 neurosurgical training programs, respectively.<sup>18</sup> Algeria has approximately 0.3 neurosurgery residency programs per million people, with Libya and Egypt both in second place with 0.15.<sup>18,29</sup>

Even though Egypt, like Algeria, commands a high number of residency programs (15) when compared to Algeria, they have a dismal number of women in the field (Table 7).<sup>8</sup> This disparity necessitates a call for more affirmative action and merit-based

**Table 8.** Select Recommendations for Improving the Number of African Women in Neurosurgery at the Level of Government, Local Community, and Academic Neurosurgery

Recommendations for Governments	Recommendations for the Local Community	Recommendations for Academic Neurosurgery
Promote international collaboration among neurosurgeons	Provide career guidance and counseling programs to children, high schoolers, and university students	Eliminate the compulsory 3-year training period prior to residency in countries such as Ghana, and replace it with a direct program into neurosurgery.
Expand the number of national, continental, and international scholarships based on diversity and merit	Foster an environment of mentorship, encouragement, and empowerment	Provide career guidance and counseling programs to children, high schoolers, and university students.
Implement affirmative action programs that promote women empowerment	Protect women working in academic and clinical settings from sexism, harassment, and other forms of discrimination	Foster an environment of mentorship, encouragement, and empowerment
Protect women working in academic and clinical settings from sexism, harassment, and other forms of discrimination	Educate the nation and the continent at large on the value of women and young girls being educated	Implement affirmative action programs that promote women empowerment
Enact protocols that will govern how discriminatory issues are handled		Protect women working in academic and clinical settings from sexism, harassment, and other forms of discrimination
Establish, authorize, and empower independent committees that will be tasked with overseeing a safe work environment		Enact protocols that will govern how discriminatory issues are handled
Create a safe environment where sexual harassment and discrimination cases can be reported without fear of retaliation		Establish, authorize, and empower independent committees that will be tasked with overseeing a safe work environment
Educate the nation and the continent at large on the value of women and young girls being educated.		Create a safe environment where sexual harassment and discrimination cases can be reported without fear of retaliation
Institute compulsory 6-month maternity leaves accompanied by severe consequences for institutions that display discriminatory hiring practices based on sex		Engage with private sector organizations, faith-based groups and philanthropic efforts focused on supporting neurosurgery training
Support the education and training of women seeking to enter neurosurgery by adequately equipping neurosurgical facilities.		
Define a minimum wage for neurosurgeons that is independent of geographical location		

Information highlighted was adapted from Adeloje 1982, World Federation of Neurosurgical Studies 2016, Karekezi et al. 2021, Banson et al. 2022, Hernandez-Duran et al. 2022).<sup>2,6</sup>

acceptances for women into these training programs. Algeria has admirably produced an unparalleled number of female neurosurgeons.<sup>8</sup> Numerous African nations exhibit a noteworthy presence of 5 or more residency programs in the discipline of neurosurgery, such as Morocco (5), Nigeria (10), Republic of South Africa (7), and Sudan (5).<sup>18</sup>

It is imperative to acknowledge gender disparities despite what may seem to be an adequate amount of training programs in certain regions. We have already discussed the case for Egypt, the country that houses the most neurosurgeons, and yet has 1 of the lowest proportions of females in neurosurgery.<sup>8</sup> Additionally, Nigeria's neurosurgery workforce consists of mere 5 female neurosurgeons out of a total of 80, with only 2 women undergoing neurosurgical training as of 2021.<sup>30</sup> On the flip side, Senegal's 3 neurosurgery residency programs included a significant proportion of women, as 13 out of 37 participants in

2021 were females. However, they still represented less than half of the total, although comprising over half of the population. Despite the challenges, it is crucial to acknowledge advancements in the recruitment process within the field. For instance, Ghana currently boasts 8 neurosurgical residents undergoing training, despite having only 25 practicing neurosurgeons within the country. Thus, there are significant opportunities for further improvement in this field.

The representation of women in the field of neurosurgery as professors is alarmingly low, with only approximately 4% holding such positions.<sup>29</sup> Moreover, it is crucial to establish systems that safeguard women in academia and clinical work from discriminatory practices such as sexism and harassment. A standardized protocol should be in place to address such issues, and independent committees should be entrusted with determining the most appropriate course of action. Creating a

secure environment that facilitates the reporting of incidents related to sexual harassment and discrimination without the threat of retaliation is crucial in fostering a more comfortable workspace for women. The above recommendations from Section 4, are further highlighted in **Table 8**.

## CONCLUSION

In light of the findings presented in the literature, there is a clear need for action to bolster the presence of WINS, particularly within AWIN. While acknowledging commendable efforts by individual countries like Algeria, Morocco, and Senegal to address the existing gender disparity, it is crucial for African nations to actively adopt and implement proactive and successful approaches that have been proven effective. We anticipate that the strategies delineated in this article may serve as a catalyst to boost female representation among neurosurgeons, both in academic spheres and leadership roles, within the African continent. We suggest periodic surveys in this topic to continue to update the literature and view progress in recruitment of AWIN. This collective effort holds promise for a more diverse and inclusive neurosurgical

community, ultimately contributing to advancements in patient care and research on a global scale.

## CRediT AUTHORSHIP CONTRIBUTION STATEMENT

**Naa Adzoa Adzeley Boi-Dsane:** Writing – original draft. **Pooja Venkatesh:** Writing – review & editing, Writing – original draft, Formal analysis, Data curation, Conceptualization. **Pearl Tenkorang:** Writing – review & editing, Validation. **Oluwaseun Omoba:** Writing – review & editing. **Bernice Limann:** Writing – review & editing. **Amoge Opara:** Writing – review & editing, Supervision, Investigation, Formal analysis, Conceptualization. **Adurape A. Osunjimi:** Writing – original draft, Data curation. **Umaru Barrie:** Writing – review & editing, Writing – original draft, Visualization, Supervision, Formal analysis, Conceptualization. **Teddy Totimeh:** Writing – review & editing, Visualization, Validation, Supervision, Project administration, Investigation. **Ibronke Emmanuel:** Writing – review & editing, Visualization, Supervision, Investigation. **Mabel Banson:** Writing – review & editing, Visualization, Validation, Supervision, Investigation, Conceptualization.

## REFERENCES

- Dmetrichuk JM, Pendleton C, Jallo GI, Quiñones-Hinojosa A. Father of neurosurgery: harvey Cushing's early experience with a pediatric brainstem glioma at the Johns Hopkins Hospital: historical vignette. *J Neurosurg Pediatr.* 2011;8:337-341.
- Ciurea A-V, Moisa HA, Mohan D, Sofia Ionescu, the first woman neurosurgeon in the world. *World Neurosurg.* 2013;80:650-653.
- Bryant J-P, Nwokoye DI, Cox MF, Mbabuike NS. The progression of diversity: black women in neurosurgery. *Neurosurg Focus.* 2021;50:E9.
- Casillo SM, Venkatesh A, Muthiah N, et al. Biographies of international women leaders in neurosurgery. *Neurosurg Focus.* 2021;50:E19.
- McClelland IHS. Alexa Irene Canady: the first African-American woman neurosurgeon. *J Natl Med Assoc.* 2008;100:439-443.
- Venkatesh P, Barrie U, Covell MM, et al. Alexa Irene Canady: first female African American neurosurgeon of the United States. *World Neurosurg.* 2023;177:26-30.
- Bowser BP. Race relations in the 1980s: the case of the United States. *J Black Stud.* 1985;15:307-324.
- Karekezi C, Thango N, Aliu-Ibrahim SA, et al. History of African women in neurosurgery. *Neurosurg Focus.* 2021;50:E15.
- Neurosurgery WFO NS-WI. WFNS-WOMEN in neurosurgery. Available at: [https://sites.google.com/site/womeninneurosurgery/home\\_1](https://sites.google.com/site/womeninneurosurgery/home_1). Accessed April 28, 2023.
- Lulla T, Hansen RTB, Smith CA, Silva NA, Patel NV, Nanda A. Women neurosurgeons around the world: a systematic review. *Neurosurg Focus.* 2021;50:E12.
- Durham SR, Donaldson K, Grady MS, Benzil DL. Analysis of the 1990–2007 neurosurgery residency match: does applicant gender affect neurosurgery match outcome? *J Neurosurg.* 2018;129:282-289.
- Banson M. Becoming a neurosurgeon: a perspective of the Ghanaian female neurosurgeon. *Ind J Neurosurg.* 2022;11:188-191.
- Ukuchukwu AK, Still MEH, Seas A, et al. Fulfilling the specialist neurosurgical workforce needs in Africa: a systematic review and projection toward 2030. *J Neurosurg.* 2023;138:1102-1113.
- Barriers to girls accessing and acquiring quality education in Africa gufasha girls foundation. Available at: <https://gufashagirls.org/barriers-to-girls-accessing-and-acquiring-quality-education-in-africa/>. Accessed July 7, 2024.
- Hobbs HO. Girl's Education in Africa: The Importance of Culture and State Capacity; 2020. Available at: <https://scholarworks.boisestate.edu/td/1664/>. Accessed August 21, 2024.
- Adesina M, Daha M, Ajobiewe A, Oladele RI, Olufadewa I, Ayorinde T. The High Proportion of Child Brides in Africa: Implications for the Girl Child and the Society; 2020. <https://doi.org/10.21203/rs.3.rs-54645/v1>.
- Atim G. Girls not brides: ending child marriage in Nigeria. *J Gender, Info Develop Africa (JGIDA).* 2017;6:73-94.
- Dada OE, Karekezi C, Mbangtang CB, et al. State of neurosurgical education in Africa: a narrative review. *World Neurosurg.* 2021;151:172-181.
- ACLU. Women's Rights in Education. American civil liberties union. <https://www.aclu.org/issues/womens-rights/womens-rights-education>; 2024. Accessed July 7, 2024.
- Green RL. Public schools and equal educational opportunity. *J Non-White Concerns Personnel Guid.* 1974;2:198-207.
- Melnick RS. *The Transformation of Title IX: Regulating Gender Equality in Education.* Washington, DC: Brookings Institution Press; 2018.
- Sandler BR. Title IX: how we got it and what a difference it made. *Cleve State Law Rev.* 2007;55:473.
- Palanisamy D, Battacharjee S. What it is to be a woman neurosurgeon in India: a survey. *Asian J of Neurosurg.* 2019;14:808-814.
- Balogun JA, Adebayo AM. Perception (of) and willingness to choose a neurosurgery career among final-year medical students in Ibadan, Nigeria. *World Neurosurg.* 2019;126:e998-e1004.
- Britsch B, Peterson K, Marra RM. The National Girls Collaborative Project: Building Capacity Through Collaboration. Women in Engineering ProActive Network; 2008. Available at: <https://journals.psu.edu/wepan/article/view/58546>. Accessed August 21, 2024.
- Abosch A, Rutka JT. Women in neurosurgery: inequality redux. *J Neurosurg.* 2018;129:277-281.
- Park J, Minor S, Taylor RA, Vikis E, Poenaru D. Why are women deterred from general surgery training? *Am J Surg.* 2005;190:141-146.
- Renfrow JJ, Rodriguez A, Wilson TA, Germano IM, Abosch A, Wolfe SQ. Tracking career paths of women in neurosurgery. *Neurosurgery.* 2018;82:576-582.
- Dada OE, Bukenya GW, Konan L, et al. State of African neurosurgical education: an analysis of publicly available curricula. *World Neurosurg.* 2022;166:e808-e814.
- Kanmounye US, Robertson FC, Thango NS, et al. Needs of young African neurosurgeons and residents: a cross-sectional study. *Front Surg.* 2021;8:647279.
- Oguntuyo S. Bridging the gender gap in science and technology in Africa: the African research

- academies for women (ARA-W). *Ann Glob Health*. 2016;82:598-599.
32. Commodore-Mensah Y, Shokunbi S, Okocha A, et al. Bridging the gender equality gap in STEM to transform the pipeline in Africa: the African Research Academies for Women (ARA-W) summer research programme. *Lancet Global Health*. 2020;8:S40.
  33. Sarpong K, Ghanney EC, Acheampong D, Oguntuyo S. Bridging the gender gap in science and technology in Africa: the African Research Academies for women (ARA-W). *Ann Global Health*. 2016;82.
  34. Konyeha S, Agwam G, Musa E, Ngonadi I, Afehomo A. Initiatives and role of women scientist forums with mentorship opportunities in STEM. *African J Health, Safety and Environment*. 2021;2:89-99.
  35. Cummings L. Gender Equality in Science, Technology, Engineering, Agricultural Science and Mathematics (STEAM) Academic Pipeline. United States Agency for International Development; 2015. Available at: <https://www.usaid.gov/sites/default/files/USAID-Report-Sep-30-2015-Final.pdf>. Accessed August 21, 2024.
  36. SAi T. List of organizations engaged in STEM education across Africa. Resource webpage. SAi collective. <https://stemadvocacy.org/organizations-engaged-in-stem-education-across-africa/>; 2023. Accessed April 28, 2023.
  37. Bakhti S. Chair's message world federation of neurological societies-women in neurosurgery. [https://sites.google.com/site/womeninneurosurgery/home\\_1/chairperson-message](https://sites.google.com/site/womeninneurosurgery/home_1/chairperson-message). Accessed April 28, 2023.
  38. Van Essen C, Steffes BC, Thelander K, Akinyi B, Li H-F, Tarpley MJ. Increasing and retaining African surgeons working in rural hospitals: an analysis of PAACS surgeons with twenty-year program follow-up. *World J Surg*. 2019;43:75-86.
  39. Nicolosi F, Rossini Z, Zaed I, Koliass AG, Fornari M, Servadei F. Neurosurgical digital teaching in low-middle income countries: beyond the frontiers of traditional education. *Neurosurg Focus*. 2018;45:E17.
  40. Adeloye A. Neurosurgical education in Africa. *Neurosurgery*. 1982;10:130-132.
  41. Hernández-Durán S, Drummond K, Karekezi C, et al. *International Women in Neurosurgery*. Switzerland: Springer International Publishing; 2022:1-33.
  42. Kato Y, Liew BS, Sufianov AA, et al. Review of global neurosurgery education: horizon of neurosurgery in the developing countries. *Chin Neurosurg J*. 2020;6:19.
  43. Studies WfONS. Global neurosurgical workforce map. WFNS. <https://www.wfns.org/menu/61/global-neurosurgical-workforce-map>. Accessed March 27, 2023.

*Conflict of interest statement: The authors declare that the article content was composed in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.*

*Received 25 February 2024; accepted 16 July 2024*

*Citation: World Neurosurg. (2024) 191:10-22.  
<https://doi.org/10.1016/j.wneu.2024.07.136>*

*Journal homepage: [www.journals.elsevier.com/world-neurosurgery](http://www.journals.elsevier.com/world-neurosurgery)*

*Available online: [www.sciencedirect.com](http://www.sciencedirect.com)*

*1878-8750/\$ - see front matter © 2024 Elsevier Inc. All rights are reserved, including those for text and data mining, AI training, and similar technologies.*