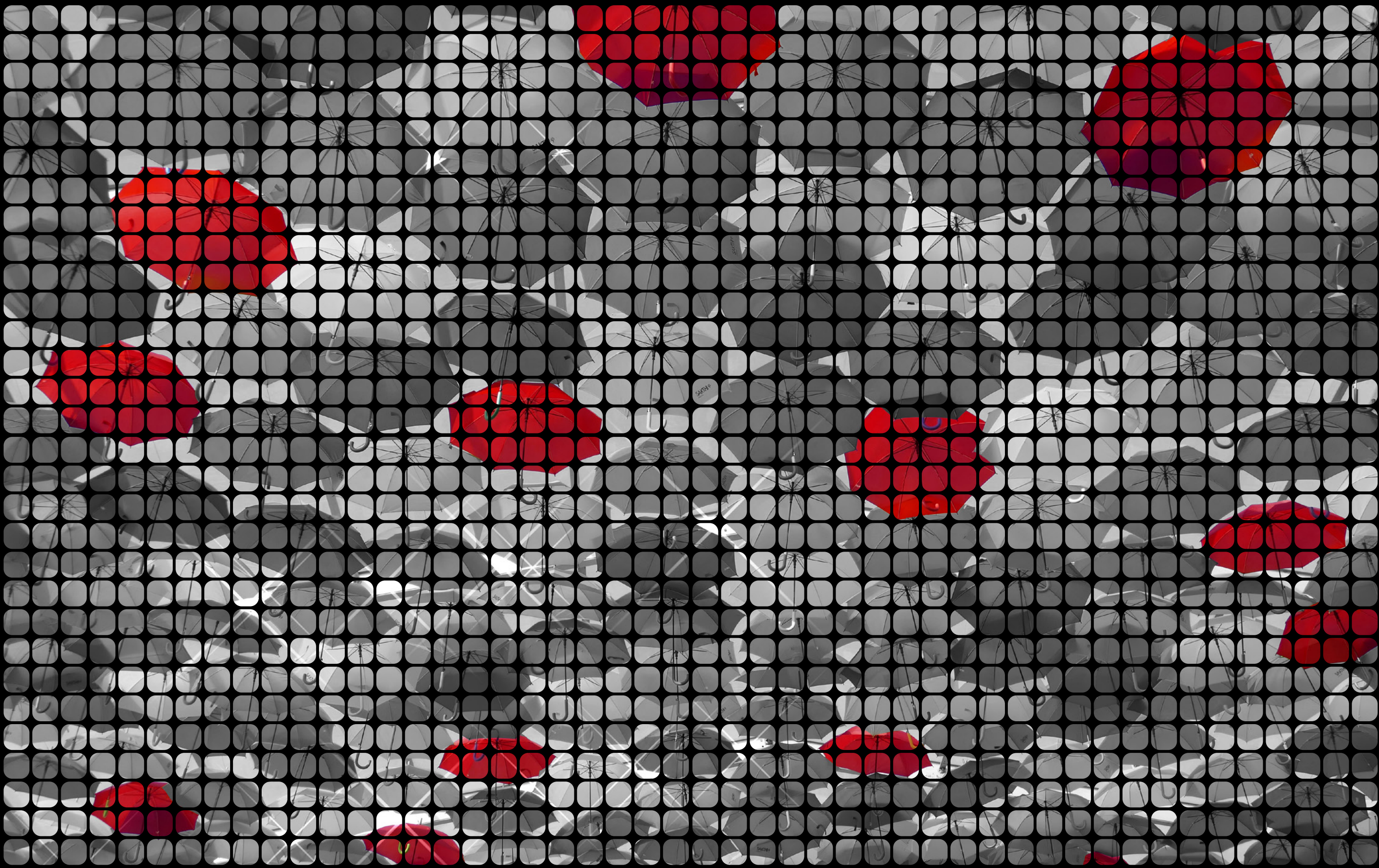

Digital Research Reports

Gender Imbalance in Cancer Research Grants

An analysis of the number and value of grants awarded to male and female cancer researchers in the UK over the last decade

Dr Hélène Draux
Foreword by Dr Suze Kundu

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DIGITAL science
Dimensions

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About the authors

Dr Hélène Draux is Research Data Scientist at Digital Science. She has an academic background in social geography, with experience in data visualisation and data science. Her work has focused on facilitating the inclusion of the general public through interactive visualisations, to communicate and collect data. She has worked in the UK and Denmark, and participated in several national and European-funded research projects. She has also worked in R&D in the private sector, where she beta-tested the use of phone applications for place discovery.
http://orcid.org/0000-0001-8837-168X

Dr Suze Kundu is a nanochemist by trade, and Head of Community Engagement at Digital Science. Her research area is functional semiconductor nanomaterials for applications in artificial photosynthesis. A passionate educator and collector of degrees, she has also studied for a PGCE in Senior School Science and an MEd in University Learning and Teaching. After six years lecturing at Imperial College London and the University of Surrey, she joined Digital Science in 2018 to head up engagement with all communities, whether they are academics, policy makers, school children, and anyone in between. As an experienced science communicator, she shares her love for science through live lectures, on TV and radio, and in print.

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Digital Science, 4 Crinan Street, London N1 9XW
consultancy@digital-science.com

Foreword

By Dr Suze Kundu, Head of Community Engagement at Digital Science

In May 2018, Zhou *et al*. published a paper[1] that looked for evidence of gender imbalance in the number and value of grants awarded to cancer researchers. Through a long process[2] of manually surveying records of funding awarded, the team created a database of information that they were able to analyse. A similar study carried out by the group involved over three years of data collection, two years of data characterisation, and six months of data analysis. By using Dimensions, researchers at Digital Science were able to demonstrate that there is now a much faster way to conduct gender studies research. A study similar to Zou et al was carried out the within a week, yielding similar results to the original study. The significant time savings that the Dimensions platform offers gender studies researchers now makes it possible to go from labour intensive periodic review to near real-time monitoring of equality and diversity across the research landscape.

Dimensions is able to quickly analyse patterns in funding, especially when compared to traditional methods of research used to carry out the same research.

Dimensions[3] is a research information tool that links every aspect of the research cycle from funding to dissemination of findings and impact, allowing researchers and research analysts alike to gain valuable insights into the research being carried out. Using the Dimensions API, Digital Science researchers were able to extract a comparable amount of information as the original study carried out by Zhou's team. Where their data mining techniques took several years to be comprehensive enough, the data scientists at Digital Science were able to gather a similar amount of data in a few moments, using the Dimensions tool. Some manual work was necessary to correctly assign gender to the names of principal investigators, but a programme was used to carry out an initial sweep of this information before the anomalies were then sorted through.

So how do the results compare? Remarkably well, in fact. Where the original study published in the BMJ surveyed grants from 2000 to 2013, the Dimensions survey chose a slightly shorter but on the whole overlapping time period, 2007 to 2017. However, the number of grants that the studies were based on differs significantly; the original study was based on 4,186 qualifying awards, compared to the 7,615 grants that Dimensions was able to identify and include, for a shorter time period, albeit one that does not directly overlap with the original study. The original study showed that women received 31% of all grants awarded, with a total value of 22%. The Dimensions study backed up this claim, stating that only 30% of funded cancer research PIs were women. What Dimensions was able to add to the analysis however was the fact that the total funding amounts had increased from 25% to 30% of the total, implying that in the decade's worth of information surveyed, women were moving towards receiving slightly larger grants in 2017 than they had done before, say in 2007. The Dimensions study also confirmed the findings of the original study that showed the types of cancer research that were being funded for men and women were imbalanced, with male PIs receiving funding for more 'technical' research, and women receiving funding for the 'softer' areas of cancer research.

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Dimensions is able to quickly analyse patterns in funding, especially when compared to traditional methods of research used to carry out the same research. Why should we care about this? Digital Science believe in

[1] https://bmjopen.bmj.com/content/8/4/e018625

[2] https://www.thelancet.com/journals/laninf/article/PIIS1473-3099(12)70261-X/fulltext

[3] https://www.dimensions.ai/

Lack of diversity is an issue across academia, and we look forward to sharing ways in which our tool can be used to analyse trends across a range of subjects, inclusively of all cultures.

opening science out to everyone, and for academia to have a more diverse and inclusive culture at all levels of research. The under-representation of any minority in science, technology, engineering and maths (STEM) can lead to disengagement with the public that scientists are trying to help, and can also lead to a lack of ground-breaking ideas that could be sourced from a wider range of people taking part in the conversation. By using Dimensions to quickly survey trends in, for example, the demographics of those being funded, researchers, funding bodies and institutions are able to monitor the effectiveness of the range of initiatives being implemented to combat this lack of diversity more frequently and more efficiently, than they have been able to before. This could lead to better evaluation of these initiatives, and a better focus on the ones that are showing greater impact in changing the academic culture.

Over the coming months, Digital Science will be releasing a range of reports in this series that uncover how else Dimensions can be used to analyse trends in the demographics of researchers. We will be showcasing tools that allow the user to observe the impact of gender diversity initiatives implemented at Department or Subject, Institution and Country level over time. We will also be asking you, as experts within the wider research community, to help us make the tool better. Currently, a lot of our automatic gender assignment tools are focused on Western names. If we want to use this tool to comprehensively analyse the state of diversity in STEM, we need to make this more inclusive, in order to make our analysis as accurate as possible. While the focus of this use-case is a comparative study on gender diversity in one particular area of research, we strongly believe that diversity is about more than just gender imbalance, and that these issues extend beyond STEM. Lack of diversity is an issue across academia, and we look forward to sharing ways in which our tool can be used to analyse trends across a range of subjects, inclusively of all cultures.

Summary

We confirmed the gender imbalance for grant receivers in one field of research; cancer research in the UK.

This report looks at gender representation in cancer research grants received by UK institutions.

The study on grants for cancer research in the UK was intended to reproduce a study published recently in BMJ Open, but using author disambiguation, data, categories, and links from Dimensions. We used the 7,615 grants about cancer received by researchers at UK institutions between 2007 and 2017. Women represented only about 30% of the funded researchers in the UK, and even though grant numbers have fluctuated a lot in these 11 years, the proportion of women receiving grants remained constant. However, the share of grant amount has increased slightly, from 25% to 30% of the total. Using pre-existing categories in Dimensions, we discovered that women received grants in widespread diseases (e.g. obesity, smoking), while men received grants in cancers with very low survival rates (pancreatic and brain cancer).

Using Dimensions, we confirmed the gender imbalance for grant receivers in one field of research; cancer research in the UK.

Introduction

Research has long been a male-dominated arena. This stems from women first been barred from universities, and then their number being quite low, reducing their chances to carry on into a professional research career. Even though access figures have now improved significantly for women, there is still a persistent stereotype that science, in which much of the funding of research resides, is for men (Miller, Eagly, and Linn 2015). Many factors reinforce this perception including: a lack of role models to inspire younger women; a lack of womens' representation in decision-maker groups such as research funders, and lack of engagement in the earliest years of schooling. Astoundingly women are now more represented than men at both undergraduate and postgraduate levels (including PhD), yet the transition from postgraduate to professional researchers remains male dominated.

We reproduced a study recently published, in order to benchmark Dimensions with manual work.

Gender disparity in education is being addressed but the active research workforce has been and is still slow to change. There are many young women in research, but fewer at the highest positions –this differentiation is clearly not based on ability but instead on a pipeline problem. For instance, in Australia while there are now more than 50% of women in early career researchers, there are still less than 50% of women in research careers overall.

Gender disparities vary by subject and by culture, but for the most part, there are globally fewer women in research. One study showed that, for instance, in countries where there is less gender-equality, there are more women in science (Stoet and Geary 2018). This can be explained, according to the authors, by women in these countries looking for a clearer path to get their freedom: reaching the most prominent positions gives them advantages they would not have in other professions.

Gender disparity has far-reaching and surprising results that not only affects the workforce but also extends to research subjects: to simplify research hypotheses, minimize sample sizes, and therefore cost, trials are often conducted on male-only animals. As a direct result, this concerningly unscientific approach has led to the removal of drugs from the market: Over 80% of the prescription drugs removed from the market between 1997 and 2000 in the US had more adverse effects in women than men (U. S. Government Accountability Office 2001). Although there has been a push to include gender-balanced clinical trials, it is still not the norm and a requirement to do so with animal studies.

Digital Science is committed to supporting universities and funders in leading the change towards more gender balance among researchers. This report highlights that rich data about funding and publications enable straightforward analyses to compare and benchmark a field or a country. We reproduced a study recently published, in order to benchmark Dimensions with manual work. Zhou et al. (2018) published a study in BMJ Open, looking at the UK research funding gender disparities in cancer research. They found that a majority of cancer funding was going towards men Principal Investigators (PIs). Using Dimensions, we have reproduced and furthered the research to find similar patterns. We found that a majority of research funded was going toward men PIs, although the women's share of funding is growing in terms of amount. Using Dimensions' links to resulting publications, we also found that women on average were publishing slower than men. Many factors influence this, including the field of research of the funding, but also potentially the housework/childcare gender gap.

Methodology

Gender Identification

Most automatic gender identifiers (or guessers) which are freely available rely on most English/Westerner names.

Most automatic gender identifiers (or guessers) which are freely available rely on most English/Westerner names. They use probability of being for a man or woman, based on frequency of occurrence, or attempt to guess genders based on letter patterns. Given the globalisation of research and mobility of researchers, we did not find these methods reliable enough, and did not want to identify the genders manually. Instead, we downloaded the data for 'persons' from wikidata (the structured data derived from Wikipedia), and counted the number of instances the person was indicated as a man or a woman. Relying on crowdsourced data has its inconveniences, and we did find vandalised pages, but this is only marginal.

We included only persons born after 1940, assuming that names can change genders across time. We first used the "given_name" as a first name, but realised that many pages describing Asian persons had not filled this field (e.g. 92% of South Korean, 91% of Chinese, and 70% of Indian names). To consolidate the data, when we did not have a given_name, we used the first part of the name of the person. We acknowledge that some of these countries use a different convention for the first name being the first part of the name. However, we used the English version of the name and can reasonably expect that contributors had followed the Western convention of putting the first name first. When this does not happen, or when the first word referred to a title for instance, this will simply create a name that does not exist and will not influence our data matching with existing names.

We attributed names to three categories: women, men, and unknown. The ratio for this was: 80% of either gender and more than 10 persons, or more than 1 person but 100% of either gender. For names falling out of these ranges (often unisex names), we categorised them as unknown.

Limitations

Dimensions' data quality is heavily correlated with the data quality of the data source. This means that in some instances the first name has not been properly identified (e.g. if authors have inverted first names / last names). In many cultures, it is customary for women are also to change their family names when they marry. In this case, even if they have kept both names, it will not be possible to uniquely identify them. It is therefore likely that our methodology will overcount the number of women but also shorten their publication life.

Cancer Research in the UK

In the UK, cancer is one of the highest-funded medical conditions from UK governmental and charity sources (Luengo-Fernandez, Leal, and Gray 2015). Given the source of funding for cancer-related studies together with the gender-neutral potential importance of research breakthroughs in this area it is important to understand the gender balance of the UK funding landscape of cancer research. A recent research project on this subject by Zhou *et al* (2018) concluded that "Female PIs clearly and consistently receive less funding than their male counterparts in terms of total investment, the number of funded awards, mean funding awarded and median funding awarded".

The authors relied on manually collecting open data or requesting it to funders, and manually classified the fields and gender of the grants. This approach is time consuming and overlooks existing tools that could achieve a similar result in much less time.

We used Dimensions data, relying on the pre-existing classifications to identify cancer research funding and disambiguated authors, and used wikidata followed by manual curation for the gender classification.

Data

We queried Dimensions for grants awarded to a UK institution, with the Health Research Classification System (HRCS) Health Classification of "Cancer"[1], and limited our data to 2007-2017. This 10-year period is a good length to assess any change. We excluded data where funders had not shared the name of the Principal Investigator (PI), as it rendered the gender analysis impossible. We found 7,615 grants, given by 55 funders; only 13 of them had given more than 100 grants to cancer research in the past 11 years. When funding was awarded to more than one person, we considered the first person as the PI, and the others were considered to be team members.

The top 5 funders with PI names can be found in Table 1.

Table 1: Top 5 funders of cancer research in the UK (with PI names)

Funder	Grants awarded
Cancer Research UK	2,405
Medical Research Council	816
Wellcome Trust	658
Biotechnology and Biological Sciences Research Council	394
NIHR Evaluation, Trials and Studies Coordinating Centre	309

We were also interested in the resulting publications from these grants and wanted to know if the gender balance was similar. We retrieved from Dimensions the resulting publications of these grants and identified the gender for all authors.

[1] *Dimensions data is categorised following multiple well-known research taxonomies. The HCRS classification attributes one or more categories of area of health or disease being studied. It features 21 separate categories covering all diseases, conditions and areas of health.*

More than two thirds of the grants (67.6%) had been attributed to men PIs.

Results

Our analysis focused on the number and funding amount of awards across time, funders, and gender. We also looked into the specific cancers that had been considered to find patterns and trends.

We found 7,615 grants, awarded from 2007 to 2017, and identified the gender for 97.7% of the Principal Investigators (PIs). More than two thirds of the grants (67.6%) had been attributed to men PIs, as shown in Table 2.

Table 2: Gender for cancer grant research awards Principal Investigators in the UK (2007-2017)

PI gender	Number	Proportion
Man	4,099	67.6 %
Unknown	142	2.3 %
Woman	1,825	30.1 %
All	6,066	100 %

Funded Grants Through Time

Research grants are awarded for a different number of years, some even spanning 30 or more years (often following extensions). In our dataset, grants were awarded for 1 to 15 years, with an average of 4.1 years. For simplicity we considered here only the starting year of the award, as they reflect the state of gender balance at that time.

Number of Grants

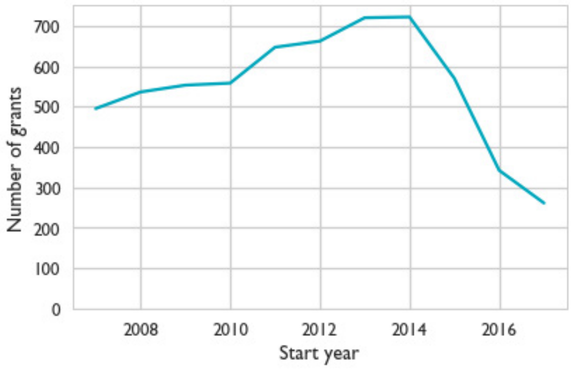

Figure 1: Evolution of the number of cancer research projects funded in the UK.

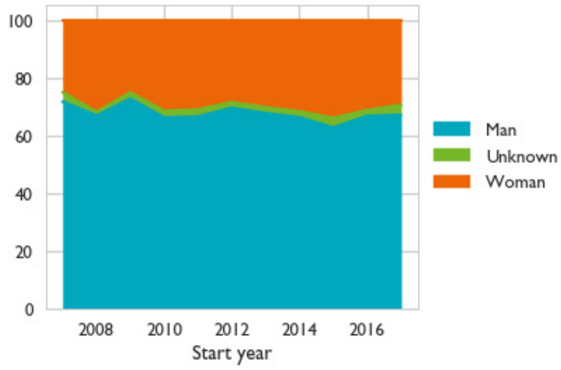

Figure 2: Evolution of gender share for researchers receiving grants

In absolute figures, fewer women received cancer research grant funding in 2017 than 2007.

The number of cancer research projects funded in the UK increased between 2007 and 2014, decreasing afterwards (nearly half of funded projects in 10 years). However, Figure 2 shows that in the past 10 years, the share of men and women scientists receiving grants related to cancer in the UK has been steadily around 70% men, 30% women. Therefore, in absolute figures, fewer women received cancer research grant funding in 2017 than 2007.

Grant Amount

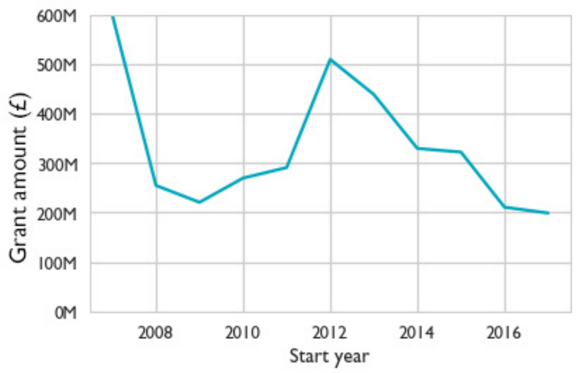

Figure 3: Evolution of the amount of funding in cancer research

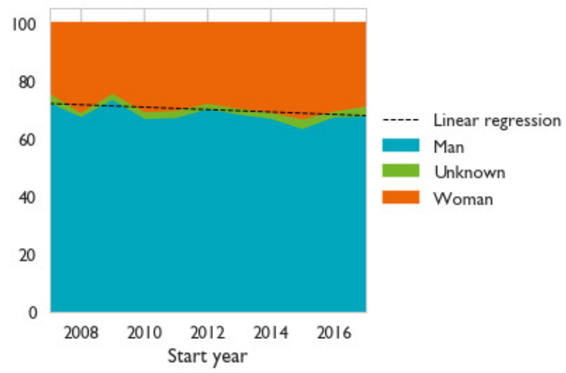

Figure 4: Share of funding amounts received by both genders

As shown Figure 3, funding amount has fluctuated, going now towards a decrease, but the share that women receive (Figure 4) has increased, from about 25% of the funding to nearly 30% (using linear regression). This suggests that women received in 2017 bigger grants than in 2007. Interestingly, 2012 represented a peak in absolute amount of funding, while proportionally men had received a larger share than women (66%-69%-68% for 2011 to 2013).

Funder Types

GRID, Digital Science's Global Research Identifier Database, has integrated a classification of funder types. In our case, the funders could be divided in Facility[2], Government, Non-profit, and Other.

Table 3: Number of grants awarded to either gender per funder type

Type	Number	Gender of PI	
		Man	Woman
Facility	104	48.5%	51.5%
Government	2,193	71.6%	28.4%
Non-profit	3,738	68.4%	31.6%
Other	31	57.1%	42.9%
All	6,066	69.2%	30.8%

Although the non-profit funders had achieved a better gender balance than Government funders, the Facility funders, which are more specialised, had outperformed them.

We looked into funders that had given more than 50 grants in the last 10 years and put them in three categories: less funding to women than average funder, more funding to women than average funder, and more funding for women than men.

[2] A building or facility dedicated to research of a specific area, usually contains specialised equipment. Includes telescopes, observatories and particle accelerators.

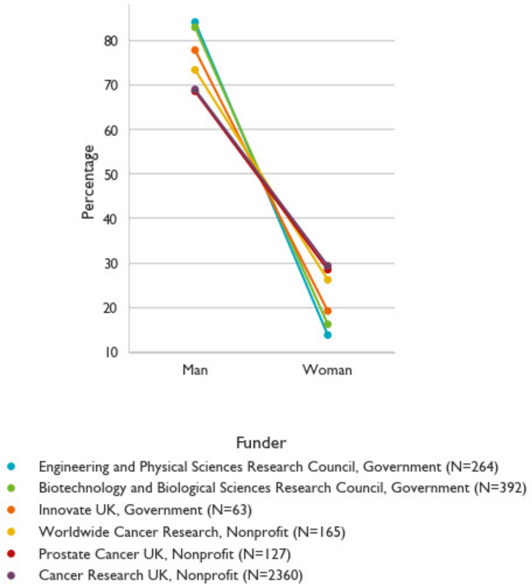

Figure 5: Funders that gave less funding to women than average funder

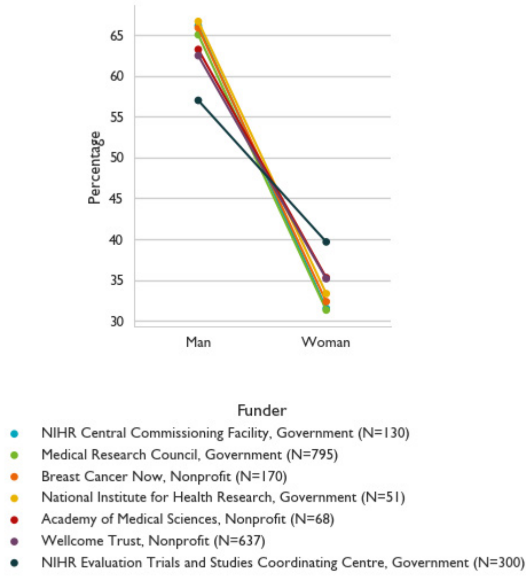

Figure 6: Funders that gave more funding to women than average funder

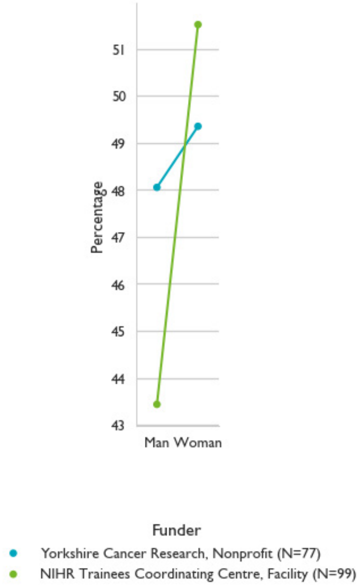

Figure 7: Funders that gave more funding to women than men

“Genetics” and “clinical research” are favoured very differently: for men, both are at equal interest, while women notably favour “clinical research” (734 grants) against genetics (494 grants).

Research Category

Research, Condition and Disease Categorisation (RCDC)

In Dimensions, grants are attributed to one or more RCDC categories; our sample represents only grants that had at least attributed the HRCS code Cancer. We used the RCDC classification to compare the research interest of both genders, if any different.

We looked at the top 20 RCDC associated to the grants for each gender. This shows different priorities in the research interests. The content of the top 10 is relatively similar, apart from “Bioengineering” which appears only for men, and “nutrition” which appears only for women. Both in their Top 3, “genetics” and “clinical research” are favoured very differently: for men, both are at equal interest, while women notably favour “clinical research” (734 grants) against genetics (494 grants). When extending to the top 20, more differences start to appear. Four RCDC codes appear solely in the Top 20 for men: Bioengineering, Orphan Drug, Diagnostic Radiology, and Hematology. On the other hand, four RCDC that are solely in the top 20 for women are: Obesity, Pediatric, Health Services, and Neurosciences.

Figure 8 and Figure 9 show the categories with the strongest differences between genders. Categories more important for men seem to include more “technical” (Bioengineering, Diagnostic Radiology, and Hematology), and specialised cancers/disorders that are reputed to be untreatable and with a low prognostic (Pancreatic Cancer, Brain Disorder). On the other hand, women were more funded for research that were softer (Behavioral and Social Science, and Health Services), and dealt with more common disease (Smoking and Health, Obesity, Pediatric, Substance Abuse).

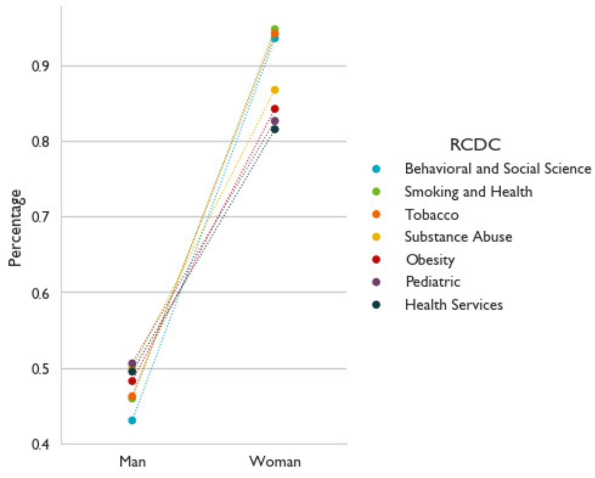

Figure 8: RCDC categories more important for men than women

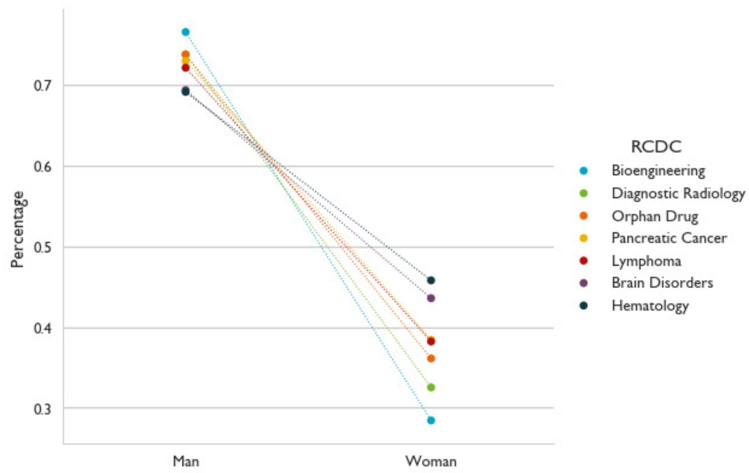

Figure 9: RCDC categories more important for women than men

Research Activity Codes (HRCS)

The Research Activity Codes (RAC) give another perspective to items indexed in Dimensions. Developed by the UK Clinical Research Collaboration to support the classification of biomedical funders' portfolios, Digital Science developed the integration of the classification in Dimensions. The classification gives an indication of the research activity, from basic to applied research. In our sample, the most common stage (23%) was *2.1 Biological and endogenous factor*. For the most important RAC codes (more than 2% of the grants), the pattern of RAC representation between genders was relatively similar, apart from the RAC code *3.1 Primary prevention interventions to modify behaviours or promote well-being*, which was better represented in the grants awarded to women (6% of their grants) than to men (2%).

The Research Activity Codes (RAC) give another perspective to items indexed in Dimensions.

Table 4: Gender representation by RAC in Cancer grants in the UK

	Man	Woman	All
2.1 Biological and endogenous factors	22%	24%	23%
1.1 Normal biological development and functioning	24%	10%	11%
5.1 Pharmaceuticals	23%	9%	11%
4.1 Discovery and preclinical testing of markers and technologies	12%	6%	7%
6.1 Pharmaceuticals	10%	4%	4%
4.2 Evaluation of markers and technologies	11%	4%	4%
4.5 Resources and infrastructure (detection)	11%	3%	4%
5.9 Resources and infrastructure (development of treatments)	9%	3%	4%
3.1 Primary prevention interventions to modify behaviours or promote well-being	11%	6%	3%

Although 67% of the grants had been attributed to a male PI, only half (51.7%) of the first author of publications were men and 43% women.

Research Outputs

Dimensions links grants to their resulting publications. The 7,615 grants from our sample resulted in 32,718 publications (for the grants that had at least one resulting publication: min=1, max=721, and average=11.03). The grant that resulted in 721 publications was an ESRC £2.9 M grant awarded to 12 researchers for 6 years (which gives an average of 60 publications per researcher).

We applied the same methodology to guess the gender of the first author of the publication, and found that although 67% of the grants had been attributed to a male PI, only half (51.7%) of the first author of publications were men and 43% women (see Table 5).

Table 5: Gender of first authors for resulting publications from cancer grants

Gender of first author	Number	Proportion
Man	17,431	51.7%
Unknown	1,791	5.3%
Woman	14,490	43.0%
All	33,712	100%

It took a man 4.64 years on average to publish all the publications resulting from the grant, while it took a woman 4.76 years on average.

There was a difference between the average number of years to publish an article after the start of the grant. When a man was awarded a grant, it took a man 4.64 years on average to publish all the publications resulting from the grant (not necessarily the same person, only the same gender). On the other hand, when a woman was awarded a grant, it took a woman 4.76 years on average to publish all the publications resulting from the grant. Table 6 summarises the gender representation as first author, depending on the gender of the grant receiver.

Table 6: Gender of grantee vs gender of first author (percentages include the unknown gender category and therefore men + women do not add up to 100%)

<table>
<tr><td></td><td></td><td colspan="2">Grant receiver</td></tr>
<tr><td></td><td></td><td>Man</td><td>Woman</td></tr>
<tr><td rowspan="2">First author publication</td><td>Man</td><td>52.7%
4.64 y</td><td>45.2%
4.78 y</td></tr>
<tr><td>Woman</td><td>42.2%
4.79 y</td><td>50.6%
4.76 y</td></tr>
</table>

Conclusion

Dimensions has allowed us to quickly analyse grants and their resulting publications, with the ability of focusing on the individual author. It showed that in the UK, cancer research grants funding has been consistently given to a share of 70% men and 30% women. However, during the 10 years, there was a trend for women to receive a larger share of the funds suggesting that they receive larger grants; either as they become more senior or that they are going after better funded research.

Pre-existing recognised categories in Dimensions have also facilitated the analysis of the content of the funded research. The comparison showed that although most of the top 20 research interest (RCDC) pursued by both genders were relatively similar, some orders of priorities differed. Women had received proportionally more funding in "softer" categories (Behavioral and Social Science, and Health Services), and widespread diseases (Smoking, Obesity); suggesting women focused on issues that would help the most people. On the other hand, grants awarded to men were in more technical categories (Bioengineering, Diagnostic Radiology, and Hematology), and diseases with very poor prognosis (Pancreatic Cancer and Brain Disorders); suggesting men focused on diseases with a higher potential for discoveries.

Aside from improve research funding and publication data, which requires more involvement from funders (some funders do not share name of grantees, or funding amount), this study would have benefited from more information on grant applications. As we have seen, although women receive 30% of the cancer research grants, they are 40% of the first authors on resulting papers. It is therefore likely that there is also a difference with the success rate between genders.

Cancer research grants funding has been consistently given to a share of 70% men and 30% women. However, during the 10 years, there was a trend for women to receive a larger share of the funds suggesting that they receive larger grants.

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