Beyond Graduation: The Struggle for Women in Academic Leadership Roles

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Abstract

This paper investigates the persistent gender disparities in academic career development in Spain, drawing on data from the National Statistics Institute (INE) to highlight the challenges faced by women in higher education. Despite an increasing number of women completing their degrees, the threshold for achieving high academic positions, such as full professorships, continues to widen, indicating systemic barriers that hinder women's professional growth. Through a probabilistic analysis, we demonstrate that even when considering caregiving responsibilities and academic success as independent events, women face a significantly lower likelihood of attaining prestigious roles in academia. However, these factors are not truly independent, as they are intertwined with various social and institutional biases. By exploring these complexities, this study aims to contribute to a deeper understanding of the structural inequalities present in academia and calls for a concerted effort to address and dismantle these barriers, ultimately fostering a more equitable academic environment for all.

1 Introduction

Over the past few decades, discussions about gender equality have gained a lot of attention, especially in the academic world. In Spain, while women have made impressive strides in education and are earning degrees at rates similar to men [4], they still face significant challenges when it comes to advancing in academia [3]. Despite being well-represented in classrooms and degree programs, women are often missing from top positions, like full professors or department heads.

The National Statistics Institute (INE) has been collecting and revealing overwhelming data on this issue. Since the majority of people graduating from higher education are women [4], as one moves up in the academy, the number of women decreases [3]. These events can be shown in Figure 1, where the number of female graduates is over the 50% from 2014 to 2020. On the other hand, Figure 2 shows the evolution of the percentage of women in academia, depending on the position they hold.

This alarming situation is also revealed by the INE in a data collection performed in 2022 [2]. It is shown that the percentage of women researchers in higher education is less than 45%. However, the most concerning situation from these data is definitely the percentage of women in research in private companies, which is less than 33% [2]. Therefore, this structural problem is applicable to other professional fields [2].

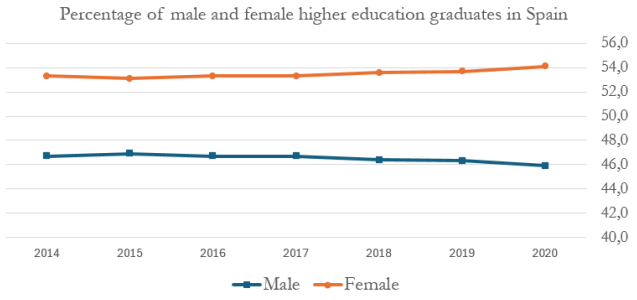

Figure 1: Percentage of male and female higher education graduates in Spain. Data from [4].

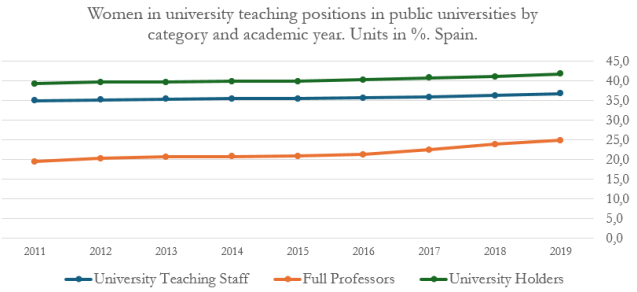

Figure 2: Women in university education teaching staff at public universities by category and academic year. Data from [3].

However, this study focuses on analyzing just the academic impact. We acknowledge that the root of this issue is fundamentally structural [8] and manifests across various cultures worldwide. Nevertheless, our analysis will adopt a simplified approach, relying solely on statistical data without considering crucial factors such as individuals' socioeconomic status.

The motivation of this study lies in addressing a critical challenge in academia: the persistent gender disparities that limit women's access to senior academic positions. Despite an increasing number of women excelling in higher education, their representation in leadership roles remains disproportionately low. This imbalance not only reflects systemic biases but also diminishes the diversity of perspectives that are essential for academic progress. The aim of

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this study is to present readers with compelling statistics that raise awareness about this pressing issue.

This paper contributes to the understanding of gender disparities in academia by leveraging recent data from INE to analyze the intersection of caregiving responsibilities and professional advancement. We show that, even when treated as independent factors, women are less likely to reach high academic positions, such as full professorships. Our findings highlight that educational attainment alone is insufficient to close the gender gap, emphasizing the need for targeted policies to address the structural barriers women face in academia.

2 Methods

We aim to calculate the probability of women attaining the status of full professor in a simplified manner. We calculate the intersection of being a full professor and at the same time performing caregiving activities. The aim is to make a comparison between being able to do these two things at the same time as being a man and being a woman. For this purpose, we have taken the data from 2016, as it was available for Table 1.

2.1 Data Sources

To conduct this experiment, we utilized data from INE. We toke data grouped by women vs. men, and specifically we focused on the following two datasets:

- Weekly frequency of caregiving and household activities in Spain [4] –Figure 2–.
- Women in university education teaching staff at public universities by category, using just full professor-related data [3] –Table 1–.

Additionally, we examined the number of men and women in Spain on 1 January 2016 [5] and the number of full professors that were in Spain in the 2017-2018 academic year [7].

Table 1: Caregiving Activities by Gender. Percentage of Men and Woman that do these activities more than once per week in Spain in 2016. Table from [1].

ID	Activity	Men	Women
1	Care or education of children	76	95
2	Care or education of grandchildren	33	32
3	Cooking or performing household chores	60	93
4	Care of sick or disabled family members, neighbors, or friends under 75 years old	7	8
5	Care of sick or disabled family members, neighbors, or friends over 75 years old	5	10

2.2 Calculation Methods

It is the opinion of many, perhaps more than we would like, that caregiving responsibilities and professional development are independent events, although actually this is not true. Therefore, we will treat them as such. Consequently, the probability of being a full professor can be expressed as follows:

$$P(A \cap B) = P(A) \cdot P(B) \tag{1}$$

where A represents the marginal probability of being a full professor and B denotes the marginal probability of caregiving responsibilities.

Since we want to discuss the gap between men and women, the equations that we want to solve are given by:

$$\begin{aligned} &P(fullprof|men \cap activity|men) = \\ &P(fullprof|men) \cdot P(activity|men) \end{aligned} \tag{2}$$

where $fullprof$ represents the probability of an individual being a full professor, given that the person is male and engaged in each of the caregiving activities showed in Table 1.

$$\begin{aligned} &P(fullprof|women \cap activity|women) = \\ &P(fullprof|women) \cdot P(activity|women) \end{aligned} \tag{3}$$

where $fullprof$ represents the probability of an individual being a full professor, given that the person is female and engaged in each of the caregiving activities showed in Table 1.

At the same time, we need to also compute the following two equations.

$$P(fullprof|men) = \frac{P(men|fullprof) \cdot P(fullprof)}{P(men)} \tag{4}$$

$$P(fullprof|women) = \frac{P(women|fullprof) \cdot P(fullprof)}{P(women)} \tag{5}$$

that represent the probabilities of becoming full professor being men or women, respectively.

Here is a step-by-step explanation of the development of Eq. 2 and Eq. 3.

(1) First, caregiving activities-related probabilities are computed using data from Table 3 [1], by dividing those numbers by 100. For example, for the first activity (ID 1) we compute probabilities as:

$$P(activity = ID1|women) = \frac{95}{100} = 0.95$$

$$P(activity = ID1|men) = \frac{76}{100} = 0.76$$

(2) Second, we compute the marginal probabilities of being men or women in Spain in 2016 [5].

$$P(men) = 0.491$$

$$P(women) = 0.509$$

(3) Third, we calculate the probability of being a full professor in Spain, during the academic year of 2017-2018 [6].

$$P(fullprof) = 2.32 \cdot 10^{-4}$$

(4) Fourth, we compute the conditional probabilities of becoming full professor being a men or a women.

$$P(fullprof|men) = 3.73 \cdot 10^{-4}$$

$$P(fullprof|women) = 9.57 \cdot 10^{-5}$$

Finally, following the Eq. 1 $P(fullprof|men \cap activity|men)$ and $P(fullprof|women \cap activity|women)$ are calculated for each of the activities.

Aditionally, the percentage difference was calculated using the formula given by Eq. 6.

$$\% = \frac{|A - B|}{\frac{A+B}{2}} \cdot 100 \tag{6}$$

where A is $P(fullprof|men \cap activity|men)$ and B is related to $P(fullprof|women \cap activity|women)$.

3 Results

Results of computing the joint probability of being a full professor and performing caregiving activities for both genders are shown in Table 3. Similarly, Table 2 shows the results of the intermediary operations to arrive at the final result.

Table 2: Probabilities of performing caregiving activities and being full professors, depending on the gender. Data from 2016. IDs are referred by Table 1. Equations are given by Eq1: $P(activity|men)$ Eq2: $P(activity|women)$ Eq3: $P(fullprof|men)$ Eq4: $P(fullprof|women)$

ID	Eq1	Eq2	Eq3	Eq4
1	0.76	0.95	$3.73 \cdot 10^{-4}$	$9.57 \cdot 10^{-5}$
2	0.33	0.32	$3.73 \cdot 10^{-4}$	$9.57 \cdot 10^{-5}$
3	0.60	0.93	$3.73 \cdot 10^{-4}$	$9.57 \cdot 10^{-5}$
4	0.07	0.08	$3.73 \cdot 10^{-4}$	$9.57 \cdot 10^{-5}$
5	0.05	0.10	$3.73 \cdot 10^{-4}$	$9.57 \cdot 10^{-5}$

Table 3: Joint probability of being a full professor and performing caregiving activities using data from 2016, for both genders. IDs are referred by Table 1. Equations are given by Eq4: $P(fullprof|women)$ Eq5: $P(fullprof|men \cap activity|men)$ Eq6: $P(fullprof|women \cap activity|women)$. % is given by Eq. 6.

ID	Eq5	Eq6	%
1	$2.84 \cdot 10^{-4}$	$9.09 \cdot 10^{-5}$	103.01%
2	$1.23 \cdot 10^{-4}$	$3.06 \cdot 10^{-5}$	120.31%
3	$2.24 \cdot 10^{-4}$	$8.90 \cdot 10^{-5}$	86.26%
4	$2.61 \cdot 10^{-5}$	$7.66 \cdot 10^{-6}$	109.24%
5	$1.87 \cdot 10^{-5}$	$9.57 \cdot 10^{-6}$	65.59%

As shown in Table 3, $P(fullprof|women \cap activity|women) < P(fullprof|men \cap activity|men)$ for all activities. The smallest difference between men and women is 65.59%, which demonstrates a gender gap in this field. Even when treating caregiving activities as an independent variable—despite the reality that they are not—women still have a lower probability of attaining full professorships. Additionally, the comparison between the columns of Eq1 and Eq2 in Table 3 reveals a significant difference in the level of commitment to these activities between men and women.

4 Conclusion

In summary, it is well documented for years that a significant gender gap persists in the academic world in Spain [3]. Data from the INE illustrate that although more women are completing their higher education, the threshold for achieving high academic positions continues to rise. This widening gap indicates systemic barriers that hinder women's progress, despite their increasing numbers in higher education.

Moreover, probability studies indicate that even if we assume caregiving responsibilities and academic advancement are independent events, women would still face a lower likelihood of attaining positions as full professors. It is crucial to emphasize that, in reality, these events are far from independent; various intersecting factors, including societal expectations, institutional biases, and familial responsibilities, compound the challenges women face in academia [6].

Addressing these disparities requires a multifaceted approach. Academic institutions must recognize and actively combat the structural barriers that perpetuate gender inequality. By fostering an environment that supports both academic and personal development for women, we can work towards closing the gap and creating a more equitable academic landscape for all.

5 Limitations and Future Work

This study has two main limitations. First, the probabilistic analysis relies on data from 2016, as caregiving activities data was only available for that year. Second, the study adopts a simplified approach, assuming independence between variables—a premise that does not fully reflect reality—and considers only two variables. Future research could address these limitations by using more recent data and exploring the main reasons why there are fewer women in top academic positions.

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