

Attitude, Perceptions, Aspirations of Women Faculty Members Towards Academic Leadership in STEM: Enabling Factors and Challenges

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Abstract— Gender equality is a stated United Nations Sustainable Development Goal (UN SDG), as it has broad socio-economic ramifications. Despite a global dialogue, increasing awareness and cogent action by all stakeholders, gender disparity exists across the spectrum. This is true for leadership positions as well, including in academia. The situation is exacerbated in large developing countries such as India. While women comprise a significant percentage of faculty positions in Indian Higher Education Institutions (HEIs), their representation as Vice Chancellors, Directors, Deans remains low. The percentage is even smaller when it comes to STEM courses. To address this imbalance, factors which act as barriers and enablers to the elevation of women to leadership positions in STEM courses in Indian academia need to be examined from multiple perspectives, including those from the women themselves. The present study analyses data from 138 women academic leaders from 73 HEIs in India, using a mixed methods approach. The results indicate that Institutional Culture, Mentoring and Institutional Support, Recognition and Equal Opportunities emerged as the enabling factors whereas Self-Perception, Societal Beliefs and Work-Family Conflict were the major barriers which hinder progression to senior academic leadership positions. The study adds to the body of the existing literature on women in academic leadership in STEM courses and provides valuable recommendations for institutions of higher education for creating an enabling environment facilitating women in getting elevated to senior leadership positions in academia and succeeding in these roles.

Keywords— Academics; Gender Equality; Higher Education; STEM; Women leadership

ICTIEE Track: *Entrepreneurship, Collaboration and Administration.*

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I. INTRODUCTION

The disparity in the number of women occupying senior leadership positions in various organizations has been an anomaly over the years. Studies suggest that companies with a higher representation of women on their boards tend to exhibit superior performance and greater profitability than their counterparts (Forbes, 2023). Despite the fact, there is an underrepresentation of women in the top positions in the organizations as highlighted in studies by (Yousaf & Shmiede, 2017; Babic & Hansez, 2021). As per the Global Gender Report 2022, the share of women in senior leadership roles has shown a steady global increase over the past five years (2017-2022). In 2022, global gender parity for this category reached 42.7%, the highest gender parity scores yet. Despite the upsurge, women's leadership roles vary across industries and women are generally found to have far lesser authority, autonomy, and control in the workplace compared to male counterparts (Fana et.al, 2023). In addition, the pay gap between men and women is widely prevalent across industries and functions (Hing et.al, 2023). This rings true for academia as well.

As per a recent study by (Muralidhar and Ananthanarayanan, 2024), the gender gap among STEM faculty is astounding with only 13.5% faculty members across 98 Universities and Institutions in India being women which clearly indicates a significant underrepresentation of the women. Table I indicates the number of women faculty members compared to the total number of faculty members in various fields of study. The gender disparity is the worst for Engineering courses with a base rate of 9.2%. The findings of the study also highlight a decline in female representation at prestigious institutions like the IITs, IISc, and TIFR. The study further indicated a concerning trend of female faculty leaving STEM careers as

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they progress, resulting in the lack of women leaders at senior positions in STEM-oriented institutions.

The Global Impact Intelligence Report, 2023 has revealed that only 22 % women occupy leadership positions in universities, globally. The World University Rankings 2023 data has revealed that out of 200 universities, 48 have women, presidents, or vice-chancellors. The percentage of women leaders falls significantly in the Indian higher education space. Out of 54 central universities, only 7 have women vice-chancellors whereas only 52 of the 437 state universities, and 10 of the 125 deemed universities, and 23 of the 388 private universities have women vice-chancellors (Deccan Herald, 2021).

The gender-bias in academic leadership has also been highlighted in several international studies like (Allen et.al, 2021; Silbert et.al, 2022; Sharafizadetal, 2021). The promotion patterns among the two genders also differ (Rouhanizadeh & Kermanshahchi, 2021). This clearly shows inequitable career growth opportunities in academia across the world. Given the population of India and the size of the Indian Higher Education sector, the differences seem starker and women in India lag their international counterparts in academia. Most of the studies on women in academic leadership roles have been conducted in the western context. (Maheshwari, 2021; Pham, 2019; Schiffecker & Naughtan, 2022; Cullough et.al, 2020). There have been very few studies in the Indian context which explore perceptions, factors and possible interventions to address this grave imbalance. The disparity is more prevalent in the STEM courses.

TABLE I
GENDER DISPARITY ACROSS FIELDS

Field	Number of Women Faculty	Total number of faculty members	Base Rate
Biology	363	1423	25.5
Mathematics	123	777	15.8
Computer Science	80	657	12.2
Earth Science	103	715	14.4
Physics	169	1298	13.0
Chemistry	86	751	11.5
Engineering	374	4058	9.2

Source: BiasWatchIndia Data Report,2024

In view of the above, there exists a genuine need to study the status of women leaders in higher education and understand the enablers as well as challenges that women faculty members in STEM Courses face preventing them from aspiring for and occupying leadership positions. While few studies conducted on women academic leadership in India have identified the barriers facing women faculty members, the present study explores the enablers and presents suggested interventions for nurturing women leaders in Indian Higher Education at all levels., via comprehensive quantitative and qualitative analysis. The rest of the paper is organized as follows: Section 2 presents a review of recent literature in the domain, while Section 3 explains the research methodology for the study. Section 4 includes the results obtained through quantitative analysis (factor analysis) as well as qualitative analysis (semi structured interviews and analysis) with the help of NVIVO software.

Section 5 presents the recommendations along with the practical and social implications of the study. Finally, section 6 concludes the study.

II. REVIEW OF LITERATURE

Gender specific studies is not a new area of research especially those pertaining to women. People have different perceptions about women as managers (Pillay, 2023). Most of the studies conducted earlier have highlighted the hindrances or the barriers women have to face in their professional journey. The disparity is even more prominent in academia where there is a very small number of women in leadership positions. The result of a study also suggests that out of 1153 Indian Higher education institutes only 110 are women led and 1031 by men (Banker ,2023).

The gender distribution in leadership roles has also been an area of study where a significant difference in women representation has been found in the leadership positions, research roles and positions of power (Morais et.al, 2022). Most of the studies pertaining to women academic leadership have been conducted in the Western Context and highlight the barriers to academic leadership (Maheshwari et.al,2021; Mayya et.al, 2021; Kulkarni & Mishra, 2022). The commonly faced issues by women mostly relate to family support, work life balance, fear factor, lack of institutional support and social stigma which hinder the progress of women to take up academic leadership (Maheshwari et.al,2023). Even the women who occupy senior leadership positions have revealed that family responsibilities, lack of technological know-how, interest in taking leadership positions, spousal support and poor time management, and lack of spousal support have been the major barriers in their professional academic journey (Islam et.al, 2023). Emotional expression and emotional competence also affect the career progression of women leaders (Singh et al., 2023). A study on women leadership by Hammad et.al (2023) was conducted in three kinds of universities settings: gender segregated, unsegregated and partially segregated universities and the results revealed that the barriers to women leadership were found to be most significant in partially segregated universities. Gender stereotypes, attitudinal aversions, family and organizational factors have also acted as barriers to women's career advancement and progression (Lahiri et.al, 2023). The challenges and barriers faced by women are also due to the fact that they are expected to perform multiple roles (Flaxman, 2023).

There is very little literature pertaining to the underrepresentation of women leaders in STEM courses. Ambrose (2024) also found several factors contributing to the underrepresentation of women in STEM Courses such as lack of female role models in STEM fields, unconscious bias in STEM workplaces, and lack of flexible work arrangements. Varma et.al (2023) in their study also tried to explore the challenges and opportunities of the Asian Women in STEM including India. A study by Stewart (2021) investigated the factors contributing to the underrepresentation of women in leadership roles within science, technology, engineering, and mathematics (STEM) education.

From the above, it can be inferred that most of the studies on women leadership have highlighted the barriers that women

face in their professional career as well as to take up leadership positions. There have been very few studies which have also tried to explore the factors that support the women to take up leadership roles. The present study has tried to identify the enablers as well as the challenges faced by women in the higher education institutes providing STEM courses of Northern India. The study has important implications for the policy makers of higher education institutes to formulate women centric policies for promoting diversity, equity and inclusion in the academic leadership roles.

III. RESEARCH METHODOLOGY

A. Research Design

The study has used a mixed method approach in which both the quantitative and qualitative analysis was conducted to identify the barriers as well as enablers that inhibit and/or promote women participation in academic leadership. The primary questions addressed by the study are:

1. What is the current state of women in academic leadership positions in higher education especially STEM Courses in India?
2. What are the perceived enabling factors and barriers that women face at leadership positions?

B. Data Collection

The data was collected from around 170 women leaders working in Central Universities, State Universities, and Autonomous Colleges at leadership positions across Jammu, Himachal Pradesh and Punjab. Out of the data collected from 170 women leaders only the data from 138 respondents was found to be useful. The respondents were women working at various academic leadership positions viz. Vice chancellors, Deans and Directors. Purposive sampling technique was used to collect data from the respondents. Before collecting the final data, pretesting was done with a sample of around 100 respondents. The purpose of conducting the pilot study was to establish the relevance of the instruments and the degree of accuracy to give the desired results. The final data of around 138 was found to be useful.

C. Survey Instruments

A self-structured questionnaire was prepared for the study for quantitative analysis. The items of the survey instrument were developed according to the previous literature. The questionnaire consisted of Section A, which contained questions related to demographics and Section B contained questions related to the attitude and perception of the women academic leaders. The study used a 5-point Likert Scale to collect the data. Before the primary collection of data, the study used continuous dialogue to find the elements that have an influence on women's academic leadership. This was followed by semi-structured interviews conducted with around 18 women academic leaders in different universities and institutes of Higher Education across Jammu, Himachal Pradesh and Punjab.

IV. ANALYSIS

A. Sample Characteristics

Out of the 138 respondents, 61.59% of the female leaders were married, 28.98 % were unmarried and 9.42% were divorced.

Around 60.46 % of respondents were doctorates and 39.53 % were post-doctorate. The participants were mostly Deans (55.07%) followed by Director (34.78%) and Vice chancellors (1.01%). Most of the respondents were from the age group of 45-54 (55.79%) followed by 55 & Above (23.91%) and 35-44 (20.2%) as shown in Table II.

B. Quantitative Analysis

Principal component analysis with orthogonal rotation approach was used in the exploratory factor analysis to minimize the size of the data set while maintaining its structural integrity. Statements with factor loadings below 0.5 and eigenvalues below 1.0 were discarded from further analysis.

A high value of KMO=0.876 which was (>0.6) demonstrates the usefulness of applying factor analysis to the data set. The Factor Analysis was applied separately to the statements of Section A containing the opportunities and Section B consisting of the barriers. The values of KMO and Bartlett's Test have been presented in Table III.

TABLE II
DEMOGRAPHIC PROFILE

Measures	Items	Frequency	Percentage
Marital Status	Married	85	61.59
	Unmarried/Single	40	28.98
	Divorced	13	9.42
Education	Doctorate	90	60.46
	Post Doctorate	48	39.53
Designation	Vice Chancellor	14	1.01
	Dean	76	55.07
	Director	48	34.78
Age Group	35-44	28	20.2
	45-54	77	55.79
	55& above	33	23.91

TABLE III
KMO VALUE AND BARTLETT'S TEST OF SPHERICITY

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	0.876	
Bartlett's Test of Sphericity	Approx. Chi-Square	1377.455
	Df	136
	Sig.	0.000

The following Table IV indicates that the 10 statements related to the enabling factors for Women Academic Leadership can be reduced to three factors. The Cronbach Alpha for each of the extracted factors was also found to be greater than 0.7, which proves its reliability. (Nunnally,1978) Table IV shows the factor loading as well as Composite Reliability of each of the statements. The table indicates that 10 statements related to the enablers of women academic leadership can be reduced to three factors, namely: Mentoring and Institutional Support, Special Women Centric facilities and Equal opportunities and Recognition.

TABLE IV
COMPONENT MATRIX- FACTOR LOADINGS

Factor	MEASUREMENT ITEMS	Factor Loading	CronBach Alpha
Mentoring & Institutional Support	Mentorship and sponsorship programs for women should be initiated.	.643	0.836
	Networking and collaboration opportunities must be provided.	.712	
	Work from home facilities should be provided as and when required.	.686	
	A special leadership Development Program must be planned for women employees.	.702	
Special Women Centric Facilities	Institute must provide a day care or Creche facility for working women.	.802	0.773
	Work-life Balance initiatives should be taken by the organization.	.754	
	The institute must provide flexibility in working hours to the working women	.816	
Equal Opportunities & Recognition	I am encouraged to do research publications, apply for research funds, attend conferences/ seminars/ workshops/ training programs, or get other benefit packages equally as my male counterparts.	0.738	0.813
	Equal opportunity must be provided to both males and females.	0.505	
	Female Faculty should get recognition from the male counterparts for their performance.	0.604	

The 17 statements related to the barriers in academic leadership were again subjected to KMO and Bartlett's test of sphericity as shown in Table V. The KMO Value of 0.777 indicated its usefulness for the Factor Analysis on the data set. Further the statements related to the barriers for women academic leadership were also subjected to Factor Analysis, the results of which have been presented in Table VI.

TABLE V
KMO VALUE AND BARTLETT'S TEST OF SPHERICITY

KMO and Bartlett's Test	
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	0.777
Bartlett's Test of Sphericity	Approx. Chi-Square
	Df
	Sig.
	1377.455
	136
	0.000

The results of the factor analysis in Table VI indicate that the 17 statements related to the barriers of women academic leadership can be reduced to four factors and the total variance explained is 67.029 percent. The factor loading for each of the statements and Cronbach Alpha for each of the factors has been indicated in table VI. The four factors extracted were Societal

Beliefs, Lack of Family Support, Work family Conflict and Lack of Confidence.

TABLE VI
FACTOR LOADINGS AND COMPOSITE RELIABILITY

Factor	MEASUREMENT ITEMS	Factor Loading	CronBach Alpha
Societal Beliefs	Belief system in society creates barriers for career advancement of women.	.500	0.712
	My opinions are not considered that seriously as compared to male counterparts.	.546	
	Female teachers are thought to be incapable of taking tough jobs.	.790	
	The male counterpart's career usually takes priority over my career opportunities.	.773	
	Glass ceiling is a major hurdle for my career advancement.	.807	
	I am given less autonomy in decision making because I am a woman.	.707	
	I do not have many networking opportunities or connections required for academic progression.	.603	
	I lost opportunities because of low expectations and negative attitudes towards women in assigning upper post or leadership roles.	.662	
	My relationship with my husband would be affected if I take up a more prestigious position than him.	.786	
	There is no support from the spouse/ family for taking up administrative positions.	.814	
Lack of Family support	I Lost opportunities due to lack of confidence for the work or post assigned.	.713	0.832
	There is a lack of family support due to which I cannot think of taking up leadership positions.	.660	
	I give priority to my responsibilities rather than my professional role.	.738	
	I am expected to reach home within the stipulated time.	.748	
Work Family Conflict	As a female, I think it is difficult to maintain a work- life balance	.664	0.779
	I opt out or decline opportunities for an administrative position.	.829	
	I have restrictions from the family's end to move out or travel out of my hometown required for work.	.660	
	I feel I will not be able to handle the leadership position.	.618	

C. Qualitative Analysis

For analyzing the qualitative data, thematic analysis using the NVivo software was used where the interview transcripts were text coded manually. The grounded theory research design has been used in the study for qualitative analysis. Participants were chosen through purposive sampling to ensure that they had the firsthand experience of the barriers as well as enabling factors in women academic leadership. Before coding the text, the names of the interviewees were replaced with unique identifiers to maintain individual privacy. The major themes related to the barriers for women academic leadership have been presented below in Table VII. The three major themes that emerged from the semi structured interviews were personal barriers, organizational barriers and social barriers. The various subthemes as well as instances have also been presented. The theme personal barrier included lack of support from family, travel difficulties, maternity breaks, long working hours, family responsibility, lack of confidence. The theme organizational barrier included lack of leadership development programmes, lack of networking and connections, biased appointments and promotions. The theme social barriers included glass ceiling, Acceptance problem, Gender Bias, Sexual Harassment and old stereotypes.

TABLE VII
THEMES FOR BARRIERS TO WOMEN ACADEMIC LEADERSHIP

Theme	Sub Theme	Instances
Personal Barriers	Lack of Support from Family	"I aspire to take up higher positions but there is no support from the family." "My in-laws feel that my job is not that important and do not support me whenever some help is required from their end".
	Travel Difficulties	"I find it difficult to travel alone and am not confident that I will be able to manage it". "Aspiring for senior positions means I will be required to travel, so I do not push myself"
	Maternity Breaks	"My institute provides very little maternity leave and so quitting the job is the only option". "There is no creche or day care facility in my college, so I would not be able to continue my academic journey further."
	Long Working Hours	"I have seen the Heads and Deans leaving very late from the office and I can't afford to stay back late even if I am offered a higher position." "I have to be back at home on time as I need to take care of my kids as well as family chores".
	Family Responsibility	"Growth is important for me but not at the cost of giving up family responsibilities". "It would not be possible for me to manage at senior leadership positions keeping in view that I have a lot of family responsibility."
	Lack of Confidence	"I don't think I will be able to handle a senior leadership position". "I lack confidence in myself and would not be able to take up a higher position."

Organizational Barriers	Lack of Leadership Development Programmes	"The organization must have a Leadership programme specially designed for female employees to create interest and aspirations." "I am not aware of the career progression opportunities and the management must design a programme to encourage women leadership."
	Lack of Networking and Connections	"I am not able to network much with other academicians as I find it difficult to travel out for conferences and seminars." "I think the lack of networking is one of the reasons I have not been able to reach the senior position."
	Biased Appointments and Promotions	"I have personally faced interviews where the selection panel has openly said that we would prefer a male candidate as females are hesitant to move out of the Institute for work related matters". "There is biasness in recruitments as well as promotions."
Social Barriers	Glass Ceiling	"In Spite of the world talking about parity, there exist glass ceilings as far as women leadership is concerned".
	Accepting Women Leaders	"It is difficult for people, especially men, to accept a female boss". "Male counterparts would never accept if a woman earns more or has a better position, it is simply hard to digest for them."
	Gender Bias	"Women are perceived to be less capable in handling leadership positions as compared to men". "Women's career is not that important as my family feels, it is important for them to take care of home and children."
	Sexual Harassment	"I don't prefer to take up senior roles as I fear that I may be exposed to situations leading to sexual harassment". "I have often heard about women facing sexual harassment if they vie for senior leadership roles."
	Old Stereotypes	"Our Society is such that females are not liked at senior positions and have to prove their credibility on a repeated basis". "It is fed into us right from childhood that a woman is expected to manage the house, and a man would work at the office or at senior positions"

The results of the semi structured interviews also highlighted some of the themes related to the enabling factors for women academic leadership which have been presented in the Table VIII.

TABLE VIII
THEMES FOR ENABLERS TO WOMEN ACADEMIC LEADERSHIP

Theme	Sub Theme	Description	Instances
Personal Drive	Confidence/Resilience	Strong Belief in Abilities	"Since Childhood I had a strong belief in me and a vision to become a leader." "I always believe in self-drive and keep doing good work and I believe it has paid off well."

Role Model	Access to mentors/ Inspiration	Admire and follow	"I have always admired Indra Nooyi and tried to follow. Her Challenges and how she tackled always gave me inspiration". "My guide has been a wonderful mentor, and the lessons learnt have helped to become what I am today".
Professional Exposure	Leadership Training/continuous learning/research opportunities	Involvement and Engagement	"The opportunities my way always instilled and boosted my confidence that I can do". "Visiting various academic institutions has given me lot of exposure and avenues for networking and growth."
Family Support	Supportive Environment	Support from husband and extended family	"My husband and my family have been the biggest support to my career". "I always knew that even when I am on travel my children are safe and taken care"

V. RECOMMENDATIONS

Based on the results of the quantitative analysis as well as the interviews and discussion with women faculty members across various universities and institutes in India, it is imperative for the institutes of higher education to undertake the below-mentioned initiatives to reduce the underrepresentation of women academic leaders and act as enablers.

- A. **Mentorship Programmes:** It has been observed that most women are not able to progress in their career and take up senior leadership positions due to lack of proper guidance and counseling. Early-stage women faculty members must be provided access to seasoned mentors who can guide them in actualizing their potential through scientific Individual Development Plans (IDPs) and handholding. The institutes of higher education must design mentoring programmes specifically to women to instill confidence in them and guide them through their academic journey.
- B. **Equity and Diversity of Leadership Team:** It is high time that organizations must understand the importance of diversity and equity in the leadership team and give a chance to women employees to take up leadership roles.
- C. **Flexible Working Arrangements:** Considering the dual role of working women, certain kinds of flexible working arrangements like flexible working hours, short leaves for women with children below 5 years, work- from a- home facility in urgent situations.
- D. **Day Care/Creche Facilities:** Although there are creche facilities in certain public universities in India, the number across the country is quite low. Every year many female faculty members quit their jobs as they have no one at home to take care of the children. In this scenario, it would be highly beneficial for the female faculty if provision of day care is provided within the Institute or University Campus.
- E. **Gender Sensitization Sessions:** As brought out in the study, problems or barriers exist for women leadership

in academics due to gender bias or discrimination which starts right from childhood due to which boundaries are created. There is a need for regular sessions on Gender Sensitization for the management at the institutes of higher education, so that they can plan for placing women in leadership roles.

- F. **Recruit Women for Leadership Roles:** To ensure women are given due importance in decision making, it is important first to offer them leadership positions at all levels. Female voices need to be valued, and their participation needs to be welcomed. Thus, diversity hiring needs to be practiced.
- G. **Women Workplace Policies:** The institutions need to rethink and create women-centric policies and supporting initiatives, especially in terms of leadership development programs, bridge programs when they join back after long-breaks, curated learning paths, shadow leadership opportunities, rewards and incentives among others to support their career trajectory.
- H. **Women Development Cells:** Institutions should create Women Development Cells to support the professional development of women. Networking with other women in such organizations, observing them and learning from their experiences boosts the confidence in women to take up leadership roles.
- I. **Stem Gender Initiatives:** Special fellowships, grants and bridge programs aimed at encouraging women leaders in STEM fields must be conceptualized and implemented.
- J. **Reforming Structures:** Organizations need to relook into the structures and hierarchies that create unintentional disadvantages for the women.

In addition to the initiatives that can be taken up at the institutional level, there is a dire need for societal change and the change must start right from parents who should not be biased in grooming their kids based on gender and undermining their potential and aspirations.

CONCLUSION

There is an underrepresentation of women as academic leaders in India. There are multiple causes which can be attributed to the dearth of women in senior positions in academia which include personal perceptions and biases, family environment, institutional culture and societal issues. Although there are studies and prominent real-world examples which endorse the competency of women in leadership positions, the paucity of women leaders in Indian academia is real. The results as exhibited in Table IV indicate that Mentoring & Institutional Support, Special Women Centric Facilities and Equal Opportunities & Recognition are the main enabling factors for women working in academic institutions. Further the results in Table VI indicate that women in Indian higher education face certain personal, organizational as well as social barriers due to which they are not able to reach to the leadership positions. There is a need for the institutions to support women in taking up leadership roles in academia through adoption of women centric policies, mentoring and coaching programs and affecting internal cultural change. Increasing representation of

women in academic leadership roles requires a consistent, multifaceted and sustained effort by all stakeholders including the women faculty members, helping alleviate many of the challenges confronting Indian High Education today. The present study has taken into consideration only the selected universities and institutions of Jammu, Himachal Pradesh and Punjab. Future work will include broadening the scope to include institutions across India to get further insights on cultural factors contributing to success of women leaders in academia.

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