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Research Article

Armenian Women in Science: An Analytical and Bibliometric Study of Current Trends

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ABSTRACT

This article investigates the role of women scientists in the Republic of Armenia, specifying their involvement and impact on the scientific community. The study is conducted from the dual perspective of biographical data (regarding age, title, academic position) and bibliometric data (regarding publications produced and respective citations). Through the lists provided by the Armenian Higher Education and Science Committee (HESC) and compiled by the Center for Scientific Information Analysis and Monitoring (CSIAM), academic biographical information on female scientists working in research organizations/institutions in the Republic of Armenia was identified. In addition, bibliometric data on the respective publications and citations were collected using the Web of Science database. Armenian women scientists make up nearly 52% of researchers in Armenia, significantly exceeding the global average of 30%. They are primarily engaged in the humanities and social sciences, chemistry, medicine and biology. While the number of women holding Ph.D. degrees has increased, women scientists with the title of so-called *doctor of science* still remain a minority. Women are underrepresented in leading scientific positions (heads of departments, laboratories, institutions, etc.,). The number of WoS Core Collection publications by women scientists in Armenia has increased almost ninefold since 1991 and women have (co-) authored almost 27% of the totality of publications. Women scientists mostly published their articles as members of research teams. This investigation can help to understand the overall development of the role and share of women scientists in Armenia and, by analogy, also in different corners of the world.

Keywords: Armenian female scientists, Gender gap, Publishing pattern, STEM, Humanities and social sciences, Bibliometric analysis.

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INTRODUCTION

Recent years have seen a critical analysis of women's roles in social and political realms, with this scrutiny extending into the sciences. There is a notable increase in female participation in science compared to past decades, sparking extensive dialogues on gender equality. Despite strides towards gender parity and female empowerment, significant gender disparities persist in the scientific community; women remain a minority among global researchers, with a continuing scarcity of female role models in science and a notable discrepancy in academic honors compared to their male counterparts.[1] According to the UNESCO Institute for Statistics, women are underrepresented in science across all regions of the world.[2] Table 1 provides some of the regional averages for the share of female researchers for 2019.

To bridge this gap and enhance women's participation in science, various international projects and initiatives have been implemented at local, regional and international levels. These include the "For Women in Science" program, i.e., a pioneering program for the promotion of women in science, the "Elsevier Foundation Awards for Early-Career Women Scientists in the Developing World", the UNESCO program "Kenya: Empowering girls through mentoring in STEM for informed career choices", some efforts to boost women's involvement in physics at the Abdus Salam International Centre for Theoretical Physics (ICTP), the Women Science Award (EMBO) and other networks to strengthen women scientists' connections all over the world.

This article aims to showcase the role and representation of Armenian women[1] in the Republic of Armenia's scientific landscape, their involvement in various scientific disciplines, and

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their impact on these fields. Leveraging data from the Web of Science (WoS) Core Collection database, this study will identify publications (co-) authored by Armenian women scientists and present key bibliometric findings. The scientific literature does not include studies on the role and contribution of Armenian women researchers. In this sense, this research can be considered as pioneering, as it focuses on the study of a post-Soviet country that has chosen a European path of development. Furthermore, this research could serve as a stimulus for understanding the general gender situation and developments in academia in other post-Soviet states.

The remainder of this article is organized into four sections. Section 2 contains a literature review exploring academic discussions on gender equality in science. Section 3 defines methodological aspects concerning data collection and analysis, including challenges and limitations. Section 4 illustrates the results while providing a discussion of them, so as to facilitate a comprehensive understanding; it also presents an overview of gender policies in Armenian science, insights into the number of active women scientists in Armenia, their distribution in various scientific fields, their publications and citation impact according to WoS. Finally, section 5 presents some concluding remarks that offer potential explanations for the research performance of Armenian women scientists.

LITERATURE REVIEW

The discourse on gender in science, initiated by Harriet Zuckerman and Jonathan Cole in 1975, has evolved significantly over the years. Their seminal work theorized a "triple handicap" faced by women in science: i.e., barriers to entry, the psychological impact of perceived discrimination, and gender-based disparities in opportunity and reward allocation.[3] Despite the passage of half a century, these issues of gender inequality and discrimination still persist in the scientific realm.

A diverse array of studies has explored gender differences in aspects such as productivity, impact, recognition, and salary. Larivière *et al.*, in their global and cross-disciplinary bibliometric analysis, found that gender imbalances persist in research output worldwide.[4] Despite the developments made by female researchers, they continue to face career challenges: they are employed less than men and earn significantly less.[5] This also extends to professional awards and prizes, where men are nominated and win more awards in science.[6] Similarly, van den Besselaar and Mom found that women have a substantially lower probability of receiving awards for Ph.D. theses in the Dutch academic system.[7]

1. By "Armenian women", we mean female researchers working today in various Armenian research institutions and organizations. Many researchers who have moved to abroad or were born into "Diaspora" communities have not been included in this research.[8]

In 2 different studies, West *et al.* and Holman *et al.* both reaffirmed the existing gender gap in publications, especially in leading authorship positions.[9,10] They further revealed that high ranking journals publish fewer works by female authors and that the latter are invited to publish by journal editors half as often as their male peers. The underrepresentation of women in leading authorship positions was also confirmed by Bendels *et al.*, who further found that articles with female key authors are also less frequently cited.[11] In its 2020 report, Elsevier highlighted the slower growth of articles by female authors, less co-authorship, and stressed that men collaborate more with those of the same gender.[12] A similar pattern was found in the Russian academic system, where male and female mentors more frequently collaborate with the authors of the same gender.[13] Avolio *et al.* provided a comprehensive categorization of the factors affecting women's access, participation, and advancement in science, identifying individual, family, social, educational, and labor-economic elements.[14]

The limited impact of women scientists within their disciplines has been a focal point of research, seeking to understand the causes behind their relatively lower productivity and impact. Factors such as family roles and responsibilities, including childcare and parenting,[15-19] career breaks,[20] resource allocation, institutional support,[21,22] research collaboration dynamics,[23-25] gender stereotypes,[26] career trajectories,[27] academic rank,[28] research specialization,[29] and workplace climate[30] have been identified as contributing factors.

Huang *et al.* found that men and women publish similar numbers of papers with comparable impact, attributing gendered differences in productivity and impact to women's shorter careers and frequent career interruptions.[31] Larivière *et al.* observed gendered differences in citation impact both in national and international collaborations.[32] Similarly, studies like Aksnes *et al.* in Norway found minimal differences in citation rates between genders, attributable to productivity variations.[33] Larivière and Costas noted that the differences are not large and can be attributed to differences in productivity.[34] Other studies

Table 1: Regional averages of female researchers as a percentage of the total research workforce in 2019 (source: UNESCO).

World	30.0%
Central Asia	48.5%
Latin America and the Caribbean	45.8%
Arab States	40.9%
Central and Eastern Europe	39.0%
North America and Western Europe	32.9%
Sub-Saharan Africa	31.1%
East Asia and the Pacific	25.0%
South and West Asia	23.1%

showed that men's higher rate of self-citation, due to their larger publication volume, tends to further enhance their visibility.[35,36]

Country-specific studies have also revealed disparities in citation impact across different research disciplines.[37-42] The role of academic social networking sites-such as Academia.edu, Mendeley, X (formerly known as Twitter)-in amplifying female-authored research has been explored, revealing their potential in increasing the reach of women's research.[43-45] The recent research on the gender-based bias in Wikipedia also revealed that publications by women are cited less by Wikipedia.[46] Zhang *et al*. investigated gender differences in motivations for choosing specific research aims and types.[47] Despite notable advancements in the inclusion and representation of women in science, they continue to be underrepresented, particularly in STEM fields.[48,49]

METHODOLOGY

This study utilized data collected in the early months of 2024 from the WoS Core Collection database,[2] encompassing all publication types by Armenian women scientists in the period 1991-2021. The year 1991 marks Armenia's independence from the Soviet Union, serving as a starting point for this research. While Scopus is also one of the widely used datasets for bibliometric analysis, WoS was chosen for this research because of the wide coverage as well as Armenia's subscription to it and the full access. In the future, we plan to integrate the results of the analysis using data from Scopus and/or other databases.

A critical step involved author identification, especially for entries listed with initials or alternate nomenclatures. Challenges in this process included variations in spelling and incomplete data regarding authors' names and surnames. For instance, Armenian surnames, which are similar for both genders, presented complexities when only initials were available; by way of example, variants such as "Hovhanisyan", "Hovhannisian", and "Ovanisyan" could represent a single author. Similarly, first names such as "Anoush", "Anush", or "Anoosh" posed challenges in identifying a unique author. Aligning authors with their organizational affiliations added another layer of complexity, given the frequent use of abbreviations or shorthand for organization names.

To minimize potential errors in author disambiguation, particularly for female authors, the data from WoS were cross-referenced with author and publication lists compiled by the Center for Scientific Information Analysis and Monitoring (CSIAM) and the Higher Education and Science Committee (HESC) of Armenia. For this analysis, we focused on research produced by women born after 1930, considering the ongoing contributions of older researchers in consulting roles. The lists of authors were predominantly based on the data provided to the HESC by the authors themselves (researchers in Armenia are required to fill in the online database about their publication record) and compiled by the CSIAM based on the CVs of Armenian researchers. Sample tests revealed that cross-referencing the information is relatively robust, achieving an accuracy higher than 95% in correctly identifying female researchers. We extracted publications featuring at least one female author, forming a dedicated database for Armenian women researchers. This database included citation counts for each publication and identified the position of female scholars in author lists (i.e., first, last, and corresponding authorship).

We categorized researchers' scientific fields based on HESC-Armenia data, while the publications' subject fields were determined according to the subject field classification by Glanzel and Schubert.[50] This led to the identification of 16 fields:

Agriculture and Environment (AGRI)	Chemistry (CHEM)
Biology (BIOL)	Physics (PHYS)
Biosciences (BIOS)	Geosciences and Space Sciences (GEOS)
Biomedical Research (BIOM)	Engineering (ENGN)
Clinical and Experimental Medicine (CLIN)	Mathematics (MATH)
Neuroscience and Behavior (NEUR)	Social Sciences (SOCSCI)
Art and Humanities (ART&HUM)	Multidisciplinary Sciences (MULT)

Thus, the methodology followed several key steps: data extraction and cleaning, identification of all authors to determine their gender. Women scientists were separated and this data was cross-checked with the data compiled by our group. The analysis was then performed on the finalized dataset.

The research presented herein primarily utilizes a *full count* of publications and citations to offer a comprehensive overview of the global impact of Armenian women scientists in the international scientific community. This approach is chosen for its clarity and straightforwardness. However, the authors are aware that the propensity to publish and cite can vary significantly between scientific fields. Therefore, a more rigorous though inevitably more laborious and complex approach would entail the implementation of an appropriate *field normalization*.[52,53] This issue will be explored in future studies. Consequently, most data are presented in Headcounts (HC), representing the total number of people employed in R&D. This includes staff employed both full-time and part-time.

2. Specifically, the active subscription of the authors to the WoS Core Collection (from 1970 to present) was utilized. This collection includes the world's leading scholarly journals, books, and proceedings in the sciences, social sciences, and arts and humanities, as part of the following editions.[51]

Table 2: Percentage of master's degree holders, postgraduate students, postdoctoral fellows, Ph.D. holders and doctors of science in Armenia, in the years 2008, 2010, 2018 and 2021 (source: Social Statistics, ARMSTAT, HESC).

	2008		2010		2018		2021	
	Women	Men	Women	Men	Women	Men	Women	Men
Master's degree holders	62.4	37.6	61.9	38.1	66.2	33.8	67.3	32.7
Postgraduate students	29.3	70.7	41.4	58.6	38.8	61.2	50.8	49.2
Postdoctoral fellows	29.4	70.6	23.1	76.9	54.5	45.5	38.5	61.5
Ph.D. holders	38.5	61.5	41.0	59.0	48.3	51.7	50.5	49.5
Doctors of science	21.4	78.6	18.2	81.8	21.5	78.5	20.6	79.4

RESULTS AND DISCUSSION

Evolving dynamics of women in Armenian science

Although Armenia regained its independence after the collapse of the Soviet Union in 1991, it took a considerable amount of time for the country to start a discourse on the issue of nondiscrimination based on sex.[54] This late transformation was similarly observed in other post-soviet states to varying degrees.[55] In 2003, Armenia ratified the European Social Charter, affirming the fundamental principle of nondiscrimination based on sex in the enjoyment of social rights. This ratification marked a pivotal step in the nation's commitment to gender equality, particularly in the realms of work and family relations. The Poverty Reduction Strategy Paper (PRSP)-developed collaboratively by the Armenian government, international bodies, and civil society organizations-further emphasized equal rights and opportunities for both genders. The National Action Plan (NAP) 2004-2010, adopted by the Armenian government in 2003, was a significant stride in enhancing women's status and their societal roles. It outlined the framework for public policies aimed at addressing women's issues, underscoring the necessity of gender equality as a cornerstone for a democratic, socially and legally sound state, and a thriving civil society. Despite these measures, it wasn't until 2013 that comprehensive legislation on equal opportunities for men and women was enacted, focusing on "ensuring equality in all spheres of public life, legal protection of women and men against discrimination, support for the formation of civil society, establishment of democratic relations in society, as well as ensuring equal rights and responsibilities, equal treatment and opportunities".[56]

The policy of bridging the gender gap, conducted by the Armenian government both in general terms and within specific scientific fields, includes different measures, such as: joining international agreements, improving national legislation, developing national strategies, and implementing targeted grant programs. In 2020, the HESC organized the first call for proposals on scientific topics, aimed at increasing the share of women in leading positions in science. Specifically, the initiative sought to foster the empowerment of women as leaders in the area of contractual funding of scientific and technical activities.

The above measures have often yielded (at least some of) the hoped-for effects, as also witnessed by various indicators, both nationally and internationally. Armenia's journey in closing the gender gap is reflected in its ranking on the Global Gender Gap Index, which evaluates gender parity across the four key dimensions of (i) economic participation and opportunity, (ii) educational attainment, (iii) health and survival, and (iv) political empowerment. The 2023 report highlighted Armenia's significant progress, with a notable leap of 28 positions from the previous year. This improvement was characterized by a remarkable increase in women's participation in scientific fields and higher education, e.g., in terms of growth in the percentage of female students in M.Sc. and Ph.D. programs at universities.

However, a disparity remains evident in higher academic ranks. Despite more women entering scientific fields, their representation diminishes in senior positions, as shown in Table 2. This inconsistency points to potential systemic barriers in career advancement for women scientists. Table 1, which illustrates the gender distribution across academic levels in the years 2008, 2010, 2018 and 2021, also reveals a substantial increase in women graduates and postgraduate students, a situation prevalent in many countries.[57,58] Although there are no studies yet about the gender involvement in Master's degree programs in Armenia, a general explanation for the dominant role of women can be associated with the following reasons: very low salaries in science, which is why male students prefer not to continue their education for a Master's degree and instead start working, while women, who are not the main breadwinners in traditional Armenian families, continue their studies. Another reason can be the mandatory army service for males, which can coincide with their study years, leading many students not to continue their studies after returning from the army. However, the proportion of women holding post-doctoral positions and Ph.D. degrees, though improving, still lags behind that of their male counterparts, particularly in the highest academic ranks, such as that of *doctor of science*.[3]

3. There are 2 academic levels in Armenia, as a legacy of the Soviet Union: *candidate of sciences* (which is equivalent to the world-recognized Ph.D. qualification) and *doctor of science*. The latter is considered superior to the former in terms of the reputation and scientific value of the holder.

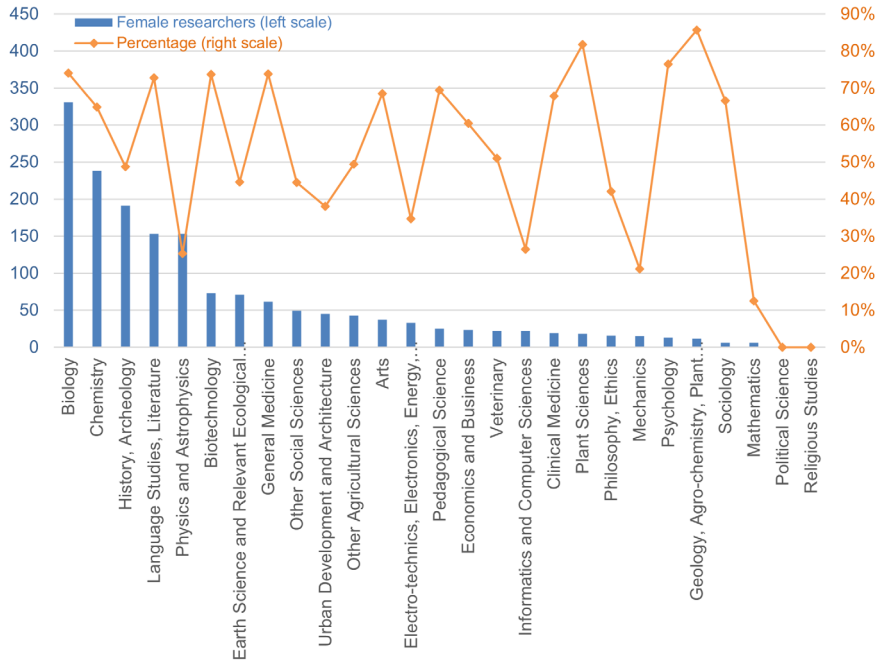


Figure 1: Absolute count (bar graph with left scale) and relative percentage (broken-line graph with right scale) of female researchers by scientific field in Armenia.

Data provided by the HESC of Armenia indicates a near gender parity in the total number of researchers in Armenia, with women constituting 51.8%. It further shows that this parity is more pronounced in the 25-44 age group, suggesting a generational shift in the scientific workforce.

Figure 1 illustrates the distribution of female researchers across various scientific fields. While the global trend shows underrepresentation of women in STEM,[48,10] Armenian women are notably prominent in chemistry, biology, and several other STEM fields. In contrast, their presence in social sciences and humanities is comparatively more dominant.

The lack of a mandatory research component for university lecturers in Armenia is an overlooked aspect that might contribute to the underrepresentation of women in scientific research. Armenia has reformed its higher education and science systems while navigating its Soviet legacy. Under Soviet rule, higher education prioritized teaching, with research centralized under the USSR Academy of Sciences. This structure, inherited by Armenia, separated research institutes from Higher Education Institutions (HEIs), concentrating research in specialized institutions. It should be noted here that women constitute 80% of the education sector workforce. Notably, Armenia ranks among the top 12 countries with the highest proportion of female college professors, according to World Bank data. Although women are primarily involved in low and mid-level roles, their representation among rectors and vice-rectors in HEIs has modestly increased over the past decade.

Recent developments in Armenia's science policy aim to integrate research institutions with HEIs and mandate scientific research and publication activities for HEI teaching staff, aligning with global academic standards. This policy gap suggests potential areas for policy intervention to harness the full potential of the female academic workforce.

Table 3 offers a view of the age-related distribution of women Ph.D. holders, *doctors of science*, and women holding leadership positions[4] in scientific institutions, providing a crucial insight into the career trajectory of women scientists in Armenia. The data reveals a noticeable percentage underrepresentation of younger women, particularly in the 25-34 age bracket, as Ph.D. holders. This disparity could be partly attributed to the policy that exempts male Ph.D. holders from military service, which might motivate several men to pursue a Ph.D. primarily as an opportunistic way to avoid military service, leading them to subsequently abandon long-term commitments in science upon obtaining their degree. Additionally, the relatively low salaries in the scientific field may contribute to this trend. In fact, salaries are often insufficient for people with a primary income to adequately support their families, a role traditionally held by men in Armenian society. On the other hand, Armenian women tend to be more motivated to embark on doctoral studies after a period of maternity leave and once their family situation has stabilized. The above reasons seem to significantly discourage women from entering doctoral programs at a very young age, delaying such entry by a few years, when their economic and family conditions seem more favourable.

4 E.g., heads of departments, research units, laboratories and institutions.

Table 3: Number (and relative percentage) of women holding a Ph.D., doctors of science, and in leading positions, by age. Source: HESC.

Age	All Ph.D holders	Women Ph.D.holders	Percentage of women among Ph.D. holders	Women doctors of science	Percentage of women among doctors of science	Women institutional leaders	Percentage of women among institutional leaders
≤ 24	0	0	0%	0	0%	0	0%
25 to 29	40	8	20%	0	0%	0	0%
30 to 34	152	54	33.5%	1	50%	1	16.6%
35 to 39	213	107	50.2%	2	100%	13	39.3%
40 to 44	192	104	54.1%	1	10%	15	45.4%
45 to 49	134	87	64.9%	3	23%	13	46.4%
50 to 54	89	56	62.9%	6	40%	9	45%
55 to 59	83	54	83%	8	30.7%	14	46.6%
60 to 64	117	67	65%	16	29.0%	6	15.7%
65 to 69	123	51	41.4%	15	19.4%	7	13.2%
70 to 74	156	73	46.7%	14	15.7%	13	16.6%
75 to 79	81	33	40.7%	7	11.2%	4	10.8%
80 to 84	45	24	53.3%	9	18.75%	5	17.8%
85 to 89	15	10	66.6%	6	24%	2	33.3%
≥ 90	1	0	0%	1	12.5%	0	0%

The situation is completely reversed in the case of *doctors of science*, a domain where men dominate. Thus, although important strides have been made in gender equality within science, the pool of women scientists is still not performing to its full potential, as their numbers in top academic and leadership positions remain disproportionately low. Delving further into this matter, a notable link exists between occupying leadership roles and possessing advanced academic qualifications (such as a Ph.D. or a *doctor-of-science* degree). It is evident that while having such degrees is a necessary condition, it is not a guarantee for securing leadership positions. Among those with these qualifications, only approximately 12.6% of women occupy leadership roles. A similar trend is observed among male scientists, but the percentage increases to about 29%. This indicates that men with higher academic degrees are more than twice as likely to assume leadership positions compared to their female counterparts. The authors acknowledge that the previous results are derived from a relatively small sample of a few hundred Armenian scientists; therefore, generalizations should be approached with caution. Future plans include seeking confirmation of these results by expanding the sample.

The presence of women in the various scientific fields varies in Armenia. It is significant in geology, agro-chemistry, plant protection (85.7%), plant sciences (81.8%), biology (74%) and biotechnology (71%), as well as general medicine (73.8%) and chemistry (64.8%). Women are particularly present in the social sciences and humanities, with a notable representation in psychology (76.4%), linguistic and literary studies (72.8%), pedagogical sciences (69.4%), arts (68.5%), sociology (66.6%) and economics and business (60.5%). In contrast, their presence is considerably lower in fields such as mathematics (12.5%), mechanics (21.1%), physics and astrophysics (25.3%). Interestingly, despite the lower representation in physics, female publications dominate this field, reflecting the historical productivity of physics in Armenia. Very similar results were highlighted in Norway, where the share of female researchers was the highest in medical and health sciences (53%), social sciences (50%), and humanities (46%), and significantly lower in natural sciences (31%) and technology (22%).[23]

Referring to global results, the share of women among all researchers worldwide is 33.3% according to data from 107 countries for the period 2015-2018. This percentage was lower in a similar survey conducted five years earlier (28.4%). Interestingly, many OECD countries have low gender parity rates in science, e.g., Japan (17%), the Republic of Korea (20%), and France and Germany (28%).[2]

The other five countries of Eastern Partnership,[5] in addition to Armenia, showed the following results: Azerbaijan-58.6% (Natural sciences-61.4%, Engineering and technology-52%,

5. The Eastern Partnership is a joint initiative launched in May 2009 by the European Union and six countries of Eastern Europe and the South Caucasus: Armenia, Azerbaijan, Belarus, Georgia, Moldova, and Ukraine. The main objective of the initiative is to strengthen political and economic relations between the EU and these countries, promoting stability, security, and prosperity in the region.

Health and welfare-50%, Agricultural sciences-42.8%, Social sciences and humanities-64.2%); Belarus-39.3% (Natural sciences-48.9%, Engineering and technology-28.7%, Health and welfare-68%, Agricultural sciences-57.4%, Social sciences and humanities-60%); Georgia-53% (Natural sciences-46.6%, Engineering and technology-38.2%, Health and welfare-63%, Agricultural sciences-50.2%, Social sciences and humanities-59.1%); Moldova-48.6% (Natural sciences-50%, Engineering and technology-23.1%, Health and welfare-55.6%, Agricultural sciences-49.7%, Social sciences and humanities-57.3%); Ukraine-44.7% (Natural sciences-43%, Engineering and technology-34.1%, Health and welfare-65.2%, Agricultural sciences-53%, Social sciences and humanities-64.2%).[2]

Trends in publications by Armenian women scientists

After regaining independence, Armenia struggled to integrate into the international scientific community. Efforts to enhance research quality have focused on adopting international standards, fostering participation in global academic networks, and promoting publications in high-impact journals. However, most Armenian scholars, especially in Social Sciences and Humanities, continued to publish primarily in national journals (123 at the time of writing), hindered by language barriers and the absence of policies supporting international dissemination. Academic journal evaluations depended on international indexing platforms and the Supreme Certifying Commission (SCC), which operated with unclear criteria for journal inclusion. Recent reforms, however, are driving substantial changes in Armenia's science and higher education sectors. Legislative amendments and new policies targeting scholars, journals, research institutions, and funding are underway. The HESC was established to unify education and science policies, consolidating departments and redefining the role of academic research institutions. To boost research effectiveness and internationalization, there is a strong focus on publishing in high-quality journals indexed in WoS and Scopus. By 2026, researchers will need specific publication records to qualify for basic funding. Additionally, new requirements for university professors are being developed to better integrate research into teaching activities.

In this part of our study, we focus on the publication trends and impacts of Armenian women in science. Utilizing the WoS database, we retrieved data on the publications issued from 1991 to 2021. In this period, Armenian scientists contributed 22,827 publications in the WoS, with women scientists being (co-)authors in 6,136 of these publications (the total number of women scientists in those 6,136 publications is 9562). The publications from Armenia are predominantly in English (95%), followed by Russian (4,6%), French (0.2%), etc., Figure 2 shows the total number of publications with Armenian (co-)authors, together with the specific number of publications including only male Armenian co-authors and those with at least one female Armenian co-author, issued from 1991 to 2021 and indexed by WoS.

An analysis of these data reveals a noticeable upward trend in the number of publications involving women scientists, with a significant increase (nearly 17 times) peaking in 2019, which coincides also with a general increase of publications from Armenian scientists in WoS. In general, the growth in publications that include at least one female Armenian scientist over the 1991-2021 period mirrors the growth in publications of all Armenian scientists, amplifying it steadily, as also evidenced by the growth in percentage terms. An exception appears to be the four-year period from 2015 to 2018, during which there was a relatively pronounced growth in publications without female co-authors. The general increase in publication volume after 2018 seems to have been (at least partly) hindered by the COVID-19 pandemic, leading to an overall decrease in the two-year period

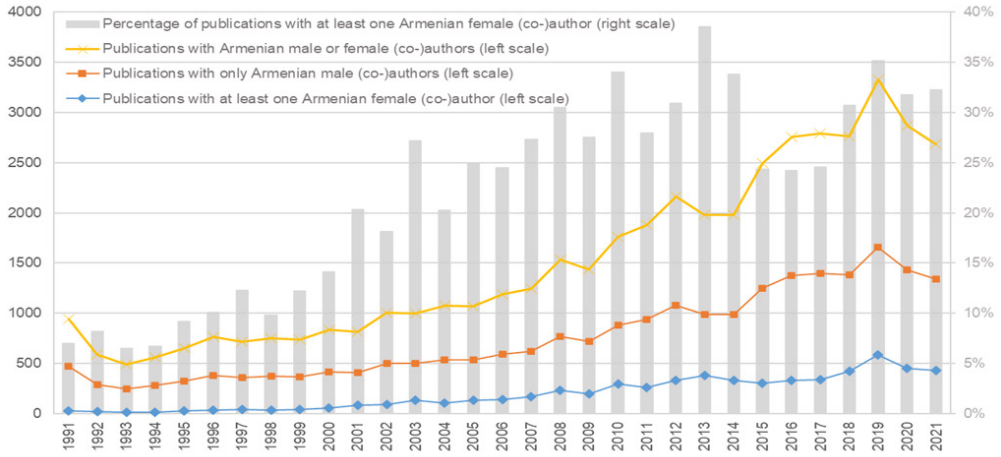


Figure 2: Trend of scientific publications of Armenian (male and female) researchers from 1991 to 2021 and indexed by WoS.

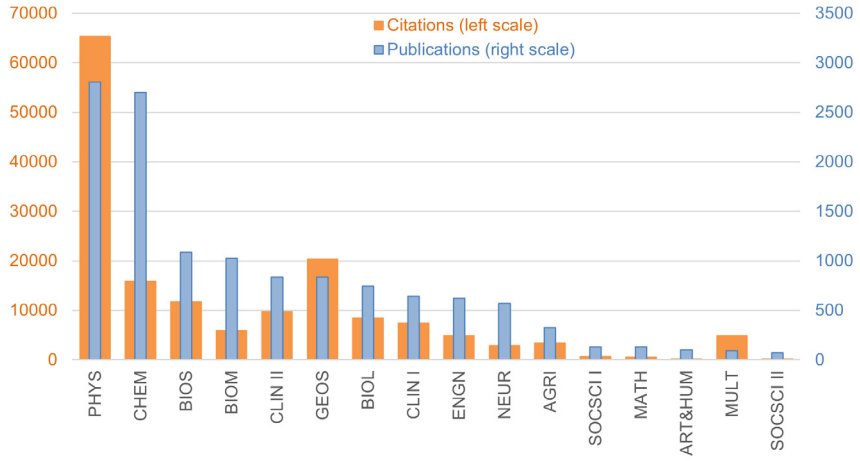


Figure 3: Subject distribution and citation impact of publications by Armenian women scientists. Data refer to publications issued from 1991 to 2021 and indexed by WoS. Unsurprisingly, a significant correlation is observed between the total number of publications and total citations accumulated, across subjects ($R^2 \approx 63.7\%$).[34]

Table 4: Document types of the publications authored and/or co-authored by Armenian women.

Document types	Number of publications
Article	7944
Proceedings Paper	829
Meeting abstract	439
Abstract	249
Review	143
letter	94
Early Access	45
Editorial Material	40
Correction	32
Book chapter	20
Book review	20
Note	8
Biographical - Item	2
Corrigendum	2
Retraction	2
News Item	1
Reprint	1

2020-21, as also observed in broader studies.[59] Here again, the decrease connected with COVID-19 pandemic displays no implicit gender differences.

In addition, it is noted that-despite the general increase in the rate of publications involving female co-authors-the percentage values remain quite low and far from the 100% that would be indicative of a complete balance between male and female co-authorship (excluding single-authored papers).

Most of the published contributions involving woman (co-) authors are in the form of journal articles, accounting for 80% of the total, followed by proceedings papers (8%), meeting abstracts (4%), and abstracts (3%). Other publication formats collectively make up the remaining 1-2% (Table 4).

The subject areas of these publications show an interesting pattern: despite a high number of women scientists in social sciences and humanities, chemistry, and biology, the bulk of their research outputs are in physics. This trend reflects the broader Armenian scientific landscape, where physics is a predominant field, constituting 55% of all Armenian publications in the WoS. In contrast, publications in social sciences and humanities are comparatively fewer (Figure 3).

Further, our study examined the roles of women in these publications, particularly focusing on their positions as first, last, or corresponding authors. This finding is quite telling: women are in leading authorship positions in about 43,6% of the publications. Specifically, they are the first author in 22%, last author in 13%, and corresponding author in 9% of these publications, positions that are quite similar to men scientists-correspondingly 26%, 15% and 12%. This therefore highlights the active and leading roles that Armenian women are playing in scientific research.

CONCLUSION

The role of women in society is undergoing a significant transformation globally. Barriers that women have historically faced are progressively diminishing, paving the way for their increased participation in leadership roles and more equitable opportunities, even in societies traditionally dominated by patriarchal norms. The field of science seems to mirror this global trend. The notion of "cognitive differentiation" between men and women has been largely discredited as academically untenable, with studies indicating that any perceived or actual differences are

more likely rooted in social and cultural factors.[60] As the world progresses in mitigating these factors, various nations have been developing unique strategies to foster more egalitarian societies.

The Republic of Armenia is currently developing strategies and policies to fully exploit the potential of women in different sectors. The results of this policy are evident in Global Gender Gap Index, where Armenia made one of the largest jumps in ranking of any state in 2023, raising 28 positions in its rank compared to its placement in 2022.[61]

The present article offered a general and comprehensive analysis of the role and representation of Armenian women in the scientific sector, revealing that female researchers comprise 51.8% of the scientific workforce in Armenia, while their contribution to publications in the WoS is only 32%. This discrepancy suggests that women in science are not contributing to publications in proportion to their representation in their respective fields. It is noteworthy, however, that this analysis might not fully capture the scope of women's contributions, as it excludes publications in local and international journals not indexed in the WoS. It should be noted that there are only 5 Armenian journals indexed in the WoS. For instance, women have a predominant presence in social sciences and humanities, with the majority of publications from these fields appearing in local journals, thus not considered in this study. According to the local national data,[6] in 28 local journals the number of publications in SSH is 5205 for 2007-2021,[7] which is 5 times higher than their number in WoS for the same years. Nevertheless, publications in globally recognized databases like the WoS and Scopus are crucial for international visibility of scientists.[62]

To date, the number of publications co-authored by women scientists has been seventeen times higher than in the early 1990s. However, these numbers do not align proportionately with the distribution of female researchers across fields. Women tend to publish less than their male counterparts in all fields, even those where they constitute a larger share of the workforce. Despite a lower overall number of publications, women play a leading role in 67% of the publications they (co-) author.

Our findings also show that, while women are well-represented in academia as Ph.D. holders, they are unfortunately still underrepresented as *doctors of science* and in institutional leadership roles, such as heads of departments, research groups, and laboratories. Thus, although Armenia has made significant progress in promoting gender equality in the sciences, the full potential of its pool of women scientists still remains underutilized, especially in senior academic and leadership positions.

6. The Armenian Science Citation Index (ASCI) is a bibliographic database of scientific publications produced in Armenia. Currently there is information about 72 journals published in Armenia (out of nearly 123) for the years 2007-2023 (around 25762 publications and about 360 316 citations). The Armenian Science Citation Index has been developed since 2018 by the Center for Scientific Information Analysis and Monitoring, Institute for Informatics and Automation Problems, National Academy of Sciences, Republic of Armenia.

7. It should be noted that the data is not complete, as not all the journals in the field of SSH are indexed, and there are also some missing issues and/or articles in the already indexed journals (mainly because of the unavailability of the sources).

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

DIGEP: Department of Management and Production Engineering; **HESC:** Higher Education and Science Committee; **CSIAM:** Center for Scientific Information Analysis and Monitoring; **WoS:** Web of Science; **STEM:** Science, technology, engineering and mathematics; **UNESCO:** United Nations Educational, Scientific and Cultural Organization; **ICTP:** International Centre for Theoretical Physics; **EMBO:** European Molecular Biology Organization; **AGRI:** Agriculture and Environment; **CHEM:** Chemistry; **BIOL:** Biology; **PHYS:** Physics; **BIOS:** Biosciences; **BIOM:** Biomedical Research; **CLIN:** Clinical and Experimental Medicine; **NEUR:** Neuroscience and Behavior; **ART&HUM:** Art and Humanities; **GEOS:** Geosciences and Space Sciences; **ENGN:** Engineering; **MATH:** Mathematics; **SOCSCI:** Social Sciences; **MULT:** Multidisciplinary Sciences; **HC:** Headcounts; **R&D:** Research and development; **PRSP:** Poverty Reduction Strategy Paper; **NAP:** National Action Plan; **ARMSTAT:** Statistical Committee Republic of Armenia; **USSR:** Union of Soviet Socialist Republics; **HEIs:** Higher Education Institutions; **EU:** European Union; **SCC:** Supreme Certifying Commission; **SSH:** Social Science and Humanities; **ASCI:** Armenian Science Citation Index; **MESCS RA:** Ministry of Education, Science, Culture and Sports of the Republic of Armenia.

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