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TECHOS DE CRISTAL Y RETOS ESTRUCTURALES EN LA TRAYECTORIA ACADÉMICA DE MUJERES INVESTIGADORAS DEL ESTADO DE TAMAULIPAS

Josefina Guzmán Acuña[1] | Teresa de Jesús Guzmán Acuña[2]

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[1] PhD in Education (UAT).
Professor at the Autonomous University of Tamaulipas.
Ciudad Victoria – Taumalipas, Mexico.
Email: josefinaguzman162023@gmail.com

[2] PhD in International Education (UAT).
Professor at the Autonomous University of Tamaulipas.
Ciudad Victoria – Taumalipas, Mexico.
Email: tjguzman@uat.edu.mx

ABSTRACT

The glass ceiling and the structural challenges that shape academic careers provide the framework for this study, which reports the findings of a research project conducted with women researchers affiliated with the National System of Researchers (Sistema Nacional de Investigadoras e Investigadores, SNII) in the state of Tamaulipas, Mexico. The findings were obtained through a mixed-methods approach combining qualitative and quantitative methodologies, with the aim of examining the glass ceiling and identifying the main challenges women researchers face in producing academic work. The findings indicate that women researchers in Tamaulipas affiliated with the SNII encounter a glass ceiling that does not manifest itself as a single, clearly defined barrier, but rather as a system of interconnected constraints operating at structural, institutional, cultural, and subjective levels. The main challenges to academic production include an overload of responsibilities, lack of time, lengthy editorial processes, difficulties balancing personal and professional life, insufficient institutional support, and explicit gender discrimination. This study makes specific contributions to the field of gender studies in higher education and science in the Latin American context.

Keywords: Glass ceiling. Structural challenges. Women researchers.

RESUMEN

El techo de cristal y los retos estructurales en la trayectoria académica son la referencia para el presente trabajo, el cual da cuenta de los resultados obtenidos de un proyecto de investigación realizado con mujeres investigadoras pertenecientes al Sistema Nacional de Investigadoras e Investigadores en el estado de Tamaulipas, México. Dichos resultados fueron obtenidos mediante una metodología mixta, de corte cualitativo y cuantitativo, cuyos objetivos fueron examinar el techo de cristal y encontrar los principales retos que enfrentan en la producción académca. El conjunto de hallazgos permite sostener que las investigadoras tamaulipecas adscritas al SNII enfrentan un techo de cristal que no se manifiesta como una barrera única y discreta, sino como un sistema de restricciones interconectadas que operan en los planos estructural, institucional, cultural y subjetivo. Entre los principales retos para la producción académica están la sobrecarga de responsabilidades, falta de tiempo y los procesos editoriales tardados, así como dificultades para equilibrar vida personal y profesional, la falta de apoyo institucional y, la discriminación de género explícita. El presente estudio realiza contribuciones específicas al campo de los estudios de género en la educación superior y la ciencia en el contexto latinoamericano.

Palabras claves: Techo de cristal. Retos estructurales. Investigadoras.

INTRODUCTION

Historically, women's participation in science has been shaped by persistent structural gaps. These inequalities have been reflected in the limited recognition of their contributions, their invisibility in textbooks, lower citation rates, and the systematic devaluation of their epistemic authority as experts in different fields of knowledge. Numerous studies have documented the persistence of horizontal and vertical segregation mechanisms that shape distinct academic trajectories for women and men in science.

In Mexico, although progress has been made in incorporating women into research, substantive parity remains far from being achieved. Women continue to be concentrated at the lower levels of the hierarchy of the National System of Researchers (SNII) under the Secretariat of Science, Humanities, Technology and Innovation (SECIHTI), which entails lower income, reduced access to funding and resources, and limited participation in decision-making spaces. The specialized literature distinguishes between two types of occupational segregation: vertical and horizontal.

Vertical segregation refers to the unequal distribution of women and men across hierarchical levels within the same occupation (Anker, 1997), in this case, within the SNII.

Chong-Carrillo et al. (2025) based their study on the official SNII registry for the first quarter of 2025 and processed 41,716 records out of a total population of 44,890 people, representing 92.9% of the registry. One of the most relevant findings is that female representation steadily declines as the system's higher-ranking categories are reached. Thus, while women account for 45.0% at the Candidate level, this proportion falls to 38.0% at Level I, 34.0% at Level II, and 25.8% at Level III, with women representing 26.4% of the Emeritus category. These figures provide a clear example of how the glass ceiling operates as a mechanism that excludes women from higher academic levels (Chong-Carrillo et al., 2025, p. 86).

Regarding the distribution of women and men across disciplinary fields, Anker (1997) defines this phenomenon as horizontal segregation, understood as the tendency for each gender to be concentrated differently in particular professional and occupational areas. In this regard, Chong-Carrillo et al. (2025) found that the disciplines with the highest female representation

are Behavioral Sciences and Education at 58.3%, followed by Humanities at 48.8%, Medicine and Health Sciences at 48.3%, and Interdisciplinary Studies at 45.7%. The pattern is reversed in Physical and Mathematical Sciences, Earth and Space Sciences, and Engineering and Industry, where women's participation does not exceed 25%. Biological and Chemical Sciences, together with Agricultural, Forestry, and Ecosystem Sciences, occupy an intermediate position, although parity is not reached in any of these areas. These findings show that disciplinary feminization persists and that the underrepresentation of women in Science, Technology, Engineering, and Mathematics (STEM) fields remains a constant.

Feminist theory interprets this unequal distribution as a result of the structures of domination inherent in the patriarchal order, which has historically placed women in subordinate positions within social and family spheres. The sexual division of labor is a concrete expression of this order, as women continue to bear the primary burden of domestic and care responsibilities (Anker, 1997). The author argues that these conditions directly affect how women and men accumulate human capital before entering the labor market, generating more fragmented career trajectories for women and reducing their opportunities for advancement compared with their male counterparts (Anker, 1997).

Anker (1997) notes that the disproportionate burden of domestic and care responsibilities placed on women, together with the gender norms that sustain it, affects how they build human capital before entering the labor market, resulting in more interrupted career paths and more limited access to promotion opportunities than men.

The presence of the glass ceiling reflected in the data presented above provides the framework for this study, which reports the findings of a research project conducted with women researchers affiliated with the National System of Researchers (SNII) in the state of Tamaulipas, Mexico. The findings were obtained through a mixed-methods approach, combining qualitative and quantitative methods, with the objectives of examining the glass ceiling and identifying the main challenges faced by women researchers in Tamaulipas in producing academic work.

GLASS CEILINGS

Rocha and Cruz (2013) argue that structural barriers arise from social and cultural constraints derived from ideological and institutional factors associated with the sexual division of labor, as well as from the validation and reproduction of gender stereotypes that have legitimized differential treatment of women and men. This gender order permeates all spheres and dimensions of social life and has historically assigned women responsibility for care and domestic work. These activities, which are socially devalued, have not been recognized as productive paid labor, but rather as natural responsibilities inherent to being a woman, thereby contributing to the reproduction of structural inequalities.

One of the most widely documented structural barriers in the literature is the so-called glass ceiling, a concept referring to structural factors that hinder women's access to the upper levels of organizational hierarchies (Rocha & Cruz, 2013).

This phenomenon is defined as a set of artificial and invisible barriers, arising primarily from prejudice, discriminatory practices, and institutional and ideological biases, that limit women's professional development and restrict their advancement to managerial positions and positions involving greater decision-making power (Ramos et al., 2022).

According to Watanabe et al. (2024), the concept consists of two complementary metaphorical elements: the "ceiling," which represents the barriers that impede women's professional advancement, and the "glass," which refers to the invisible, subtle, and often normalized nature of these constraints, making them difficult to identify and challenge within organizational structures.

In universities and academia, the glass ceiling originates in the gender order. As Buquet (2016, p. 28) states:

> Women's participation in universities is shaped by conditions of inequality that obstruct their access, retention, and mobility. It is precisely this gender order that subordinates women and constructs arbitrary differences, resulting in differentiated and hierarchical social roles that are reproduced across all spheres of being and doing.

Peñaherrera (2024) notes that these invisible barriers can be classified into two broad categories: internal or personal barriers and external or social barriers. The former are associated with cultural factors as well as aspects related to individual motivations, self-perception, and leadership. The latter encompasses structural and relational dimensions, such as social relationship dynamics, organizational culture, human resources policies, government and institutional policies, and the power structures that shape and reproduce gender inequalities in academic and scientific settings.

One of the most prominent internal barriers involves difficulties constructed through cultural perspectives and gender roles surrounding domestic and care work, which creates challenges in reconciling work and family life. Likewise, external barriers shaped by social pressure affect women's professional trajectories (Peñaherrera, 2024).

Undoubtedly, glass ceilings are perceived yet often invisible constraints on women's professional development in academia. These invisible barriers manifest through gender bias in research evaluation, limited collaboration, perceptions of sexism, and discrimination in the workplace. The persistence of gender stereotypes, the lack of work–family balance, and the presence of a sexist organizational culture contribute to the reproduction of gender inequalities in academia. All these factors hinder advancement to better professional and academic positions (Peñaherrera, 2024).

Glass ceilings also reveal gender inequalities within academic institutions, particularly through the limited presence of women in leadership roles. The predominance of men in managerial and decision-making positions not only reflects persistent gender inequities but also affects the individual professional development of female academics and has repercussions for the quality of educational processes and institutional management (Peñaherrera, 2024).

THE RESEARCH STUDY

This project was guided by the following research questions: How does the glass ceiling manifest itself in women's scientific production? What challenges do women researchers in the state of Tamaulipas face in carrying out their academic production?

To answer these questions, the objectives of this study were to examine the glass ceiling and identify the main challenges faced by women researchers in Tamaulipas in producing academic work.

To achieve these objectives, a mixed-methods design was adopted, integrating qualitative and quantitative approaches in a complementary manner. This methodological decision responds to the complexity of the phenomenon under study: while the quantitative component makes it possible to measure and describe the structural conditions affecting the performance of women researchers, the qualitative component explores experiences, perceptions, and trajectories that cannot be captured through numerical data. Both approaches were developed in parallel, and their findings were integrated during the interpretive phase, following the logic of methodological triangulation proposed by Creswell and Plano (2018).

QUALITATIVE APPROACH

The qualitative component sought to explore the experiences, perceptions, and trajectories of women researchers affiliated with the National System of Researchers (SNII) in the state of Tamaulipas in relation to the glass ceiling phenomenon and the challenges they face in reconciling their personal, family, and professional lives.

Ten semi-structured interviews were conducted. According to Kvale (2011), this technique provides a balance between predetermined questions and the flexibility to explore issues that emerge during the conversation.

Participants were selected through purposive sampling, using SNII membership and academic activity at higher education institutions in the state of Tamaulipas as inclusion criteria.

Participants of different ages, research trajectories, levels within the National System of Researchers, and fields of knowledge were included in an effort to obtain a diverse sample that would add depth and breadth to the findings (Patton, 2015).

The interviews were conducted both in person and virtually. All interviews were recorded with the participants' authorization and subsequently transcribed in full for analysis. Confidentiality was ensured through the use of pseudonyms, and informed consent was obtained from each participant in accordance with the ethical principles governing qualitative research (Hernández Sampieri et al., 2014).

To ensure the content validity of the data collection instruments, the semi-structured interview guide was subjected to expert judgment by three specialists, a procedure widely supported in the methodological literature as a strategy for verifying that instruments effectively measure or explore the constructs for which they were designed (Escobar-Pérez & Cuervo-Martínez, 2008; Lynn, 1986).

The qualitative data were analyzed using thematic coding following Braun and Clarke (2006), a procedure focused on identifying patterns of meaning within the collected material. Coding was conducted manually, working directly with the digital transcripts. Manual coding facilitated a close and sustained reading of the corpus, consistent with the hermeneutic approach adopted (Gadamer, 1998).

The coding process produced a total of 78 first-order descriptive codes during the open-coding phase. These were reduced through semantic and conceptual grouping to 24 second-order codes, organized around six final analytical categories: (1) Time, work fragmentation, and scientific productivity; (2) Gender stereotypes and the symbolic devaluation of women's knowledge; (3) Family responsibilities and the double workday; (4) Institutional conditions and the reproduction of inequalities; (5) Glass ceiling and opportunities for advancement; and (6) Visibility, recognition, and the absence of institutional policies.

Hermeneutic analysis was subsequently incorporated. Gadamer (1998) defines hermeneutics as the art and science of interpretation; in this study, it made it possible to move beyond the literal meaning of the data and explore the deeper meanings contained in the participants' accounts, while identifying the tensions and contradictions that permeate their narrated experiences.

QUANTITATIVE APPROACH

The quantitative component employed a descriptive, non-experimental design, since the variables were not manipulated but observed in their natural context. Its purpose was to measure and analyze variables related to academic conditions, scientific productivity, and institutional factors affecting the performance of women researchers in Tamaulipas.

The study population consisted of 201 women researchers affiliated with higher education institutions in the state, specifically the Universidad Autónoma de Tamaulipas, the Instituto Tecnológico de Ciudad Victoria, and the Colegio de Tamaulipas, all recognized within the National System of Researchers. From this population, a probability sample was calculated using the finite population formula:

$$n = \frac{NZ^2pq}{e^2(N-1) + Z^2pq}$$

With a 95% confidence level (Z = 1.96) and a 5% margin of error, using N = 201, p = q = 0.5, and e = 0.05, the resulting sample size was 110 researchers, selected through simple random sampling.

The data collection instrument consisted of a 34-item questionnaire structured around the following dimensions: general information; academic production and working conditions, personal and structural challenges, access to opportunities and recognition, structural and symbolic barriers, perceptions of the glass ceiling, and perspectives and proposals. The content validity and reliability of the instrument were assessed through expert judgment by specialists in research and gender studies. The three experts selected for validation have established academic careers in mixed-methods research and higher education, qualifying them to assess both the methodological coherence of the instruments and their suitability for the institutional and population context of the study. Selection criteria included direct experience in designing and applying qualitative and quantitative instruments.

After all observations provided by the experts had been incorporated, the instruments underwent a final internal-consistency review by the research team, which verified that the adjustments did not alter the correspondence between the items or questions and the analytical dimensions established in the conceptual framework. The final 34-item questionnaire was used for data collection, thereby ensuring that both instruments had evidence of content validity prior to application.

The questionnaire was administered through Microsoft Forms, facilitating access for participants regardless of their geographic location within the state.

Methodological note. The study design was based on a binary conceptualization of gender, defining inclusion as belonging to the SNII in the category of woman, in accordance with the system's official categorization under SECIHTI. Consequently, the data collection instruments used in this project did not include questions about gender identity that could explore expressions of identity beyond the binary system.

QUALITATIVE RESULTS: BARRIERS, STRATEGIES, AND AGENCY IN THE RESEARCHERS' ACADEMIC TRAJECTORIES

The hermeneutic analysis of interviews with women researchers affiliated with the National System of Researchers (SNII) in the state of Tamaulipas made it possible to construct an interpretive map of the conditions shaping their academic trajectories. Thematic coding yielded six analytical dimensions that dialectically articulate the structural, institutional, and cultural barriers faced by the participants, as well as the agency strategies they employ to sustain their scientific production. Rather than appearing as isolated experiences, these dimensions intersect and reinforce one another, creating a complex framework in which gender inequalities are reproduced systemically within academia.

TIME, WORK FRAGMENTATION, AND SCIENTIFIC PRODUCTIVITY

One of the most recurrent tensions in the interviews relates to time management in the context of institutional over-demand. Researchers must simultaneously perform teaching, advising, administrative management, community engagement, and scientific production, resulting in a structural fragmentation of the workday that erodes the necessary conditions for sustained intellectual work.

> I consider academic work to be more than just an assembly line, you know? Academic production requires you to think and rethink, write and rewrite. Then, for example, you start writing something and say, "I'll continue later," but then you go to class and come back, and by then the idea may no longer be as clear. (Participant 7, personal communication, 2025)

This accumulation of roles is neither accidental nor neutral; it results from an inequitable distribution of institutional workloads that disproportionately falls on women, who frequently assume service and care responsibilities within the academic community itself (Acker, 2006; Morley, 2013).

This becomes even more significant when considering that high-impact scientific production, publications in indexed journals, research project leadership, and the training of human resources require extended periods of concentration that are difficult to preserve within a fragmented workday. In response, the researchers have developed rigorous time-management strategies, setting aside periods devoted exclusively to research and distributing responsibilities collaboratively within their academic groups. The consolidation of these groups emerges in the accounts as a key mechanism of academic resilience, as it allows researchers to share the cognitive burden and sustain long-term projects that would be unfeasible under an individual-work model.

GENDER AND THE SYMBOLIC DEVALUATION OF WOMEN'S KNOWLEDGE

In the gender dimension, the analysis reveals the persistence of stereotypical representations that operate differently across disciplinary fields. Researchers in the exact sciences, engineering, and technology more frequently report having their work questioned, minimized, or attributed to collaboration with male colleagues, constituting a form of epistemic violence that undermines their scientific authority. These dynamics are not limited to interpersonal interactions; they are also expressed through evaluation mechanisms, funding-selection processes, and the composition of collegiate bodies that make decisions about academic careers (Benschop & Brouns, 2003).

> There is a point at which they say, "No, you don't know that because you're a woman," that's what they tell me. "You wouldn't know about that because you're a woman and we are men; men are more knowledgeable." (Participant 6, personal communication, 2025)

Relatedly, the interviewees identify informal promotion networks, often male-dominated, that operate as channels of social capital to which women have restricted access. These networks largely determine who receives invitations to relevant projects, who is appointed to academic leadership positions, and who accumulates the visibility needed to advance within the system. In response to this structural exclusion, participants identify as strategies the strengthening of their economic and professional independence, the consolidation of a strong academic identity based on self-recognition of their merits, and the promotion of gender-sensitive education from the earliest stages of training, in line with Acker's (2006) call to transform the organizational culture of academia.

DOUBLE WORKDAY AND CARE RESPONSIBILITIES

Domestic work and caregiving constitute critical dimensions of the researchers' trajectories. The accounts show that childrearing, caring for dependents, and household responsibilities overlap with the demands of scientific careers, creating what O'Connor (2014) calls the "double workday," a total workload that far exceeds that faced by male peers under equivalent social conditions. This situation is not the result of individual choices, but of a social structure that continues to assign women primary responsibility for reproductive labor, even when they occupy highly qualified professional positions.

My vacations are spent in front of the computer. I get up very early, at 5 in the morning you can find me working on the computer, and by 8:30, when the children get up... well, I've already gotten some work done. (Participant 10, personal communication, 2025)

The impact of this condition on scientific productivity is measurable. Researchers acknowledge having postponed or reduced their publication rate during maternity periods or intensive caregiving, decisions that, within evaluation systems based on continuous production metrics, may have lasting consequences for their standing in the field. As a coping strategy, participants rely on detailed planning, establishing priorities that integrate both academic and family demands. Although effective in the short term, this strategy entails an additional cognitive burden that paradoxically intensifies pressure on the researchers.

INSTITUTIONAL CONTEXT AND THE REPRODUCTION OF INEQUALITIES

Structural conditions in the institutional environment emerge as a major risk factor. Interviewees report insufficient allocation of research-support resources, particularly limited access to graduate students for their projects, an unequal distribution of teaching loads that does not adequately account for academic trajectory or research responsibilities, and administrative bureaucracy that consumes time and energy that should be devoted to scientific production.

There is now a triangulation that does not work in our favor... And it happened to us with a piece of equipment: they did not purchase it according to the specifications we provided, and the equipment has simply been sitting there since it arrived... It is completely useless. (Participant 2, personal communication, 2025)

Deem and Morley (2006) have argued that these conditions are not neutral; rather, they reflect and reinforce historically embedded gender hierarchies within academic organizations.

In response to this situation, researchers have built horizontal collaboration networks that function as spaces for mutual support, resource exchange, and the generation of collective academic capital. Peer mentoring, particularly with more experienced women researchers, emerges as a mechanism for transmitting tacit knowledge about how the scientific field operates, including the unwritten rules governing access to funding, publication dynamics, and institutional positioning strategies. Some participants have also taken an active role in proposing institutional reforms aimed at a more equitable redistribution of teaching and administrative workloads, demonstrating a political dimension of their academic agency.

THE GLASS CEILING AS A STRUCTURAL AND LIVED PHENOMENON

Regarding opportunities for advancement and leadership, the researchers' accounts confirm the continued presence of the glass ceiling as a phenomenon combining visible and invisible barriers. Participants identify power dynamics operating through criteria of affinity and group membership, in which proximity to male-dominated networks of influence frequently determines decisions concerning promotion, recognition, and access to leadership positions.

> So, the more informed we become, the more educated we become, the stronger we are. And the more tools we have to break through that glass ceiling. That is the reflection I have. It is very difficult, very, very difficult, because there are forces in Mexico; there is power in Mexico that favors men. So, honestly, I am not looking to break it—not that I don't want to break it—but rather, I seek to join with more women and work together, because that is how we will make ourselves visible. (Participant 10, personal communication, 2025)

Cotter et al. (2001) conceptualized the glass ceiling as a barrier that does not result from deficits in merit or preparation, but from discriminatory mechanisms that become activated precisely at the highest levels of institutional hierarchy; the testimonies collected confirm the relevance of this interpretive framework in the Tamaulipas context.

A particularly relevant element emerging from the accounts is the critical awareness researchers have developed regarding these dynamics. They not only identify mechanisms of exclusion but also develop deliberate strategies to navigate them. These include maintaining a strong and independent academic trajectory, refusing to participate in clientelist practices, and joining open and diverse academic networks at both national and international levels. This reflective awareness of the rules governing the field constitutes, in itself, a valuable strategic resource.

VISIBILITY, RECOGNITION, AND THE ABSENCE OF INSTITUTIONAL POLICIES

The final dimension analyzed concerns professional development and academic visibility. Interviewees point to the absence of formal institutional initiatives designed to support women's academic trajectories. In most cases, there are no structured mentoring programs, differentiated leave policies for periods of caregiving, or mechanisms for specifically recognizing women's scholarly production.

Van den Brink and Benschop (2012) have demonstrated that the absence of explicit equity policies does not imply neutrality; rather, it favors the reproduction of inequalities by allowing pre-existing biases and privileges to operate without correction.

In response to this institutional absence, researchers have built their visibility through sustained individual strategies: systematic publication in high-impact journals, active participation in national and international conferences, continuous training and professional development, and the deliberate construction of a recognizable academic presence within their disciplinary fields.

> We need to make what we do visible. Sometimes, for example, we publish a book and keep it; we do not make it public, or our faculties do not make it public. There are no dissemination strategies for what faculty members do. There should be, I don't know, a series of events where, little by little, this becomes visible events that highlight what women are doing in terms of scholarly production. (Participant 1, personal communication, 2025)

Although effective, these strategies reveal a structural paradox: women must invest significantly greater effort to achieve levels of visibility comparable to those of their male colleagues, thereby reproducing, in the accumulation of academic capital, the same asymmetry that characterizes their trajectories.

QUANTITATIVE RESULTS

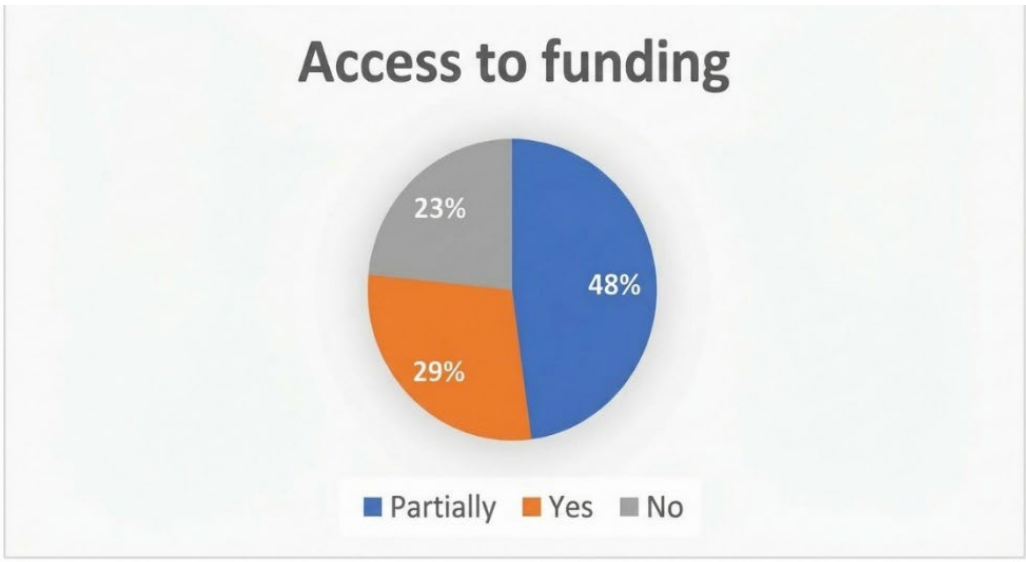
ACADEMIC PRODUCTION AND WORKING CONDITIONS

The analysis of working conditions reveals a structural paradox that runs through the entire productive dimension: researchers achieve significant levels of scientific output despite working in an institutional environment that does not guarantee the minimum conditions required for research.

Regarding institutional time, 51% of participants reported having time officially allocated to research activities, while the remaining 49% reported having no such formal recognition. This finding is revealing for nearly half of the respondents, scientific production is sustained through time that is not recognized by the institution, implying a workload that exceeds the ordinary workday and falls disproportionately on women researchers.

Regarding funding, the main limitation is not an absolute denial of resources but rather their partial and unstable nature: 47.96% have access to funding only partially, and when the responses "Partially" and "No" are combined, 71.43% of researchers do not have full and guaranteed access to resources for their projects. This financial precariousness forces a majority of the sample either to conduct research with insufficient funds or to invest considerable time and energy in seeking alternative support (Figure 1).

Figure 1 | *Access to funding*



Note: Author's own elaboration based on project findings

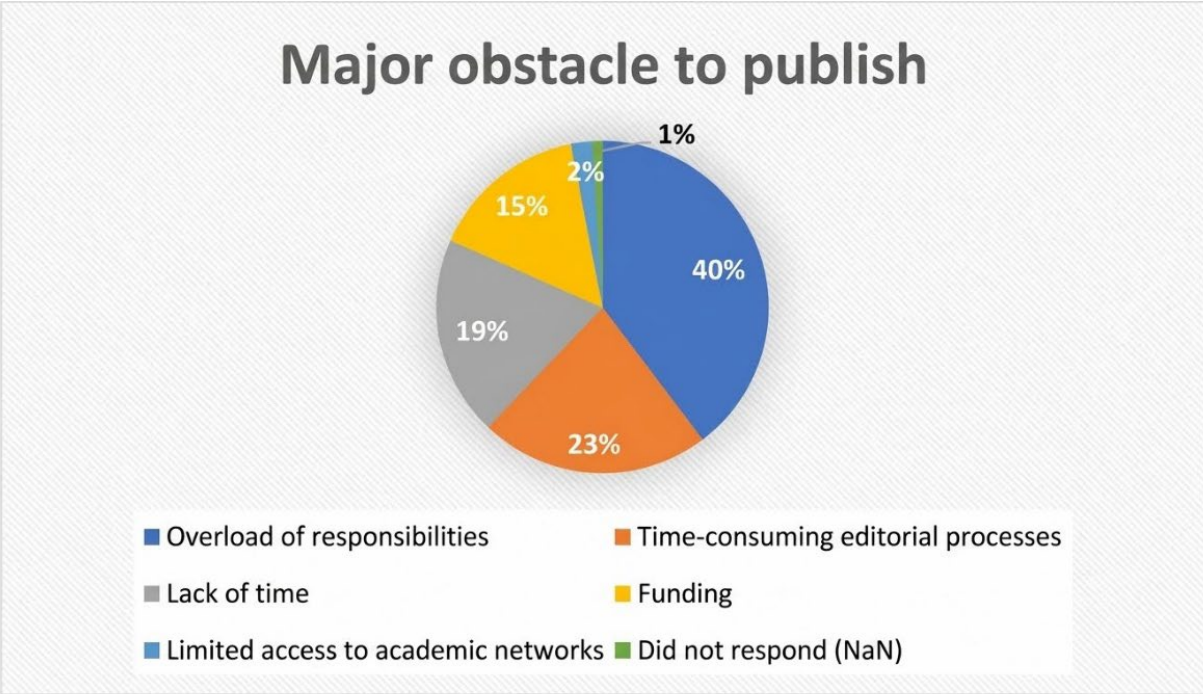
Despite these adverse conditions, participants' scientific productivity is notable. A total of 74.49% published three or more articles during the previous three years, with 3–5 articles being the most common range (43.88%). Academic production is dominated by articles in indexed journals (66.33%), which is consistent with SNII evaluation criteria that prioritize this form of scientific dissemination. Nevertheless, access to collaboration networks and calls for papers in high-impact journals is far from equitable. Although 34.69% perceive such access as available, the combined proportion who rate it as "slightly accessible" or "moderately accessible" reaches 52.04%, indicating that participation in the circuits of greatest scientific visibility remains an area of inequality for more than half of the researchers.

PERSONAL AND STRUCTURAL CHALLENGES

This dimension contains some of the study's most compelling findings. When researchers were asked about the main obstacle to publishing their results, an overload of responsibilities emerged as the dominant barrier (39.80%), followed by lack of time (19.39%) and lengthy editorial processes (22%). Overall, 59.19% of participants identify managing workload and available time as their primary challenge, a figure that becomes even more meaningful when considered alongside the earlier finding concerning the absence of officially allocated research time.

When participants were asked to rank the barriers present in their work as researchers, workload overload consistently occupied first place. This was followed by a shortage of scholarships and research assistants, difficulties balancing personal and professional life, lack of institutional support, and, in fifth place, explicit gender discrimination. This ranking is analytically significant: although gender discrimination was the barrier least frequently identified as the top-ranked issue, the barriers preceding it—work overload, lack of caregivers, and work–family reconciliation difficulties—are themselves expressions of structural gender inequality, often rendered invisible by being presented as universal conditions (Figure 2).

Figure 2 | Major Obstacle to Publish

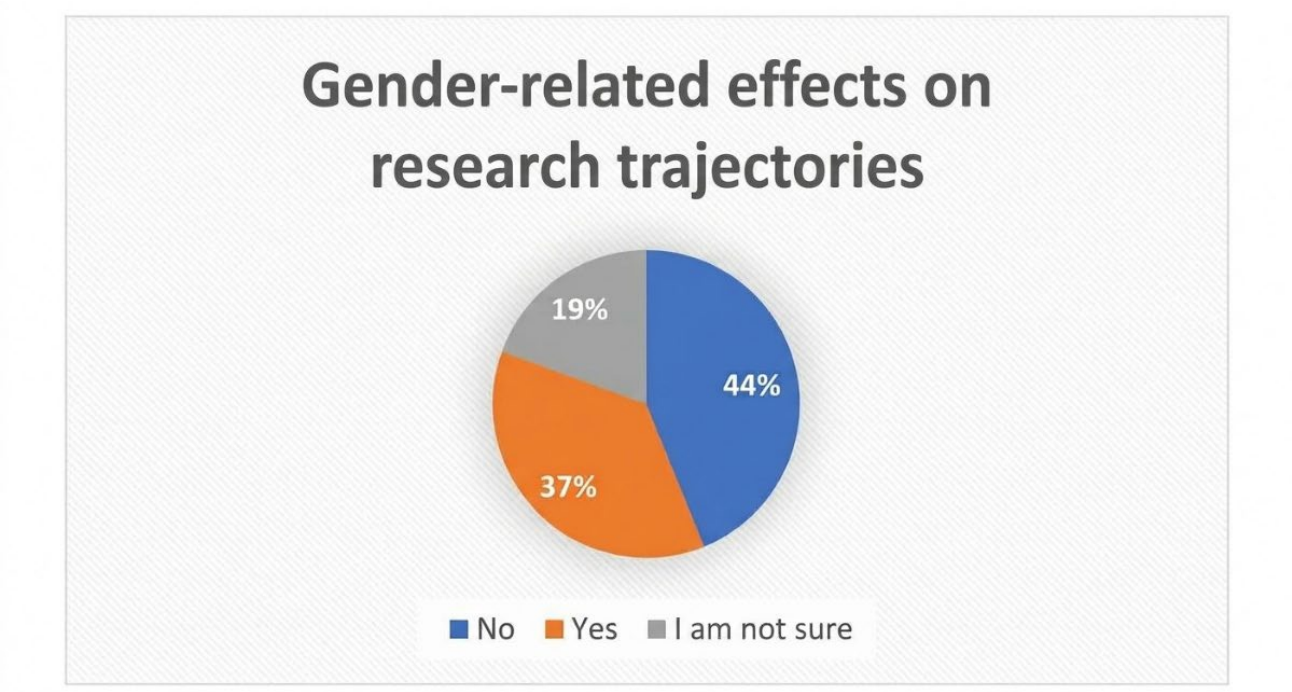


Note: Author's own elaboration based on project findings

Another important finding in this section concerns interruptions to the pace of work due to caregiving responsibilities: 88.78% of researchers, combining the responses "Yes, sometimes" and "Yes, always," reported having interrupted or reduced their research activity because of these responsibilities. This figure constitutes statistical evidence of the double workday that characterizes women's academic trajectories (O'Connor, 2014) and confirms that the unequal distribution of reproductive labor has measurable consequences for women's scientific production.

Finally, when asked whether being a woman had affected their research trajectory, 43.88% responded negatively; however, the combined proportion of affirmative responses and those expressing uncertainty ("I am not sure") reached 56.12% (Figure 3). The coexistence of these two perceptions in similar proportions reflects the often-opaque nature of gender discrimination mechanisms in academia. Many of their manifestations are neither direct nor readily identifiable as such but operate through structural conditions that those affected may not recognize in their systemic dimension (Benschop & Brouns, 2003).

Figure 3 | Gender-related effects on research trajectories



Note: Author's own elaboration based on project findings

ACCESS TO OPPORTUNITIES AND RECOGNITION

This dimension reveals significant fractures in perceptions of institutional equity. Regarding promotion and resource allocation, the most frequent response indicates that processes are "generally" equitable (31.63%); however, the combined responses indicating some form of inequality or uncertainty— "Sometimes," "No," and "I don't know"—reach 40.81%, constituting a relative majority that calls into question the impartiality of institutional mechanisms.

This perception becomes more pronounced when participants are asked directly about equal opportunities for professional growth. Although 42.86% report having had such opportunities, the remaining 57.14% deny or question whether they received them under conditions equivalent to those of their male colleagues. Similarly, when comparing their promotion and recognition trajectories with those of male peers, the affirmative and negative responses are exactly tied (38.78% each), while the remaining 22.44% express uncertainty. Taken together, these findings underscore the opacity of evaluation criteria and the absence of transparent accountability mechanisms in academic recognition processes.

Regarding leadership positions, 71.43% of the researchers have held some form of leadership role. However, this figure must be interpreted considering the nature of those positions: 42.86% correspond to coordination roles and 37.14% to technical project responsibilities, while only 11.43% have reached a director-level position. This distribution confirms the pattern documented by Van den Brink and Benschop (2012), according to which women participate extensively in operational and middle-level leadership but encounter concrete barriers to accessing the highest strategic decision-making positions, precisely those in which the structural conditions of academic careers are defined.

The devaluation of merit based on gender was reported by 28% of participants, while 19% expressed uncertainty about it. Taken together, nearly one-third of the sample has experienced, or suspects having experienced this form of symbolic discrimination, despite reporting high levels of scientific productivity. Relatedly, 55.10% of researchers perceive that their work has little visibility outside their institution, limiting their access to broader collaboration networks, reducing opportunities for external recognition, and reinforcing the inequalities observed in the preceding categories.

STRUCTURAL AND SYMBOLIC BARRIERS

When researchers were asked about the factors that have limited their access to higher positions or greater recognition, the main obstacle identified was the absence of mentoring or support networks, followed by limited visibility in decision-making spaces, institutional preference for men, gender stereotypes, and, finally, insufficient support for reconciling family and professional life. This hierarchy is analytically revealing: the factor identified most frequently, the lack of mentoring, is precisely one of the mechanisms through which academic social capital is transmitted and reproduced, and women have more restricted access to it in environments where informal networks of influence are predominantly male (Cotter et al., 2001).

Perceptions of an institutional culture that favors men's careers show a polarized distribution: 37.76% responded negatively, 34.69% positively, and 26.53% expressed uncertainty. When affirmative and uncertain responses are combined, 61.22% of the sample perceive, or cannot rule out, that organizational culture operates to the detriment of women's trajectories. This constitutes a significant institutional signal that goes beyond individual experience and points to systemic conditions of inequality.

Regarding access to decision-making spaces, nearly half (47.96%) rate it as "neutral," while 24.49% describe it as difficult or inaccessible. From a critical perspective, the apparent neutrality of the majority response is problematic. In contexts where inequalities are structurally embedded, neutrality may function as a way of naturalizing asymmetries; the absence of explicit obstacles does not necessarily mean that equitable access conditions exist (Acker, 2006). This finding becomes more meaningful when contrasted with the earlier data on the types of leadership positions held, suggesting that accessibility is concentrated at intermediate levels of the institutional hierarchy while strategic decision-making spaces remain restricted.

PERCEPTIONS OF THE GLASS CEILING

In this dimension, the data converges toward a statistical confirmation of the phenomenon under study. When asked directly about the presence of the glass ceiling in their institutions, 34.69% of researchers selected a neutral response, while 42.85% perceived it as "present" or "very present." When those who identified it as "slightly present" are included, 85.71% of the sample recognize some degree of presence of this barrier, providing empirical evidence of the continued relevance of the phenomenon in the academic context of Tamaulipas.

The most striking finding in this dimension concerns the perception of differential effort required: 60.20% of researchers believe they must work harder than their male colleagues to achieve the same academic outcomes. This majority perception is consistent with the set of barriers documented throughout the study—work overload, caregiving responsibilities, devaluation of merit, and limited access to networks and resources—and confirms that the glass ceiling does not operate as a single, isolated barrier, but as a cumulative system of disadvantages that requires women to make sustained additional efforts to reach positions equivalent to those of their male peers (Cotter et al., 2001).

Regarding experiences of exclusion or discrimination based on gender, 44.90% responded negatively; however, the combined proportion of affirmative responses (31.63%) and those who preferred not to answer (22.45%) reaches 54.08%. The high rate of nonresponse to this question itself is analytically significant. It may indicate situations perceived as sensitive or as potentially carrying consequences for those who report them, pointing to an institutional environment in which reporting gender discrimination is not perceived as an entirely risk-free act.

PERSPECTIVES, PROPOSALS, AND STRATEGIES OF AGENCY

The final dimension of the study reveals both deficiencies in the institutional support ecosystem and the researchers' capacity to formulate proposals. Regarding participation in support networks for women researchers or spaces for academic empowerment, 65.31% reported not participating in any. This figure is concerning because the absence of formal mentoring and support networks was identified in the previous dimension as the main factor limiting access to higher positions and recognition. Low participation in these structures does not necessarily reflect a lack of interest, but rather the absence of an established institutional offering. The 32 unique mentions of networks and support spaces among those who do participate reveal fragmentation into small, informal groups, often limited to specific disciplinary areas, rather than a broad and institutionally sustained support structure.

When asked about the changes needed to improve the conditions of academic production for women researchers, participants identified the formal allocation of research time within institutional workloads as a priority reform, along with direct financial support through scholarships for research assistants and graduate students. These proposals are directly consistent with the diagnosed barriers: the demand for workload reductions that recognize the double workday is a logical response to a system that currently requires high-impact scientific production without guaranteeing the minimum conditions needed to achieve it.

Regarding the personal strategies used to sustain academic production, most researchers have relied on self-directed mechanisms that systematically encroach upon personal life: extending the workday by working from home outside regular hours, personally financing publication expenses, and using personal time for training and dissemination activities. This finding confirms that the academic success of women researchers in the context studied rests to a considerable extent on extraordinary individual effort that compensates for structural deficiencies in the system, while perpetuating the illusion that conditions are equitable because outcomes are comparable.

Finally, when discussing the actions needed to eliminate the glass ceiling in academic production, researchers emphasized the need to ensure parity on evaluation committees and governing bodies, as well as to translate political will into concrete resources and equitable institutional decisions. This demand reflects a collective and mature understanding of the problem: researchers recognize that inequalities cannot be transformed through individual effort but require structural changes in the systems of power that govern academia.

CONCLUSIONS

HORIZONTAL AND VERTICAL SEGREGATION AND DIFFERENTIAL ACCESS TO ACADEMIC POWER

The study's findings document two complementary forms of gender segregation in Tamaulipas academia. Horizontal segregation is reflected in the fact that women researchers are concentrated primarily in disciplines historically associated with female participation, such as Social Sciences and Medicine and Health Sciences, while their participation in Engineering and the Exact and Technological Sciences is considerably lower, consistent with the global patterns identified by Schiebinger (2001).

Vertical segregation is expressed in two complementary dimensions. On the one hand, the distribution of women researchers within the SNII shows a marked concentration at the system's initial levels. On the other hand, although most have held some leadership positions, these roles are primarily limited to coordination and technical project management, while director-level positions remain the exception within the group studied.

Taken together, the qualitative findings support the conclusion that women researchers in Tamaulipas affiliated with the SNII face a glass ceiling that does not manifest itself as a single, discrete barrier, but as a system of interconnected constraints operating at structural, institutional, cultural, and subjective levels. Work overload, gender stereotypes, the double workday, adverse institutional conditions, power dynamics surrounding advancement, and the invisibility of women's scholarly production create a context in which inequalities are perpetuated through mechanisms that are often normalized and therefore difficult to challenge.

This conceptualization moves beyond one-dimensional approaches to the phenomenon and is consistent with the arguments of Cotter et al. (2001), who emphasize that the barriers women face at the top of organizational hierarchies do not result from individual deficits in merit or preparation, but from systemic mechanisms of discrimination that are activated precisely at the highest levels of the career ladder.

The quantitative data strongly confirm this interpretation: 85.71% of researchers recognize some degree of presence of the glass ceiling in their institutions, 60.20% believe they must work harder than their male colleagues to achieve equivalent accomplishments, and 57.14% deny or question having had equal opportunities for professional growth. The convergence between statistical evidence and participants' narratives strengthens the validity of the findings and constitutes a methodological contribution of the study. The integration of mixed methods made it possible to capture both the scope of the phenomenon and its lived texture, dimensions that neither approach could have documented separately with the same analytical richness.

CONTRIBUTION TO THE FIELD AND IMPLICATIONS FOR THE RESEARCH AGENDA

This study makes specific contributions to the field of gender studies in higher education and science in the Latin American context. First, it provides systematic empirical evidence of the glass ceiling in an understudied regional context in Mexico, addressing a gap in the national literature, which has tended to focus on large metropolitan universities and aggregate national-level analyses without sufficient attention to the specific dynamics of state scientific systems.

Second, the mixed-methods design provides an understanding of the phenomenon that moves beyond both quantitative reductionism, which can capture the extent of inequalities but not their lived experience, and qualitative particularism, which explores individual trajectories in depth but limits the generalizability of findings. Integrating both approaches produces more robust knowledge with greater potential to inform both theory and public policy.

Third, the study documents and conceptualizes the paradox of high productivity under conditions of inequality as an analytically relevant phenomenon that deserves greater attention in the literature. The coexistence of high scientific-production indicators and adverse structural

conditions is not a contradiction that must be resolved by discarding one of its elements; rather, it is an object of study in its own right, revealing the mechanisms through which the scientific system extracts value from women's work without guaranteeing the conditions that make it possible.

The findings also point toward a research agenda that extends beyond the scope of the present study. Further longitudinal analysis of women's trajectories within the SNII is needed, with particular attention to periods of interruption and re-entry into the system and their association with intensive caregiving stages.

It would also be relevant to extend the comparative analysis to other Mexican states and to higher education institutions with different forms of governance and funding, including public and private institutions focused on research and teaching, in order to determine the extent to which the findings from Tamaulipas represent broader national dynamics. Finally, examining the effects of specific institutional gender-equity policies, where such policies exist, on indicators of productivity, retention, and advancement among women researchers would constitute a research line with strong potential to inform evidence-based interventions.

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ETHICAL CONSIDERATIONS

The Research Ethics Committee of the Faculty of Education Sciences and Humanities of the Universidad Autónoma de Tamaulipas, meeting in an extraordinary session, reviewed the documentation submitted in support of the request for an opinion on project UAT/SIP/PIRP/2024/076, entitled Analysis of the Academic Production of Women Researchers in Tamaulipas, submitted by Dr. Josefina Guzmán Acuña, a faculty member of this academic unit.

The research was conducted in strict accordance with ethical principles, guaranteeing the fully voluntary participation of the researchers, formalized through informed consent following a detailed presentation of the study's objectives and procedures. Participants were guaranteed the right to withdraw from the study at any time without any adverse consequences. Confidentiality and anonymity were fundamental principles: data were treated confidentially, and findings were presented in aggregate form to prevent the identification of individuals.

I, Mario Humberto Pool Rangel Bachelor of Communication and Public Relations with Professional License, Expert Translator authorized by the Council of the Judiciary of the Judicial Power of the State of Tamaulipas, with registration number 165 according to Official List of Auxiliary Experts of the Administration of Justice of the Judicial Power of the State of Tamaulipas dated January twenty-eight of two thousand twenty-six, I declare that the foregoing is, to the best of my knowledge, a faithful translation from Spanish to English of the source document before me, consisting of [22] useful pages, including the grammatical revisions and adaptations of the Spanish language into English. The accuracy of the translation is certified, but no responsibility is assumed for the authenticity of the source document. This translation is only valid if it bears a signature in blue ink and the stamp that authorizes in blue ink on each of its pages. Digital or physical copies of this document must be approved and certified by the subscriber. Data for the receiving authority

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