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The contribution of women in Iranian scholarly publication

Iranian scholarly
publication

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Abstract

Purpose – The purpose of this paper is to provide an overall picture of women's participation in Iranian scientific production.

Design/methodology/approach – A sample of 7,846 articles was obtained from the three ISI databases: Science Citation Index (SCI), Social Science Citation Index (SSCI), and Arts and Humanities Citation Index (AHCI) for the study period 2005-2010. The articles were broken down by gender. Then for the scope of this study, research productivity, collaboration pattern, scientific-disciplinary, and research impact were investigated.

Findings – A chi-square test showed that there is a significant difference between the male and female research output in the three databases. Females accounted for 13 percent of the articles indexed in ISI databases during the study period. There is a gap of approximately 87 percent in research productivity between males and females in Iran. Iranian women are more active in the areas of chemistry, clinical medicine and general social sciences.

Originality/value – The paper highlights the role of women in science and the gap of research productivity between men and women; it may help illuminate policy decisions to promote female research in the country.

Keywords Iran, Research work, Gender, Women, Sciences, Publishing, Citation indexes

Paper type Research paper

Introduction and background

Since the Islamic Revolution of 1979, new universities and colleges have been established in Iran. Two Ministries (Science, Research and Technology, and Health, Treatment and Medical Education) are responsible for non-medical and medical higher education, respectively. In 2011 the Ministry of Science, Research and Technology reported that there were over 1,891 institutions of higher education of which 163 were universities, 1,433 were higher education centres and government agencies, 295 were non-governmental private colleges. Islamic Azad University was established in 1981, with 385 branches expanded throughout the country.

Universities normally offer a full range of courses. Most of the universities offer masters and doctoral programmes in a considerable variety of subject fields. The main branches currently offered in the Iranian universities comprises natural and basic sciences, medical and health sciences, engineering, agriculture, social sciences, and humanities and arts. According to the Iranian Ministry of Science, Research and Technology, the number of students was standing at 175,675 in 1979. The latest



statistics show that there were about 4,116,593 enrolled students in the academic year 2010-2011, of which about 50 per cent were female. In fact, the number of university students has increased more than 23 times during the three decades. In addition, there are many Iranian students who study abroad. Currently there are over 382,690 students engaged in master and doctorate level study, which indicates research potential in the country. In 2011, full and part time teaching staff numbered 63,818, of whom 49,307 were male (77.6 per cent) and 14,511 (22.73 per cent) female.

Since the revolution the Iranian Government has increased attention on gender equality in higher education. In 2004 they developed policy and strategy to improve women's opportunities in the academic community. The strategy indicates that women are about half of Iran's population. The Islamic message stresses gender equity and rights for women. In keeping with Islamic value and using the female workforce, Iranian women should make headway in the field of science, to play an important role in different social sectors (The Supreme Council of Cultural Revolution, 2004). Despite the fact that there is an increasing proportion of females in the academic community, it is necessary to devise means to monitor their success in the research sphere and its effect on scholarly research production.

Literature review

Numerous studies completed since the 1980s clearly show that female scientists publish at lower rates than male scientists (Cole and Zuckerman, 1984). Symond *et al.* (2006) examined gender differences in the research performance of 168 life scientists in the field of ecology and evolutionary biology. They found that there is a clear difference in the number of publications produced by males and females in this field, with males publishing on average almost 40 per cent more papers than females.

Abramo *et al.* (2009) confirmed the presence of significant differences in productivity between males and females through bibliometric examination of the entire population of research personnel working in the scientific-technological disciplines of the Italian university system. Leahey (2006) identified that the difference in performance between male and female is significant, but noted that such differences can be traced to factors other than gender, such as level of specialisation.

Larivière *et al.* (2010) by using the publication of professors at universities in the province of Quebec, Canada, analysed the relationship between sex and research funding, productivity and impact. The study shows that females after the age of about 38 receive less funding for research than males, and consequently are less productive and at a slight disadvantage in scholarly impact. Prpic (2002), Scheibinger (2003) and Fox (2005) found that women publish between 70 and 80 per cent as many articles as men; in other words, there is a gap of approximately 30 per cent in research productivity between men and women.

A set of studies have compared the scholarly impact of men's and women's research outputs. Some of these have indicated similar levels of impact of their publications (Bordons *et al.*, 2003; Mauleón and Bordons, 2006; Gonzalez-Brambila and Veloso, 2007). Borrego's *et al.* (2010) study has shown that women had a higher impact in certain scientific disciplines. Other studies showed that female publication received fewer citations than those of their male counterparts (Turner and Mairesse, 2005; Penas and Willett, 2006). Mozaffarian and Jamali (2008) studied the gender differences in Iranian articles indexed in SCI in 2003, and found that females accounted for 6 per cent and males

for 94 per cent of the articles. Although there are many studies on gender differences in other countries, few bibliometric studies relevant to women's scholarly publication output in Iran have been undertaken. Therefore, little is known about women's participation in research productivity.

Objectives

The aim of the present investigation is to provide an overall picture of women's participation in Iranian international scientific production over the six years 2005-2010 in terms of the following variables:

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- research productivity;
- scholarly impact;
- collaboration pattern;
- prolific authors; and
- subject distribution.

Methodology

The research data on Iranian scholarly publications were taken from the three ISI Web of Science (WoS) databases: Science Citation Index (SCI), Social Science Citation Index (SSCI) and Arts and Humanities Citation Index (AHCI). Research productivity was defined as the total number of articles published in refereed journals indexed in ISI databases. Although these databases index several different types of document, only articles published in scholarly journals are taken into consideration as research outputs. The study uses time-series data for a period of six years from 2005 to 2010. The data for the study were downloaded from the three databases in May 2011.

During the study period the total number of Iranian articles identified was 70,707 for SCI, 2,827 for SSCI and 257 for AHCI. Because of the large number of authors and the large number of duplicate names, attributing articles to researchers is a more complex process. By using a stratified random sample method a sample of 6,467 articles from SCI, 1,154 from SSCI and 225 from AHCI were selected as sample. Therefore, the study was carried out using a total of 7,846 articles. The female authored papers in this study are those papers that are written either by one female or have at least one female author. In order to compile authors' relevant socio-demographic information and their gender, forenames of the authors were needed. Normally ISI WoS does not give the full version of authors' forenames and this makes it hard to identify their gender. Therefore, for those authors that their forenames were not available in the ISI databases, the socio-demographic data were identified by extraction from a database at the Ministry of Science, Research and Technology and also the web sites of the affiliated universities. For the scope of this study, seven variables were taken into particular consideration: gender, research productivity, fractional output, collaboration pattern, scientific-disciplinary sector and research impact. A full- or integer-counting scheme was applied for the data analysis. One thing more that it should be noted here is that the WoS does not cover all the work published by researchers from Iran, since some are disseminated through non-indexed national journals. WoS limitations affect our examination. As noted by Archambault *et al.* (2006) this limitation is amplified in the case of non-English speaking countries.

Findings

Research productivity

The distribution of publication frequency by males and females in the SCI, SSCI and AHCI databases along with the rate of growth for the six year study period is given in Tables I-III.

As the tables show, 2,162 articles (33.43 per cent) in SCI, 422 articles (36.57 per cent) in SSCI and 58 articles (25.77 per cent) in AHCI were found to have at least one female author, while the remaining of 4,305 articles (66.57 per cent), 732 articles (63.43 per cent) and 167 articles (74.22 per cent) were published only by men (66.33 per cent of all articles). A χ^2 test showed that there is significant differences between the male and female research output in the three databases during the study period ($\chi^2 = 836.58$, $p = 0.001$) and that female contribution was significantly lower than male. Out of 2,642 total female authored articles, 2,162 articles (81.83 per cent) were indexed in SCI, 422 articles (15.97 per cent) in SSCI, and 58 articles (2.16 per cent) in AHCI. There are significant differences between females research productivity in the three databases ($\chi^2 = 2,871.65$, $p = 0.001$). In other words, the percentage of female authors in each database or disciplinary sector differs considerably. The data clearly indicates that

Table I.
Gender distribution of
articles indexed in SCI

Year	Total	Women	%	Growth	Men	%	Growth
2005	545	143	26.24		402	73.76	
2006	717	234	32.64	63.63	483	67.36	20.15
2007	854	270	31.62	15.38	584	68.38	20.91
2008	1,198	415	34.64	53.70	783	65.36	34.07
2009	1,493	517	34.63	24.57	976	65.37	24.65
2010	1,660	583	35.12	12.76	1,077	64.88	10.35
Total	6,467	2,162	33.43		4,305	66.57	

Table II.
Gender distribution of
articles indexed in SSCI

Year	Total	Women	%	Growth	Men	%	Growth
2005	92	20	21.74		72	78.26	
2006	148	54	36.47	170.00	94	63.51	30.55
2007	186	66	35.48	22.22	120	64.51	27.66
2008	260	118	45.38	78.78	142	54.62	18.33
2009	234	87	37.18	-26.27	147	62.82	3.52
2010	234	77	32.91	-11.49	157	67.09	6.80
Total	1,154	422	36.57		732	63.43	

Table III.
Gender distribution of
articles indexed in AHCI

Year	Total	Women	%	Growth	Men	%	Growth
2005	16	2	12.50		14	87.50	
2006	13	4	30.77	100.00	9	69.23	-35.71
2007	28	2	7.14	50.00	26	92.86	188.88
2008	56	20	35.72	900.00	36	64.28	38.46
2009	56	17	30.36	-15.00	39	69.64	8.33
2010	56	13	23.21	-23.53	43	76.79	10.26
Total	225	58	25.78		167	74.22	

females have produced many articles in science, therefore, they are more active in science disciplinary sectors than in social science or arts and humanities.

Analysis of the data shows a steady rise from 2005 to 2010 of male research output in the three databases. The female research output in SCI has risen but in the SSCI and AHCI it has experienced some ups and downs during the period. The average rate of growth indicates that female research output growth in the three databases is higher than male research output growth. Collectively the overall number of articles in the three databases indicates that the yearly percentage of female authored scholarly publications has increased from 20 to 32 per cent during the study period.

Table IV presents the number of authors contributing to the female authored papers. Data analysis indicated that 8,899 authors contributed 2,162 articles in SCI, 1,666 authors contributed 422 papers in SSCI and 115 authors contributed 58 publication indexed in AHCI during the study period. The average number of authors per article was 4.12 in SCI, 3.95 in SSCI, and 1.98 in AHCI, ranging from a minimum of one to a maximum of 25. As it is obvious from Table IV the pattern of author distribution is different across the three databases. The data also indicates that in SCI 63.47 per cent, in SSCI 59.42 per cent and in AHCI 40.87 per cent of the authors are male. It means that the female authored papers were produced with help of male co-authorship.

In order to gain a more accurate estimate of females' contribution in the articles, based on the data presented in Table IV we calculated the sum of the females' fractional contribution. To do this, we removed the single female author papers, then divided the number of articles remaining by the number of authors remaining. For example, if we divide 2,128 (SCI, $2,162 - 34 = 2,128$) articles by the number of 8,865 ($8,899 - 34 = 8,865$) authors, the result will be 4.16 articles per author. This indicates that 5,648 male authors (SCI) produced 1,357 articles (62.77 per cent) and 3,217 female authors ($3,251 - 34 = 3,217$) produced 771 articles. Then 771 articles plus 34 single female authored articles will be 805 papers (37.23 per cent) out of 2,162 articles published in SCI. Accordingly the sum of the fractional contributions for women in the three databases is 1,036 articles. Therefore, out of total of 7,846 sample articles in the three databases women contributed 1,036 articles which is 13.20 per cent of all articles.

Collaboration

This measure enables us to distinguish five different categories of authorship to calculate the level of collaboration in a given publication:

- (1) Single author.
- (2) Female first author (co-authorship).
- (3) Male first author with female authors.
- (4) National (Iranian author).
- (5) International (non-Iranian author).

Variables	SCI	SSCI	AHCI	Total
Number of articles	2,162	422	58	2,642
Number of male authors	5,648	990	47	6,685
Number of female authors	3,251	676	68	3,995
Total number of authors	8,899	1,666	115	10,680

Table IV.
Numbers of authors in
the female authored
papers

These indicators can be taken to represent the degree of cooperation among female researchers in Iran. Table V presents a breakdown of the articles by contributing pattern of female authors.

Out of 7,846 total surveyed articles, just 2,642 articles were female authored articles or have at least one female author. There were only 34 articles (1.57 per cent) in SCI, 42 articles (9.95 per cent) in SSCI, and 25 articles (43.10 per cent) in AHCI that were solely written by females. A high proportion of the articles in AHCI were written by female single author.

The most common contribution in the three databases (SCI, SSCI, and AHCI) was female author collaborating with male authors. In other words in SCI 98.43 per cent, in SSCI 90.05 per cent and in AHCI 56.90 per cent of the samples were written through teamwork and collaboration. Articles in the national collaboration category account for 85.47 per cent in SCI, 71.56 per cent in SSCI, and 56.89 per cent in AHCI. International collaboration among Iranian female scholars in SCI was 12.95 per cent, in SSCI 18.47 per cent and in AHCI was zero. Overall, 13.55 per cent of scholarly articles published during the study period by Iranian female authors were international co-authorships. These numbers show that the collaboration network of women scholars is more local in nature.

Subject-disciplinary

The data analysis showed that in SCI the highest number of articles belonged to chemistry (582 articles or 26.90 per cent) and clinical medicine (484 articles or 22.37 per cent), in SSCI the highest rate of female contribution belong to psychology (164 articles or 38.86 per cent) and public health (82 articles (19.43 per cent)) and in AHCI the highest number of articles published were in archaeology and literature (both with eight articles or 13.78 per cent). Apart from the above mentioned subject categories in SCI and SSCI, females had a considerable rate of contribution in molecular biology and genetics (7.02 per cent), engineering (5.77 per cent), nursing (6.87 per cent), and information science and library science (6.16 per cent). The finding at the highest level in SCI are in line with the findings of Mozaffarian and Jamali (2003), but they found that computer sciences (with no female authors) was followed by agriculture, physics, metallurgy, engineering and geology with the lowest levels of female contribution. However, the result of this study shows that in the recent years Iranian female authors have increased their contributions in these disciplines.

Table VI presents the articles by 22 broad fields in the three databases. Out of 22 broad fields under consideration, nine areas (chemistry, clinical medicine,

Authorship	No. of SCI papers	SCI percentage of 2,162	No. of SSCI papers	SSCI percentage of 422	No. of AHCI papers	AHCI percentage of 58	Total	Percentage of 2,642
Single Female first author	34	1.57	42	9.95	25	43.10	101	3.82
Male first author	904	41.81	187	44.31	11	18.96	1,102	41.71
National	1,224	56.61	193	45.73	22	37.93	1,439	54.46
International	1,848	85.47	302	71.56	33	56.89	2,183	82.62
	280	12.95	78	18.48	0	0.00	358	13.55

Table V.
Collaboration pattern of female authors' published articles

Broad fields	No. of papers	%	Iranian scholarly publication 267
Chemistry	588	22.25	
Clinical medicine	558	21.12	
Social sciences, general	226	8.55	
Psychiatry/psychology	171	6.47	
Molecular biology and genetics	153	5.79	
Engineering	128	4.84	
Neuroscience and behaviour	118	4.46	
Plant and animal science	103	3.89	
Pharmacology	98	3.70	
Immunology	90	3.40	
Physics	75	2.83	
Materials science	67	2.53	
Computer science	65	2.46	
Microbiology	49	1.85	
Biology and Biochemistry	42	1.53	
Agricultural science	34	1.28	
Environment/ecology	26	0.98	
Mathematics	25	0.94	
Geosciences	15	0.56	
Economics and business	9	0.34	
Space sciences	2	0.70	
Multidisciplinary	0	0.00	
Total	2,642	100	

Table VI.
Female productivity in
different fields

social sciences general, psychiatry/psychology, molecular biology and genetics, engineering, neuroscience and behaviour, plant and animal science, pharmacology, and immunology) account for 84.47 per cent of the total articles submitted by females.

Prolific female authors

The data analysis indicated that in SCI 22 authors in SSCI four authors and in AHCI only one author (as first or co-author) contributed five or more papers. These 27 prolific authors contributed 161 articles (6.09 per cent of the total). The number of prolific female authors that published five or more articles is small. Table VII lists the most prolific female authors during the period. Out of 27 prolific authors, six belong to university Tehran Medical Sciences and four to University of Tehran. Alzahra University, the women's university in Iran, has three authors and the Shiraz University of Medical Sciences, Shiraz University, Isfahan University Technology, and Isfahan University of Medical Sciences each with two authors are the other universities that the most prolific female authors.

Scientific impact

The number of citations is generally used in order to assess the scientific impact of articles. Table VIII shows the scientific impact of Iranian researchers' articles in the three databases according to sex.

The mean citation among the databases are significantly different. In other words, the scientific impact of the articles varies across the fields. The impact of the articles indexed in SCI is significantly high (3.26 for men, 3.21 for women) while is minimal

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61,4

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Authors	Institution	No. of papers	Database
Javadnia, Katatyoun	Shiraz Univ. Med. Sci.	10	SCI
Safavi, Afsaneh	Shiraz Univ.	10	SCI
Rafiee, Zahra	Isfahan Univ. Technol.	8	SCI
Bamoharram, Fatemeh F.	Alzahra Univ.	7	SCI
Yazdanparast, Razieh	Univ. Tehran	7	SCI
Azarpira, Negar	Shiraz Med. Sci.	7	SCI
Kelishadi, Roya	Isfahan Univ. Med. Sci.	7	SCI
Meghadadi, Soraia	Isfahan Univ. Technol	7	SCI
Rafiee, Ezat	Razi Univ.	7	SCI
Rahimi, Firoozeh	Univ. Tehran Med. Sci.	6	SCI
Baghernejad, Bita	Alzahra Univ.	6	SCI
Morteza-Semnani, Katayoun	Mazandaran Univ. Med. Sci.	5	SCI
Nikfar, Shekoufeh	Univ. Tehran Med. Sci.	5	SCI
Emam-Djomeh, Zahra	Univ. Tehran	5	SCI
Atyabi, Fatemeh	Univ. Tehran Med. Sci.	5	SCI
Fotouhi, Lida	Alzahra Univ.	5	SCI
Goharshadi, Elaheh K.	Ferdowsi Univ. Mashhad	5	SCI
Sadjadi, Samane	Alzahra Univ.	5	SCI
Sheikhshoaie, Iran	Shahid Bahonar Univ. Kerman	5	SCI
Yaraee, Roya	Shahed Univ.	5	SCI
Akhondzadeh, Shahin	Univ. Tehran Med. Sci.	7	SSCI
Shahrivar, Zahra	Univ. Tehran Med. Sci.	6	SSCI
Rezayof, Ameneh	Univ. Tehran	6	SSCI
Sarafzadegan, Nizal	Isfahan Univ. Med. Sci.	5	SSCI
Ghasemi, Parvin	Shiraz Univ.	5	AHCI

Table VII.
Most prolific authors

Gender	SCI mean citation	SSCI mean citation	AHCI mean citation
Male	3.26	2.74	0.71
Female	3.21	2.32	0.46

Table VIII.
Mean citation according to sex

in AHCI (male = 0.71, female = 0.46). When considering the qualitative dimension of scientific production, the performance difference seems somewhat higher for male than that for female. The general average scientific strength of males is greater than that of females. However, the differences are statistically insignificant, it means that women's articles received comparable citations. It can be concluded that women's contribution to the field of science is valuable. Some of them gained recognition worthy of their work while some were left ignored.

Conclusion

A significant difference in research productivity was considered with males being more productive than their female counterparts, a trend that is consistent during the study period. It may be conclude that men and women have different pattern of research productivity. This supports the results of other studies in the literature.

The study found that women accounted for about 13 per cent of the articles indexed in ISI databases during the study period. In fact, there is a gap of approximately 87 per cent

in research productivity between male and female in Iran. However, as the number of female students has increased during the study period (2005-2010) some positive changes has been occurred in the contribution of Iranian women in science, compared to the result of previous study in 2003 (Mozaffarian and Jamali, 2008). In academic year 2009 about 56 per cent of the graduate and undergraduate students in state universities were female (Ministry of Science, Research and Technology, 2011). Therefore, one would expect females to have about 50 per cent impact on Iranian research productivity, but women's contribution is much lower than expected. The difference may be a consequence of social factors such as the role of the mother and time devoted to children. Such social factors may imply less time and effort available for women to do research, thus making less productive than their male counterparts (Fox, 2005; Hunter and Leahey, 2010). Bellas and Toutkoushian (1999), Brazebat (2006) and DesRoches *et al.* (2010) also showed that females typically devote more time to administrative and teaching activities than their male counterparts. However, we can develop a hypothesis that female researchers in Iran are thus caught in a negative feedback loop: although they achieve more educational opportunity than previously, on average, there is a reduced amount of future scholarly research, thus reducing the amount of future number of publications. It is yet to be seen whether the rise of women in higher education will change a genuine change in the current scholarly publication growth, or if it will simply lead to the continuation of the same or less growth.

Different trends were observed in the three surveyed databases. Although the number of female authors' articles are increasing more quickly, the number of male authored articles increased fairly regularly as well during the period. The 81.83 per cent of the Iranian female authored articles are indexed in the SCI database that represent technological-scientific disciplinary areas and the remaining (18.17 per cent) are covered by SSCI and AHCI. The data shows that the concentration of women in AHCI who published a single authored article is greater than for SCI and SSCI. Women in AHCI have fewer collaborators than women in other fields. This indicates that women in AHCI fields tend to have more restricted collaboration networks. In general, a high proportion of female authored papers (81.79 per cent out of the total) are the result of collaboration. The results also revealed that female authors in Iran especially in humanities were less likely to be working on international projects, as was found by Lewison (2001) in Iceland. The data reveals that Iranian women prefer to collaborate more with partners from Iran than those from abroad. The large proportion of local collaboration could be linked to a greater dependence on other researchers or research team in Iran. We can also conclude that women, on average, have a wider national than international scholarly (in particular scientific) networks.

The prolific female authors data showed that women were more inclined to work in high research-intensive universities such as University of Tehran Medical Sciences, University of Tehran, Shiraz University Medical Sciences, Shiraz University, and Isfahan University Medical Sciences are more productive than their colleagues in less research-intensive universities. Similarly, Xie and Shauman (1998) showed that access to graduate students and post-doctoral researchers as well as to research funding, equipment and available time for doing research were unequally divided among faculty members.

Investigating the scholarly publication activity of the Iranian women based on 22 broad ISI fields showed that women are more active in the areas of chemistry, clinical medicine, general social sciences, psychology, molecular biology and genetics,

engineering, neuroscience and behaviour and plant and animal science. It seems that women's research topics continue to be directed towards areas that are more prestigious like those chosen by men; it is possible that significant changes may occur within future years. The Iranian women are less active in economics and business, and space sciences. There is no clear difference between men and women in sciences with regard to the quality of their research output. The findings indicate a similar level of impact of male and female publications.

It must be noted that the number of women in Iran's universities is overtaking the number of men. Iran's Government has significantly reduced both gender gaps and the formerly wide differences in average attainment between Iran as a Muslim nation and non-Muslim societies. The situation of women in Iran is similar to their counterparts in high Gender-related Development Index (GDI) countries that practice greater gender equality and have espoused affirmative action legislation. The result of this study may help illuminate policy decisions to promote female research in the country.

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