



ORIGINAL ARTICLE

Gender inequalities in authorship of the main Spanish medical journals in 2017[☆]

Sebastián Tornero Patricio^{a,*}, Inmaculada O. Alonso Rueda^b,
Julia García Gozalbes^c, José Antonio Domínguez Domínguez^d,
Liliana Charris-Castro^e, María Dolores González-Soria^f, María del Mar García Calvente^g

^a Subdirección Médica, Área de Gestión Sanitaria Osuna, Hospital La Merced, Servicio Andaluz de Salud, Osuna, Sevilla, Spain

^b Centro de Salud Alamillo, Servicio Andaluz de Salud, Sevilla, Spain

^c Centre d'Urgències d'Atenció Primària Sant Martí, Institut Català de Salut, Barcelona, Spain

^d Centro de Salud Ronda Histórica, Servicio Andaluz de Salud, Sevilla, Spain

^e Unidad de Cuidados Intensivos, Hospital Universitario Virgen del Rocío, Servicio Andaluz de Salud, Sevilla, Spain

^f Centro de Salud La Candelaria, Sevilla, Spain

^g Escuela Andaluza de Salud Pública, Instituto de Investigación Biosanitaria iibs.GRANADA, Granada, Spain

Received 28 June 2019; accepted 21 January 2020

Available online 16 July 2020

KEYWORDS

Gender inequalities;
Authorship;
Health Services
Research;
Gender bias;
Medical publications

Abstract

Introduction: Some studies have shown a lower female participation in scientific publications. The objective of this study is to analyse the gender inequalities in the main Spanish journals of medical publications.

Material and Method: Cross-sectional study of the main Spanish medical journals classified by *SCImago Journal & Country Ranking* (n=24) and their publications (n=3.375), during the year 2017. Women/men ratio in authorship was calculated for all journals and types of papers. Bivariate analyses were developed with the type of article as the dependent variable, and gender, institution, and country of the first and last authors as the independent variables. Logistic regression models were performed to calculate adjusted odds ratios (aOR) and their 95% confidence intervals (95%CI) of the types of papers according to authorship gender, institution, and country. The statistical program used was R.

Results: The total number of authors was 16,252 (44.2% women, 53.9% men, and 1.9% non-identified gender). Women represented 46% of the first authors and 33.5% of the last ones. Women were the first authors of *Editorials* less often than men (aOR = 0.39; 95%CI = 0.30–0.51), but more often in *Originals* (aOR = 1.55; 95%CI = 1.33–1.80). Women were the last authors with less frequency in all types of papers, especially in *Editorials* (aOR = 0.50; 95%CI = 0.35–0.70). The women/men ratio in authorship was less than 0.80 in 10 of 26 journals analysed (41.7%).

[☆] Please cite this article as: Tornero Patricio S, Alonso Rueda IO, Gozalbes JG, et al. Desigualdades de género en la autoría de las principales revistas médicas españolas durante el año 2017. An Pediatr (Barc). 2020;93:84–94.

* Corresponding author.

E-mail addresses: sebastornero@yahoo.es, sebastian.tornero.sspa@juntadeandalucia.es (S. Tornero Patricio).

PALABRAS CLAVE

Desigualdades de género;
Autoría;
Investigación en Servicios de Salud;
Sesgo de género;
Publicaciones médicas

Conclusions: These results show the gender inequalities in the authorship of the main Spanish medical journals in 2017, especially as first authors and *Editorials*.

© 2020 Published by Elsevier España, S.L.U. on behalf of Asociación Española de Pediatría. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Desigualdades de género en la autoría de las principales revistas médicas españolas durante el año 2017

Resumen

Introducción: El objetivo del estudio es analizar la desigualdad de género en la producción científica de las revistas médicas españolas.

Material y método: Estudio transversal de las principales revistas médicas españolas clasificadas por *SCImago Journal & Country Ranking* ($n=24$) y sus publicaciones ($n=3.375$) durante el año 2017. Se calculó la ratio mujer/hombre de autoría según revista y tipo de artículo. Los análisis bivariantes se desarrollaron con la variable dependiente tipo de artículo y las independientes: sexo, centro de trabajo y país de primeras y últimas autorías. Se realizaron modelos de regresión logística para el cálculo de odds ratios ajustadas (ORa) con intervalos de confianza al 95% (IC95%) del sexo de autoría según tipo de artículo, mediante el programa estadístico *R*. **Resultados:** El número total de firmantes fue 16.252 (44,2% mujeres, 53,9% hombres y 1,9% sexo no identificado). Las mujeres representaron el 46% de las primeras autorías y el 33,5% de las últimas. Las mujeres fueron primeras autoras de *Editoriales* con menor frecuencia que los hombres (ORa = 0,39; IC95% = 0,30–0,51), pero con mayor frecuencia en los *Originales* (ORa = 1,55; IC95% = 1,33–1,80). Las mujeres fueron últimas autoras con menor frecuencia en todos los tipos de artículos, especialmente en *Editoriales* (ORa = 0,50; IC95% = 0,35–0,70). La ratio mujer/hombre del total de autoras y autores fue inferior a 0,80 en 10 de las 24 revistas analizadas (41,7%).

Conclusiones: Se demuestra la desigualdad de género en la autoría de las principales revistas médicas españolas en el año 2017, principalmente en las últimas autorías y los *Editoriales*.

© 2020 Publicado por Elsevier España, S.L.U. en nombre de Asociación Española de Pediatría. Este es un artículo Open Access bajo la licencia CC BY-NC-ND (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Introduction

In recent decades, there has been progress towards closing the gap in career opportunities for men and women, but further efforts are still needed to achieve equality. Official data from 2017 show that while the proportion of women with university degrees education is greater compared to the proportion of men in Spain and in Europe,^{1,2} the rate of unemployment is higher in women.^{3,4} Disparities in the burden of informal caregiving in households and career interruptions associated with motherhood are some of the determinants at play in the lower representation of women in positions of power in industry and in academic and research institutions.⁵ This phenomenon is known as the *glass ceiling*⁶ and explains actual inequalities, such as women amounting to only 21% of teaching positions in higher education in Europe and the United States, the higher proportion of women in part-time or temporary positions and the wages of women being up to 18% lower compared to men.^{7,8} In Spain, women amount to only 39.9% of the teaching and research staff in public universities and 20.8% of tenure positions.⁹

Glass ceilings also manifest in public health and health care institutions. Studies in Spain and abroad have evinced

the inferior representation of women in executive and management positions of scientific associations and societies and in the editorial boards of scientific journals.^{10–14} A review conducted in 2014 of the management of 173 scientific associations in Spain found only 41 female presidents (22.5%). Also, only 32.4% of management positions and 36.2% of the seats in executive boards were filled by women.¹⁰ According to a study published in 2010 that analysed 172 Spanish biomedical journals, only 13% were led by women.¹³

Research output has become a very important factor in career advancement in the health care field. For the first time in history, in 2017 the number of female doctors exceeded slightly the number of male doctors in Spain.¹⁵ The proportion of female doctors in Europe in the same year was 49%.¹⁶ In spite of these, there are substantial differences between the sexes (gender gap) in the authorship of scientific publications. A review of the articles published over 35 years in 6 journals with a high impact factor found a lower proportion of women in the first and last listed authors.¹⁷ There was an increase in the proportion of female first authors from 5.9% in 1970 to 29.4% in 2004, and of last-listed (senior) authors from 3.7%–19.3% in the same period. Although the number of female authors of articles has increased compared to previous decades, this increase

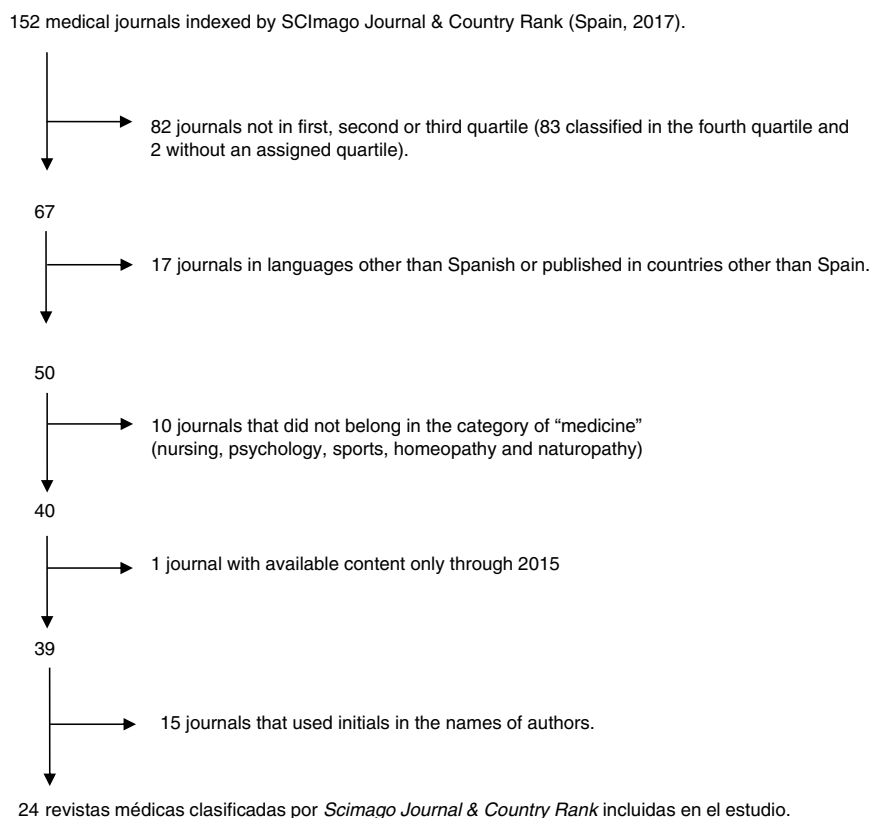


Figure 1 Flow chart of journal selection.

varies based on the type of article. Thus, studies of national and international scope demonstrate that the number of female authors commissioned pieces (editorials) by journals continues to be substantially smaller compared to the number of male authors, rarely exceeding 20% of the total.^{17–21}

Several recent articles have focused on the research output in paediatrics.^{20,22} A study on gender differences in authorship in 3895 original articles published in *Pediatrics*, *JAMA Pediatrics* and *The Journal of Pediatrics* (2001–2016)²² found an increase through time in the percentage of female first authors, which reached 57.7% in 2016, with a slower advance in the percentage of female senior authors (38.1%). These findings were similar to those of another study published in *ANALES DE PEDIATRÍA* analysing data for 2017,²³ which concluded that editorials and special articles were commissioned to female authors less frequently (35.0%).

The growing awareness of some scientific journals of the gender gap in research output has spurred articles analysing this phenomenon and offering recommendations to close the gap.^{24–26} In 2016, *ANALES DE PEDIATRÍA* joined the ranks of the journals publishing the full name of authors, facilitating a perspective on gender in its publications.^{27,28} Although there are signs suggesting advances toward greater equality, this progress is greater in medical specialities more likely to be chosen by women, such as paediatrics. There is an increasing trend in the representation of women in leadership positions in paediatrics journals and associations in Spain.^{29–31} However, the current evidence shows that measures still need to be implemented to guarantee progress toward gender equality both in paediatrics and in other medical specialities in Spain.

The objectives of our study were: 1) to determine the position of *ANALES DE PEDIATRÍA* relative to other Spanish journals in regard to the gender gap and 2) to analyse gender disparities in the scientific output of the main Spanish medical journals.

Material and methods

We conducted a cross-sectional study of authorship in the articles of the main Spanish scientific journals indexed in the SCImago Journal & Country Rank portal,³² a public online portal that provides bibliometric indicators for scientific journals based on data from the Scopus® database. The SCImago Journal Rank is computed using an algorithm that weights the citations received by each publication in the past 3 years based on the prestige of the citing journal.³³

We established 2 units of analysis: *journals* and *articles*. The main sources of the data for our study were the SCImago Journal & Country Rank (*journals*) and the websites of the included scientific journals (*articles*). The terms we used in the portal to obtain data for the *journal* unit were: subject area = medicine, subject categories = all, country = Spain, type = journal and year = 2017 (last available year).³⁴ The search identified 152 journals, to which we applied the following exclusion criteria: ranking in the 4th quartile or not specified, language other than Spanish, country other than Spain, non-medical content, no content published in 2017 and use of initials in author names. The total number of journals included in the analysis was 24 (Fig. 1). We collected data for the *articles* unit by reviewing all the articles published in 2017 in the 24 journals,

Table 1 Medical journals and articles included in the study.

Journal	SJR ranking	SJRIndicator	Quartile	<i>n</i>	%
<i>Revista Española de Cardiología</i>	11	0.553	Q2	301	8.9%
<i>Reumatología Clínica</i>	12	0.539	Q3	104	3.1%
<i>Gaceta Sanitaria</i>	16	0.495	Q2	111	3.3%
<i>Revista Española de Enfermedades Digestivas</i>	20	0.417	Q3	280	8.3%
<i>Nutrición Hospitalaria</i>	21	0.411	Q3	252	7.5%
<i>Enfermedades Infecciosas y Microbiología Clínica</i>	23	0.373	Q3	162	4.8%
<i>Archivos de Bronconeumología</i>	24	0.366	Q3	258	7.6%
<i>Endocrinología, Diabetes y Nutrición</i>	28	0.346	Q3	109	3.2%
<i>Actas Españolas de Psiquiatría</i>	30	0.333	Q3	40	1.2%
<i>Acta Otorrinolaringológica Española</i>	31	0.307	Q3	75	2.2%
<i>Nefrología</i>	32	0.294	Q3	130	3.9%
<i>Atención Primaria</i>	33	0.288	Q2	122	3.6%
ANALES DE PEDIATRÍA	39	0.277	Q3	169	5.0%
<i>Medicina Clínica</i>	40	0.262	Q3	416	12.3%
<i>Revista Española de Quimioterapia</i>	43	0.254	Q3	102	3.0%
<i>Cirugía Española</i>	45	0.249	Q3	146	4.3%
<i>Revista Española de Salud Pública</i>	46	0.249	Q3	51	1.5%
<i>Clínica e Investigación en Arteriosclerosis</i>	47	0.241	Q3	39	1.2%
<i>Educación Médica</i>	48	0.236	Q3	56	1.7%
<i>Revista Española de Geriatria y Gerontología</i>	49	0.225	Q3	96	2.8%
<i>Gastroenterología y Hepatología</i>	52	0.218	Q3	125	3.7%
<i>Farmacia Hospitalaria</i>	54	0.215	Q3	81	2.4%
<i>Neurocirugía</i>	58	0.203	Q3	42	1.2%
<i>Archivos Españoles de Urología</i>	70	0.178	Q3	108	3.2%
Total	–	–	–	3375	100

Q, quartile; SJR, SCImago Journal Rank.

excluding the following types: in memoriam, acknowledgments, special collaborations, prizes and awards, congress abstracts and errata. The total number of articles included in the analysis was 3375. Table 1 presents the characteristics of the included journals and articles.

To pursue the first objective, we performed a bivariate analysis describing the sex of the authors in every article in each journal by means of absolute and relative frequencies. We determined the sex of the author based on the full name. In case of unusual names, we consulted the first and last name database of the Instituto Nacional de Estadística (National Institute of Statistics),³⁵ assigning the sex corresponding to the greater proportion of individuals with that name in Spain. We assigned the “unidentified sex” category to names not included in that database. To compare the participation of women in the authorship of each journal, we calculated the female-to-male ratio for the total signing authors in each journal. We defined “high participation” as a ratio greater than 1.20, and “low participation” as a ratio lower than 0.80. We extrapolated these cut-off points from the Organic Law on Equality 3/2007,³⁶ which establishes as acceptable a maximum difference of 20 percentage points in general public settings. We have expressed quantitative variables (number of female authors, number of male authors and total signing authors

per article) as absolute frequencies, mean and standard deviation (SD).

We pursued the second objective of our study with the *journals* analysis unit by means of bivariate analyses, calculating the female-to-male ratio for the total of signing authors to compare the participation of female authors in different types of articles. We also performed bivariate analysis comparing the dependent variable (type of article) and different independent variables (sex, affiliation and country of the first and last authors). When more than one affiliation was reported for a single author, we selected the affiliation that was listed first. We eliminated observations missing information on one of these independent variables, which left a total of 3303 observations for the first author and 3067 for the last author. We used the χ^2 test or the Fisher exact test in case of expected counts of less than 5. Lastly, we fitted binary logistic regression models to perform the multivariate analysis. To this end, we created dichotomous qualitative dependent variables based on the type of article for the categories editorial, letter to the editor/director, original article/brief original article and case reports/scientific letters/images. We defined statistical significance as a *p*-value of less than 0.05. We calculated the odds ratio for the sex of the first and last author adjusted by affiliation and country

Table 2 Bivariate analysis of authorship by sex and type of article.

Journal	Female		Male		Unidentified sex		Total	F:M ratio
	n	%	n	%	n	%		
<i>Revista Española de Cardiología</i>	450	28.2	1113	69.7	33	2.1	1596	0.40
<i>Reumatología Clínica</i>	251	48.7	260	50.5	4	0.8	515	0.97
<i>Gaceta Sanitaria</i>	308	54.5	252	44.6	5	0.9	565	1.22
<i>Revista Española de Enfermedades Digestivas</i>	492	40.6	694	57.2	27	2.2	1213	0.71
<i>Nutrición Hospitalaria</i>	1004	52.3	879	45.8	36	1.9	1919	1.14
<i>Enfermedades Infecciosas y Microbiología Clínica</i>	422	49.6	422	49.6	6	0.7	850	1.00
<i>Archivos de Bronconeumología</i>	426	41.1	564	54.4	46	4.4	1036	0.76
<i>Endocrinología. Diabetes y Nutrición</i>	298	52.3	264	46.3	8	1.4	570	1.13
<i>Actas Españolas de Psiquiatría</i>	100	52.9	88	46.6	1	0.5	189	1.14
<i>Acta Otorrinolaringológica Española</i>	129	40.2	190	59.2	2	0.6	321	0.68
<i>Nefrología</i>	409	47.1	403	46.4	56	6.5	868	1.01
<i>Atención Primaria</i>	245	49.3	250	50.3	2	0.4	497	0.98
ANALES DE PEDIATRÍA	480	56.7	354	41.8	13	1.5	847	1.36
<i>Medicina Clínica</i>	689	43.4	878	55.3	20	1.3	1587	0.78
<i>Revista Española de Quimioterapia</i>	306	50.3	300	49.3	2	0.3	608	1.02
<i>Cirugía Española</i>	249	32.0	503	64.7	25	3.2	777	0.50
<i>Revista Española de Salud Pública</i>	145	54.5	121	45.5	0	0.0	266	1.20
<i>Clínica e Investigación en Arteriosclerosis</i>	64	36.2	110	62.1	3	1.7	177	0.58
<i>Educación Médica</i>	50	29.9	113	67.7	4	2.4	167	0.44
<i>Revista Española de Geriátría y Gerontología</i>	186	44.8	225	54.2	4	1.0	415	0.83
<i>Gastroenterología y Hepatología</i>	340	47.9	370	52.1	0	0.0	710	0.92
<i>Farmacia Hospitalaria</i>	238	64.0	134	36.0	0	0.0	372	1.78
<i>Neurocirugía</i>	60	28.3	149	70.3	3	1.4	212	0.40
<i>Archivos Españoles de Urología</i>	142	26.1	393	72.1	10	1.8	545	0.36
Type of article								
Original or brief original	3724	47.2	4012	50.8	154	2.0	7890	0.93
Scientific letter, case report or images	1603	42.6	2080	55.2	82	2.2	3765	0.77
Letter to the editor/director	930	46.2	1036	51.5	45	2.2	2011	0.90
Editorial	233	29.4	545	68.7	15	1.9	793	0.43
Other	695	38.8	1092	60.9	6	0.3	1793	0.64

F, female; M, male.

(aOR) with the corresponding 95% confidence intervals (CIs). We performed the analysis with the software R, version 3.5.1.

Since category assignments in the analysis of the 3375 articles were not automated, we performed a quality control analysis of the database. We reviewed the first original article in every issue of the journals, detecting errors in 4.6% and 3.6% of the 195 reviewed articles in the identification of the gender and affiliation of the first author and in 2.6% and 5.6% of the articles in the gender and affiliation of the senior authors, respectively.

Results

We included a total of 3375 articles published in the 24 medical journals included in the study. The 6 journals with the highest output were *Medicina Clínica* (12.3%), *Revista Española de Cardiología* (8.9%), *Revista Española de Enfermedades Digestivas* (8.3%), *Archivos de Bronconeumología* (7.6%), *Nutrición Hospitalaria* (7.5%) and *ANALES DE PEDIATRÍA* (5.0%). Combined, these journals account for nearly half of the total articles (49.6%) (Table 1).

The total number of authors of both sexes listed in the 3375 articles was 16 252 (mean, 4.81; SD, 3.33). Of all authors, 44.2% were women, 53.9% men and 1.9% of unidentified sex. The mean number of female authors per article was 2.13 (SD, 2.05) and the mean number of male authors, 2.60 (SD, 2.34). After excluding observations in which we could not identify the sex of an author, we found that 46% of the 3308 first authors and 33.5% of the 3071 senior authors were women.

The journals with a greater participation of female authors were *Farmacia Hospitalaria* (female-to-male ratio,

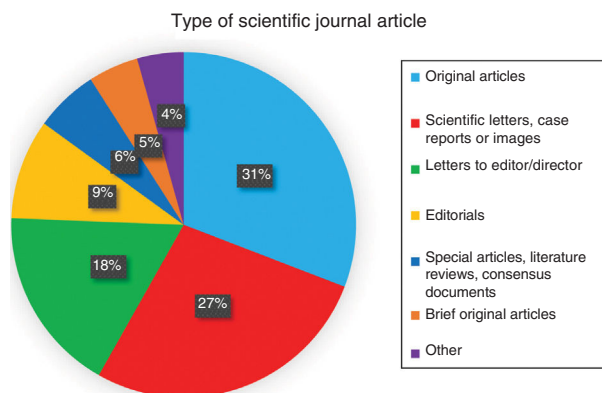


Figure 2 Distribution by type of article.

1.78), *ANALES DE PEDIATRÍA* (1.36) and *Gaceta Sanitaria* (1.22). Ten journals had low rates of female authorship, and 11 had equal distribution (Table 2).

The most frequent types of articles were original articles (30.8%), followed by scientific letters-case reports-images (27.3%) and letters to the editor/director (17.5%) (Fig. 2). The bivariate analysis of all signing authors by sex and type of article for the total articles in every journal found a predominance of male authors over female authors in every type of article, with female-to-male ratios lower than 0.80 for the editorials (0.43), scientific letters-case reports-images (0.77) and other articles (0.64) (Table 2).

Table 3 presents results of the bivariate analysis of the type of article and sex, affiliation and country of the first author. With the exception of original articles-brief original articles, we found a higher proportion of male authors in all other types of articles. Of the 302 editorials included in

Table 3 Bivariate analysis of the main types of article in relation to sex, affiliation and country of first author.

Variables	Main types of articles																			
	Editorials			Letters to editor/director			Original and brief original articles			Case reports, scientific letters, images										
	Yes	No	$P(\chi^2)$	Yes	No	$P(\chi^2)$	Yes	No	$P(\chi^2)$	Yes	No	$P(\chi^2)$								
<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%							
Sex																				
Female	81	5.3	1562	94.7	<.001	266	17.5	1254	82.5	.965	621	4.9	899	59.1	<.001	418	27.5	1102	72.5	.656
Male	221	12.4	1439	87.6		311	17.4	1472	82.6		562	31.5	1221	68.5		478	26.8	1305	73.2	
Affiliation																				
SC	200	8.3	2202	91.7	<.001	447	18.6	1955	81.4	<.001	693	28.9	1709	71.1	<.001	820	34.1	1582	65.9	<.001
PC	6	6.5	87	93.5		27	29.0	66	71.0		38	4.9	55	59.1		15	16.1	78	83.9	
RC-U	63	9.9	575	9.1		84	13.2	554	86.8		375	58.8	263	41.2		49	7.7	589	92.3	
Other	63	19.4	137	8.6		19	11.2	151	88.8		77	45.3	93	54.7		12	7.1	158	92.9	
Country																				
Spain	246	9.0	2474	91.0	.670	475	17.5	2245	82.5	.985	928	34.1	1792	65.9	<.001	777	28.6	1943	71.4	<.001
Not Spain	56	9.6	527	9.4		102	17.5	481	82.5		255	43.7	328	56.3		119	2.4	464	79.6	

PC, primary care; RC-U, research centres and universities; SC, speciality care.

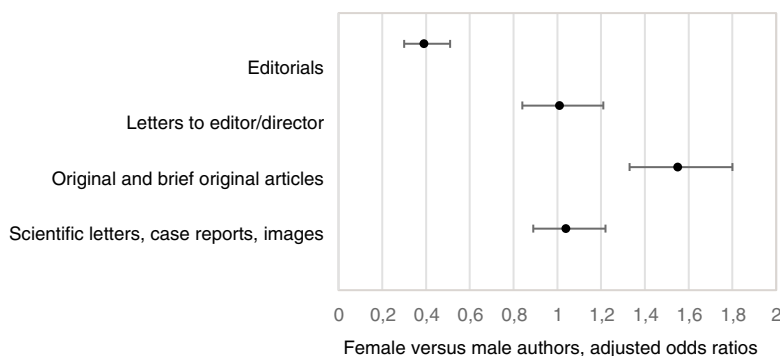


Figure 3 Odds ratio of multivariate analysis considering the type of article and author sex adjusted for author affiliation and country.

this analysis, 81 (36.7%) had a female first author. Of the total of female first authors, 5.3% corresponded to authors of editorials, compared to 12.4% of male first authors ($P < .001$). However, when we analysed original and brief original articles, we found a greater proportion of female first authors compared to male first authors (40.9 vs 31.5%; $P < .001$), with a gender gap of + 9.4% in favour of women. When it came to the affiliation of the first author in relation to the type of article, we found a higher proportion of authors employed in primary care in the letters to the editor/director (29.0%), of authors employed in research centres or universities in the original and brief original articles (58.8%), and of authors engaged in speciality care in the scientific letters-case reports-images (34.1%) ($P < .001$). Last of all, the comparison of the type of article and the country listed for the first author revealed statistically significant differences in the original and brief original articles and the scientific letters-case reports-images, with a greater proportion of first authors not from Spain in case of the original articles and original brief articles (43.7 vs. 34.1%) and a greater proportion of first authors from Spain in scientific letters-case reports-images (20.4 vs 28.6%) ($P < .001$). In the binary logistic regression analysis of the type of article by sex, affiliation and country of the first author we found statistically significant aORs for the variable sex (female vs male author) in editorials (aOR, 0.39; 95% CI, 0.30–0.51) and original and brief original articles (aOR, 1.55; 95% CI, 1.33–1.80) ($P < .001$) (Fig. 3).

When it came to the bivariate analysis of the type of article by sex, affiliation and country of the last author, we found distribution trends similar to those observed in the analysis of first authors (Table 4). We found a male predominance in the senior authors of all 4 types of articles under study. This was also the case of original and brief original articles, in which we found no statistically significant differences ($P = .326$). Of the 200 editorials analysed, 42 (21%) listed a female senior author and 158 (79%) a male senior author. In the multivariate analysis of authorship of editorials by sex, affiliation and country of the senior author, we only obtained a statistically significant aOR in the comparison of female versus male authors: 0.50 (95% CI, 0.35–0.70) (Fig. 4).

Discussion

The results of our study evince gender inequality in the authorship of articles published by the leading Spanish medical journals in 2017 analysed as a whole. However, we found substantial differences between journals in the sex distribution of authors. The female-to-male ratio of the 24 journals analysed ranged from 0.36 (*Archivos Españoles de Urología*) to 1.78 (*Farmacia Hospitalaria*). *ANALES DE PEDIATRÍA* is the second leading journal in terms of the participation of women authors (1.36).

The number of female authors was lower compared to the number of male authors both in the analysis of the total of signing authors for all the articles in all the included journals and when we only analysed the first- and last-signing authors. The differences were greatest when it came to the senior, last-signing author. The analysis by type of article and by sex revealed that male authors exceeded female authors in all types of articles except in the case of first authors of original articles. These findings were consistent with those of previous studies^{17–23} and support the hypothesis of female first authors being expected to work on tasks that require more effort in the publication of a manuscript.³⁷ The predominance of men among senior authors in most types of articles may be an indirect marker of gender inequality in positions of leadership and power in top management positions in health care facilities and research centres and in the funding of research projects led by women.^{7,8,24,25,38}

The results of the analysis of the secondary independent variables, the affiliation of the author and the country of origin, revealed the association between the time available to the author to devote to research and scientific output. Thus, professions involving clinical practice and Spain as the country of origin are associated with the publication of fewer original articles in the Spanish journals included in our study.

These findings were consistent with those of other studies conducted in Spain and in other countries^{11,17–22} as regards gender inequalities in scientific output. While there has been an increasing trend in the scientific output of

Table 4 Bivariate analysis of the main types of article in relation to sex, affiliation and country of senior author.

Variables	Main types of articles																			
	Editorials					Letters to editor/director					Original and brief original articles				Case reports, scientific letters, images					
	Yes		No		$P(\chi^2)$	Yes		No		$P(\chi^2)$	Yes		No		$P(\chi^2)$	Yes		No		$P(\chi^2)$
	<i>n</i>	%	<i>n</i>	%		<i>n</i>	%	<i>n</i>	%		<i>n</i>	%	<i>n</i>	%		<i>n</i>	%	<i>n</i>	%	
Sex																				
Female	42	4.1	987	95.9	<.001	189	18.4	840	81.6	.148	404	39.3	625	60.7	.326	289	28.1	740	71.9	.504
Male	158	7.8	1880	92.2		332	16.3	1706	83.7		763	37.4	1275	62.6		596	29.2	1442	70.8	
Affiliation																				
SC	131	6.0	2056	94.0	.003 ^a	416	19.0	1771	81.0	<.001	627	28.7	1560	71.3	<.001	819	37.4	1368	62.6	<.001
PC	0	0.0	50	100		16	32.0	34	68.0		25	50.0	25	50.0		4	8.0	46	92.0	
RC-U	46	7.2	590	92.8		62	9.7	574	90.3		410	64.5	226	35.5		54	8.5	582	91.5	
Other	23	11.9	171	88.1		27	13.9	167	86.1		105	54.1	89	45.9		8	4.1	186	95.9	
Country																				
Spain	140	5.6	2370	94.4	<.001	447	17.8	2063	82.2	.101	912	36.3	1598	63.7	<.001	767	30.6	1743	69.4	<.001
Not Spain	60	10.8	497	89.2		74	13.3	483	86.7		255	45.8	302	54.2		118	21.2	439	78.8	

PC, primary care; RC-U, research centres and universities; SC, speciality care.

^a Fisher exact test (expected counts <5).

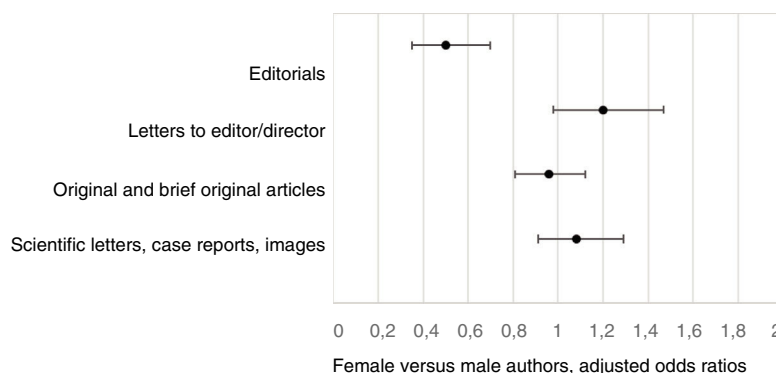


Figure 4 Odds ratio of multivariate analysis considering the type of article and senior author sex adjusted for author affiliation and country.

women at the international level,^{17,19} it continues to be less than the output of men, despite women amounting to 50% or more of professionals in medicine.^{7,8,15,24} Our study adds to the scientific evidence demonstrating the gender gap in scientific journals by type of article, with a greater frequency of women signing as first authors in original articles and a greater frequency of men signing as first and last authors in editorials.²¹⁻²³ These findings may reflect the presence of unintentional gender biases in favour of men when it comes to the selection of authors for articles commissioned by journals, which would not manifest in spontaneously submitted articles subject to peer review.^{7,14,37}

One of the strengths of our study is the large number of authors ($n = 16\,252$) and articles ($n = 3375$) analysed, all from the 24 Spanish medical journals that are most relevant in the current scientific scene. The inclusion of 2 units of analysis allowed us to differentiate scientific output by sex in each journal and by type of article. The analysis of both the total number of signing authors and of the numbers of first and last authors contributes information on the scientific output of each sex at different levels. And the multivariate analyses adjusted by author affiliation and country of origin complemented these results with impact indicators. Some of the limitations of our study include the potential risk of bias due to nondifferential misclassification in relation to the erroneous determination of the sex of the author, which, given the quality control analysis that we performed, could have amounted to 4.6% of first authors and 2.6% of last authors, a percentage comparable to the percentage reported by a study performed with similar methods.¹⁹ On the other hand, the proportions of female and male authors in a journal may be affected by the number of female and male clinicians active in each speciality. To adjust for this potential effect, we sent a message to the official e-mail addresses of the journals and the associations they were affiliated to asking about the sex distribution of members in the speciality that was the focus of the journal, but due to the low response rate we were unable to assess the impact of this factor in our analysis.

The participation of female authors in the scientific output of ANALES DE PEDIATRÍA is high. These are encouraging data in regard to the fight against gender inequality, but additional studies are required to determine the extent to which

these positive outcomes can be attributed to the greater number of female paediatricians today. Furthermore, we invite a reflection on the causes of the persisting gender gap in senior authorship and the commission of editorials by the journal, the sex distribution of peer reviewers (40.4% women)³⁹ and the sex distribution of the editorial committee (29.5% women).³¹ The development of a gender equality policy in scientific publications could contribute to this goal.⁴⁰

Conflicts of interest

The authors have no conflicts of interest to declare.

References

1. Instituto Nacional de Estadística de España. Nivel educativo de la población mayor de 16 años en España [Internet]. 2018 [citado el 22/06/2019]. Disponible en: <http://www.ine.es/jaxiT3/Datos.htm?t=6347>.
2. Eurostat. Nivel educativo por sexo de la población de la Unión Europea, 2018 [Internet]. 2019 [citado el 22/06/2019]. Disponible en: <https://ec.europa.eu/eurostat/data/database>.
3. Eurostat. Porcentaje de la población de 20 a 64 años empleada en los 28 países miembros de la Unión Europea [Internet]. 2017 [citado el 22/06/2019]. Disponible en: <https://ec.europa.eu/eurostat/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=t2020.10&language=en>.
4. Instituto Nacional de Estadística de España. Encuesta de población activa en España [Internet]. 2018 [citado el 22/06/2019]. Disponible en: https://www.ine.es/dyngs/INEbase/es/operacion.htm?c=Estadistica_C&cid=1254736176918&menu=resultados&secc=1254736195128&idp=1254735976595.
5. García Calvente MM, Jiménez Rodrigo ML, Martínez Morante E. Guía para incorporar la perspectiva de género a la investigación en salud [Internet]. Escuela An. In: García Calvente MM, editor. Serie Monográfica EASP nº48. 2010. p. 173 [citado el 22/06/2019]. Disponible en: <https://www.easp.es/project/guia-para-incorporar-la-perspectiva-de-genero-a-la-investigacion-en-salud/>.
6. Colomer Revuelta C, Peiró Pérez R. ¿Techos de cristal y escaleras resbaladizas? Desigualdades de género y estrategias de cambio en SESPAS. *Gac Sanit.* 2002;16(4):358-60.
7. Directorate-General for Research and Innovation of the European Commission. SHE figures 2015 [Internet]. European

- C. European Union. 2016. 224 p. [citado el 22/06/2019]. Disponible en: https://ec.europa.eu/research/swafs/pdf/pub_gender_equality/she_figures_2015-final.pdf.
8. Shen H. Inequality quantified: Mind the gender gap. *Nature* [Internet]. 2013;495:22–4 [citado el 22/06/2019]. Disponible en: <https://www.nature.com/news/inequality-quantified-mind-the-gender-gap-1.12550>
 9. Ministerio de Educación Cultura y Deporte del Gobierno de España. Datos y cifras del sistema universitario español, curso 2015-2016 [Internet]. Catálogo de publicaciones del Ministerio. 2016 [citado el 22/06/2019]. Disponible en: https://sede.educacion.gob.es/publiventa/descarga.action?f_codigo_agc=18170.
 10. Casado-Mejías R, Botello-Hermosa A. Representatividad de las mujeres en las sociedades científicas españolas del ámbito de la salud en 2014. *Gac Sanit*. 2015;29(3):209–12.
 11. Mauleón E, Hillán L, Moreno L, Gómez I, Bordons M. Assessing gender balance among journal authors and editorial board members. *Scientometrics*. 2013;95(1):87–114.
 12. Amrein K, Langmann A, Fahrleitner-Pammer A, Pieber TR, Zollner-Schwetz I. Women underrepresented on editorial boards of 60 major medical journals. *Gend Med* [Internet]. 2011;8(6):378–87 [citado el 22/06/2019]. Disponible en: <https://doi.org/10.1016/j.genm.2011.10.007>
 13. Miqueo Miqueo C, Germán Bes C, Fernández-Turrado T, Barral Morán MJ. Disparidad de género en los órganos directivos de las revistas biomédicas españolas [Internet]. In: Grupo de Investigación Genciana, editor. Instituto de la Mujer. Zaragoza: Ministerio de Igualdad del Gobierno de España; 2010. p. 459 [citado el 22/06/2019]. Disponible en: <http://www.inmujer.es/areasTematicas/estudios/estudioslinea2010/docs/disparidadGenero.pdf>
 14. García-Calvente MM, Ruiz-Cantero MT, Río-Lozano M, Borrell C, López-Sancho MP. Desigualdades de género en la investigación en salud pública y epidemiología en España. *Gac Sanit* [Internet]. 2015;29(6):404–11 [citado el 22/06/2019]. Disponible en: <https://doi.org/10.1016/j.gaceta.2015.07.013>
 15. Instituto Nacional de Estadística de España. Número de profesionales médicos colegiados por año [Internet]. 2017 [citado el 22/06/2019]. Disponible en: <https://www.ine.es/jaxi/Datos.htm?path=/t15/p416/serie/l0/&file=s01001.px>.
 16. Eurostat. Healthcare personnel statistics: physicians [Internet]. 2018 [citado el 22/06/2019]. Disponible en: https://ec.europa.eu/eurostat/statistics-explained/index.php/Healthcare_personnel_statistics_-_physicians.
 17. Jagsi R, Guancial EA, Worobey CC, Henault LE, Chang Y, Starr R, et al. The “gender gap” in authorship of academic medical literature a 35-year perspective. *N Engl J Med* [Internet]. 2006;355(3):281–7 [citado el 22/06/2019]. Disponible en: https://www.nejm.org/doi/10.1056/NEJMsa053910?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%3dwww.ncbi.nlm.nih.gov
 18. Rexrode KM. The gender gap in first authorship of research papers. *Br Med J*. 2016;352:i1130.
 19. Filardo G, Da Graca B, Sass DM, Pollock BD, Smith EB, Martínez MAM. Trends and comparison of female first authorship in high impact medical journals: Observational study (1994-2014). *BMJ*. 2016;352(i847):1–8.
 20. Williams WA, Garvey KL, Goodman DM, Lauderdale DS, Ross LF. The Role of Gender in Publication in The Journal of Pediatrics 2015-2016: Equal Reviews, Unequal Opportunities. *J Pediatr* [Internet]. 2018:1–8 [citado el 22/06/2019]. Disponible en: <https://doi.org/10.1016/j.jpeds.2018.06.059>
 21. Schiaffino A, García M, Fernández E. Autoría y presentación de resultados según el género en cuatro revistas biomédicas españolas. *Gac Sanit*. 2001;15(3):251–4.
 22. Fishman M, Williams WA, Goodman DM, Ross LF. Gender Differences in the Authorship of Original Research in Pediatric Journals, 2001-2016. *J Pediatr*. 2017;191:244–9.
 23. Tornero Patricio S, Charris-Castro L, Alonso Rueda IO, González Soria MD. Factores relacionados con la autoría de las publicaciones en Anales de Pediatría. *An Pediatr* [Internet]. 2019;90(3):201–3 [citado el 22/06/2019]. Disponible en: <https://www.analesdepediatría.org/es-pdf-S169540331830362X>
 24. Nature Editorials. Science for all. *Nature* [Internet]. 2013;495:5 [citado el 22/06/2019]. Disponible en: <https://www.nature.com/news/science-for-all-1.12535>
 25. Shannon G, Jansen M, Williams K, Cáceres C, Motta A, Odhiambo A, et al. Gender equality in science, medicine, and global health: where are we at and why does it matter? *Lancet* [Internet]. 2019;393(10171):560–9 [citado el 22/06/2019]. Disponible en: [https://doi.org/10.1016/S0140-6736\(18\)33135-0](https://doi.org/10.1016/S0140-6736(18)33135-0)
 26. Borrell C, Vives-Cases C, Domínguez-Berjón MF, Álvarez-Dardet C. Las desigualdades de género en la ciencia: Gaceta Sanitaria da un paso adelante. *Gac Sanit*. 2015;29(3):161–3.
 27. Tornero Patricio S, García Calvente MM, Charris Castro L. Necesidad de la perspectiva de género en el anuario de Anales de Pediatría. *An Pediatr* [Internet]. 2015;83(3):225 [citado el 22/06/2019]. Disponible en: <http://www.analesdepediatría.org/es-necesidad-perspectiva-genero-el-anuario-articulo-S1695403315002799>
 28. Lurbe i Ferrer E, Alsina Manrique de Lara L, Rodríguez Fernández LM, Solís Sánchez G. Necesidad de la perspectiva de género en el anuario de Anales de Pediatría. Respuesta de los autores. *An Pediatr* [Internet]. 2015;83(3):226 [citado el 22/06/2019]. Disponible en: <http://linkinghub.elsevier.com/retrieve/pii/S1695403315003124>
 29. Asociación Española de Pediatría. Junta Directiva de la Asociación Española de Pediatría [Internet]. 2019 [citado el 22/06/2019]. Disponible en: <https://www.aeped.es/junta-directiva>.
 30. Tornero Patricio S, Charris-Castro L, Alonso Rueda IO. Representación femenina en las juntas directivas de las asociaciones y sociedades de Pediatría en España. *An Pediatr* [Internet]. 2018;89(1):71–4 [citado el 22/06/2019]. Disponible en: <https://www.analesdepediatría.org/es-representacion-femenina-las-juntas-directivas-articulo-S1695403318301863>
 31. Anales de Pediatría. Comité Editorial de la Revista Anales de Pediatría [Internet]. 2019 [citado el 22/06/2019]. Disponible en: <https://www.analesdepediatría.org/es-comite-editorial>.
 32. SCImago Journal & Country Ranking. About us [Internet]. 2019 [citado el 22/06/2019]. Disponible en: <https://www.scimagojr.com/aboutus.php>.
 33. Guerrero VP, Moya F. A further step forward in measuring journals’ scientific prestige: the SJR2 indicator. *J Informetr* [Internet]. 2012;6(4):674–88 [citado el 22/06/2019]. Disponible en: <https://doi.org/10.1016/j.joi.2012.07.001>
 34. SCImago Journal & Country Ranking. Criterios de selección de revistas médicas SCImago [Internet]. 2019 [citado el 04/09/2018]. Disponible en: https://www.scimagojr.com/journalrank.php?area=2700&country=ES&type=j&min=0&min_type=cd.
 35. Instituto Nacional de Estadísticas. Base de datos de nombres y apellidos [Internet]. 2018 [citado 04/09/2018]. Disponible en: <http://www.ine.es/widgets/nombApell/index.shtml>.
 36. Agencia Estatal Boletín Oficial del Estado. Ley Orgánica 3/2007, de 22 de marzo, para la igualdad efectiva de mujeres y hombres [Internet]. Boletín Oficial del Estado. 2007. p. 12611–45 [citado el 17/04/2019]. Disponible en: <https://www.boe.es/buscar/doc.php?id=BOE-A-2007-6115>.

37. Macaluso B, Larivière V, Sugimoto T, Sugimoto CR. Is science built on the shoulders of women? A study of gender differences in contributorship. *Acad Med*. 2016;91(8):1136–42.
38. Heidari S, Babor TF, De Castro P, Tort S, Curno M. Sex and gender equity in research: rationale for the SAGER guidelines and recommended use. *Res Integr Peer Rev* [Internet]. 2016;1(2):1–9 [citado el 22/06/2019]. Disponible en: <https://doi.org/10.1186/s41073-016-0007-6>
39. Rey C, Alsina L, De Lara M, Garcinu AC. Informe anual de los editores de Anales de Pediatría. *An Pediatr* [Internet]. 2019;90(6):329–37 [citado el 22/06/2019]. Disponible en: <https://www.analesdepediatria.org/es-informe-anual-los-editores-anales-articulo-S1695403319301511>
40. Heidari S, Babor TF, De Castro P, Tort S, Curno M. Equidad según sexo y de género en la investigación: justificación de las guías SAGER y recomendaciones para su uso. *Gac Sanit* [Internet]. 2018;33(2):203–10 [citado el 22/06/2019]. Disponible en: <https://doi.org/10.1016/j.gaceta.2018.04.003>