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GENDER INEQUALITY IN SPANISH MEDICAL RESEARCH: A PARADIGMATIC CASE

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Abstract

In order to assess gender inequality in medical scientific research, the institutional research databases of the University of Valencia (2000-2018), of the schools of health sciences (Medicine and Dentistry, Pharmacy, Nursing and Physiotherapy) are analyzed, considering sex, academic category, age and clinical specialty of the researchers. Male academics are responsible for an overwhelming number of research projects and contracts, also of a much higher amount, than those led by their female colleagues. The study also reveals horizontal segregation and a significant gender pay gap, highlighting the need for policies that optimize the talent and work of Spanish medical women scientists for the benefit of society.

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DESIGUALDAD DE GÉNERO EN LA INVESTIGACIÓN MÉDICA ESPAÑOLA: UN CASO PARADIGMÁTICO

Resumen

Con el objeto de evaluar la desigualdad de género en la investigación científica médica, se analizan las bases de datos institucionales de investigación de la Universidad de Valencia (2000-2018), de las facultades de ciencias de la salud (Medicina y Odontología, Farmacia, Enfermería y Fisioterapia), considerando sexo, categoría académica, edad y especialidad clínica de los investigadores/as. Los académicos son responsables de un número abrumador de proyectos y contratos de investigación, de importes mucho más elevados que los dirigidos por sus colegas mujeres. El estudio revela también segregación horizontal y una brecha salarial de género significativa, subrayando la necesidad de políticas que optimicen el talento y el trabajo de las científicas médicas españolas en beneficio de la sociedad.

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DESIGUALDADE DE GÊNERO NA PESQUISA MÉDICA ESPANHOLA: UM CASO PARADIGMÁTICO

Resumo

Com o objetivo de avaliar a desigualdade de gênero na pesquisa científica médica, foram analisadas as bases de dados institucionais de um estudo da Universidade de Valencia (2000-2018) das faculdades de ciências da saúde (Medicina e Odontologia, Farmácia, Enfermagem e Fisioterapia) considerando sexo, categoria acadêmica, idade e especialidade clínica dos/as pesquisadores/as. Os acadêmicos são responsáveis por um significativo número de projetos e contratos de pesquisa, com valores muito mais elevados que os dirigidos por suas colegas mulheres. O estudo também revela segregação horizontal e uma notável brecha salarial de gênero, destacando a necessidade de políticas que otimizem o talento e o trabalho das cientistas médicas espanholas em benefício da sociedade.

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INÉGALITÉ DE GENRE DANS LA RECHERCHE MÉDICALE ESPAGNOLE : UN CAS PARADIGMATIQUE

Résumé

Pour mesurer les inégalités de genre dans le domaine de la recherche médicale, ce travail a analysé les bases de données relatives aux recherches de l'Université de Valence (2000-2018) provenant des facultés des sciences de la santé (Médecine, Dentaire, Pharmacie, Soins Infirmiers et Kinésithérapie), en prenant en compte le sexe, la catégorie universitaire, l'âge et la spécialité clinique des chercheur/chercheuses. Les hommes sont responsables d'un grand nombre de projets et de contrats de recherche dont les valeurs sont beaucoup plus élevées que pour ceux menés par leurs collègues femmes. En outre, l'étude a montré qu'il existe une ségrégation horizontale ainsi qu'un fort écart salarial entre les sexes, ce qui renforce l'idée que sont nécessaires des politiques qui optimisent les talents et le travail des scientifiques espagnols du médical, pour le bénéfice de la société dans son ensemble.

RECHERCHE • INÉGALITÉ DES SEXES • SCIENCES MÉDICALES • UNIVERSITÉ

FOR MORE THAN TWO DECADES, THE NUMBER OF FEMALE STUDENTS WHO ACCESS THE

Schools of Medicine and in general of health sciences in the Spanish university has been increasing dramatically, so that at the University of Valencia they currently represent 70.3% of students in undergraduate degrees, and 74.1% in master's degrees. In doctoral studies, they fell very slightly, although they still make up a significant majority of students (63.2%). These data that undoubtedly reveal important steps towards achieving parity, while crucial, have no important effect in reversing the inequity trends that are still very present in Spanish universities. Primarily, the finding that the aforementioned predominance of female students in health sciences does not correspond to the gender distribution of people who choose to pursue an academic career at the university as faculty and researchers, a group where women already start out as a minority, compared to a significant proportion of men, who continue to rise as they move towards figures of higher rank and category.

Along with this female abandonment, explanatory of a weaker presence in all groups of faculty and research personnel, and particularly in the higher academic categories – the so-called academic funnel – (Paulus et al., 2016), various studies have confirmed the strength of other trends that run parallel to the previous one, such as different leadership styles between men and women (Monroe et al., 2015; Rochon et al., 2016; Pingleton et al., 2016), and gender inequality in raising funds for research (Bates et al., 2016; Ministerio de Ciencia, Innovación y Universidades [MCI], 2018a). All of these factors explain the underrepresentation of women and its perpetuation, especially in top academic positions (Carr et al., 2018), even in modern societies with policies and plans in favor of gender equality (Plank-Bazinet et al., 2016).

When addressing the issue of academic research in particular, again we find performance gaps between males and females (Besselaar & Sandstrom, 2016; Lee & Ellemers, 2015), that have clear effects on scientific production. Male researchers get more research funding (Waisbren et al., 2008; Ceci & Williams, 2011; Lee & Ellemers, 2015; Ovseiko et al., 2016; MCI, 2018a), publish more papers (Astegiano et al., 2019; Raj et al., 2016), obtain higher citation scores for their work and scientific contributions (Alloza Frutos et al., 2012; Raj et al., 2016; European Commission [EC], 2019), direct and occupy leading positions in scientific journals and committees to a greater extent (Mauleón et al., 2013; EC, 2019), receive more and better recognized scientific prizes and awards, obtain more patents (EC, 2019) and join research networks more easily, thus developing more valuable international and co-authoring collaboration schemes than their female colleagues (European Institute for Gender Equality [EIGE], 2019b; Shannon et al., 2019).

Meritocratic explanations as a single element do not seem very convincing, and, therefore, the academic literature offers a varied range of widely accepted factors, some personal and some structural, social and institutional (Fox et al., 2011; EIGE, 2016), that may explain gender differences in research productivity.

Among the first ones, with detrimental effects on the professional careers of women, we find parenthood and in general a greater dedication to domestic and family issues (Fox et al., 2011; EIGE, 2016; EC, 2019; Bowen et al., 2018; Shannon et al., 2019), with the consequent impact on their research career, in a context of scarce resources for research and great competitiveness. Women's own perceptions are also brought up, as female researchers do not advance with the same confidence in their professional careers (Butkus et al., 2018), they have leadership and interaction styles different from those of men

(Carr et al., 2018); as well as a lower professional ambition, once they have reached tenure in university (Escolano, 2006), which would also explain their lower demands when negotiating (Buckley et al., 2000), an important factor in research contracts. There is also a greater strategic planning by male academics, who tend to focus their work on themes and approaches more oriented to what is trending, compared to female researchers, who are more oblivious to such calculations. The planning of the academic career with a more pragmatic and profitable sense, is reflected in a notable way in the investigative facet, essential to advance in the professional trajectory of the academic staff (Escolano, 2006).

As a general rule, female academics who are part of consolidated research groups do not usually lead them either, as they usually occupy a secondary position, although having in many cases a greater workload. Male principal investigators who lead such teams are credited with the prestige of raising funds or achieving relevant results, to a much greater extent than their female colleagues, who also develop in many cases choices and career trajectories that are not so focused on research, but much more on teaching (Wenneras & Wold, 1997; EC, 2019).

From the social and institutional perspective, various studies have highlighted the validity of gender biases and stereotypes, even unconscious, that favor men. They point out that those who evaluate requests for research funding for projects and manuscripts submitted for publication, as well as the people who read them once published, generally tend to overvalue works by male authorship, considering to a lesser extent those carried out by female academics, either due to the theme, approach, methodology, etc. (Shen, 2013; Leslie et al., 2015; Pingleton et al., 2016; Besselaar & Sandstrom, 2016; Pattani et al., 2018). This is sometimes done in a way that is not entirely conscious, since stereotypes about men and women are still fully valid, and research excellence tends to be more implicitly related to male images, given the historical lack of female references in science and the linking of female images with private spheres, at odds with the demands of time and effort that scientific research entails (Alloza Frutos et al., 2012; Pattani et al., 2018). The male intellectual tradition remains predominant in the field of medical sciences. All of the above factors make up a hostile academic environment (Fox et al., 2011), which offers women less support, guidance and sponsorship than men (Yedidia & Bickel, 2001; Westring et al., 2016), consolidating the glass ceiling in the research career (MCI, 2018a).

The functioning of the Spanish university, on the other hand, refers us to the extraordinary importance of contacts, relationships, and network memberships, even though the procedures for accessing funds from competitive research projects are formally open and objective (EIGE, 2016). And women in such informal spheres of action are not as present and have fewer contacts. Male academics have greater dexterity when it comes to managing groups and academic lobbies, which is key in the field of research, due to the influence of networks of known colleagues, as well as the convenience of working in groups, in many cases interdisciplinary. And in the case of research transfer contracts, relationships are practically the fundamental element when it comes to achieving them, assuming the research quality of both sexes. Academic women do not manage so well in such networks, nor do they dedicate the necessary effort to participate in them, nor are they invited to do so. And it is in this terrain that another important element appears, the wage gap (Connolly & Holdcroft, 2009; Shen, 2013; Bates et al., 2016; EC, 2019; EIGE, 2019b), which arises from the pay differences between men and women in medical science research, given that, from the research funds of these contracts, the faculty and researchers of Spanish universities receive important supplementary remuneration. Although ordinary salaries are the same for men and women when they work in a public university, a salary gap arises in this way that benefits male academics significantly.

There is a strong interaction between the two types of elements mentioned (Zuckerman, 2001), since social and institutional factors tend to reinforce the personal ones, such as the choices and steps women take in their professional careers. In the end, all of these individual and social selections over time lead to cumulative disadvantage for female academics (Eurostat, 2019), with slower and much less remarkable research careers (MCI, 2018b).

In recent times, the promotion of gender equality in research and innovation is a commitment assumed at the European level, as established by the Horizon 2020 Program, which fosters to guarantee the effective promotion of equality between men and women ensuring gender balance in research teams, both in decision-making (panels, expert committees, advisors...), as mainstreaming gender equality in research and innovation (training, approaches, funding...), thus reinforcing the commitment of participating teams and institutions. In Spain, important positive discrimination measures have been implemented, established by the state and regional equality law regulations, highlighting the creation in 2005 of the Women and Science Unit, as the body responsible for the incorporation of the gender perspective in science, technology and innovation in our country. Spanish universities have also integrated various actions into their equality plans (in particular, the University of Valencia's third Equality Plan is currently in effect), many of which are focused on achieving greater equity in research, as well as on analyzing the progress of academics in their professional careers.

This study evaluates the participation and role of women and men in academic research in the field of health sciences at the University of Valencia (UV), Spain, an institution with more than five centuries of existence, that stands out for its background and its academic and research excellence, especially relevant in medical sciences. Its characteristics make it a paradigmatic institution of Spanish public universities, where data of academic categories, participation, prominence and leadership of men and women are similar, which suggests that the trends observed in this study may have a broader generality.

The research seeks to explore the participation and leadership of women and men in academic research in the field of health sciences and to determine whether there is an equal situation in what concerns access to funds and in leadership and responsibility for research activities and projects, thus highlighting the factors that would explain eventual gender discriminations in a deeply transformed society that has gender equality policies underway. It also seeks to find out if there is a salary gap between academics of both sexes, via the revenue that researchers receive from the research contracts through which the research results are transferred to society.

Materials and methods

Research funds in Spanish universities are mainly obtained in two ways. The first one is the participation of researchers and their teams in calls, through which public Administrations (the State, the Regional governments and the European Union) competitively subsidize research projects. The second source of resources for academic research is the signing of contracts and agreements between faculty and researchers with companies and public and private institutions, a way stated in article number 83 of Organic Law 6/2001 on Universities (LOU), through which public universities transfer to society the results of scientific and technical research, carried out on request.

In order to analyze the resources dedicated to research in the area of health sciences from a gender perspective, the study uses as sources anonymized institutional data from the research databases of the University of Valencia, that the academic government team specifically provided for the conduct of this study, upon request.

Three institutional databases have been used, utilizing all of the variables of interest for the purpose of our research:

1. Database of research funds: This database includes all of the research projects, as well as the research, development and innovation (R & D & i) contracts signed in the period under analysis, led by health science professors and researchers, men and women, as principal investigators.
2. Payroll database, module corresponding to payments to researchers, from their participation in contracts of the aforementioned article 83 of the LOU.
3. Database of research groups registered in the List of Research Structures of the University

of Valencia (REIUV). Data from the Health Sciences groups, available for the 2018 annuity, the last of our analysis, have been utilized.

1) The data provided span practically two decades (2000-2018) and include complete information regarding all of the resources dedicated to research in force in said period of time, either coming from public aid that finances R & D & i projects – in the framework of the State Plan, European projects or research grants from the Valencian government –, as well as those generated by contracts signed for the transfer of research results on request.

The academics, men and women who lead them as main researchers, belong to the totality of departments and disciplines in the area of health sciences. Specifically, they are faculty and researchers assigned to the Schools of Medicine and Dentistry, the Faculty of Pharmacy, the Faculty of Nursing and the Faculty of Physiotherapy. Data have been exploited and analyzed to assess the gender distribution of research funds for the entire study period (2000-2018), not only globally or cumulatively, but also longitudinally, in order to track eventual changes over time and check the trends observed in their evolution. For this last purpose, several intervals have been established, within the global time period, specifically the periods 2000-2005; 2006-2010; 2011-2015; and 2016-2018.

Moreover, we filtered the data considering three variables in addition to the researchers' sex, in order to find out to what extent they influence and modulate the overall results.

The first is the academic category, since the professional rank is usually decisive in obtaining funds for research, as numerous studies have shown (among all, Waisbren et al., 2008). Therefore, all of the analyzed questions were additionally considered, taking into consideration the academic category of the researchers, obtaining different results for four groups of faculty: firstly, for the temporary hired professors (a set that includes Assistant professors, as well as Ph.D. Assistant professors, and some other residual figure); secondly, the faculty who have a permanent relationship with the university (Associate Professors from various categories of Spanish universities) were studied; Full Professors, considering that they constitute the highest university category, were also analyzed specifically; as well as Emeritus professors, since they practically are all Full Professors, as the LOU describes this figure as professors who have performed outstanding services to university.

Secondly, we used four age ranges to detect possible differences in access to research funds throughout the life and professional careers of university researchers, given that age is an essential factor in the patterns of dedication to a professional career, either due to the greater need to accumulate merits in the early stages, until reaching tenure, or due to the incidence of various family obligations and especially children raising, specifically for female researchers. The ranges used have been four: from 30 to 40 years; from 41 to 50 years; from 51 to 60 years; and finally, the group of faculty and researchers over 60 years of age.

Finally, gender differences in research throughout the different medical specialties (23 in particular) have also been considered, analyzing the data of each one of them in terms of leadership of research teams and funding dedicated to clinical research, both regarding contracts and research projects, in order to assess whether, considering the issues analyzed, we find situations that make horizontal segregation evident in this academic field.

2) One last issue that this study addresses in order to detect an eventual gender pay gap is the additional remuneration received by male and female researchers from the research contracts in which they participate. For this purpose, the payment invoices delivered by researchers of both sexes have been analyzed, whose amounts have been obtained through the payroll database. In particular, we have analyzed the perceptions of the last five years of data from our study, which cover the period 2014-2018.

We conducted all research throughout the second quarter of 2019.

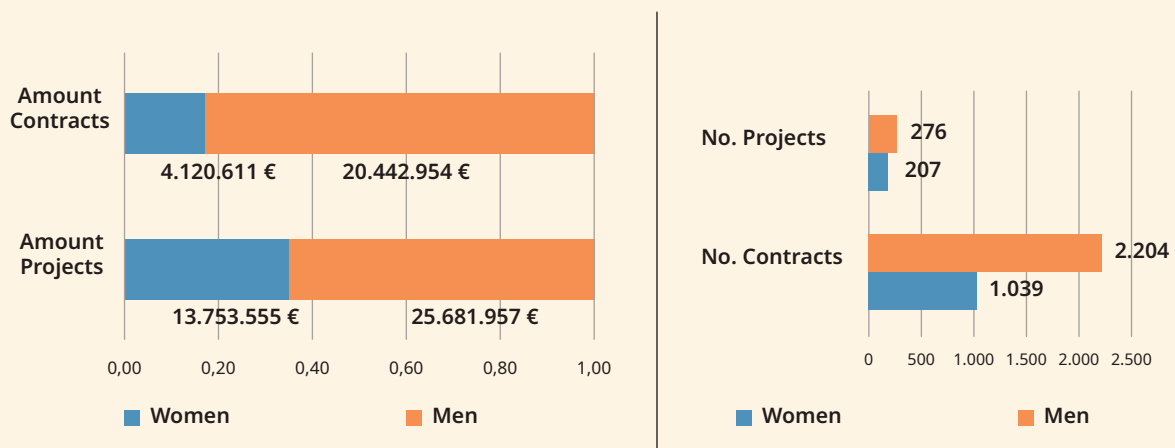
Results and discussion

Research funds

Firstly, if we analyze from a gender perspective the raising and management of funds dedicated to medical research, for which men and women academics appear as principal investigators, for the entire period 2000-2018, and starting with the Research projects, which result from competitive calls, these are mostly controlled by men, to a much greater extent than by their female colleagues, since they practically double the available research funds (€ 25.681.957, compared to € 13.753.555, respectively). The number of research projects by sex also shows a balance that favors male academics, who lead 276 projects, compared to 207 in which the principal investigator is a female researcher. Although the numerical difference is not excessive, the fact that the amounts of research funds managed by men practically double those controlled by women, allows us to conclude that they are awarded projects with greater economic endowment than the latter. We also registered a male predominance in the groups of researchers that lead more than 4 projects, from 5 to 9, or more than 10 projects.

Much greater is the imbalance when considering the amounts corresponding to research agreements and contracts, whose subscription implies much more than being a researcher with solvency and competence, since it implies having contacts and knowing how to sell one's own work to the institutions, companies and stakeholders with which such commitments are signed, which are important sources for funding research in a country like Spain, which dedicates modest amounts to research in public budgets. An analysis of the funds obtained in the time elapsed from the beginning of the 21st century to the present, allows us to conclude that male researchers quintuple the amounts available to their female colleagues in medical sciences (€ 20.442.954, compared to € 4.120.611). And again, they are also the ones who appear as responsible, in their role as principal investigators, for a much greater number of research contracts and agreements than their female colleagues (more than double, 2.204 compared to 1.039 led by female researchers), also clearly predominant as incumbents of 3, 4 or more than 5 of these agreements and contracts for the period analyzed. Figure 1 clearly shows such gender gaps.

FIGURE 1
AMOUNT AND NUMBER OF CONTRACTS AND RESEARCH PROJECTS IN HEALTH SCIENCES BY SEX 2000-2018



Source: Institutional Research database of the University of Valencia (2019).

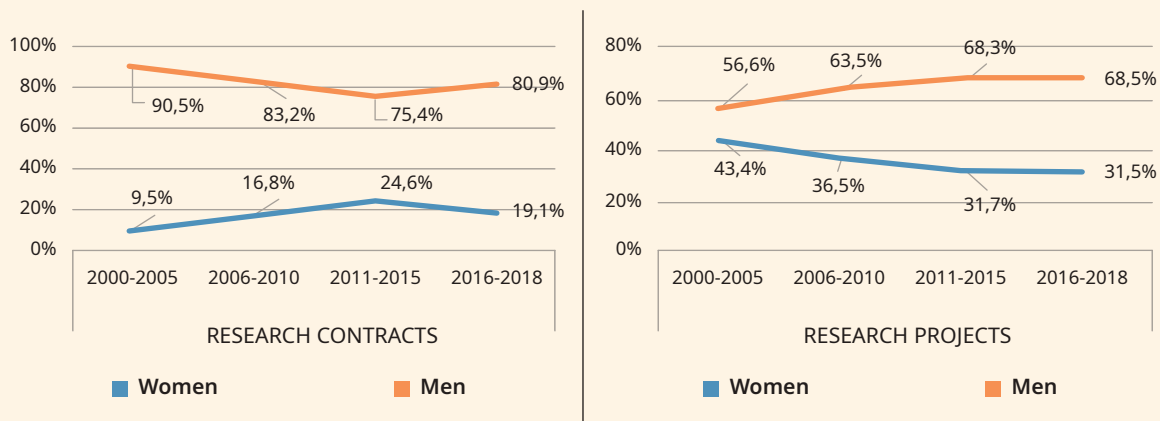
The analysis of the evolution of the amounts of research contracts and projects by sex throughout the period, carrying out the same study for each one of the selected intervals considered individually (2000-2005; 2006-2010; 2011-2015; 2016-2018), allows us to slightly refine the previous results. Thus,

if we consider research contracts, if in the first period male researchers concentrate 90% of the funding (out of a total of € 7.270.779), such amounts lower down to 83.2% (of 8.662 .180 €) in the second interval, representing 75.4% (of € 5.963.662) in the third, to rise slightly to almost 81% (of a global of € 2.666.945) in the 2016-18 period.

In any case the full study of the period shows a decrease in the funds of contracts and agreements for the transfer of the results of medical research for which male researchers are responsible, with the correlated increase in those in charge of a female academic as principal investigator, practically 10 percentage points.

The progress of the research funds obtained through competitive projects, financed by the European Union, the state or regional administration, has differed. The analysis of the aforementioned time intervals shows that men have increased the funds for which they are principal investigators, from 56.5% to 68.5%, while their female colleagues have seen the amounts of their projects gradually reduced, from 43.4 to 31.4 percent. Graph 2 clearly shows the amounts of such contracts, by sex, for each of the chosen intervals, as well as the trend of the evolution operated in them.

FIGURE 2
EVOLUTION OF FUNDING IN RESEARCH CONTRACTS AND PROJECTS IN HEALTH SCIENCES BY SEX 2000-2018



Source: Institutional Research database of the University of Valencia (2019).

To sum up, much higher amounts of research funds, together with the responsibility for a higher number of research projects and contracts, is the balance of gender inequality within research in health sciences at the University of Valencia in the analyzed period, thus showing a situation that is highly common in the rest of the Spanish universities as well. These gaps imply less visibility of female scientists in medical sciences who then can hardly constitute models for other female students who may want to follow their path, and offer the false construct that scientific progress in medical disciplines is a male achievement; this feeds and consolidates inequality in an area in which there has been a clear predominance of women in Spanish schools for some decades already.

Although male leadership and the predominance of male researchers in the role of principal investigator of funded research projects, contracts and agreements are indisputable facts, this hides a reality in which female academics carry the weight of the teams, given that they predominate in its composition. In this sense, a complementary analysis of the data from the University of Valencia Registry of Research Teams, shows that, in the area of Health Sciences, there are 70 consolidated research groups, and only 30 (42.9%) are led by men academics as main researchers. 498 researchers

participate in them, from which 285, that is, 57.2%, are women. These data show that female academics carry out important research tasks integrated into research groups, the majority of them led by men, but with a quantitative predominance of women in their composition. However, they have a glass ceiling when it comes to reaching the position of principal investigators, where their number decreases, and even more when it comes to obtaining funds for their projects, as we have seen, since in the funded research initiatives, male preeminence is absolute.

Age and academic category

When analyzing the age of researchers, considering both research projects and contracts, there is a clear advance towards practically egalitarian situations in the younger and intermediate generations, compared to the absolute predominance of men in the older ones. We particularly observed this situation when analyzing the number and amount of research projects led by women and men from various age groups up to 50 years, as well as, for research contracts, in the group of 41 to 50 years, which has a female predominance as well. It is an age in which women have consolidated their academic career, freeing themselves from the family responsibilities involved in raising children during their first years.

From there, however, the male predominance is absolute, both for projects and for research contracts, considering numbers and quantities, in the cohorts that exceed 50 years old, and particularly in the group of researchers over 60 years of age, where the gap widens dramatically.

Several factors can explain these trends. It has already been noted that funding, in the case of research contracts is usually obtained directly, on request, whereas one gets financing for projects competitively. In the latter, data shows a trend that points to more egalitarian positions between men and women, which can be observed in the younger cohorts, that may respond to elements such as the positive assessment of gender parity in the evaluation of projects, to the impact of some public gender equality policies, such as identical permits and licenses for men and women on issues of childcare, recently implemented in Spain, or the increasing importance that women academics themselves give to their professional careers. The data do, however, present differences by age intervals, which correspond to different phases of the academic career, since after an egalitarian initial stage, in which men and women are strongly committed to finding their place in the university, developing important research work, once tenure is achieved, in many cases women tend to have their first child, a fact that can slow down their professional careers in a second stage. What is indisputable is that, in the older cohorts, male researchers have had and still have an absolute hegemony, in amounts and in the number of research projects and contracts. For such age groups, at the peak of their careers, women did not have as many opportunities as their male colleagues. Perhaps these trends will alter in a few years, in a more egalitarian sense, so it would be interesting to continue studying them over time.

TABLE 1
RESEARCH PROJECTS AND CONTRACTS, BY SEX, ACADEMIC CATEGORY AND AGE, 2000-2018

	Number of researchers			Research Fundings			Amount per researcher	
	Total	Men (%)	Women (%)	Total	Men (%)	Women (%)	Men (%)	Women (%)
ACADEMIC CATEGORY								
Research Contracts								
Assistant Professor	32	68,8%	31,3%	723.654,6 €	85,4%	14,6%	28.091,0 €	10.565,3 €
Associate Professor	101	63,6%	36,4%	5.801.767 €	63,6%	36,4%	71.124,5 €	35.693,5 €
Full Professor	78	63,6%	36,4%	17.102.703 €	63,6%	36,4%	308.080,7 €	84.610,0 €
Emeritus Professor	11	100,0%	---	935.441 €	100,0%	---	85.040,1 €	---

(to be continued)

	Number of researchers			Research Fundings			Amount per researcher	
	Total	Men (%)	Women (%)	Total	Men (%)	Women (%)	Men (%)	Women (%)
Research Projects								
Assistant Professor	27	59,3%	40,7%	2.042.369 €	56,2%	43,8%	71.743 €	81.317 €
Associate Professor	71	52,1%	47,9%	6.642.955 €	61,5%	38,5%	110.353 €	75.291 €
Full Professor	79	60,8%	39,2%	30.236.478 €	65,9%	34,1%	415.361 €	332.231 €
Emeritus Professor	5	100,0%	---	513.709 €	100,0%	---	102.742 €	---
AGE								
Research Contracts								
From 30 to 40	18	50,0%	50,0%	128.542 €	73,8%	26,2%	10.546 €	3.737 €
From 41 to 50	29	55,2%	44,8%	616.629 €	37,6%	62,4%	14.490 €	29.599 €
From 51 to 60	91	58,2%	41,8%	9.616.465 €	73,6%	26,4%	133.594 €	66.736 €
More than to 60	92	77,2%	22,8%	14.411.729 €	91,9%	8,1%	186.557 €	55.534 €
Research Projects								
From 30 to 40	17	47,1%	52,9%	535.907 €	50,6%	49,4%	33.879 €	29.431 €
From 41 to 50	32	46,9%	53,1%	3.174.852 €	46,3%	53,7%	97.946 €	100.333 €
From 51 to 60	84	53,6%	46,4%	21.183.772 €	57,3%	42,7%	269.891 €	231.761 €
More than to 60	45	73,3%	26,7%	16.629.680 €	83,5%	16,5%	420.768 €	228.696 €

Source: Institutional Research database of the University of Valencia (2019)

On the other hand, one of the most interesting filters when analyzing university research funds in terms of gender equality is undoubtedly the academic category of researchers.¹ The study of the data allows us to conclude that the academic rank is a relevant factor, that particularly affects research projects, showing a pattern according to which, in the highest categories (Full professors and Emeritus professors), there is a male predominance, both in amounts and in number of projects, while in other figures of lower rank, the situation of men and women researchers is much more egalitarian. The achievement of funds by sex in each of the academic categories has a direct correlation with the proportion of women in each one of them, since although the data in the table cover almost two decades, throughout which the number of female academics in the area of health sciences at the University of Valencia has been on the rise, the fact is that even in 2018, the final year of the analysis, as already noted, female university professors only represent 26.2%, while in the category of emeritus teachers there are no women. And in the other two groups of teaching staff used for the analysis, Assistant Professor and Associate Professor, women academics do not reach more than 4 out of 10. This unequal proportion by sex in the various categories of faculty, and particularly, the fact that women only represent a very discreet proportion of top academic positions, who are the ones who appear as principal investigators in the majority of projects that achieve the highest volume of public funding in the different calls, explains the minor female role in the allocation of R & D & i funds.

This is not the case in research contracts, in which the differences by gender, both in amounts and in number of contracts, do not follow a pattern consistent with the academic category. Male

1 In order to analyze the distribution of research funds by academic categories, four groups have been used. Full professors are academics of the highest category, as well as the Emeritus professors, who are retired professors who have performed outstanding services at Academe, and can continue to be linked to the university for a maximum of six years after retirement. In this last group, which is only accessible to a limited number of people, we usually find only Full Professors with great weight and influence in the university, since they must be appointed as Emeritus Professors by the Governing Council of the university in secret ballot. An intermediate group in terms of academic category is that of Associate Professors, who have tenure, but they have not reached the highest category, Full Professor. Finally, the lowest academic category is that of PhD Assistant and other temporary contract figures, who have a maximum relationship of 5 years with the university, so, in order to reach tenure, they need to be promoted to other categories.

researchers prevail over their female colleagues as principal investigators of such funds for medical research, both in intermediate and higher academic ranks and positions. The reason that research projects do observe a direct relationship with the academic category, unlike contracts, can be found in the fact that in the first, funds are awarded in a competitive way, and the researchers from the higher category tend to have a better curriculum regarding the valuable elements in said calls, while they have a higher ease when configuring teams, to which such funds are awarded. Whereas in the case of research transfer contracts, their achievement does not derive from a process of competitive concurrence, but rather their signature responds to relational elements or others: the academic category of the researcher is not so relevant. Table 1 shows the results of the study in detail, considering the academic category and the age of the researchers.

Clinical areas

If we introduce as a variable the clinical specialties to which the research funds are allocated, the first thing we find is the existence of a group of medical specialties that only have male researchers. This happens in Surgery, Dermatology, Ophthalmology, Obstetrics and Gynecology, Otorinolaryngology, Radiology and Physical Medicine, and Traumatology and Orthopedics. In addition, in the areas of Stomatology and Legal and Forensic Medicine, there are no female academics with research projects; they are only principal investigators of research contracts. Conversely, there is a specialty in which there are only female academics in charge of research funds (Toxicology), while in Pediatrics, male researchers only have research contracts, but no projects.

TABLE 2
RESEARCH CONTRACTS AND PROJECTS, BY SEX AND CLINICAL AREA, 2000-2018

Area	RESEARCH CONTRACTS					
	Number of researcher		Research Fundings		Amount per researcher	
	Men	Women	Men	Women	Men	Women
Anatomy and Human Embryology	6	4	735.674 €	19.613 €	122.612 €	4.903 €
	60,0%	40,0%	97,4%	2,6%		
Dermatology	2	---	21.600 €	---	10.800 €	---
	100,0%	---	100,0%	---		
Forensic and Legal Medicine	4	1	201.829 €	67.584 €	50.457 €	67.584 €
	80,0%	20,0%	74,9%	25,1%		
Medicine	15	2	2.010.360 €	22.226 €	134.024 €	11.113 €
	88,2%	11,8%	98,9%	1,1%		
Microbiology	15	11	2.853.613 €	787.069 €	190.241 €	71.552 €
	57,7%	42,3%	78,4%	21,6%		
Pharmacy and Pharmaceutical Technology	7	8	270.697 €	385.004 €	38.671 €	48.126 €
	46,7%	53,3%	41,3%	58,7%		
Pharmacology	9	10	7.957.386 €	683.279 €	884.154 €	68.328 €
	47,4%	52,6%	92,1%	7,9%		
Physiology	11	5	1.067.733 €	154.573 €	97.067 €	30.915 €
	68,8%	31,3%	87,4%	12,6%		
Physiotherapy	5	6	567.886 €	14.000 €	113.577 €	2.333 €
	45,5%	54,5%	97,6%	2,4%		
Nursing	10	4	125.603 €	137.029 €	12.560 €	34.257 €
	71,4%	28,6%	97,4%	2,6%		
Nutrition and Bromatology	5	9	683.587 €	803.280 €	136.717 €	89.253 €
	35,7%	64,3%	46,0%	54,0%		

(to be continued)

(continuation)

Area	Number of researcher		Research Fundings		Amount per researcher	
	Men	Women	Men	Women	Men	Women
Obstetrics and Gynecology	3	---	250.171 €	---	83.390 €	---
	100,0%	---	100,0%	---		
Ophthalmology	2	---	2.728 €	---	1.364 €	---
	100,0%	---	100,0%	---		
Parasitology	4	3	92.058 €	101.173 €	23.014 €	33.724 €
	57,1%	42,9%	47,6%	52,4%		
Pathology	8	4	570.403 €	318.265 €	71.300 €	79.566 €
	66,7%	33,3%	64,2%	35,8%		
Pediatrics	1	2	18.000 €	300 €	18.000 €	150 €
	33,3%	66,7%	64,2%	35,8%		
Preventive Medicine and Public Health	5	4	107.073 €	490.130 €	21.415 €	122.532 €
	55,6%	44,4%	17,9%	82,1%		
Psychiatry	8	1	479.567 €	21.574 €	59.946 €	21.574 €
	88,9%	11,1%	64,2%	35,8%		
Radiology and Physical Medicine	1	---	1.724 €	---	1.724 €	---
	100,0%	---	100,0%	---		
Stomatology	9	5	1.974.739 €	91.279 €	219.415 €	18.256 €
	64,3%	35,7%	95,6%	4,4%		
Surgery	8	---	266.972 €	---	33.372 €	---
	100,0%	---	100,0%	---		
Traumatology and Orthopedics	3	---	396.800 €	---	132.267 €	---
	100,0%	---	100,0%	---		
Toxicology	---	2	---	24.233 €	---	12.116 €
	---	100,0%	---	100,0%		
RESEARCH PROJECTS						
Anatomy and Human Embryology	4	4	122.530 €	55.000 €	30.633 €	13.750 €
	50,0%	50,0%	69,0%	31,0%		
Forensic and Legal Medicine	2	---	133.962 €	---	66.981 €	---
	100,0%	---	100,0%	---		
Medicine	14	3	2.551.463 €	508.419 €	182.247 €	169.473 €
	82,4%	17,6%	83,4%	16,6%		
Microbiology	11	11	1.873.941 €	3.641.652 €	170.358 €	331.059 €
	50,0%	50,0%	34,0%	66,0%		
Nursing	4	2	83.175 €	8.500 €	20.794 €	4.250 €
	66,7%	33,3%	90,7%	9,3%		
Nutrition and Bromatology	4	8	1.392.725 €	1.724.496 €	348.181 €	215.562 €
	33,3%	66,7%	44,7%	55,3%		
Obstetrics and Gynecology	2	---	1.931.680 €	---	965.840 €	---
	100,0%	---	100,0%	---		
Otolaryngology	1	---	11.318 €	---	11.318 €	---
	100,0%	---	100,0%	---		
Parasitology	5	2	1.776.399 €	389.596 €	355.280 €	194.798 €
	71,4%	28,6%	82,0%	18,0%		
Pathology	6	7	2.176.179 €	1.053.118 €	362.696 €	150.445 €
	46,2%	53,8%	67,4%	32,6%		

(to be continued)

(continuation)

Area	Number of researcher		Research Fundings		Amount per researcher	
	Men	Women	Men	Women	Men	Women
Pediatrics	---	3	---	205.845 €	---	68.615 €
	---	100,0%	---	100,0%		
Pharmacy and Pharmaceutical Technology	5	5	288.413 €	971.924 €	57.683 €	194.385 €
	50,0%	50,0%	22,9%	77,1%		
Pharmacology	9	14	3.246.779 €	3.891.544 €	360.753 €	277.967 €
	39,1%	60,9%	45,5%	54,5%		
Physiology	14	9	7.311.822 €	351.029 €	522.273 €	39.003 €
	60,9%	39,1%	95,4%	4,6%		
Physiotherapy	2	3	24.000 €	21.935 €	12.000 €	7.312 €
	40,0%	60,0%	52,2%	47,8%		
Preventive Medicine and Public Health	4	5	354.165 €	816.065 €	88.541 €	163.213 €
	44,4%	55,6%	30,3%	69,7%		
Psychiatry	5	1	1.609.006 €	53.135 €	321.801 €	53.135 €
	83,3%	16,7%	96,8%	3,2%		
Surgery	1	---	56.265 €	---	56.265 €	---
	100,0%	---	100,0%	---		
Stomatology	5	---	744.087 €	---	148.817 €	---
	100,0%	---	100,0%	---		
Traumatology and Orthopedics	1	---	68.285 €	---	68.285 €	---
	100,0%	---	100,0%	---		
Toxicology	---	1	---	61.297 €	61.297 €	---
	---	100,0%	---	100,0%		

Source: Institutional Research database of the University of Valencia (2019).

For the rest of the medical areas, in the vast majority of them there is a clear male predominance in both projects and research contracts, which is even more pronounced when considering the difference in the amount of funds that male and female academics receive to investigate, than by quantifying the number of researchers by sex for each specialty. The medical specialties that stand out, in this regard, are Nursing, Medicine and Physiology, both in projects and in contracts; Human Anatomy and Embryology, as well as Pharmacology and Physiotherapy in research contracts; and Psychiatry, considering research projects: in almost all these areas male researchers concentrate more than 90% of the available funds. Female researchers, on the other hand, have more research fundings in the specialties of Pharmacy and Pharmaceutical Technology, Preventative Medicine and Public Health, and Nutrition and Bromatology, both from contracts and from research projects; and in Microbiology, if we only consider the latter. Table 2 clearly shows all the facts and trends noted.

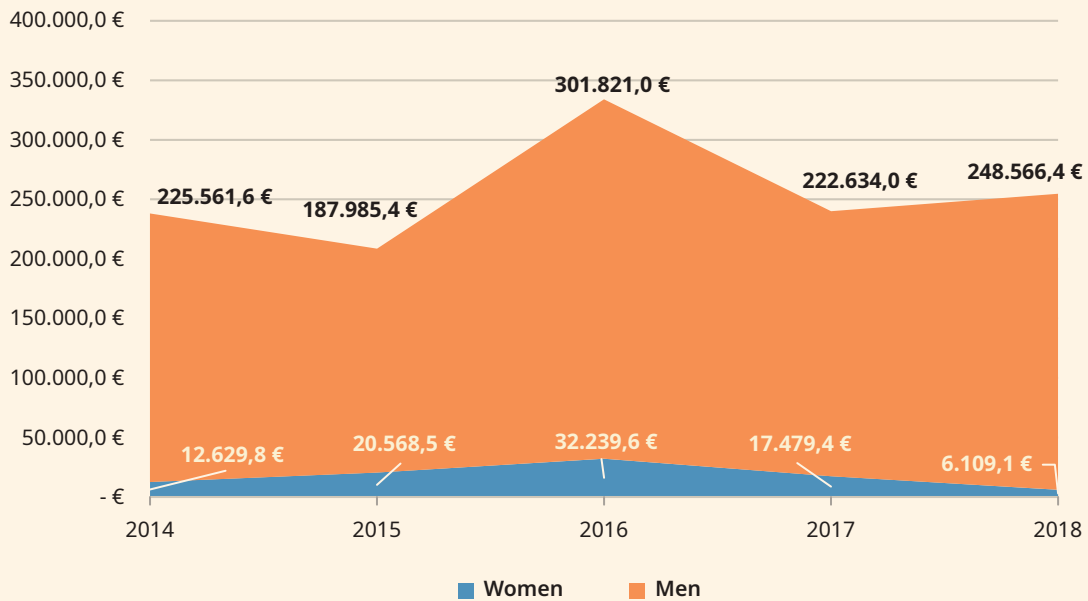
Revenues from research transfer contracts

In Spanish public universities, ordinary remunerations are necessarily identical for men and women in every academic category. Hence, one of the ways by which there may be salary differences, and with them a gender wage gap, is precisely this: the salaries from research contracts.

The analysis of the amounts received by researchers from R + D + i contracts also shows profoundly uneven results. If there were 41 female scientists who have received supplementary remuneration from R & D & i contracts in the period under study, the number of male academics in the same situation practically triples this figure (there are 117). Much more striking is the wage gap between both sexes, that highlights a significant inequality between men and women (€ 89,026.4

for female scientists, € 1,186,568.4 for male colleagues). Or what is the same, of every € 100, € 93.02 has been collected by men, while the researchers have only received € 6.98. Graph 3 clearly shows the existence and breadth of this wage gap.

FIGURE 3
INCOME FROM RESEARCH CONTRACTS IN HEALTH SCIENCES, BY SEX 2014-2018



Source: Institutional Payroll database of the University of Valencia (2019).

Situations of gender inequality result in female scientists, in the field of medical disciplines, being responsible for a much smaller number of research transfer contracts, and thus receiving substantially lower salaries than their male colleagues.

Conclusions

Data from the University of Valencia, in the area of medical sciences, in a situation that probably coincides essentially with other Spanish universities, show that male academics are unquestionably leading competitive research projects, as well as research contracts through which the results of scientific work are transferred to society. Male academics are responsible for an overwhelmingly greater number of research projects and contracts and agreements, of a much higher amount than those led by their female colleagues. And this is so, despite the fact that the participation of female academics in health science research groups is higher than that of their male colleagues, which reveals that their work continues to be in the background, and that there is a glass ceiling whose effects are fully in force.

Considering age, there is a slightly more egalitarian situation, especially with regard to research projects, resulting from competitive calls, in the younger and intermediate generations. The academic category is also relevant, since in the case of research projects it reveals the significant male predominance, both in amounts and in number of projects, more pronounced in the highest categories (Full professors and Emeritus professors), which softens in the lower ones, more prone to gender parity. Along with this, there is a horizontal segregation which makes academic research an absolutely male territory in a significant number of specialties.

Finally, as a consequence of the greater prominence of male researchers, they receive revenues

from research contracts, additional to the ordinary remunerations, which are comparatively very high in relation to their female academic colleagues, thus generating a significant gender wage gap.

The study has therefore confirmed the persistence of a significant degree of gender inequality in academic medical research, with pernicious effects in many facets. This situation finds its explanation in a series of arguments, which undoubtedly continue to be very valid and still hold an important strength, highlighting the already classic personal and institutional barriers: family responsibilities; an imperfect integration of women in the academic culture, which results in less skills when it comes to management within an organization, university, which has its own operating rules; scarce mentoring, unequal functioning in teams and groups and belonging to academic lobbies, compared to men, who are much more skilled in the academic professional field; in general, less strategic planning of their careers in the case of female researchers, compared to their male colleagues; more or less conscious sexist stereotypes and prejudices, present in research evaluations; or the current representations and the symbolic images of medical sciences, still masculine in certain specialties, representing the idea of scientific excellence itself.

It is striking, however, to see the few advances in gender equality that have been achieved in medical science research within academia, considering some undeniable changes in the Spanish society that could have undermined some of the personal and institutional barriers that prevent more gender equality in the Spanish university. The first one is the high number and the brilliance of female students of Schools of Medicine and other health specialties, which has been recognized for some decades already, whose effects are not reflected in the proportion and importance of female academics in this field. Second, it is not easy to measure accurately the impact of family factors on the career development of female academics, since there are studies with different conclusions. Thus, some empirical studies minimize its weight, considering that there is no evidence that women with children register lower scientific productivity and academic performance than those who do not, whose academic career prospects continue to lag behind those of their male colleagues (European Union, 2012).

Other data and studies, on the contrary, conclude that women spend a much greater portion of their daily time than men on educating their descendants and on caring for the family (at a European level, 37.5 of the women, compared to 24.7% of men, figures that in Spain are, respectively, 39.8 and 27.7%), as well as doing daily cooking and housework (78.7% of women, compared to only 33.7% of men, on a European average, indicators that in Spain account for 84.5 and 41.9% respectively), temporary dedication that can undoubtedly affect the professional sphere (EIGE, 2019a). In any case, this impact should be substantially cushioned by elements such as a –theoretical– greater involvement of men in child rearing and in domestic tasks,² or by the fact that in Spain we have one of the lowest fertility rates in the European Union –1.31– (Eurostat, 2019). Furthermore, academic researchers can usually afford external help for some domestic tasks (Escolano, 2006). In the present study, unfortunately, it has not been possible to measure the impact of housework and childcare on the greater or lesser availability of research funds from the academics involved, as this data is not available. It would be, therefore, desirable, and without a doubt very interesting and useful for various studies on gender and equal opportunities, if the number of children of academics, strictly respecting the data protection regulations, could become part of the databases of the various educational institutions. Finally, numerous and important regulations have been reinforced in Spanish public universities for some time, establishing measures towards gender equality, which nowadays has been achieved on the formal level, but that is bankrupt in reality, as this study reflects. And all of this despite the implementation of positive action measures

2 In this sense, Spanish legislation has advanced significantly, through the granting of paternity leave and other measures aimed at conciliation and joint responsibility, although the involvement of men in domestic and child-rearing tasks is still very far from that of women, and presents a less egalitarian situation than the European average: 64, compared to 65.7 (EIGE, 2019a).

already present in the competitive calls for research projects, and in the University Equality Plans, which contain monograph positive action measures provided by the University Equality Plans, which contain monographic actions aimed at achieving gender equality and combating discrimination in scientific research.

All of the advances and transformations in this field have not yet managed to change the landscape of Spanish universities in health sciences, revealing the extraordinary resistance of those obstacles that prevent real equality between male and female academics. It is necessary to explore new ways that allow us to go beyond the formal surface and achieve real equality in university medical research, so that Academe becomes a space of equity capable of taking advantage of the talent and work of Spanish medical scientists for the benefit of society.

Strengths and limitations of the current study and directions for future research

This study has noteworthy strengths and limitations. Its fundamental limitation is that the research was carried out at a single Spanish university, although it includes data from several important departments and schools, all of which belong to the field of Health Sciences. This feature prevents rigorous confirmation that its conclusions are applicable to all Spanish universities. However, the characteristics that outline the situation of female academics in the institution analyzed are very similar to those of the rest of Spanish universities in terms of number, category, academic rank, leadership, and involvement in academic culture. This can be verified, among other ways, by analyzing the data on the composition of faculty of said institutions by sex and category (in both cases, women's access to the highest category, Full professor, in the field of health sciences, is far from presenting an egalitarian situation: if, in the Spanish university system as a whole, Full professors are 25.5%, in the UV they represent 26.2% – 15.3% in the School of Medicine and Dentistry, more than double, 36.4%, in the School of Pharmacy³). Likewise, the diagnostics provided by the Offices for diversity, equity, and inclusion of Spanish universities regarding research and gender, show a degree of inequality practically coincident (Red de Unidades de Igualdad de Género por la Excelencia Universitaria [Network of Gender Equality Units for University Excellence] [RUIGEU], n.d.). Furthermore, although the study is limited to one university, it is a highly relevant academic institution in the field of medical sciences.

In spite of this limitation, it is also important to highlight an important strength of this study, which is that there is no work in the field of health sciences that performs a gender analysis of university contracts for the transfer of research results. Nor has any investigation been carried out comparing the additional remuneration of men vs. women specific to said contracts in order to determine whether there is a gender pay gap. Therefore, this study represents an important initial step in addressing the challenges of gender disparities in medical academic research. It is essential to continue conducting rigorous analysis on this issue in order to increase support for scientific research of female academics in this essential field.

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Data availability statement

The data underlying the research text are available at: <https://roderic.uv.es/handle/10550/74617>

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