

A Comparative Analysis of Gender Representation across Scientific Education and the Active Research Workforce in India

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Abstract

Women constitute 43.0 percent of total enrolment in Science, Technology, Engineering and Mathematics (STEM) disciplines in Indian higher education, yet they account for only 18.6 percent of the country's active research and development (R&D) workforce. This paper examines this 24.4 percentage-point gap using two official secondary data sources – the All-India Survey on Higher Education (AISHE) 2021–22 and the Department of Science and Technology's (DST) Research and Development Statistics Report-2023 – alongside the sector-wise distribution of women R&D professionals reported by the Government of India in Rajya Sabha in January 2026. It is argued that this pattern reflects a “leaky pipeline,” a phenomenon in which the production of qualified women scientists is not matched by institutional capacity to support their progression into active research careers. Three structural drivers are examined: institutional gatekeeping in recruitment and promotion, the absence of institutional childcare support, and the career-interruption barriers associated with marriage, childbirth and re-entry. Existing government interventions – including Vigyan Jyoti, WISE-KIRAN, BioCARE and ASPIRE – are reviewed and found to address financial barriers more effectively than structural workplace barriers. Because national datasets cannot capture local, lived experience, primary data was collected through 48 structured in-person interviews conducted across institutions in Sonipat, Haryana, and these field findings are analysed alongside the national statistics.

Keywords: LEAKY PIPELINE, WOMEN IN STEM, RESEARCH WORKFORCE, HIGHER EDUCATION

Introduction

Science, Technology, Engineering and Mathematics (STEM) capability is widely treated as a determinant of national economic competitiveness. It has been noted that closing the gender gap in India's workforce is central to the country's ambition of becoming a 30 trillion dollar economy by 2047, a goal that is estimated to require the addition of approximately 145 million women to the workforce [4]. Within STEM specifically, government data placed before Parliament records that women form 43.0 percent of higher-education enrolment in STEM disciplines but only 18.6 percent of the R&D workforce [1, 2]. This divergence between the supply of qualified women and their presence in active research careers is commonly described in the international literature as a “leaky pipeline” [5].

The present paper constructs a comparative metric analysis of the enrolment-to-workforce gap using official secondary data, disaggregates the active women R&D workforce by employing sector, and

proposes a primary data collection instrument for a small-scale field study in Sonipat, Haryana, so that local, ground-level evidence can eventually be read alongside the national picture.

Objectives

1. To quantify the gap between women's enrolment in STEM higher education and their representation in the active R&D workforce in India.
2. To examine the sector-wise distribution of women in the R&D workforce and relate it to structural barriers documented in the literature.
3. To identify the government schemes currently addressing this gap and assess the barriers they do and do not address.
4. To design and pilot a primary survey instrument capable of measuring these barriers at the level of a single district (Sonipat, Haryana).

Methodology

The research project was carried out as follows:

1. Secondary data was obtained from official Government of India sources, namely the AISHE 2021–22 report, the DST Research and Development Statistics Report-2023, and a written Rajya Sabha reply of January 2026 [1, 2, 3].
2. The enrolment share and workforce share reported in these sources were compared to obtain an indicative measure of enrolment-to-workforce gap across the STEM pipeline (Table 1).
3. The active women R&D workforce was further disaggregated by employing sector – government, higher education and industry – using the sector-wise figures in the Rajya Sabha reply (Table 2).
4. A structured, ten-item interview schedule was designed around the three drivers identified in the secondary literature – institutional gatekeeping, childcare and care-work burden, and career interruption – together with items on scheme awareness and retention intentions.
5. This schedule was administered in person to 48 respondents across institutions in Sonipat, Haryana. Respondents included current women STEM students and postgraduate scholars, women faculty and researchers, and women who had taken a career break from or left STEM, the latter identified through personal and alumni referral (Table 3). Respondents were assured of anonymity, particularly for items concerning perceived discrimination, and responses were recorded during the interview and tabulated afterward.
6. As this is a small, purposively selected sample drawn from a single district, findings are indicative of the population interviewed and are not claimed to be statistically representative of Sonipat, Haryana or India as a whole; they are intended to be read alongside, not as a substitute for, the national secondary data in Tables 1 and 2.

Observations, Data Collection and Analysis

1. On the Basis of Secondary Data

Table 1: Comparative Metrics of Women's Participation Across the STEM Pipeline

Metric Stage	Percentage Value	Source
Total Enrolment in STEM Higher Education	43.0% (Women)	AISHE 2021–22 [1]
Total Active R&D Workforce	18.6% (Women)	DST R&D Statistics Report-2023 [2]
Difference in Representation	24.4 Percentage Points	Calculated by Author

A gap of 24.4 percentage points separates the enrolment share and the workforce share of women in Indian STEM (Table 1). This is consistent with a leaky-pipeline pattern: the education system produces women scientists at close to gender parity at entry, but a large proportion of them are not subsequently retained as active researchers.

Table 2: Sector-Wise Distribution of Women Employed in R&D in India

Sector of Employment	Share of Women R&D Workforce	Source
Government Institutions	45.87%	PIB Delhi [3]
Higher Education Sector	27.62%	PIB Delhi [3]
Industrial Sector	26.51%	PIB Delhi [3]

The largest share of women in R&D, 45.87 percent, is concentrated in government institutions, with 27.62 percent in higher education and only 26.51 percent in the industrial sector [3]. It has been reported that women in India capture only 18 percent of total labour income against 82 percent captured by men [6], that 75 percent of working mothers in India experience a measurable career setback after childbirth [4], and that women globally perform 76 percent of unpaid care work [4]. Government schemes currently addressing these barriers include Vigyan Jyoti, WISE-KIRAN, WISE-PhD, WISE-PDF, WISE-IPR, WIDUSHI, BioCARE and ASPIRE, together with enabling provisions such as hostel accommodation, career counselling, maternity benefits, structured mentoring and exposure visits [3].

2. On the Basis of Primary Data Collected Through Field Interviews, Sonipat, Haryana

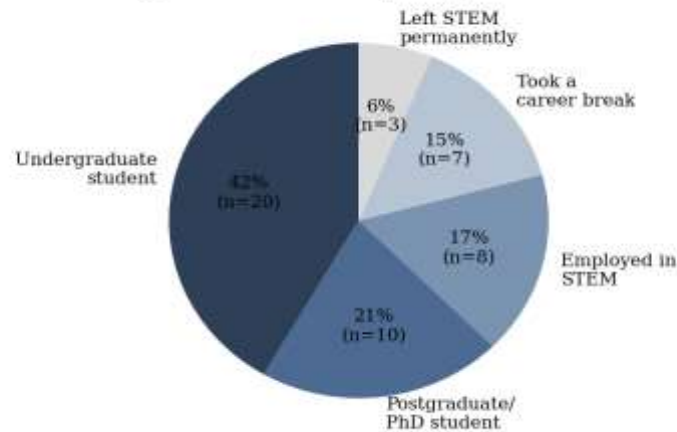
Primary data was collected through structured in-person interviews conducted with 48 respondents across institutions in Sonipat, Haryana, as summarised in Table 3. The findings reported below reflect these interview responses.

Table 3: Respondent Groups Interviewed in the Sonipat Field Study (Total n = 48)

Respondent Group	Method
STEM undergraduate and postgraduate students	In-person interview
Women faculty and researchers	In-person interview
Women who had taken a career break from or left STEM (reached via referral)	In-person interview
Total	48

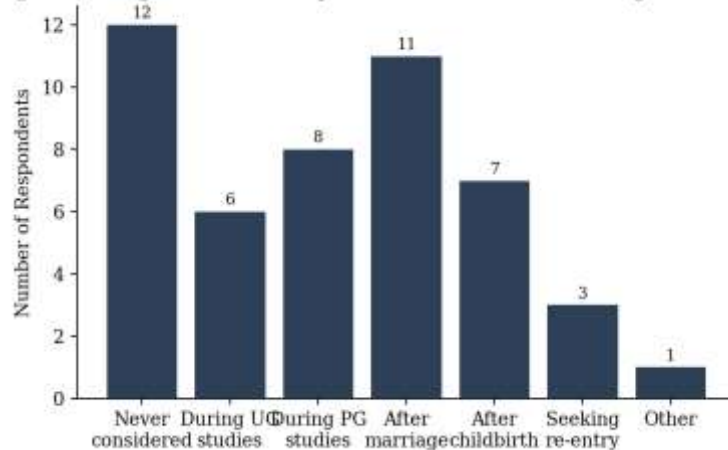
1. 42 percent of respondents interviewed are current undergraduate students, with the share of respondents falling at every later career stage – 21 percent postgraduate/PhD, 17 percent employed in STEM, 15 percent on a career break, and only 6 percent having left STEM permanently – a pattern that mirrors the national enrolment-to-workforce representation gap documented in Table 1.

Figure 1: Current Stage in STEM Among Respondents Interviewed (n = 48)



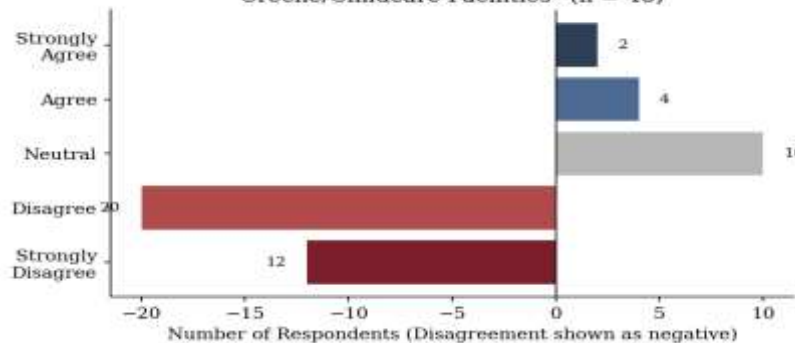
2. Marriage emerged as the single largest trigger after “never considered” (11 of 48 respondents), followed closely by childbirth (7) and postgraduate studies (8), suggesting that life-stage transitions specific to women, rather than academic performance, drive the intention to exit.

Figure 2: Stage at Which Respondents Considered Leaving STEM (n = 48)

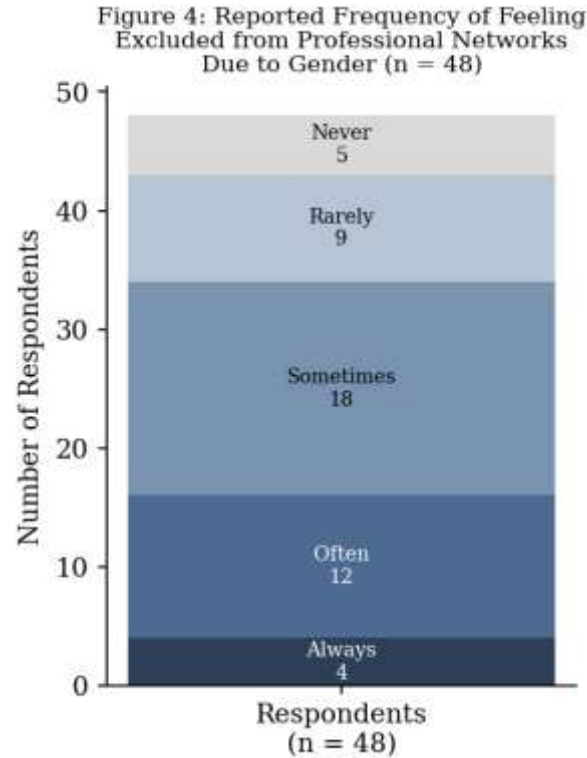


3. A combined 32 of 48 respondents disagreed or strongly disagreed that their institution provides adequate crèche or childcare facilities, against only 6 who agreed or strongly agreed, pointing to a concrete infrastructure gap at the institutional level.

Figure 3: Reported Agreement – “My Institution Provides Adequate Crèche/Childcare Facilities” (n = 48)

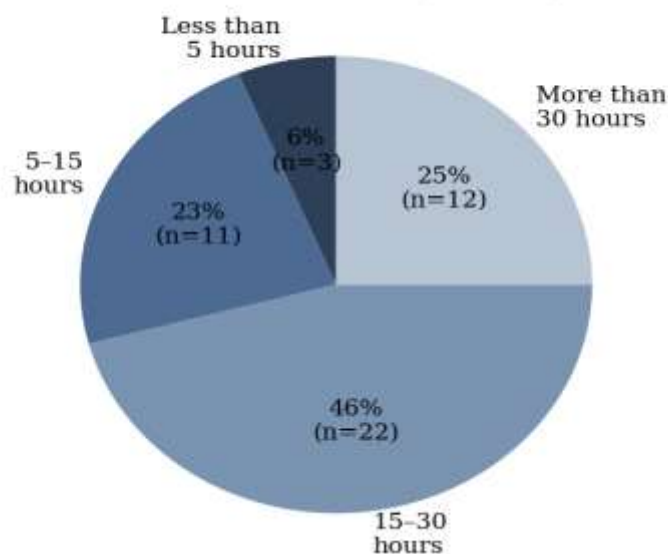


4. 34 of 48 respondents reported feeling excluded from informal professional networks “always,” “often” or “sometimes” because of their gender, consistent with the “old boys’ club” barrier identified in the national literature [4].

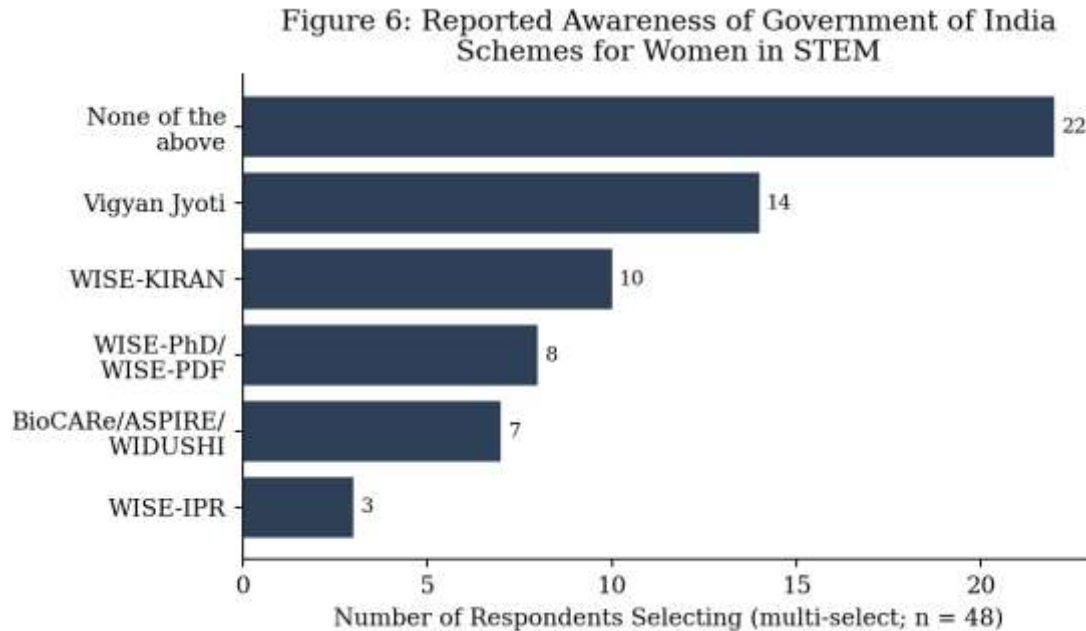


5. 71 percent of respondents (34 of 48) reported more than 15 hours of unpaid household or care work per week, with 25 percent exceeding 30 hours – a domestic time burden that competes directly with the long, inflexible hours typical of laboratory-based research.

Figure 5: Reported Weekly Unpaid Household/ Care-Work Hours (n = 48)

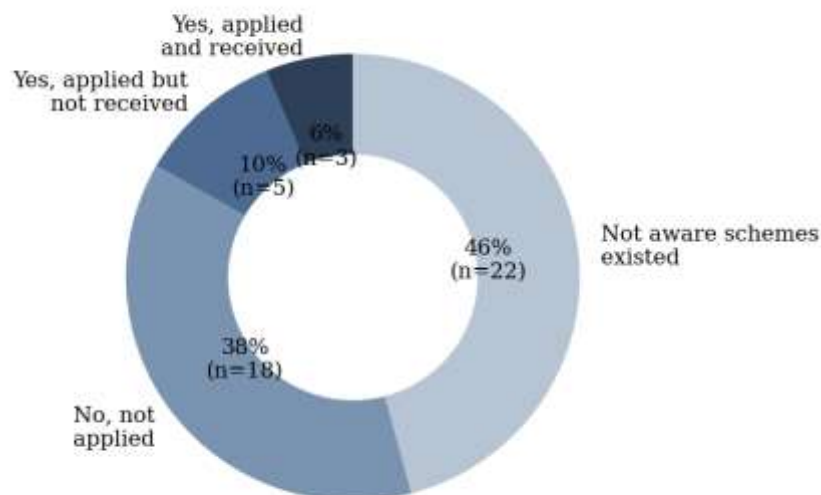


6. Awareness of specific government schemes was low: 22 of 48 respondents selected “none of the above,” more than selected any individual scheme, with Vigyan Jyoti (14) the most recognised and WISE-IPR (3) the least, indicating a communication gap between scheme design and on-the-ground awareness in a non-metro district.

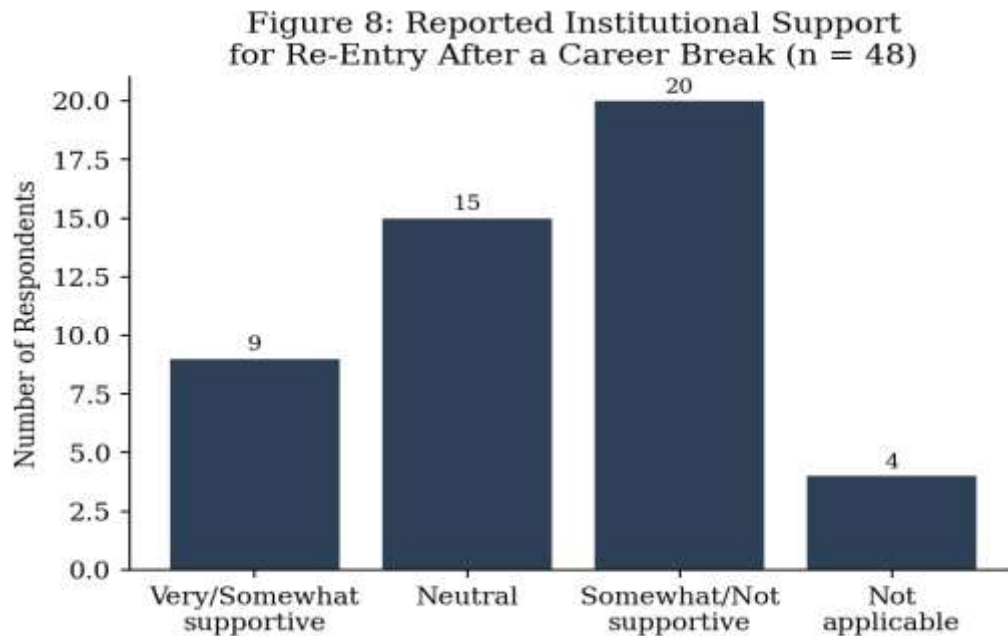


7. 22 of 48 respondents were unaware that re-entry or fellowship schemes existed at all, and only 3 reported having applied for and received support, suggesting that the low utilisation of schemes such as WISE-KIRAN and BioCARE may reflect an awareness gap as much as an eligibility or design gap.

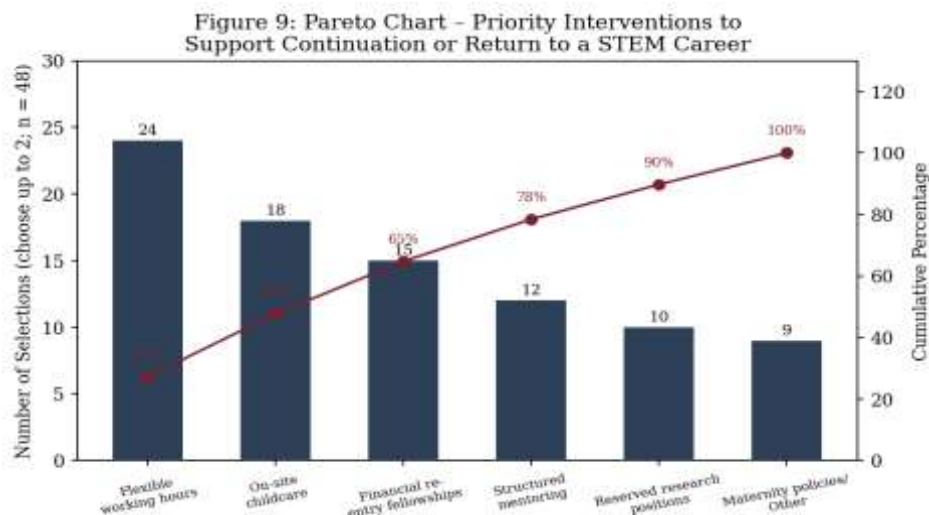
Figure 7: Reported Scheme Application/ Benefit Status (n = 48)



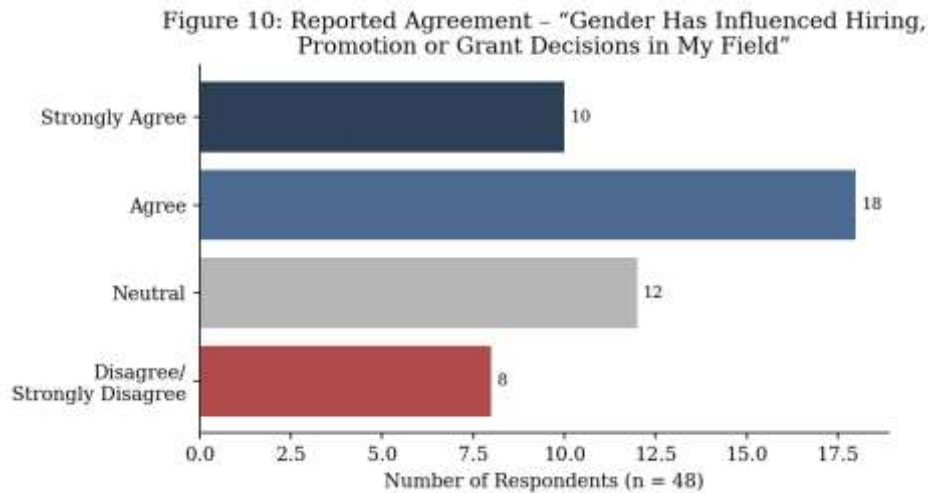
8. 20 of 48 respondents described their institution as “somewhat” or “not supportive” of re-entry after a career break, against only 9 describing it as supportive, reinforcing the concern raised in the secondary literature that re-entry fellowships are not, by themselves, sufficient to overcome institutional resistance to hiring returning researchers.



9. Flexible working hours (24 selections) and on-site childcare (18 selections) were the two most frequently chosen interventions, ahead of financial re-entry fellowships (15), indicating that respondents prioritise workplace-structure reform over the purely financial schemes that currently dominate government policy.



10. 28 of 48 respondents agreed or strongly agreed that gender has influenced hiring, promotion or grant decisions in their field, against only 8 who disagreed, corroborating the institutional-gatekeeping mechanism discussed in the secondary literature [5].



Interpretation and Results

- Sonipat hosts a significant concentration of STEM higher-education capacity, yet both the field interviews and the national R&D statistics point to stark contrast between enrolment and active research careers.
- Marriage and childbirth were the two life-stage transitions most strongly associated with women considering an exit from STEM, ahead of purely academic transitions such as the postgraduate stage.
- Inadequate institutional childcare, a heavy unpaid domestic-work burden, and perceived exclusion from informal professional networks co-occurred among respondents, consistent with the three structural drivers – gatekeeping, childcare and career interruption – identified in the secondary literature.
- Awareness and utilisation of existing government schemes (Vigyan Jyoti, WISE-KIRAN, BioCARE, ASPIRE) was low among respondents, suggesting that scheme design alone does not guarantee reach into non-metro institutions such as those in Sonipat.
- Respondents prioritised workplace-structure reforms – flexible hours and on-site childcare – over financial fellowships, indicating a possible mismatch between current policy emphasis and the interventions women themselves consider most useful.
- As the interview sample was purposively drawn from institutions in a single district, these findings should be read as indicative of the population studied rather than as statistically representative of Sonipat, Haryana or India as a whole.

Conclusion

Official data shows that Indian women are entering STEM higher education at close to parity with men but are retained in the active research workforce at a substantially lower rate, with government institutions absorbing a disproportionate share of the women who remain in R&D relative to industry. This pattern is consistent with a leaky-pipeline framework in which institutional gatekeeping, inadequate childcare support and unmanaged career-interruption penalties act together to filter women out of research careers after they have already qualified for them. Existing government schemes have expanded financial support

for entry, re-entry and leadership development, but the persistence of the aggregate gap suggests that financial support alone has not resolved the structural barriers identified in this paper. The Sonipat field survey provides preliminary respondent-level evidence that complements the national data and literature. While its purposive, single-district sample does not permit generalisation to Indian STEM institutions as a whole, the findings highlight specific areas for further investigation, including childcare provision, informal professional networks, career re-entry and institutional support. Future research could build on these findings through larger, multi-institutional studies to assess whether the patterns observed in Sonipat are replicated across different regions and sectors, and to identify which interventions may be most relevant to universities, industrial employers and district-level stakeholders.

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