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A Snapshot of Female Representation in Twelve Academic Psychiatry Institutions Around the World

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All authors read and approved the final manuscript.

Declaration of competing interest

There are no conflicts of interest associated with this study.

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Abstract

The study presented here aims at bringing a global perspective to the phenomenon of unequal representation of females in science by offering empirical data of female representation in neuroscience/schizophrenia academic or clinical departments in several institutions around the world. We took advantage of a budding network of scientists and colleagues from different countries to bring the data together. The data presented are related to sex, that is the biological distinction between males and females, based on genetics and reproductive anatomy, while gender, considered a cultural concept was harder to determine. We report data from two clinical/academic departments in Nigeria, Africa; 2 clinical/academic departments from Sudan, Africa; 1 clinical/academic department from South Africa, Africa; 3 academic institutions from Ireland, Europe; 1 clinical/academic institution from Spain, Europe; 2 academic institutions from Buenos Aires University, Argentina; and the Psychiatry Departments at Harvard Medical School, Boston, USA.

Keywords

Leaky pipeline; Bottleneck effect; Unconscious bias; Women representation in psychiatry; Women representation in neuroscience; Women representation in Africa, South America, European Community, North America; Women representation global perspective

1. Introduction

At the Schizophrenia International Research Society (SIRS) meeting, held virtually in April 2021, Drs. Susana Ochoa and Elisabetta del Re, co-chaired a roundtable focused on sex inequalities in neuroscience and in psychiatry.

The roundtable was attended by 30 schizophrenia researchers and clinicians. There were 2 males and 28 females with academic ranks and ages widely represented, from graduate students to senior scientists/clinicians. The SIRS's roundtable on sex was spurred by efforts that have emerged to bring egalitarian roles for males and females in science and neuroscience. This effort aligns with the idea that all people deserve equal rights and opportunities. As of 2021, data show that it takes females a longer time to transition to senior author, with an average of 9 years versus 5 years for males (Hart, 2019; Bearden, 2019). Data (Dworkinn, 2020) also indicate that papers with males in the first and last authorship positions are cited more often than papers with females in first and last authorship positions. In support of this notion, a rigorous meta-analysis of comprehensive data obtained across five high-impact neuroscience journals (i.e. Brain, Journal of Neuroscience, Nature Neuroscience, NeuroImage, and Neuron) showed that male first and last author research publications cite 20% fewer research papers with females in corresponding authorship positions (Dworkin, 2020; Fairhall and Marder, 2020). Similar data are found in cognitive neuroscience (Fulvio 2020).

Several research papers have addressed other aspects of sex and gender inequality (DeLisi 2021). The recent Huang and colleagues' paper published in PNAS (2020) focused on the 'productivity puzzle', i.e. that women publish less than men. The study analyzed more than 7,863,861 scientists' publication records in the Web of Science (WoS) database between

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1955 and 2016. Overall, across countries, Huang's analysis indicated that the science authorship sex/gender gap is ~73% male to ~27 % female, with some differences by science fields, where for example, the numbers in health sciences are ~70%/~30% and in math ~85 %/~15%. This persisting sex/gender gap in productivity from the 1950s to 2016, was deconstructed (Huang, 2020) by comparing sex/gender differences in the number of publications/year instead of looking at publications throughout the entire academic career. With this methodological approach, the sex/gender difference in productivity i.e. number of paper published/year, is reduced to almost none. Within this rigorous and innovative conceptual framework, Huang (2020) showed that the key variable in productivity difference between male and female scientists resides in career duration or length, where women have greater drop-out rates from science careers; counter-intuitively, data indicate that, as the number of females in science has increased, the female productivity gap and impact has also increased steadily (from 10% productivity gap in 1950 to 35% in the 2000s (Huang, 2020; see also Hunt, 2016; Bernardi et al., 2020; Gonzalez-Alvarez, 2019).

A perspective on this seemingly incongruous reality of academia might reside in the effective work roles and primary activities that female and male scientists hold within academia. Eagly's commentary (PNAS, 2020) points to the importance of looking beyond academic titles, as these are not equivalent to knowing the daily percent of time males and females scientists spend on research/writing papers. Data (NSF, 2019) indicate that among PhD holders, actual roles under similar academic titles for male and female scientists are not equivalent, underscoring persistent occupational segregation (Foley, 2019).

Further analyses and studies have produced relevant data indicating that, within academia, females are less likely to have access to relevant positions, less likely to be appointed to leadership positions (Clark and Horton, 2019); and are paid significantly less than male scientists (Shen, 2013; Else, 2018; Woolston, 2021).

As promotion and academic advancement are increasingly based on the number of publications and citations (h-index; i10-index), the themes emerging from the referenced studies indicate that the sex/gender gap in science results from multiple interacting factors.

The themes that emerged during the sex/gender gap SIRS symposium were in line with both the themes of published studies and with the known difference of outside work activities that females "traditionally" take on as sole carers of children and aging parents; problems that were worsened during the COVID-19 pandemic (del Re and Tan, 2021). One important point that was voiced unanimously in the SIRS sex/gender gap symposium was that of implicit bias [see also papers by Bearden (2019), Regner (2019), McKinnon and O'Connell (2020)], the unconscious prejudice against particular people or groups, more difficult to address than the more explicit structural and more visible barriers for women in academia. The 2011 Yale experiment, where professors from six major US universities were asked to rank the identical CV of an imaginary applicant either explicitly male or otherwise female remains one of the best examples of unconscious bias. The science professors of either sex were more prone to hire the male candidate, more prone to pay the male candidate more; and more prone to mentor him (Mervis 2012). The experiment beautifully showcases

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'unconscious bias', a behavior that goes against logic or reason, but that originates in the dictates of societies and the culture we are brought up into.

But do these data apply to institutions on a global scale? What is the situation when we give a face and a voice to individual institutions around the world?

Here, we do not attempt a comprehensive review of sex/gender gap based on global data. Instead, we attempt to bring a global perspective to the male/female gap literature by presenting empirical data on female representation in neuroscience/schizophrenia research across different academic or clinical departments in several institutions around the world. We took advantage of the SIRS network of scientists and colleagues from different countries to bring the data together. The data presented are mostly related to sex, that is the biological distinction between males and females, based on genetics and reproductive anatomy, while gender, considered a cultural concept, was harder to determine (Luckhoff et al., 2021). Understanding the role of gender identity in publication, promotion, and career success certainly merits further study.

We report data from two clinical/academic departments in Nigeria, Africa; 2 clinical/academic departments from Sudan, Africa; 1 clinical/academic department from South Africa, Africa; 3 academic institutions from Ireland, Europe; 1 clinical/academic institution from Spain, Europe; 2 academic institutions from Buenos Aires University, Argentina; and the Psychiatry Departments at Harvard Medical School, Boston, USA.

As can be seen in Table 1, countries represent different levels of human development (or standard of living) according to the World Economic Forum (https://www.weforum.org/reports/ab6795a1-960c-42b2-b3d5-587eccda6023) and have received Gender Gap Rankings (GGR) from both the World Economic Forum and the Global Gender Gap Report (https://countryeconomy.com/demography/global-gender-gap-index).

2. Methods

2.1 Design

We created a network of psychiatrists and neuroscience researchers based in different psychiatric and neuroscience institutions in different countries. Networking was started at the SIRS Conference 2021 during the Gender/Sex Equality roundtable, which was chaired by Drs. del Re and Ochoa.

2.2 Institutions

A brief description of the different institutions is provided in Table 1, and further details can be found in the Supplement.

2.3 Data Acquisition

Data were acquired by co-authors/network participants in each individual department/institution, using the specific ranking of each institution/academic system. Specific methods of male/female data acquisition are detailed below, presented by country/institution. All co-authors adopted the Athena SWAN methodology of acquiring gender profiles of academic

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staff across career stages (see Donald et al., 2011) (‘Advance HE’s Athena SWAN Charter Ireland Guide to processes’ document (2021), Advance HE.)

South Africa: Data on the representation of male versus female research staff at the Department of Psychiatry, Faculty of Medicine and Health Sciences (FMHS) at Stellenbosch University (SU), South Africa were collected via telephonic and online communication with administrative staff. For post-doctoral researchers and fellowships, the Coordinator of Emerging Research Programmes at the Research Development and Support Division was contacted. For PhD students, information on student enrolment at the Division of Business Management was acquired. For Research Assistants, appointments were confirmed via information captured on a database by administrative staff at the Department of Psychiatry. For Extraordinary Appointments, Human Resources were contacted. Aggregated career levels: Early Career, Research Assistant and PhD Students; Mid Career: Post-doc, Clinical Research Fellow / Research Fellow, Senior Post-doc, Assistant Professor; Senior, Full/Associate/Extraordinary Professor, Extraordinary Associate Professor, Lecturer, Extraordinary Senior Lecturer, Extraordinary Lecturer, Director of Research Unit, Coordinator of Research Group/Project.

Sudan: Data were collected from two institutes: the Department of Psychiatry, Faculty of Medicine, University of Khartoum, and from Taha Baasher Psychiatry Teaching Hospital, in Khartoum. Data was provided by the medical director and by the staff. Aggregated Career Levels: Early Career, Teaching Assistant; Mid, Lecturer, Assistant Professor, Specialist; Senior, Director, Coordinator of Unit, Professor, Coordinator of Research Group, Co-coordinator, Head of Unit, Consultant

Nigeria: Data were collected from Delta State University (DELSU) and Olabisi Onabanjo University (OOU). In DELSU, the history of the Department Staff record and Associate Assistants were collated from the Secretary of the Department of Pharmacology and Therapeutics. They were further confirmed with the help of the Head of Department as well as from other staff who have been working in the institute since inception of the Department. The data represent the number of technologists, academic researchers, lecturers and professors in the Department of Pharmacology and Therapeutics. Aggregated career levels: Early, Technologist (Assistant Technologist), Graduate/Research Assistant, Assistant Lecturer; Mid, Technologist (Technologist II/I),/Clinical Lecturer/Lecturer (Lecturer II/I - PhD researchers), Research Fellow; Senior, Technologist (Principal/Chief Technologist), Senior Lecturer/Consultant Senior Lecturer, Associate professor/Associate professor consultant, Coordinator of research group, Full Professor, Director/Coordinator of the Unit. The data presented from Olabisi Onabanjo University (OOU) however represents the number of academic researchers, professors, lecturers and graduate students across the departments of Anatomy, Biochemistry, Physiology, Pharmacology, and Pharmacy; as well as consultants and resident doctors within the teaching hospital (OOUTH) who specialize in Psychiatry and neuroscience research. The data were acquired through the staff and student archives in the respective departments. Aggregated career levels: Early, Research Assistant, PhD Researcher, Student; Mid, Research Fellow, Assistant Professor, Lecturer,

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Clinical Lecturer; Senior, Full professor, Associate Professor, Senior Lecturer, Consultant Psychiatrists.

Spain: Data from Spain were collected from the Research Unit Parc Sanitari Sant Joan de Déu. Parc Sanitari Sant Joan de Déu (PSSJD) is a clinical institution that has provided services in mental health. The information obtained in the present study has been obtained from institutional memories of the Research Unit of PSSJD. The information of researchers in each group is available in the web page of the PSSJD institution. Specifications about degrees have been collected by asking the leader of each research group. Aggregated career levels: Early, Research Assistant, PhD student; Mid, Clinical Researcher, Clinical Research Fellow, Research Fellow, Senior Post-doc; Senior, Director, Coordinator of the Unit, Coordinator of Research Group, Co-coordinator.

Republic of Ireland: Psychiatry departments in Irish Higher Education Authority (HEI) who took part in the Athena Swan process were contacted and invited to contribute the psychiatry research staff by sex/gender numbers in their respective departments. The Athena Swan process was launched in Ireland in 2015 and is funded by the Higher Education Authority (HEA). The HEA linked Athena SWAN awards to institutional research funding eligibility to Ireland's main research funding bodies. Institutions and their departments (i.e. faculties or schools) apply for an Athena SWAN award following an intense one-two year period of analysing and reflecting on both quantitative and qualitative findings related to a range of areas, including: family leave, culture, career development and supports for staff and students. Following this review of data, policies and staff consultation, the institution or department puts forward a four-year sex/gender equality action plan, based on these findings. Departmental awards build on institutional Athena SWAN success and help to further embed sex/gender equality within school-level practices while also shining a light on any gaps that the institution could improve upon. Aggregated career levels: Early, Research Assistant, Research Fellow, Researcher; Mid, Assistant Professor, lecturer, clinical lecturer; Senior, Associate Professor, Senior Lecturer, Full Professor.

Argentina: Female/male profiles were collected from the Institute of Pharmacology, which is a research institute dependent on the Faculty of Medicine, and from the Chair II of Psychological Clinic and Psychotherapies, which belongs to the Faculty of Psychology, both from Buenos Aires University (UBA). Data from the Institute of Pharmacology were obtained through the annual reports submitted to the dean of the Faculty of Medicine https://www.fmed.uba.ar/instituto-de-farmacologia/informacion-general. Aggregated career levels: Early, PhD researcher/student, Research Assistant; Mid, Research Fellow; Senior, Director/Coordinator of the unit, Coordinator of research group.. Data from the Chair II of Psychological Clinic and Psychotherapies, of Faculty of Psychology of UBA were obtained through consultation with one of the chair's referents. It has not been possible to obtain the data from written sources http://www.psi.uba.ar/academica.php?var=academica/carrerasdegrado/psicologia/obligatorias/index.php&id=84. Aggregated career levels: Early, Assistant of practical work (with rent), Assistant of practical work (ad honorem); Mid, Head of Practicum; Senior, Full Professor in charge, Full Professor..

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Massachusetts, Boston: Using the Harvard Faculty Directory, 2,500 individuals were found to be affiliated with the Harvard Medical School Psychiatry Department. The sex/gender of each individual was evaluated through a google search for their Linkedin profile, hospital staff profile, or personal website. One hundred and ten (110) individuals were excluded due to having no digital footprint that indicated their sex/gender or having a role in the psychiatry department that was outside of the standard faculty appointment hierarchy, such as a Special Projects Coordinator. Aggregated career levels: Early, Graduate Students, Post-doc; Mid, Clinical Research Fellow, Research Fellow, Senior Post-doc, Lecturer, Assistant Professor; Senior, Full Professor, Associate Professor, Senior Lecturer.

2.4 Analysis and Data Presentation

Individual Tables for each country/institutions are included in the Supplement.

In order to make data comparable across institutions, a classification into Early Career, Mid Career and Senior positions was adopted upon agreement and review of all the co-authors and is included in the Supplemental: Table 1.

3. Results

3.1 Cohort of Data Across Institutions

Twelve institutions provided data on the number of female and male academicians/clinicians across different career stages. The total number of female academicians in the cohort was 1555 in the year 2020; the number of males was 1101. Numbers for the years 2017, 2018, 2019 and 2020 are included in Figure 1, while Table 1 provides a brief description of each of the institutions that participated in the project.

3.2 Percentages of Males and Females Across Career Stages And Institutions

To aggregate numbers of female and male academicians across institutions by career levels, different rankings across different institutions were defined as early, mid and senior level. The percentages of female/male academicians according to these aggregated categorizations, for the years 2017, 2018, 2019, and 2020 are presented in Figure 1 as percentages of females/males out of the total number of academicians at that specific career level (See Table 1 in Supplement for details on data aggregation). At early career stages, data indicate a higher percentage of female researchers and slightly higher numbers of female researchers at mid-career level. At senior career levels, the percentage of female researchers drops significantly, while that of males researchers significantly surpasses that of female colleagues.

Percentages of males and females in each institution by aggregated career levels are presented in the Supplement. the data indicate decreasing numbers of females along the career path in all but three institutions, the Taha Basher Psychiatric Teaching Hospital in Khartoum; the Department of Psychiatry at Stellenbosch University in South Africa; and the Institute of Pharmacology in the Faculty of Medicine at the University of Buenos Aires. In the Supplement, we also include numbers and percentages of females/males according to the specific academic rankings associated with each institution.

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Discussion

The empirical research data we present here were acquired across twelve institutions in different parts of the world. The aim was to contribute to the growing body of literature acknowledging sex biases in academia and academic publications with an eye at inclusivity and equal representation of scientists and institutions beyond the confines of Western science. As neuroscientists and clinicians and as part of the Schizophrenia International Research Society major goals, we focused on neuroscience and psychiatry institutions and departments within institutions.

As indicated in Table 1., countries included represent different levels of standard of living according to the Economic World Forum, allowing a wider understanding of gender/sex gap on the background of countries economic status.

Overall, the summary of the aggregated data in Figure 1 indicates and confirms that in the institutions that participated in this study from around the world, women represent a large majority of early career scientists/clinicians, while their presence steadily decreases as the career stages progress to mid and further to senior stages. This trend is well epitomized by the expressions ‘leaky pipeline’ or ‘sticky floor’, the existing negative correlation between career stages and female presence in science (Goulden et al., 2011; Resmini et al., 2016; Ysseldyk et al., 2019; Brown et al 2020; Hingle and Barrett, 2020). Another expression is that of bottleneck effect, whereas women find significant barriers in their promotion to senior academic appointments in some parts of the world (Llorens et al., 2021).

We found some geographical differences that are worth noting and are described below

Sudan

The longitudinal data from the Faculty of Medicine, University of Khartoum, which was founded as Kitchener School of Medicine in 1924 as the first college of medicine in Sudan (Faculty et al., 2021) indicate that the number of female graduates has been increasing steadily.

The data collected for the years 2017 to 2020, indicate that females in the institution are underrepresented at leadership career stages and the first female doctor to head the psychiatry department was appointed in 2016; nonetheless the whole body of female doctors in the department remains at the assistant professor career stage. The trend differs in Taha Baasher Psychiatric Teaching Hospital, as a more clinically oriented institution, where females dominate the senior and junior posts in the clinical practice and around 70% of the units are led by a female consultant.

A 2012 study, focused on Sudanese female medical doctors presence in clinical and academic institutions, notes that the roots of female underrepresentation in many Sudanese academic institutions reside in commitments outside the workplace, such as rearing of children and caring for the elders, as reported for many other countries around the globe, as well in sociocultural factors specific to Sudanese society (Mohammed, 2012). Here, Hamid (2020) points to the enormous cultural and economic regional differences of Sudan, with

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great variation in the availability of academic resources. Thus, the impressive representation of women at Taha Baasher, might not be representative of the whole country, in that most agricultural regions of Sudan suffer from lack of local academic institutions with strong economic pushes for women to remain at the margin of the educational system (Hamid 2020).

Nigeria

The situation of women representation in Nigeria academic institutions differs from that of Sudan, although both countries are characterized by great geographical inequalities in terms of availability of resources and access to higher education.

In Delta State University (DELSU), the Department of Pharmacology and Therapeutics is housed in the Faculty of Basic Medical Sciences, College of Health Sciences. Three of the faculties in the department are strongly involved in neuroscience and neuropsychiatric research including co-author Dr. Benneth. Right from the inception, the department has only seen three female lecturers. In the Olabisi Onabanjo University (OOU) and Teaching Hospital (OOUTH), no female representation was observed across the 4 years of study in the senior career stage of neuroscience and psychiatry researchers. As in other academic institutions around the world, the number of female enrollments in PhD neuroscience and psychiatry specialties, in 2017 and 2018, is slightly higher than the number of males enrollments (Goulden 2011; Ysseldyk et al., 2019) while the number of females in the mid-career stage remains strongly below that of males, and the overall percentage of females in the institution remains at ~11%. In DELSU, plans are currently being put in place to kick-start a postgraduate program for both Masters and Doctor of Philosophy degrees based on the current increasing staff strength in 2021. In the long run, this may help female postgraduate education in pharmacology and its specialties including neuropharmacology and neuropsychiatry. As in Sudan, although the reason for the scarcity in female academic staff in Nigeria is ill-defined, both cultural stereotypy and socio-economic factors are at play. Notably, an environment of delayed employability; contending cultural and economic factors such as marriage life, child-bearing circles, financial limitation, lack of scholarship programs as well as the significant variation in the availability of academic Institutions for postgraduate studies particularly in the field of neuroscience in some regions of the country can all be listed as contributing factors to lack of women representation (Ogbogu, 2011). The data for the two Universities in Nigeria may not give a complete reflection of the representation of females in the Nigerian academia, nonetheless there is a strong and concerted push to change the sex/gender perspectives of Nigerian Universities and equity policies have been implemented in some academic centers (Oluwakemi, 2021).

South Africa

The Department of Psychiatry at Stellenbosch University in South Africa shines as a model of female integration and representation in Academia. The University, founded in 1956, has made active efforts in the last few years toward establishing principles of equity, accountability, respect, and inclusivity. The picture that is provided by the data in our study, though, should again be looked at in the context of the overall higher education institutions in South Africa. A report by the ministry of higher education in 2017 (https://

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www.dst.gov.za/images/2020/02/Report_MTT_RRP_of_Black_Academics_web_final1.pdf) indicates substantial sex/gender inequalities in South Africa higher education institutions that intersect with race inequalities (see also Shober, 2014; Zulu, 2017; Moodly and Tony, 2017).

Argentina

Jumping to South America, data from two Institutions in Argentina, while still showing an inverse correlation between career stage and female representation, indicate lesser inequalities in females' presence in academia, and stability in the trend of greater female representation across the 4 years of data collection. In the Institute of Pharmacology surveyed in this study, specifically, there is a growing number of women in senior positions. Argentina is reported to having more women in science than many other countries (Zhang, 2015) and programs and policies are in place to reach sex/gender equality in academia (Ludovico, 2019). For example, in the Argentinian system based on age eligibility limits to apply to academic positions, females are allowed an additional year over the age limit for each child. Inequalities nonetheless exist with a lower number of females in senior academic positions (Ludovico, 2019). A recent survey conducted by the Ministry of Science, Technology and Innovation of Argentina, entitled "Diagnosis of the situation of women in science and technology" (Tignino et al., 2020) indicates that gender inequality does not occur in the mental health fields, traditionally led by women as 'caring field', but between sub-areas of knowledge that traditionally have been led by men (engineering and technology and natural and exact sciences).

Spain

The data from the Parc Sanitari Sant Joan de Déu in Spain, a clinical institution that has provided mental health services to the community since 1854, pertains to the Research Unit. The unit was created in 2001, in an attempt to introduce theoretical knowledge into mental health clinical services. The evolution of the personnel hired in the Research Unit of PSSJD can be deduced from the data presented. The proportion of females within the category of research assistants, research fellow and researchers is greater than that of males in most of the years and the number of females in the position of 'Coordinator of Research Group' has increased over the years. Here though numbers can be deceiving, because the category of 'Coordinator of Research Group' includes both coordinators and co-coordinators, where females represent the vast majority of co-coordinator and men that of coordinator, with differences in tasks and activities (Foley, 2019; Eagly 2020).

Ireland

Data from Ireland include numbers from departments of Psychiatry from two academic institutions, the National University of Ireland, Galway and Trinity College Dublin; and from the department of Child and Adolescent Psychiatry at University College Dublin. Here, the 'leaky pipeline' or/and 'the bottleneck effect' are unquestionable and striking. A clear majority of females at lower career stages, with 90% female representation in the Research fellow category, is replaced by a clear majority of males at higher career stages, with only 20% of females as full professor in 2020, and none in the years 2017–2019. The Higher Education Authority Institutional Staff by Gender Report 2020 indicated that, across Irish

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universities in 2019, 74% of Professor positions were held by males and 26% were held by females.

We have discussed reasons for this disappearance of women at higher career levels, but the numbers from these Irish institutions remain surprising in perpetuating the strong negative correlation between number of women in academia and career stage.

The data from Spain and Ireland are in line with overall data from the European Community, where women have a ~40.0% representation in academia and represent ~21.0% of senior positions (Europaische Kommission, 2016).

North America

The North American data were acquired for the year 2020 across 15 Psychiatry Departments at Harvard Medical School and affiliates in Boston. Here as in Ireland and in Nigeria and to some extent, Spain, Sudan and Argentina, numbers show a majority of female representation across early career stages and a progressive higher proportion of males at higher levels of the academic ladder. Our data are representative. According to a 2018 survey of 23 US psychiatry training programs, 42% of psychiatrists were women, but 91% of psychiatry chairmanship was male (Sheikh et al., 2018).

We acknowledge that individual institutions and countries are unique and diverse; with this spread of institutions we hoped to capture the general trends in various global institutions.

All in all, there are a few points that can be derived from this empirical study of neuroscience/psychiatry departments/institutions from different parts of the world.

The general data trend confirms unequal representation of women in senior positions across countries and institutions. The phenomena of ‘leaky pipeline’, high drop-out rates of female scholars from science, neuroscience/psychiatric academic departments; as well as the bottleneck effect, implicit or explicit barriers to women promotions, are key in interpreting the data. Indeed, the possibility that a lower number of women in senior academic positions is due to the relatively recent increase in the number of women enrolling in science fields, does not explain the inverse relation between career stage and female representation. For example, in 2003 (Nature Neuroscience, 2006), 50% of neuroscience graduates were females. Considering roughly 20 years since 2003, it is not comprehensible how representation of women at senior positions in neuroscience remains very thin.

The data should be considered together with the good news that there is an ever growing number of female students enrolling in science in higher education, and that, with exceptions, there is growing representation of females in academia and neuroscience.

We posit that it is important to consider, as the study by Huang (2020) demonstrates that the decrease of female scientists in academia increases with increased seniority, suggesting that policies and action are needed to focus on the whole length of female careers, and not be confined to junior scientists. Whereas the phenomena of the leaking pipeline as well as bottleneck effect perpetuate sex and gender inequalities (Long, 2010), the effects are multiplicative, for example in perpetuating the insufficient number of female mentors

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at advanced career stages (Machlovi et al., 2019). Historical data indicate that the gap in women representation at senior academic position in neuroscience is growing: in 2003 in the US, 50% of students in neuroscience and 22 % of full professors in neuroscience were females (Nature Neuroscience, 2006); versus 53% female student representation and 13.8% female full professors representation in 2017–2018 (McDermott et al., 2018).

Planned interventions to eliminate bias toward women in science, whether implicit or explicit are the essential step forward to better equality in science (for example Uhlmann et al., 2007; Bearden, 2019; Hart et al., 2019; Regner et al., 2019; McKinnon and O'Connell; 2020).

Countries such as Argentina are actively implementing policies to this end, and numbers there toward female equal representation are gradually increasing. The numbers of female representation in the Department of Psychiatry at the University of Khartoum, appear to be more inclusive than those in the academic departments sampled in both US and Europe. One of the fundamental questions that arises from our study is the growing and puzzling sex/gender inequalities along the academic career path in institutions such as in the US and Europe.

While this paper represents a first important effort to understand sex and gender inequalities beyond the confines of western institutions, this will continue as a stable project with the co-authors of this paper and an increasing network of scientists from diverse psychiatry and neuroscience institutions around the world.

Our goal is to prolong this research and form partnerships with diverse institutions around the globe with the goal of producing collaboration and tangible solutions and efforts to address these concerns and to encourage other researchers to maintain these dynamics at the forefront of their research goals.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Highlights

- Unequal representation of women exists in psychiatry and neuroscience across countries
- Data from twelve institutions from Africa, South America, European Community and North America indicate similar negative correlation between women representation and career stage in academia, with exceptions
- “There are some differences in the degree of leaky pipeline across institutions. Leaky pipeline refers to the attrition of the number of women such that at early career stages, women outnumber men but at senior ranks, men greatly outnumber women. Leaky pipeline may reflect the fact that women leave academia at higher rates than men or/and by women facing significant barriers in attaining academic promotion, the so-called ‘bottleneck’ effect.”
- Both common and country-specific underlying mechanisms appear to be at the root of unequal representation of women in psychiatry and neuroscience across countries

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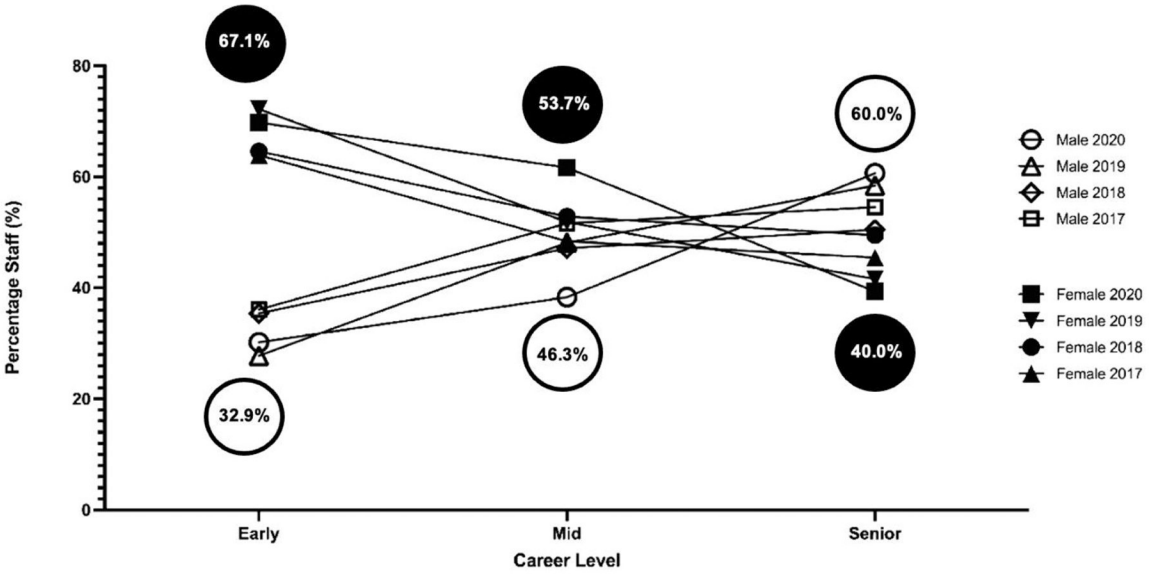

Career Stage	2017			2018			2019			2020		
	M	F	%F	M	F	%F	M	F	%F	M	F	%F
Early	48	85	63.90	51	93	64.58	40	104	72.22	45	104	69.79
Mid	16	15	48.38	33	37	52.85	13	14	51.85	841	1353	61.66
Senior	48	34	41.46	49	42	46.15	59	36	37.89	225	140	38.35

Figure 1. Percentages of Males and Females Across Aggregated Career Levels.

The Percent of females/males were calculated by considering the number of females/males researchers against the total number of researchers at the specific career stage. The table includes raw numbers and percentages by career stage. The percentages in the color-coded ovals represent the total percentage of male and females by career stage across the years data were collected. Data from Harvard University were available only for the year 2020. **Black**, Females; **White**, Males.

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Table 1.

Countries' Gender Gap Scoring-Index and Human Development

	2018 GGR (GGI)*	2019 GGR (GGI)**
Ireland	9 (0.80)	23 (0.093)
Spain	29 (0.75)	16 (0.07)
USA	51 (0.72)	46 (0.2)
Argentina	36 (0.73)	75 (0.33)
South Africa	19 (0.76)	93 (0.41)
Nigeria	133 (0.62)	no data
Sudan	no data	138 (0.55)

* Data for 2018 are from https://countryeconomy.com/demography/global-gender-gap-index;

** Data for 2019 are from the Global Gender Gap Report, https://www.weforum.org/reports/ab6795a1-960c-42b2-b3d5-587eccda6023

GGR, Gender Gap Ranking; GGI, Gender Gap Index, where 1 represents parity, 0 imparity

Dark grey, countries with very high human development or standard of living(HDI);

Medium grey, countries with high HDI; Light grey, countries with low HDI.

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Table 2

Institutions Included in the Study: Historical and Geographical Notes

Table 2. Institutions	Historical and Geographical Notes
Africa	
University of Khartoum, Khartoum, SUDAN	The Kitchener school of medicine was founded in 1924 as the first College of Medicine in Sudan, i.e. is the oldest medical school in Sudan (Faculty et al., 2021). The Faculty of Medicine offers both undergraduate and postgraduate studies and has 14 academic departments. Data for the two Institutions in Sudan were acquired by 1 of the co-authors)
Taha Baasher Psychiatric Teaching Hospital, Khartoum, SUDAN	Taha Baasher Psychiatric Hospital was established in 1960 as an outpatient clinic in Khartoum Bahri by Professor Taha Ahmed Baaher, one of the Sudanese pioneer psychiatrists (Sirag, 2009). Currently, it serves patients from different parts of Sudan with an emergency and inpatient facility, and it receives around 1500 patients monthly in its OPD department. (Data were acquired by one of the co-authors)
Olabisi Onabanjo University and teaching hospital, Southwestern NIGERIA	Olabisi Onabanjo University (OOU) was established in 1982. OOU consists of ten faculties and fifty-six departments in total. The Sagamu campus (where this survey was executed) hosts the Faculties of Basic Medical Sciences, Pharmacy and Clinical Sciences, while the Olabisi Onabanjo University Teaching Hospital (OOUTH; also captured in the survey) is also located within the same premises in Sagamu, Ogun State. (Data were acquired by one of the co-authors)
Department of Pharmacology and Therapeutics, Delta State University, NIGERIA	Delta State University popularly known as DELSU was created in 1992 and runs a multi-campus system. It is one of the Nigerian degree awarding Institutions and houses different faculties all of which offer degrees in a wide range of undergraduate and postgraduate programs ranging from full-time to part-time platforms. Among others, faculties include: Sciences, Pharmacy, Basic Medical Sciences and Clinical Sciences. (Data were acquired by one of the co-authors)
Department of Psychiatry, Faculty of Medicine and Health Sciences, Stellenbosch University, Stellenbosch, SOUTH AFRICA	The Faculty of Medicine and Health Sciences (FMHS) at Stellenbosch University (SU), located in the Western Cape province of South Africa, was established in 1956. It provides five undergraduate and eighty postgraduate programs and is recognized for its world-class research. SU FMHS emphasizes the importance of research translation. (Data were acquired by one of the co-authors).
Europe	
Research Unit of Parc Sanitari Sant Joan de Déu, Barcelona, SPAIN, EU	Parc Sanitari Sant Joan de Déu was founded in 1854 as a clinical institution providing services in mental health. In 2001, the Research Unit was created and added to the clinical services. During the years the Research Unit has experienced continuous and exponential growth in basic and clinical research projects, publications and hired personnel. (Data were acquired by one of the co-authors).
UCD, TCD, NUIG IRELAND, EU	Child and Adolescent Psychiatry is a discipline of the School of Medicine at the University College Dublin (UCD), a Irish leading research institution founded in 1854. The Discipline of Psychiatry is a discipline of the School of Medicine at Trinity College Dublin involved in teaching and research. Trinity College Dublin was founded by Queen Elizabeth I in 1592. The Discipline of Psychiatry at the National University of Ireland, Galway is a discipline of the School of Medicine, founded in 1845. (Data for the three Irish institutions were acquired by four of the co-authors)
North and South America	
Harvard Medical School, Boston, MA, USA	Founded in 1782, Harvard Medical School is a leading institution in medical research and education. Over 10,000 physicians and scientists hold faculty appointments for Harvard Medical School and its affiliated 15 hospitals and research institutions. (Data for Harvard were acquired by two of the co-authors)
University of Buenos Aires, Faculty of Psychology, Buenos Aires, ARGENTINA	The University was established in 1821 and the Faculty of Psychology was founded 35 years ago. Previously, Psychology was studied at the Faculty of Philosophy. Psychoanalysis is the most deeply rooted theoretical orientation within the faculty. However, in recent years, some subject's programmes have been updated and new evidence-based chairs have been created (Data from the two Argentinian institutions were acquired by two of the co-authors)
Institute of Pharmacology, Faculty of Medicine, University of Buenos Aires, ARGENTINA	The Institute of Pharmacology is a research center, which belongs to the Faculty of Medicine of the University of Buenos Aires. It is integrated by an interdisciplinary group of researchers, including psychiatrists and clinical doctors, pharmacologists, biologists, biotechnologists, biochemists, geneticists, and statisticians. Most members are also professors at Buenos Aires University.