

# Research Output of Women Faculty Members in Physics: A Scientometric Study of Select Central Universities

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## Abstract

This paper examines the research output of women faculty in physics in 10 central universities in India. The data was collected for the period of 2011-15 (5 years). A total of 36 women physics faculty members contributed 282 papers. The study mainly focused on research output, citations, h-index, i10-index, place of women authors when writing papers jointly, proportion of women authors per paper and the central university with highest number of women authors and papers. The results showed that women authors acted as corresponding author more as compared to first or both (first and corresponding). University of Delhi topped the rank in terms of highest women contributors and papers. The ratio of women authors per article was found 0.3. Journal of Applied Physics was found to be the most preferred journal by women authors in Physics.

**Keywords:** Central Universities, H-Index, I10-Index, India, Physics, Research Output, Women Authors

## 1. Introduction

Higher Education sector has witnessed a tremendous growth in terms of number of Universities/University level Institutions and Colleges since Independence. The number of Universities has increased from 20 in 1950 to 819 in 2017. The sector boasts of 47 Central Universities of which 40 are under the purview of Ministry of Human Resources Development. The growth in Higher Education sector is spearheaded by Universities, which are the highest seats of learning. In India, "University" means a University established or incorporated by or under a Central Act, a Provincial Act or a State Act and includes any such institution as may, in consultation with the University concerned, be recognized by the University Grants Commission (UGC) in accordance with the regulations made in this regard under the UGC Act, 1956. Every year, millions of students from within the country and abroad, enter these portals mainly for their undergraduate, and post graduate studies while millions leave these portals for the world outside. Higher Education is the shared responsibility of the Centre and

the States. At present, the main categories of University/University-level Institutions are: Central Universities, State Universities, Deemed-to-be Universities, private Universities and University-level institutions. A Central University is what established or incorporated by a Central Act<sup>1</sup>.

### 1.1 Scientometric Methods as a Tool to Measure Scientific Research Productivity

Publication in refereed journals has become a major criterion of assessing academic excellence in the competitive environment of global higher education. Universities are engaged in a global arms race of publication<sup>2</sup>.

The statistical analysis of scientific literature began in the first quarter of the 20th century by comparing the scientific productivity of several countries, based on the works published. The appearance of the Science Citation Index database in 1963 constituted a turning point providing an instrument for quantitative evaluation. This resulted in a quantum jump in scientometric studies<sup>3</sup>.

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In this paper authors have studied the productivity of women faculty in Physics of Central Universities of India during 2011-2015.

In the past several scientometric studies have been carried out. Recently a study on Central Universities of India has been done by Marisha, Banshal and Singh<sup>4</sup>. Findings of the study showed that DU performed best among all CUs. Another study on contributions of women faculties in physics was carried out by Bebi and Kumar<sup>5</sup>. On the basis of collected data they found that number of women faculty is less as compared to male faculty. A gender bias study was also carried out by Kretschmer et.al<sup>6</sup>. A study by Hasan et.al<sup>7</sup> found no significant difference in the contributions made by the male and female research scholars of CSIR. A study by Amico and Vermigli<sup>8</sup> was conducted on publication productivity and career advancement by male and female psychology faculty in Italy. This study also found that women published somewhat less than men.

## 2. Objectives

Examine the publication productivity of women faculty members in Physics in central universities.

## 3. Data and Methodology

The data on women faculty in physics in Central Universities in India was collected from various sources, such as: Curriculum Vitae (CV) downloaded from the universities websites, Annual reports, Google scholar, Research gate and Web of Science for 2011-2015. The authors have used different sources to collect the data

because all publications have not been covered by any single source. The authors prepared a list of women faculty members of Physics departments of all Central Universities in India and the bibliographic details of journal publications.

## 4. Limitations of the Study

There are 47 Central Universities in India. In the present study the authors have covered only those central universities which are at least 15 years old. Among these only those universities were chosen for the current study in which physics department and women faculty both were found. IGNOU was excluded from the study.

## 5. Results and Discussion

### 5.1 Distribution of Faculty by Gender in Central Universities

Table 1 presents the list of ten central universities which were included in the study along with their staff strength in terms of male and female faculty. It clearly indicates that out of total faculty (214) only 36 are women. The highest number was found in University of Delhi (8). When preparing the list of faculty by university, it was found that out of 47, in 15 Central universities, where there is Physics department, no women faculty were found, i.e. Physics department of BHU, where faculty strength is 30, but no women faculty among them. It can also be said that in every university the female faculty is in single digit as shown in Table 1.

**Table 1.** Gender-wise numbers of faculties in Central Universities

Sl. No.	Name of University	Year of Establishment	Total Faculty	Women Faculty
1.	University of Allahabad	1887	13	2
2.	Aligarh Muslim University	1920	33	4
3.	Jamia Millia Islamia	1920	18	2
4.	University of Delhi	1922	42	8
5.	Dr. H S Gour University*	1946	14	4
6.	Jawaharlal Nehru University	1969	19	3
7.	HNBGU**	1973	8	2
8.	University of Hyderabad	1974	29	7
9.	Assam University	1989	10	2
10.	Tezpur University	1994	20	4
Total			206	36

\* Dr. HSG University: Dr. Hari Singh Gour University, \*\*HNBGU: Hemvati Nandan Bahuguna Garhwal University

**Table 2.** University-wise research output

Sl. No.	University	Papers	No of times cited	Average citations	h-index	i10-index
1.	University of Delhi	133	1296	9.74	18	39
2.	University of Hyderabad	33	758	22.9	13	13
3.	JNU	33	352	10.66	12	16
4.	Tezpur University	29	196	6.75	8	7
5.	University of Allahabad	12	312	26	9	7
6.	Jamia MilliaIslamia	12	39	3.25	3	1
7.	HNBGU	11	51	4.63	5	1
8.	AMU	8	27	3.37	5	0
9.	Assam University	6	15	2.5	3	1
10.	Dr. HS Gaur Vishwavidyalaya	5	6	1.2	0	0
<b>Total</b>		<b>282</b>	<b>3052</b>	<b>10.82</b>	<b>26</b>	<b>85</b>

## 5.2 Research Output by Universities and Impact

The data was analyzed (Table 2). It gives the most productive university with citations, h-index and i10-index. It can be observed clearly that University of Delhi ranks at the top in publications and citations received by them followed by University of Hyderabad (33) and Jawaharlal Nehru University (33). The impact of output has been examined by using the following indicators.

### 5.2.1 Citations per Paper

The average number of *citations per paper* is calculated by dividing the total number of *citations* by the total number of *papers*. This is a very useful metric to assess the average impact for a journal or author or an institution.

### 5.2.2 h-Index

The *h index* was proposed by J.E. Hirsch in 2005. The index is based on a list of publications ranked in descending order by the number of citations these publications received. The value of h is equal to the number of papers (N) in the list that have N or more citations.

### 5.2.3 I10-index

Introduced by Google scholar in 2011 *i10- index* refers to the number of paper with at least 10 or more citations.

## 5.3 Place of Women Authors

In this study an attempt has been made to identify the place and designation of women authors. The data shows

that out of 282 papers written jointly, only in 43 (15.2%) papers female authors figured as first author, in 152 (53.9%) female authors acted as corresponding author and in 22 (7.8%) papers female authors figured both as first author and corresponding author (Table 3).

**Table 3.** Place of women authors

Sl. No.	Place of women author	Number of papers	%
1.	As 1st Author	43	15.2
	Other Places	239	84.7
2.	Corresponding author	152	53.9
	Non-corresponding	130	46.1
3.	1st Author + Corresponding	22	7.8
	Other	260	92.2

## 5.4 Number of Women Authors vis-à-vis Total Number of Authors

Of the 1278 authors who contributed 282 papers, 462 were women and 816 were men. To examine this, authors multiplied each female fraction by the number of articles in that category. For example, there are 57 articles in the category of 1/2 female fraction (Table 4), which means that there are two authors per article and only one of them is a female. Based on this, women's fractional contribution is 28.5 articles out of 57 ( $1/2 \times 57 = 28.5$ ). Based on this calculation, the sum of the fractional contributions for women is 138 articles. Share of women author per article is only 0.3 ( $138/462 = 0.3$ ). It indicates that the productivity of women authors is less than the male authors. Data

**Table 4.** Ratio of women authors to the total number of authors

(1) Female Ratio	(2) No. of Papers	(3) 1*2 (Count of WA)	(4) Female Ratio	(5) No. of Papers	(6) 4*5 (Count of WA)	(7) Female Ratio	(8) No. of Papers	(9) 7*8 (Count of WA)
1/1	5	5	3/3	3	9	5/9	0	0
1/2	57	28.5	3/4	7	5.25	5/10	0	0
1/3	33	11	3/5	5	3	6/6	0	0
1/4	21	5.25	3/6	4	2	6/7	0	0
1/5	16	3.2	3/7	1	0.4	6/8	0	0
1/6	6	1	3/8	1	0.3	6/9	1	0.6
1/7	7	1	3/9	0	0	6/10	0	0
1/8	2	0.25	3/10	0	0			
1/9	1	0.1	4/4	1	4			
1/10	0	0	4/5	0	0			
2/2	22	22	4/6	0	0			
2/3	24	16	4/7	0	0			
2/4	15	7.5	4/8	0	0			
2/5	15	6	4/9	0	0			
2/6	11	3.6	4/10	1	0.4			
2/7	4	1.1	5/5	0	0			
2/8	2	0.5	5/6	0	0			
2/9	2	0.4	5/7	0	0			
2/10	2	0.4	5/8	0	0			

**Total of column 3,6 and 9**  
 $= 112.8+24.35+0.6=137.75$   
 $=138$   
**Article per author by wom-**  
**en= $138/462=0.3$**

\*WA=Women author

**Table 5.** University-wise highest number of women authors and papers

Universities	Type of Authorship							Rank
	Single authored	Two authored	Multi authored (3&4)	Mega authored (>4)	Total authors		Total papers	
					M	F		
DU	0	39	42	52	479	241	133	1
UoH	4	5	14	10	81	51	33	2
JNU	0	4	15	14	103	41	33	2
TU	0	14	12	3	46	46	29	3
UoA	1	5	6	0	13	20	12	4
JMI	0	3	4	5	30	19	12	4
HNBGU	0	6	2	3	19	16	11	5
AMU	0	0	6	2	25	8	8	6
AU	0	3	3	0	5	11	6	7
Dr. HSGV	0	0	2	3	15	9	5	8
Total	5	79	106	92	816	462	282	

presented in Table 4 also indicates that women authors work more in a team as out of 282 papers only 5 papers are written by single women author, four from UoH and one from UoA.

### 5.5 Highest Number of Women Authors and Papers by University

Table 5 presents the output in terms of single authored papers, two authored papers, multi-authored papers

**Table 6.** Rank list of most productive women authors

Sl. No.	Author	Designation	Affiliation	No. of Publications	%	Rank
1.	S. Annapoorni	Professor	University of Delhi	33	11.7	1
2.	Amarjeet Kaur	Professor	University of Delhi	26	9.2	2
3.	Amita Chandra	Professor	University of Delhi	18	6.3	3
4.	Rupmanjari Ghosh	Professor	JNU	17	6.0	4
5.	Tanuja Mohanty	Asst. Prof.	JNU	14	4.9	5
6.	Shyama Rath	Professor	University of Delhi	14	4.9	5
7.	Jyoti Rajput	Asst. Prof.	University of Delhi	13	4.6	6
8.	Poonam Silotia	Professor	University of Delhi	13	4.6	6
9.	Rukmani Mohanta	Professor	Uni of Hyderabad	12	4.2	7
10.	Nilakshi Das	Professor	Tezpur University	12	4.2	7
11.	NS Bhattacharyya	Professor	Tezpur University	12	4.2	7

(papers with 3 & 4 authors) and mega authored papers (papers with >4 authors) for each university. Here, an attempt has been made to explore the highest number of women authors and their contributions in each university. As mentioned in Table 1, that a total of 214 faculty members in 10 central universities only 36 were women faculty. Data presented in Table 5 indicates that University of Delhi is the highest producing institution contributing 133 papers by 720 authors followed by University of Hyderabad with 33 papers by 132 authors. Pattern of authorship indicates that trend of collaboration is more pronounced. Overall it can be said that University of Delhi ranked first.

### 5.6 Rank List of Most Productive Women Authors

Table 6 represents the ranked list of most productive women authors of central universities. Data reveals that out of 36 faculty members, S. Annapoorni with 33 publications topped the list, followed by Amarjeet Kaur (26) and Amita Chandra (18). It indicates that all three top ranked women authors were from University of Delhi and in all out of 11 women authors, 6 are from University of Delhi.

### 5.7 Contribution in Indian and Foreign Journals

Of the 143 journals used for publishing 282 papers, 18 papers were published in 9 Indian journals and the remaining 264 papers in journals published abroad. The one possible reason why faculty publishes their work in foreign journals may be the impact factor of journals and

citations received if published in a foreign journal (Table 7).

**Table 7.** Contribution in Indian and foreign journals

Journal countries	Number of papers	%
India	18	6.3
Foreign	264	93.7
Total	282	100

### 5.8 List of Most Preferred Journals by Women Authors

Table 8 represents ranked list of 10 most preferred journals by women authors of Central Universities. Out of 143 journals, “*Journal of Applied Physics*” has published the highest number of articles i.e. 14 (4.9%) followed by “*Pramana*” with 9 (3.1%) publications, occupied second rank and “*Physical Review C*” with 8 (2.8%) publications, occupied third rank.

## 6. Findings and Conclusion

This study evaluates the publication productivity of women faculty members in physics in central universities of India of with special reference to journal articles. When collecting the data from each central university it was observed that the number of women faculty is very less in number as compared to number of male faculty members. Surprisingly, Banaras Hindu University, which is one of the oldest universities in India, has no women faculty member in Physics department. The paper

**Table 8.** List of most preferred journals by women authors

Sl. No.	Name of journal	IF (2016)	Country	No. of articles	%	Rank
1.	Journal of Applied Physics	2.068	USA	14	4.9	1
2.	Pramana	0.520	India	9	3.1	2
3.	Physical Review C	3.82	USA	8	2.8	3
4.	Applied Physics Letters	3.411	USA	7	2.4	4
5.	Physical Review D	4.568	USA	7	2.4	4
6.	Physics Letters A	1.772	Nether-lands	6	2.1	5
7.	Modern Physics Letters A	1.165	Singapore	5	1.7	6
8.	Applied Surface Science	3.387	Nether-lands	5	1.7	6
9.	Physical Review A	2.925	USA	5	1.7	6
10.	Physics of Plasmas	2.115	USA	5	1.7	6

examined research output, citations, h-index, i10-index, place of women authors when writing papers jointly, ratio of women authors per paper and the central university having highest number of women authors and papers. It is clear from the study that University of Delhi ranked at the top in terms of women faculties and publications. The study found big difference of men and women faculty members in central universities (Table 1).

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