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Original Article

Gender Representation in Global Neuroscience Conferences (2014–2023): Trends, Challenges, and the Inclusion of Pakistani Women

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Abstract

Background: Neuroscience, like many scientific fields, has been historically dominated by male researchers. In recent years, efforts to increase female representation at international neuroscience conferences have gained momentum. The aim was to analyze gender representation in keynote and symposium roles, poster presentations, and organizing committees across three time periods (2014-2016, 2017-2019, and 2020-2023), and explore the barriers faced by Pakistani women in neuroscience.

Methodology: A mixed-methods approach was employed. Quantitative data from reports on the Society for Neuroscience (SfN), Federation of European Neuroscience Societies (FENS), International Brain Research Organization (IBRO), and regional conferences were analyzed. Descriptive statistics and chi-square tests were used to assess changes in gender representation over time. Qualitative interviews with Pakistani women neuroscientists provided insights into personal challenges and strategies, focusing on issues such as funding, visibility, institutional support, cultural barriers, and networking.

Results: The study found that while female representation in neuroscience conferences has increased, men still dominate key roles. Female participation in keynote speeches, symposiums, poster presentations, and organizing committees has risen from 2014 to 2023, with the most significant increase occurring between 2020 and 2023. However, statistical analysis revealed that men continue to hold the majority in leadership positions. Women face challenges such as insufficient funding, cultural expectations, and lack of institutional support. Despite these barriers, women have used strategies like crowdfunding, mentorship, and international collaborations to overcome obstacles.

Conclusion: Although female representation in neuroscience conferences has grown, men continue to dominate leadership roles. Challenges like funding and institutional support persist, but women have made strides through collaborative efforts.

Keywords

Women in Neuroscience, Gender Identity, Organizational Culture.

Introduction

The underrepresentation of women in science and academia, particularly in STEM fields such as neuroscience, is a longstanding issue that continues to impede the progress toward gender equity. Although substantial strides have been made over the past few decades to address gender disparities in academia, women remain significantly marginalized, particularly in leadership roles. These roles include keynote speakers, committee members, and organizers of scientific events, all of which are critical to shaping the direction of scientific inquiry and fostering innovation[1,2]. This disparity is particularly evident in neuroscience, where women are still underrepresented in high-profile scientific gatherings despite the growing number of women entering the field at the undergraduate and graduate levels. Studies examining gender representation in other academic disciplines and at international conferences have shown that women face significant barriers in attaining leadership positions[3]. However, despite the increasing recognition of gender imbalance, there is limited research specifically focused on the participation and representation of women in the neuroscience community.

Recent studies have highlighted the gap in gender representation in the leadership of major scientific conferences, but most analyses have concentrated on broader scientific disciplines or regions, leaving a gap in understanding how these trends play out in neuroscience[4]. This study seeks to address this gap by analyzing female participation at prominent neuroscience conferences held between 2014 and 2023. The focus is particularly on the leadership roles women hold at these events, such as keynote speakers, symposium organizers, and committee members. Key organizations that will be examined include the Society for Neuroscience (SfN), the International Brain Research Organization (IBRO), and various regional neuroscience conferences. By analyzing the proportion of female representation in these roles, the study will shed light on any patterns or trends that may have emerged over the past decade.

In addition to assessing current representation, this study will explore the potential barriers that limit women's participation in neuroscience, especially in leadership positions. These barriers can include systemic biases, structural inequalities, and the lack of mentorship opportunities, all of which can hinder career advancement for women in academic settings[5]. To complement the quantitative data, qualitative interviews will be conducted with female neuroscientists in leadership roles to gather insights into their experiences, challenges, and strategies for overcoming these barriers. The goal is to identify factors that influence women's visibility and career progression in neuroscience and to suggest strategies for improving representation.

This research aims to contribute to the ongoing discourse about gender equity in neuroscience and provide actionable recommendations to promote inclusion. By fostering a more inclusive environment at scientific conferences and in academic spaces, we can not only support women's professional development but also enhance the scientific community's ability to address complex issues in neuroscience through diverse perspectives.

Methodology

Study Design

This study employed a descriptive cross-sectional design to analyze gender representation in major neuroscience conferences globally over the past decade. It combined both quantitative and qualitative approaches to assess the representation of women, particularly Pakistani women, in the field of neuroscience. The study also evaluated the impact of diversity initiatives on gender and regional equity in these conferences.

Ethics

Ethical considerations were paramount in this study. All data collection, especially from surveys or interviews, adhered to ethical research standards:

- **Informed Consent:** Consent was obtained from participants (Pakistani women neuroscientists) for surveys or interviews,

ensuring voluntary participation and awareness of the study's objectives.

- **Confidentiality and Anonymity:** All personal and professional data, including interview responses and survey results, were kept confidential and anonymized to protect participant identities.
- **Data Privacy:** Data collected from publicly available sources (e.g., conference programs, abstracts) did not contain personal identifiers, ensuring privacy. For any data obtained directly from individuals (e.g., surveys), consent and ethical approval were sought before participation.

Setting

The study analyzed global neuroscience conferences, with a particular focus on:

- **International Conferences:** Major neuroscience events such as the Society for Neuroscience (SfN), Federation of European Neuroscience Societies (FENS), and the International Brain Research Organization (IBRO).
- **Regional Conferences:** Conferences in the Asian-Pacific and African regions were also analyzed to assess regional diversity.
- **Time Frame:** Conferences from 2014 to 2023 were analyzed, providing a decade-long dataset for gender representation trends and diversity initiatives.

Participants

The study adopted a retrospective design and did not rely on a fixed sample size, as it analyzed data from selected conferences spanning a 10-year period (2014–2023). The sample consisted of all sessions, speakers, and organizers from the chosen conferences during this period, with a particular focus on gender and regional representation.

- **Pakistani Women Neuroscientists:** The study specifically tracked the participation of Pakistani women by identifying them in conference speaker lists, abstract submissions, and organizing committees. Pakistani women were also identified through databases such as ORCID, Scopus, and Web of Science, which provided information on affiliations and academic contributions.
- **General Conference Participants:** The broader group included all neuroscientists participating in the selected conferences. The focus of the analysis was on gender distribution (male, female, non-binary) and regional representation (with a particular emphasis on Pakistani women) in relation to the effectiveness of diversity initiatives over time.

The total number of conference programs, abstracts, speaker lists, and diversity reports were considered as the study population. These sources were analyzed to quantify gender and regional representation, and trends in diversity initiatives were assessed across the decade-long period.

Variables

- **Gender Representation:** The primary variable was the gender of the conference speakers, abstract presenters, and committee members (male, female, non-binary).
- **Regional Representation:** A secondary variable was regional representation, specifically the participation of Pakistani neuroscientists and those from underrepresented regions (e.g., South Asia, Africa).
- **Diversity Initiatives:** The presence and implementation of diversity programs or policies at these conferences were key independent variables, assessed to understand their impact on representation.

Data Sources/Measurement

- **Conference Program Booklets (2014–2023):** These were the primary source for gathering information on speakers, session chairs, and abstract submissions. They were used to measure gender and regional representation at each conference.

- **Speaker Lists, Abstract Submission Databases, & Attendee Statistics:** Data from these sources provided more granular details on the number of male and female participants, their roles, and regional distribution.
- **Diversity Reports:** Publicly available diversity reports from conference organizers were analyzed to measure the impact of diversity initiatives over the years.
- **Databases (ORCID, Scopus, Web of Science):** These were used to track the affiliations, publications, and scientific output of Pakistani women neuroscientists, helping to correlate conference participation with academic presence.

Bias

In the case of surveys or interviews, recall bias may have occurred if participants had difficulty accurately recalling their experiences or participation. This was minimized by using clear, specific questions and ensuring respondents were familiar with the conferences being analyzed.

Quantitative Variables

- **Gender Distribution:** The number and percentage of male, female, and non-binary speakers, session chairs, and committee members were quantified.
- **Regional Representation:** The number and percentage of participants from Pakistan and other underrepresented regions were calculated.
- **Impact of Diversity Initiatives:** A comparison of gender and regional representation before and after the introduction of diversity initiatives was made. This involved tracking changes in the number of women and underrepresented scientists in the years following the implementation of diversity programs.

Statistical Methods

Statistical methods were employed to analyze the gender and regional representation in the conferences. Descriptive statistics were used to summarize the data, including calculating the percentages of male and female participants. A comparative approach was applied to assess trends over time, focusing on changes in gender and regional representation before and after the introduction of diversity initiatives. The Chi-square test was utilized to determine whether there were statistically significant differences in the representation of women and underrepresented regions in relation to diversity programs.

Results

Over the 10-year period from 2014 to 2023, there was a general increase in female representation across major neuroscience conferences, although men continued to dominate in key roles.

Female keynote speakers at the Society for Neuroscience (SfN) and the Federation of European Neuroscience Societies (FENS) increased from 20-25% to 35-40%, while female participation in symposiums and poster presentations also grew. Despite this progress, organizing committees remained predominantly male.

At the International Brain Research Organization (IBRO), female representation in keynote roles rose significantly from 10-15% to 35-40%, reflecting a strong push for gender diversity. However, male dominance still persisted in many areas, including keynote and symposium roles.

Regional conferences in the Asian-Pacific and African regions saw slower progress, with men continuing to dominate in keynote and symposium positions. However, the visibility of female participants in poster presentations improved.

Regarding Pakistani women in neuroscience, there was a gradual increase in their visibility, particularly in symposium and poster presentation roles. However, their representation in organizing committees remained limited, although there was a small but steady rise. While diversity initiatives have contributed to a rise in female participation across various roles, significant gender imbalances remain, especially in leadership positions such as keynote speakers and organizing committees.

Quantitative Analysis

Table 1: Gender Distribution Across Neuroscience Conferences (2014–2023).

Conference	2014-2016 (Female)	2014-2016 (Male)	2017-2019 (Female)	2017-2019 (Male)	2020-2023 (Female)	2020-2023 (Male)	Observations
Society for Neuroscience (SfN)							
Keynote Speakers	20-25%	75-80%	30%	65-70%	35-40%	60-65%	Female keynote speakers increasing, still dominated by men.
Invited Symposium Speakers	30%	60-65%	35%	55-60%	40-45%	50-55%	Women's representation increasing in symposium roles.
Poster Presenters	50-55%	45-50%	55-60%	40-45%	60-65%	35-40%	Women increasingly dominate in poster presentations.
Organizing Committees	20-25%	75-80%	30%	70-75%	40%	60-65%	Female committee representation is rising but men still dominate.
Attendees	40-45%	55-60%	45-50%	50-55%	50-55%	45-50%	Female attendance is steadily rising, while male participation slightly declines.
Federation of European Neuroscience Societies (FENS)							
Keynote Speakers	25%	70%	30%	65%	35%	60%	Men remain dominant, but efforts to improve diversity are evident.
Invited Symposium Speakers	30%	60%	35%	55%	40%	50%	Women's participation rising, but men remain the majority in symposia.
Poster Presenters	55%	40%	60%	35%	65%	30%	Female participation increasing, while male involvement is declining.
Organizing Committees	25%	60%	30%	55%	40%	50%	Committee inclusion of women improving, but still dominated by men.
International Brain Research Organization (IBRO)							
Keynote Speakers	10-15%	55%	20%	45%	35-40%	35%	Significant push for gender diversity has resulted in more female representation in keynote roles.

Invited Symposium Speakers	20%	50%	25%	45%	35-40%	40%	Increasing participation of women in symposia, though men still dominate.
Poster Presenters	40-45%	45%	50-55%	40%	55-60%	35%	Women consistently increasing their presence in poster sessions.
Organizing Committees	20%	55%	30%	50%	40%	45%	Increased female representation in organizing committees.
Regional Conferences (Asian-Pacific, African)							
Keynote Speakers	5-10%	80-85%	10-15%	75-80%	15-20%	70-75%	Male dominance in regional conferences but gradual improvement in female participation.
Invited Symposium Speakers	10-15%	70%	15-20%	65%	20-25%	60%	Women's increasing role in symposium sessions, though men still outnumber women.
Poster Presenters	45%	55%	50%	50%	55%	45%	Women's presence rising steadily but male participation is still high in regional settings.
Organizing Committees	5-10%	85-90%	15%	80-85%	20%	75-80%	Gender diversity in organizing committees growing slowly.
Pakistani Women in Neuroscience							
Keynote/Plenary Speakers	1-2%	10-15%	2-3%	10-15%	5-7%	10-12%	Gradual increase in Pakistani women's visibility in keynote roles.
Symposium Speakers	3%	10-15%	5%	15-20%	8-10%	15-18%	Women's representation in symposia increasing through regional networks (e.g., PASBAN, IBRO).
Poster Presenters	5-8%	12-15%	10%	15-20%	15%	20-25%	Increased visibility of Pakistani women in poster sessions, especially at regional events.
Conference Committees	<1%	10-15%	3%	12-18%	5%	15-18%	Increasing but still low female representation in organizing committees in Pakistan.

Qualitative Analysis

A thematic analysis was conducted on interviews with Pakistani women neuroscientists to identify recurring challenges and explore examples of how these barriers were overcome. The analysis covers key themes such as funding, visibility, institutional support, cultural barriers, and networking opportunities.

1. Funding Challenges

A significant number of interviewees highlighted insufficient funding as one of the primary obstacles to advancing their research and attending international conferences. Many women expressed frustration over limited access to scholarships, travel grants, and research funding, which often restricted their participation in global scientific dialogues.

"We struggle to secure research funding, especially for projects that focus on local issues in Pakistan. It's much harder for women to get funding compared to their male counterparts."

"I missed out on several conferences due to lack of travel grants. These opportunities are critical for career growth."

Overcoming Barriers:

- **Crowdfunding and External Collaborations:** Some women turned to crowdfunding platforms and external collaborations with international research groups to raise money for attending conferences or funding research projects.
- **Partnerships with NGOs and International Organizations:** Others sought funding through partnerships with non-governmental organizations (NGOs) and international organizations like IBRO and FENS, which increasingly offer support to women researchers in Pakistan.

2. Visibility and Representation

Many women pointed out that lack of visibility in the scientific community was a persistent challenge. They felt their contributions were often overlooked in favor of their male counterparts, and there were fewer platforms for them to present their research at major conferences.

"Even though I've published several papers, I rarely get invited to speak at conferences or lead symposia. It's a struggle to get noticed."

"The space for women in neuroscience is growing, but we still face difficulty being seen as credible experts in our fields."

Overcoming Barriers:

- **Leveraging Mentorship Networks:** Several interviewees mentioned that joining mentorship networks like PASBAN and AEIRC helped increase their visibility by providing them with opportunities to present their research at national and international platforms.
- **Social media and Online Platforms:** Another strategy was to actively use social media and academic platforms like ORCID and ResearchGate to share research and engage with a global audience. This increased their chances of being invited to speak at international events.

3. Institutional Support

Lack of institutional support for female neuroscientists in Pakistan was mentioned by many as a key challenge. This included issues such as limited opportunities for career advancement, insufficient research infrastructure, and a general lack of encouragement from academic institutions to support female scientists.

"Our universities don't prioritize female researchers in the same way they do male faculty members, especially when it comes to securing resources for research."

"There's a lack of policies that actively support the inclusion of women in academia, especially in leadership roles."

Overcoming Barriers:

- **Establishing Women's Research Groups:** Some women took the initiative to create their own research groups and networks, focusing on fostering a more inclusive environment.
- **Working with International Networks:** Collaborating with international organizations like IBRO and FENS was another way that women managed to overcome institutional barriers in Pakistan. These collaborations provided access to resources, funding, and visibility that they otherwise wouldn't have had access to.

4. Cultural and Societal Barriers

Cultural and societal expectations often act as a barrier for women in science. Many women faced pressure from family or society to balance their academic careers with domestic responsibilities, which sometimes hindered their ability to attend conferences or pursue research opportunities.

"It's challenging to balance my family obligations with the demands of my research. The societal pressure is real, especially when you're a woman in a male-dominated field."

"I often face questions about why I spend so much time at conferences or in the lab. There's a perception that women should prioritize home over career."

Overcoming Barriers:

- **Supportive Family Networks:** Women who overcame these cultural barriers often had strong support systems, either from their families or other female researchers who helped share the load.
- **Institutional Family Support:** Some academic institutions have implemented family-friendly policies, such as providing flexible working hours or family support services, which enabled female researchers to manage their academic and domestic responsibilities better.

5. Networking and Collaborations

Limited networking opportunities and a lack of collaboration with international researchers were seen as barriers that hindered women's professional growth.

"It's difficult to build networks when you don't have the same opportunities for collaboration as male researchers."

"I've often felt isolated in my field. Women in neuroscience in Pakistan don't have the same access to global networks as their male counterparts."

Overcoming Barriers:

- **International Collaborations:** Women actively sought international collaborations by reaching out to global researchers through networking events, conferences, and online platforms like LinkedIn.
- **Creating Regional Networks:** In addition to formal networks, some women created informal networks with other female neuroscientists, both in Pakistan and abroad, to share resources, collaborate on research, and support each other.

Discussion

Our findings suggest a noticeable upward trend in female participation at major neuroscience conferences over the past decade, particularly in roles such as keynote speakers and symposium participants. While this increase is encouraging, it is crucial to recognize that men continue to dominate key leadership positions, such as organizing committee memberships and senior roles in program development. These trends align with broader patterns observed in academic and scientific fields, where women, despite entering the workforce in increasing numbers, still face significant challenges in attaining influential positions[1,6].

For instance, the Society for Neuroscience (SfN) has seen an increase in female keynote speakers, rising

from 20-25% in the early 2010s to 35-40% in recent years. Despite these improvements, male dominance remains evident in organizing committee roles, which reflects broader institutional barriers. These barriers include gendered expectations, biases in committee selection processes, and a lack of mentorship opportunities, all of which contribute to the persistent gender gap in leadership positions[7]. The trend in IBRO conferences, where the percentage of female keynote speakers has also risen to 35-40%, highlights the potential for diversity initiatives to impact gender equity positively, yet there is still much work to be done to achieve parity across all roles within the conference structure.

In contrast, regional conferences, particularly in underrepresented regions such as Asia-Pacific and Africa, have demonstrated slower progress in addressing gender disparities. While there has been an increase in female participation in poster presentations and other junior roles, senior leadership positions continue to be largely male-dominated. This disparity could be attributed to a combination of cultural norms, institutionalized gender biases, and limited access to resources for women from these regions[2,8]. Furthermore, the challenges of securing funding, gaining recognition, and overcoming institutional barriers are compounded for women from underrepresented backgrounds[9], resulting in slower progress toward gender equity in these areas.

Our qualitative analysis highlights the significant barriers that women face in gaining leadership roles within neuroscience. These barriers include limited access to funding, inadequate mentorship networks, and the overrepresentation of male-dominated scientific communities in decision-making roles. Financial limitations, in particular, continue to be a major challenge for women, especially in resource-constrained settings. Many women in our sample reported difficulty securing funding for their research or for attending conferences, further hindering their ability to rise to leadership positions[1]. Some women have managed to circumvent these barriers through alternative funding mechanisms, such as crowdfunding and international collaborations[7]. However, these solutions are not universally accessible and may only benefit a select few, further exacerbating existing inequities.

The lack of visibility and recognition of women's contributions to neuroscience remains a critical issue. While women are increasingly visible in junior roles, such as poster presentations and symposia, they are often absent from the decision-making processes that shape the direction of the field. This invisibility in leadership roles reflects broader gender dynamics in academia, where women's contributions are often undervalued or overlooked[10]. Structural issues such as unconscious bias, a lack of institutional support, and limited access to mentorship and networking opportunities continue to hinder women's advancement in neuroscience[3].

Despite these challenges, our study also highlights the potential for change through active diversity initiatives and mentorship programs. Conferences and organizations that prioritize diversity, equity, and inclusion such as those implemented by IBRO and SfN serve as models for other organizations. These initiatives have shown promise in improving female representation, particularly in speaker roles, and could be expanded to address leadership positions more effectively. Policies that promote work-life balance and gender-responsive leadership development are essential in creating environments where women can thrive and achieve equal representation in neuroscience[11].

Conclusion

In conclusion, while there has been notable progress in increasing female representation at neuroscience conferences, the gender gap in leadership positions remains a significant challenge. To foster a more inclusive and equitable neuroscience community, it is essential to continue addressing the structural barriers that limit women's advancement. This includes increasing support for women in securing funding, providing mentorship opportunities, and fostering networking environments that prioritize diversity

and inclusion. Furthermore, concerted efforts are needed to ensure that women from underrepresented regions have equal opportunities to participate in the global scientific conversation. Only by addressing these barriers will we be able to achieve true gender parity in neuroscience and other STEM fields.

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