Gender dimensions in popular science writing in India

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Studies on gender disparity in science, technology, engineering and medicine (STEM) are gathering considerable attention across the globe. Almost in every field of STEM a male predominance can be noticed. Gender analysis in popular science writing has not been studied so far. The present study was carried out to analyse the gender dimension in popular science writing in India using Science Reporter, India's leading popular science magazine. All the issues of the monthly magazine published between 2010 and 2020 were analysed. The study supports the hypothesis that gender disparity is evident even in popular science writing. The number of articles contributed by women is considerably lower than men. Women tend to show more interest in collaboration in popular science writing.

Keywords: Gender gap, popular science, science communication, *Science Reporter*.

TRADITIONALLY and globally, women scientists and science communicators are grossly under-represented and frequently misrepresented in the media and society. Often the profession of women in science has been undermined while giving substantial precedence to their feminine and sexual qualities[1–4]. Such skewed and stereotypical portrayal of woman intuitively suggests that they do not belong in the science field and will further result in the alienation of women from science education, research and other related careers[5,6]. Greater representation of women in science communication is important because it can potentially promote the interest and engagement of women in science[7,8].

Science communication includes the introduction and broadcasting of science as a part of everyday life and making it accessible to the masses to bridge the gap between science and the non-specialist community. Scientific awareness is important as it helps demystify myths and in tackling superstitions that are often used to deceive people. Science communication also helps in promoting scientific know-how with regard to commonplace affairs and to approach them with logical reasoning. There is a steady increase in scientific output and a variety of outreach efforts. However, public understanding or appreciation of a vast majority of scientific knowledge generated by Indian researchers is minimal. Strengthening the foundations of science journalism and science communication in the country can be a panacea to this widening gap between the scientists and society at large. Women can play an important role in science communication.

Women and science communication

Science communication offers opportunities for women in science who are looking for alternative career paths. They are often under social pressure to seek careers that fulfil societal goals and a career in science communication is therefore especially appealing to women[3,8]. Also, many women in science are encouraged to participate in outreach activities and to serve as role models for young girls in society[9]. Women in general are known to possess better communication skills[10] and their ability to listen, talk, empathize and deal with emotions are all qualities of an able communicator. This ability to communicate can be used to better advantage, especially in the fields of science and science communication. Nevertheless, women continue to face many challenges in the field of science communication and are unable to maintain visibility and play important roles in this field[11].

India is a multilingual country and the Indian constitution recognizes 22 official languages. The literacy rate for women in the country is 39% against 64% for men[10]. About 35% of science graduates are women. It is perceived that majority of women enter into graduate programmes in science with less degree of confidence than men. Also, pregnancy and child-bearing can be hindering factors for women when pursuing higher education and careers thereof. Many of them, either out of free will or due to societal pressure, leave the field altogether due to constraints of family and motherhood[10].

There are several science communication organizations in India. These include the National Council for Science and Technology Communication (NCSTC), CSIR-National Institute of Science Communication and Policy Research (NIScPR), Marathi Vigyan Parishad (MVP), Kerala Sastra Sahitya Parishath (KSSP), Vigyan Prasar, Indian Science Writers Association (ISWA), National Centre for

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Science Communicators (NCSC) and Homi Bhabha Centre for Science Education (HBCSE). The participation of women in communicating science in Hindi, which is the official language in nine states and three Union Territories, is merely 7–8% (ref. 10). KSSP has a membership of about 45,000 and the share of women is around 11% (ref. 10). Likewise, women science communicators are overwhelmingly under-represented in various organizations in the country.

Across the world, there are more men who are active in science, technology, engineering and medicine (STEM) than women. What is the sociology behind this gender divide? Research shows that when men and women apply for jobs – be in the labour market, or in places where high-level qualification is demanded, male candidates engage in self-promotion and are boastful, while equally qualified women are more 'modest' and 'undersell' themselves. Even in groups and situations where men and women are present as colleagues, the views of women are either ignored or taken less seriously than those of men[12]. As a result, women tend to underestimate their ability relative to men, especially in public settings, and negotiate less successfully.

Gender discrimination and inequality have denied Indian women opportunities for education and employment on par with men, as reported in a study by the Indian National Science Academy, New Delhi[13]. The study aimed to obtain information about women employed in various capacities, including faculty and technical positions in various government organizations and institutions such as the Department of Science and Technology (DST), Department of Biotechnology (DBT), Council for Scientific and Industrial Research (CSIR), Indian Council for Agricultural Research (ICAR), Indian Council for Medical Research (ICMR), Department of Atomic Energy (DAE), Department of Defence (DOD) and Indian Institute of Science (IISc), Bengaluru[13].

Science is fundamentally embedded in social structures and this is realized by the practitioners of science communication and scholars as the field develops through questions raised by researchers in communication, science and technology studies, sociology, science education and museum studies. Practising science results in knowledge that transcends the boundaries of time, space and culture, but the productivity and reliability of it are unfortunately shaped by factors that are beyond the scope of science, viz. gender, race, class and access to power.

Women account for 30% of scientific researchers worldwide, with just one in five countries showing male to female parity. In Australia, male and female students enter tertiary science at equal rates, yet women hold less

Table 1. Year-wise distribution of articles during the last 11 years

Year	Total no. of items
2010	175
2011	172
2012	177
2013	183
2014	180
2015	184
2016	182
2017	215
2018	205
2019	210
2020	213
Total	2096

Table 2. Gender-wise distribution of authors during the last 11 years

Year	Total no. of male authors	Total no. of female authors	Male to female ratio
2010	124	28	31 : 7
2011	119	32	119 : 32
2012	118	37	118 : 37
2013	104	33	104 : 33
2014	123	44	123 : 44
2015	108	49	108 : 49
2016	103	45	103 : 45
2017	80	44	20 : 11
2018	94	60	47 : 30
2019	97	50	97 : 50
2020	116	57	116 : 57

Table 3. Details of authors who have contributed 10 or more articles during the last 11 years*

Author	No. of articles	Male/ female	State
Bansal, Kirti	28	Female	Delhi
Dharmapalan, Biju	28	Male	Kerala
Shivani	27	Female	Delhi
Srinivas, Susheela	24	Female	Karnataka
Nagar, Sonali	23	Female	Delhi
Pandey, Shakunt	23	Male	West Bengal
Singh, Mayanglambam Ojit Kumar	21	Male	Delhi
Murthy, M. S. S.	19	Male	Karnataka
Chhabra, Kirti	18	Female	Delhi
Choudhary, Sonam	18	Female	Delhi
Mondal, Amal Kumar	18	Male	West Bengal
Datta, Sukanya	15	Female	Delhi/West Bengal
Ghosh, Dipanjan	15	Male	West Bengal
Prathap, Gangan	15	Male	Delhi/Kerala
Saha, Babita	13	Female	West Bengal
Bast, Felix	12	Male	Punjab
Mascarenhas, K. Smiles	12	Male	Tamil Nadu
Raghav, Prashant	12	Male	Delhi
Venkataraman, K.	12	Male	Tamil Nadu
Mohapatra, Bibhuprasad	11	Male	Odisha
Basu, Biman	10	Male	Delhi
Datta, Siraj	10	Male	West Bengal
Jain, Sanjay D.	10	Male	Maharashtra
Venkatesh, G.	10	Male	Maharashtra

*Editorials not taken into consideration.

Table 4. Top performing states

State	Total no. of articles published	Total no. of contributing authors	Contribution from male authors	Contribution from female authors	Male to female ratio
Delhi	563	360	207	153	207 : 153
West Bengal	287	212	155	57	155 : 57
Maharashtra	196	160	122	38	61 : 19
Uttar Pradesh	172	155	109	46	109 : 46
Karnataka	196	100	77	23	77 : 23
Tamil Nadu	100	88	74	14	37 : 7

than 10% of senior academic positions and fellowships[14]. Both anecdotal and survey reports show that women in STEM face greater hurdles for success than their male counterparts[15]. Despite years of campaigning and equal opportunity enterprises, women working in STEM fields continue to experience marginalization and bias. This is evident from the fact that women tend to win fewer awards, get lower salaries, have lower chances of being hired, are cited less and are able to secure fewer – and less – grants than their male counterparts[14,16,17]. This is the result of a complex range of social, cultural and structural influences and biases[14], but critical among these are media representation and role models. The media tends to represent STEM careers not in accordance with the stereotype images of femininity, which has resulted in a masculinized perception of STEM among young women and has additionally resulted in women devaluing their own potential to pursue science[18].

The present study aims to elucidate the state of gender dimension in popular science writing in India by analysing the representation of male and female authorships from the science magazine, *Science Reporter* (Council of Scientific and Industrial Research) in the last 11 years (from 2010 to 2020).

Methodology

Science Reporter, which was first published in 1964, is a long-standing monthly Indian popular science magazine. For the present study, data were collected for the period 2010–2020 from the digital issues of the magazine (http://nopr.niscair.res.in). Details of author, gender, types of articles contributed and collaboration were tabulated. In many articles, the title Ms/Mrs is given. Wherever the title is not given, the gender has been determined by the name. There can be errors in gender determination in such cases.

Results and discussion

The contributions in the *Science Reporter* online repository were tabulated. This included covers stories, features, short features, meeting reports, quizzes, cartoons, etc. Names and other details of the contributors of sections like puzzle corner, crossword, wild haven, spectrum, ingenious inventions, etc. were not provided in the database and hence were excluded from the study. In all, 2096 articles have been published with an average of 190.55 articles per year (Table 1).

Table 2 shows that contributions by women authors are less than those by men. The distribution of authors during the last 11 years shows that maximum female authorships was in 2018 (60) and minimum in 2010 (28). Male contribution was maximum during 2010 with 124 authors and minimum during 2017 with 80 authors (Table 2).

Table 3 gives the list of authors who contributed 10 or more articles. There are 24 such authors, of which 8 are women and 16 are men. The leading authors Biju Dharmapalan (male) and Kirti Bansal (female) have contributed 28 articles each (Table 3).

The present study shows that contributions from certain States and Union Territories are nil. These include Andaman and Nicobar Islands, Dadra and Nagar Haveli, Daman and Diu, Ladakh, Lakshadweep, Meghalaya and Tripura. Mostly the North East Indian states recorded poor publishing rate. It was observed that the maximum number of contributions was made by authors from Delhi – 563 articles were published during the last 10 years, showing male dominance (Table 4).

In order to study the collaboration in popular science writing, we obtained details of multi-authored articles published by top-performing male and female authors. It was observed that the tendency for collaboration was more among women (75%) than men (43.75%). Among men, out of 16 top-performing authors only 7 published articles jointly with co-authors. Among them, only five collaborated with female authors (Table 5). Whereas for women, out of eight top-performing authors, six have published jointly with co-authors, of which only three have collaborated with males (Table 6).

The cover story is an important part of a magazine. It is an important story or article that is the main subject shown on the cover of a magazine, and it is planned well in advance by the editors. In the cover stories also there is clear domination of male authors. Analysis showed that female authors contributed 63 cover stories and male authors contributed 92 cover stories (Table 7).

Table 5. Details of collaborative work carried out by top-performing male authors

Author	No. of single-author articles	No. of articles by multiple authors	No. of female collaborators
Dharmapalan, Biju	19	9	3
Pandey, Shakunt	23	0	0
Singh, Mayanglambam Ojit Kumar	21	0	0
Murthy, M. S. S.	19	0	0
Mondal, Amal Kumar	0	19	19
Ghosh, Dipanjan	6	9	7
Prathap, Gangan	15	0	0
Bast, Felix	12	0	0
Mascarenhas, K. Smiles	12	0	0
Raghav, Prashant	9	3	3
Venkataraman, K.	12	0	0
Mohapatra, Bibhuprasad	11	0	0
Basu, Biman	10	0	0
Datta, Siraj	0	10	9
Jain, Sanjay D.	0	10	0
Venkatesh, G.	9	1	0

Table 6. Details of collaborative work carried out by top-performing female authors

Author	No. of single-author articles	No. of articles by multiple authors	No. of male collaborators
Bansal, Kirti	26	2	1
Shivani	24	3	0
Srinivas, Susheela	24	0	0
Nagar, Sonali	21	2	0
Chhabra, Kirti	18	1	0
Choudhary, Sonam	15	3	1
Datta, Sukanya	15	0	0
Saha, Babita	0	13	7

Table 7. Details of cover stories written by female and male authors

Female authors	Contribution in cover stories (nos)	Male authors	Contribution in cover stories (nos)
Srinivas, Susheela	8	Basu, Biman	6
Bansal, Kirti	3	Parthasarathy, Anand	4
Nagar, Sonali	3	Mascarenhas, K. Smiles	4
Karmarkar, Ujwala	3	Venkateswaran, T. V.	4
Karmarkar, Ujwala	3	Arunkumar N. S.	3
Choudhary, Sonam	3	Jain, Sanjay D.	3
Koul, Monika	2	Dharmapalan, Biju	3
Saxena, Swati	2	Pandey, Shakunt	3
Datta, Sukanya	2	Nanoti, Vivek M.	3
Dekhane, Malvika	2	Mande, Shekhar C.	2
Tripathi, Neha	2	Singh, Mayanglambam Ojit Kumar	2
Subramanian, Vrishali	2	Raghav, Prashant	2
Saxena, Richa	2	Khan, Hasan Jawaid	2
Kanaujia, Amita	2		
Kushwaha, Sonika	2		
Kunwar, Shobhna	2		
Single authors	20*	Single authors	51**
Total	63		92

*20 Female authors with once contribution each.
**51 Male authors with once contribution each.

During the last 11 years, 131 cover stories have been published in the magazine. Most of them were written by single authors. For three cover stories, author details were not provided in the magazine. In 22 cover stories, collaborations were observed between male–male, male–female and female–female authors (Table 8). Collaboration between

Table 8. Collaboration in cover stories

		Multiple authors		
Total no. of cover stories	Single author	Male–male	Male–female	Female–female
131	106	10	8	4

Author details of three cover stories are not provided in the respective issues of the magazine.

females is considerably lower than male–male or male–female while writing cover stories.

Conclusion

In almost every field of STEM, gender gap is predominant. The present study was carried out to assess gender gap in popular science writing in the Indian scenario using *Science Reporter*, one of India's long-standing popular science magazines published by CSIR. The study shows that as in other fields of STEM, gender gap can be seen in popular science writing as well. The contribution of women in popular science writing is poor compared to men in all states of India. The situation is little better in Delhi, where the contribution by men and women was almost similar, which may be due to the contribution of interns and other staff members associated with the magazine.

There is a predominance of women in collaboration or as co-authors, among the top authors in *Science Reporter*. This is contradictory to published works. In an earlier study carried out by Nielsen[19], it has been reported that women tend to publish more single-authored articles than men. The number of cover stories contributed by women was good. The results of the present study can be utilized for developing policy guidelines for science and technology communication.

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