

Superwomen in Neuroscience***Sinirbilimde Süper Kadınlar****Merve Sevgi İnceⁱ, Rabet Gözilⁱⁱ, Meltem Bahçelioğluⁱⁱⁱ**ⁱMSc., Yüksek İhtisas University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation.Gazi University, Institute of Health Sciences, Department of Anatomy, <https://orcid.org/0000-0002-7121-7210>ⁱⁱProf. Dr., Yüksek İhtisas University, Faculty of Medicine, Department of Anatomy, <https://orcid.org/0000-0002-5493-7734>ⁱⁱⁱProf. Dr., Gazi University, Faculty of Medicine, Department of Anatomy.

Gazi University, Institute of Health Sciences, Department of Anatomy.

Gazi University, Neuropsychiatry Education, Research and Application Center, Neuroscience and Neurotechnology Center of

Excellence (NÖROM), <https://orcid.org/0000-0001-5279-3450>**ABSTRACT**

The emergence of women is seen as occurring very early when we examine the growth of neuroscience and related sciences globally. From the ancient Roman graves to the present, there are numerous examples of contributions made by women in the area of medicine. Female neuroscientists have faced several challenges, particularly gender inequality, like in every other scientific discipline. All these difficulties have been encountered by numerous female neuroscientists, many of whom have found great success. Some of the female neuroscientists who opened the door for us are Sofia Ionescu, Diana Beck, Aysima Altınok, Alexa Canady, M. Deborah Hyde, Augusta Dejerine Klumpke, Julia Barlow Platt, Laura Forster, Manuela Serra, and Mara Soledad Ruiz-Capillas. These superwomen are wives, mothers, and grandmothers, in addition to all their other achievements. As female neuroscientists, it is important for us to be aware of the inspiring tales of these women who have paved the way for us and inspired future generations to endure in the face of difficulties. For future generations, hearing the tales of the superwomen who propelled women to this position in neuroscience will serve as motivation and inspiration. We also think that raising awareness about this field will contribute to the recognition of female neuroscientists in the future.

Keywords: Women, Neuroscience, History, Gender inequality, Neurosurgery, Neurophysiology**Öz**

Sinirbilim ve ilgili bilimlerin küresel olarak büyümesini incelediğimizde, kadınların ortaya çıkışının çok erken gerçekleştiği görülmektedir. Antik Roma mezarlarından günümüze kadınların tıp alanında yaptığı katkıların sayısız örneği bulunmaktadır. Kadın sinirbilimciler, diğer tüm bilim dallarında olduğu gibi, başta toplumsal cinsiyet eşitsizliği olmak üzere çeşitli zorluklarla karşı karşıya kalmışlardır. Tüm bu zorluklar, birçoğu büyük başarı elde eden çok sayıda kadın sinirbilimci tarafından aşılmıştır. Yolumuza ışık tutan kadın sinirbilimcilerden bazıları Sofia Ionescu, Diana Beck, Aysima Altınok, Alexa Canady, M. Deborah Hyde, Augusta Dejerine Klumpke, Julia Barlow Platt, Laura Forster, Manuela Serra ve Mara Soledad Ruiz-Capillas'tır. Bu süper kadınlar bahsettiğimiz tüm başarılarının yanında aynı zamanda birer eşler, anneler, büyükannelerdir. Kadın sinirbilimciler olarak, bizler için yol açan ve gelecek nesillere zorluklar karşısında dayanma gücü veren bu kadınların ilham verici hikayelerinin farkında olmamız oldukça önemlidir. Gelecek nesiller için, kadınları sinirbilimde bu konuma getiren süper kadınların hikayelerini öğrenmek, motivasyon ve ilham kaynağı olacaktır. Ayrıca bu alanla ilgili farkındalık yaratmanın gelecekte kadın sinirbilimcilerin daha fazla tanınmasına katkı sağlayacağını düşünmekteyiz.

Anahtar Kelimeler: Kadınlar, Sinirbilim, Tarih, Cinsiyet eşitsizliği, Beyin cerrahisi, Nörofizyoloji

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İletişim - Correspondence Author: Merve Sevgi İnce <mervesevgiince@yiu.edu.tr>

Introduction

Amelia Earhart wrote to her husband, before attempting to fly across the Pacific: *"Please know that I am quite aware of the hazards. Women must try to do things as men have tried. When they fail, their failure must be but a challenge to others."*

Researchers interested in neuroscience know the names of the pioneers in their fields, but how many of us know the names of superwomen who shed light on our way?

When we look at the development of neuroscience and related fields in the world, we see that the emergence of women is relatively early. The earliest findings about female doctors are based on Ancient Roman tombs. It was understood from these tombs that female physicians could give and treat medicines without permission from male superiors. Between 1273-1410, twenty-three women were allowed to perform surgery in the Lordship area of Napoli. Nevertheless, the period between the 7th and 13th centuries is called the "dark age" in which female physicians were neglected. In the 15th century, *Cerahiyyetül Haniyye*, written by Şerafettin Sabuncuoğlu using old Turkish, is also the first source in which female surgeons are depicted, as well as being the first written medical treatise. The first female doctor, whose name was not recorded, graduated from medical school in 1754. But, because her name was not recorded, Elizabeth Blackwell was regarded as the first woman in the United States to acquire a medical degree. About the same period, Mary Edwards Walker (1832-1919) participated in the Civil War as a surgeon in the army.¹

The stereotypes about women's roles in the family, pregnancy, breastfeeding, and parental leave have led to greater responsibilities regarding working life on women's shoulders. This concept, which is called the "glass ceiling" in the literature, leads to inequality of opportunity between women and men in almost every field such as education, experience, and promotion.²

Women should act boldly together and take advantage of their innate adaptive features to deal with all these challenges in all areas of medicine. Many female neuroscientists have struggled with all these difficulties and achieved significant achievements. Knowing the stories of the superwomen leading women to this position in neuroscience will be a source of encouragement and inspiration for the new generations.

The Paris Faculty of Medicine accepted Augusta Dejerine Klumpke in 1877. She studied science in addition to her lectures at Sorbonne University. Subsequently, she assisted Professor Joseph Auguste Fort for two years in the areas of anatomy and dissection. She was awarded the "Anatomy Prize of Free Teaching" in 1879 for her work on dissection and anatomy. In 1880, she performed autopsies and studied in a histology laboratory in Chary's clinic at the Charité Hospital. After all, she became an extern with Professor Fort's suggestion she had wanted for a long time. Klumpke studied lower brachial plexus injury in the second and third externship years. Afterward, her research was published in *Revue de Médecine*, and 1886, the Academy of Medicine awarded her paper the Godard Prize. Klumpke was the first female intern accepted to the Parisian Hospital in 1887 following the completion of her successful work there. During her internship, Klumpke married Dr. Joseph Jules Dejerine, one of the most excellent neurologists of the period. Then, she worked as a neuroanatomical illustrator in many works of her husband. Klumpke, who shed light on our way on many issues such as serial sectioning anatomy concepts, standardized protocols in the treatment of paraplegic patients, and rehabilitation of spinal cord injury, passed away in 1927. She left almost 60 neuroanatomy and neurology publications and two honors medals, which would be honored by all female neuroscientists.³⁻⁵

One of the first female neuroscientists in history, Julia Barlow Platt, received her degree from the University of Vermont. She spent nine years pursuing her graduate studies at Harvard University. She got the chance to interact with some of the most well-known comparative zoologists of the day during this time. Also, for the first time, Platt identifies separate anterior head segments in *Squalus* embryos. She was one of the first

women to earn a Ph.D. from a German University after researching the germ layer concept in 1989. She ended her scientific career and retired as she could not find a suitable academic position after graduation. With her contributions to science, Julia Barlow Platt is an unforgettable comparative embryologist, neurobiologist, and neuroscientist for centuries.⁶

Laura Forster graduated from the University of Bern in 1894 with an M.D. Then she started working at the Institute of Pathology. Here she studied and published her first scientific article about the structure of muscle spindle fibers six years. In 1900, appointed to Cutler Boulter Dispensary in East Oxford, Forster started her studies on the relationship between ovarian diseases and mental problems in women. She continued her studies in the Cajal's laboratory to learn some neurophysiological techniques. Here, with the guidance of Santiago Ramón y Cajal, she focused on investigating traumatic spinal cord injuries in birds and the degeneration of nerve fibers. Due to the First Balkan War outbreak in 1912, she could not continue her academic studies. Forster became the first female Australian doctor appointed to the British Field Hospital. During the war, she served in many cities, such as Erzurum (Turkey), Caucasus, and Zolishchyky. At the end of these challenging but successful years, Laura Forster, who became tired of being exposed to infectious diseases under war conditions, passed away in 1917.⁷

Manuela Serra was working as an assistant at the Laboratorio de Investigaciones Biológicas. In 1921, she became the sole author of an article describing the frog's intracellular fibrils of the spinal cord. In her research, she used Cajal's new method to color neuroglia. Also, all the illustrations of this study belonged to Serra.⁸

María Soledad Ruiz-Capillas began her medical education at Universidad Central at Madrid in 1917. She graduated as MD in 1924. In 1928, she joined the research group of neuropathologists and neuropsychiatrist Gonzalo R. Lafora at the Cajal Institute. She studied the relationship between sleep disorders and mesencephalic and infundibular lesions. In addition, she researched on diencephalon of cats, diencephalon physiology, and the histology of these structures. Besides all these studies, María Soledad Ruiz-Capillas is considered the first female doctor who worked in Spanish Province.^{7,9}

Sofia Ionescu, the first female neurosurgeon in Romania, is considered the world's first female surgeon, according to some sources in the literature. This situation, which has not been clarified for more than thirty years, became definite at the 13th World Congress of the World Federation of Neurosurgical Societies (WFNS) in Morocco in 2005. Yoko Kato, chair of the Women in Neurosurgery Committee, formally acknowledged Sofia Ionescu as the first female neurosurgeon in history. Ionescu decided to intern in the neurosurgery department of the "Central Hospital for Mental, Nervous, and Endocrine Disorders" in Bucharest in 1943. She met the "golden neurosurgical team," which included Professor Dimitrie Bagdasar, Dr. Constantin Arseni, and Dr. Ionel Ionescu, thanks to this internship. She would subsequently wed Dr. Ionel Ionescu. Ionescu worked in the spine and neurosurgery departments and was a mother of two. From graduation until her retirement, she kept up her activities by writing and publishing articles in Romanian medical journals. Even though the first female surgeon in the world claimed to be Diana Beck, it was documented that Sofia Ionescu performed her first surgery in 1944 and Diana Beck in 1952. Sofia Ionescu, the world's first female surgeon, passed away at 88 in 2008, leaving us with a bright path.¹⁰

According to the literature, Diana Beck is considered the first female surgeon in the world. After completing her general surgery training at the Royal Free Hospital, she enrolled in the London School of Medicine for Women. During her education, she won outstanding awards and scholarships. In 1939, she started working with Sir Hugh Cairns in Oxford after realizing her ability in neurosurgery. Sir Cairns, a student of Harvey Cushing and William Halstead, was one of the founders of British neurosurgery and trained his students for the famous "Halstead Cushing Technique." Beck researched many essential topics with the pathologist

Dorothy Russell through William Gibson Research Scholarship from the Royal Society of Medicine in 1939. Their studies on otitic hydrocephalus and benign intracranial hypertension were published in the Journal of Neurosurgery. In addition, Russel and Beck suggested that alternative materials, such as acrylic resin, can be used instead of iliac crest grafts to repair large cranial defects. In 1947, she was appointed to the Middlesex hospital in London as the first woman and neurosurgeon. This position was the peak of her career.

Beck, who left her mark in the history of neurosurgery, was diagnosed with Myasthenia Gravis, a neurological disease, late in his life. Myasthenia Gravis, whose main symptom is fatigue, was initially misdiagnosed as hysteria. After this diagnosis, some colleagues doubted his performance, but Beck achieved her surgeries properly. Thanks to the athymectomy performed late in her life, she largely coped with Myasthenia Gravis. She died on March 3, 1956, due to a pulmonary embolism.^{11, 12}

In Turkey, women entered the field of neurosurgery sooner than in the majority of other nations. Dr. Aysima Altnok studied at Istanbul University's Faculty of Medicine after graduating from high school. She was lucky to live in Istanbul, where she could pursue her passion of becoming a doctor while also expanding her cultural background. She saw that the functioning of the brain was not covered in the phase II anatomy and physiology classes. She chose to pursue a career in neurosurgery in phase II due to her fascination with this mystery. Dr. Feyyaz Berkay finished his neurosurgery residency in the US when Dr. Altnok was in phase IV, and upon his return to Istanbul University, he became aware of her interest in the field. After graduating from the Faculty of Medicine in 1952, Dr. Altnok began her specialization in general surgery at the 3rd Surgery Clinic in Cerrahpaşa. Upon the request of Dr. Berkay, they tried to find a department of neurosurgery for almost three years. She began working as a neurosurgical assistant at Haydarpaşa Numune Hospital in 1956 as a result of the failure of this endeavor. At that time, Haydarpaşa Numune was the only hospital in Turkey offering training in neurosurgery. She finished her residency in neurosurgery at Haydarpaşa in 1959, authored a thesis on brain tumors, and received her certification in the field. Dr. Altnok became Turkey's first female brain surgeon in this way, making medical history. After 33 years of working life, she was finally appointed to Bakırköy Emrazi and Akliye Hospital and retired.

African-American women were given the chance to become board-certified neurosurgeons as a result of the civil rights struggle. The University of Minnesota's Alexa Canady was the first African-American woman to finish neurosurgery training there and earn board certification from the American Board of Neurological Surgery in 1984.¹³

M. Deborah Hyde was admitted to Case Western Reserve University School of Medicine in 1973 after earning a biology master's degree. Even though the medical school professor said she could not compete with better-prepared students, Hyde graduated from medical school in 1977 as a medical doctor by studying undauntedly. Then she was elected to The Alpha Omega Alpha Medical Honor Society. As a result of his interest in the central nervous system and surgery in the first years of medical school, she decided to become a neurosurgeon. With the aid of Dr. Harold Rekate, she was accepted into neurosurgery training, chaired by the great Dr. Frank Nulson, who had worked to create the famous Spitz-Holter Valve used in the treatment of hydrocephalus at Case Western University.

Hyde left her mark in history as the first woman and African American to graduate from Case Western University neurosurgery training in 1982. Yet in 1985, she became the second African American woman to receive certification from the American Board of Neurological Surgery. She worked at the Guthrie Clinic at Robert Parker Hospital after completing her residency training.¹⁴

From the past to the present, as in many scientific fields, problems related to gender inequality have emerged in the field of neuroscience. Studies show that female neuroscientists are less likely to find staff in faculties

after their training than men.¹⁵ In addition, the gender imbalance in publishing, conference participation, citations, education, grant funding, credit for collaborative work, authorship, hiring and promotions, and careers has caused female neuroscientists to stay in the background. Today, various programs are carried out to balance the disadvantaged position of female neuroscientists. In recent years, the position of women in the field of neuroscience has improved.¹⁶ We think that raising awareness about this field will contribute to a higher recognition of female neuroscientists in the future.

We can write hundreds of articles about the lives, perspectives, challenges, struggles, academic achievements, and contributions of all these superwomen who contributed to neuroscience, even if not mentioned in this article. These superwomen are partners, mothers, and grandmothers, and all the successes we have mentioned. We, as female neuroscientists, should know the fascinating stories of these women who shed light on our way and show the next generations that they can overcome all difficulties if they work.

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Author Contribution

Merve Sevgi İnce: Idea/Concept, Design, Analysis And/Or Interpretation, Literature Review, Writing the article, Critical review, References and fundings

Rabet Gözil: Idea/Concept, Design, Control/Supervision, Analysis And/Or Interpretation, Critical review, References and fundings

Meltem Bahçelioğlu: Idea/Concept, Design, Control/Supervision, Analysis And/Or Interpretation, Literature Review, Critical review, References and fundings

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