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Gender Leadership in Cancer Research

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Introduction

Cancer is a major global health problem. In 2022, there were an estimated 20 million new cancer cases and 9.7 million deaths, with projections indicating 35 million cancer cases by 2050. In Europe, cancer is the second leading cause of death, almost equal to cardiovascular diseases (WHO, 2024). Research progress in this area has traditionally been reported through scientific publications, the analysis of which has included bibliometric studies of the content and authorship of scientific activity, with a particular focus on the gender distribution of authorship. The aim of this study was to assess the progress made in incorporating a gender perspective in cancer research, comparing the years 2011 and 2021, using a dual approach that includes both the analysis of authorship in the publications derived and the evaluation of the scientific content of the research carried out according to the type of cancer studied.

Methods

Identification of cancer articles and retrieval of MeSH terms

A bibliographic search was carried out for articles and reviews in the field of oncology that were signed by at least one Spanish institution during the period 2011-2021 through the Science Citation Index Expanded database of the Web of Science Core Collection, which yielded 50,776 documents (Lucas-Domínguez et al., 2024). A PubMed/Medline search was then performed using the PMIDs of the retrieved records, which produced 47,940 papers. All MeSH

terms were then downloaded from the records and a total of 43,086 papers containing MeSH terms were identified (89.87% of the total number of papers indexed in PubMed/Medline). The retrieved records were exported to a relational database in Microsoft Access using in-house developed bibliometrics software.

Classification of papers by cancer type

Global cancer statistics indicate that the highest incidence is mainly due to lung, breast, colorectal, prostatic and stomach cancers. On the other hand, lung and colorectal cancer are the leading causes of death, followed by liver, breast and stomach cancer (Bray et al., 2024). The 43,086 papers containing MeSH terms were evaluated according to the above-mentioned cancer typologies using the specific representative descriptors obtained from the MeSH tree (Neoplasms by Site [C04.588]) (Table 1).

Table 1. MeSH descriptor analysis of retrieved cancer papers.

Cancer type	MeSH	Papers	%*
BREAST	Breast Neoplasms	3,417	93.6
	Triple Negative Breast Neoplasms	210	5.8
	Carcinoma, Ductal, Breast	192	5.3
COLORECTAL	Colorectal Neoplasms	1,969	62.7
	Colonic Neoplasms	626	19.9
	Rectal Neoplasms	409	13.0
LUNG	Lung Neoplasms	2,424	95.3
	Carcinoma, Non-Small-Cell Lung	1,193	46.9
	Adenocarcinoma of Lung	163	6.4
PROSTATIC	Prostatic Neoplasms	1,458	87.7
	Prostatic Neoplasms, Castration-Resistant	224	13.5
LIVER	Liver Neoplasms	1,276	96.4
	Carcinoma, Hepatocellular	816	61.7
	Liver Neoplasms, Experimental	35	2.6
STOMACH	Stomach Neoplasms	453	100.0

*The percentages do not add up to 100% as there may be more than one MeSH in a record

Gender analysis of authorship in cancer publications

To identify the signatures of the 43,086 papers, the authors' names were manually standardised and gender was assigned using the statistical package Genderize.io (https://genderize.io/#overview). The papers were then assigned to the following groups: gender parity (P), when the percentage of one of the genders was between 40% and 60% of the total number of authors signing the article; female majority (FM) and male majority (MM) authorship.

Results

The 43,086 retrieved articles on cancer that were signed by at least one Spanish institution were analysed using MeSH terms to classify them into the different types of cancer (Table 1). The description of the frequency of research on the different types of cancer in the articles is shown in Figure 1. As can be seen, publications on 6 cancers predominate: breast, colorectal, lung, prostatic, liver and stomach, demonstrating the correlation between the cancers with the highest incidence and mortality and the research carried out.

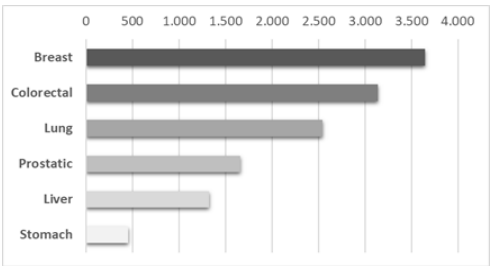

Figure 1. Analysis of the 6 most common cancers covered in oncology publications for the period 2011-2021.

The 12,272 articles corresponding to the 6 most studied cancer typologies are 24.5% of the cancer records retrieved for the entire period 2011-2021 (Table 2). Of these, 11,019 articles had all author signatures identified, highlighting the majority of male authorship in all the cancers studied, except for breast cancer, where the parity of signatories predominates. Comparing the years 2011 and 2021 and the participation in authorship by sex, 828 articles (123 FM, 253 P, 324 MM) and 1,388 articles (269 FM, 478 P, 504 MM) respectively were identified.

Table 2. Classification of papers by cancer type and gender of authors.

Cancer type	Papers	All author signatures identified	% Papers all author identified	Female Majority	% Female Majority	Parity	% Parity	Male Majority	% Male Majority
Breast	3,649	3,159	86.57%	847	26.81%	1,346	42.61%	966	30.58%
Colorectal	3,141	2,716	86.47%	566	20.84%	1,051	38.70%	1,099	40.46%
Lung	2,544	2,224	87.42%	272	12.23%	768	34.53%	1,184	53.24%
Prostatic	1,662	1,360	81.83%	195	14.34%	407	29.93%	758	55.74%
Liver	1,323	1,177	88.96%	187	15.89%	389	33.05%	601	51.06%
Stomach	453	383	84.55%	76	19.84%	144	37.60%	163	42.56%

The analysis of specific authorship groups by cancer type shows that in 2021, compared to 2011, there is a slight trend towards an

increase in papers with parity compared to a decrease in papers with male majority authorship, except for liver cancer (Figure 2). In contrast, the increase in female majority authorship is minimal, except for colorectal cancer and stomach cancer.

Conclusion

The integration of gender equality in science remains a critical issue despite various socio-political initiatives across Europe and global commitments, such as the 2030 Agenda and the United Nations System-wide Plan of Action for Gender Equality and the Empowerment of Women (UN-SWAP). These efforts, including those by the World Health Organization, emphasize gender mainstreaming in research. However, significant challenges persist, highlighting the need for continued and expanded actions to address the structural and cultural barriers that hinder women's full participation in science and decision-making in research and innovation. Urgent efforts are needed to achieve true gender equity and human rights integration in scientific policies and practices (Rius et al., 2024).

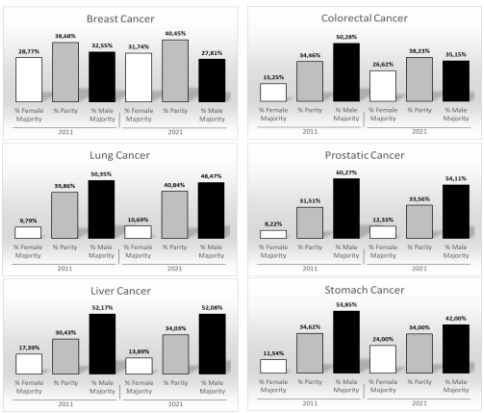

Figure 2. Gender gap in cancer research between 2011 and 2021.

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