Exploring Gender's Impact on Co-authorship and Citation Networks in Cancer Research

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Gender plays a crucial role in shaping the networks and career outcomes of scientists [1-4]. Previous work illustrated that contributions of female scholars receive less credit [5] and that scientific collaborations tend to be segregated by gender [6-7]. Combining methods from Network Science with domain knowledge from bio-medicine, this study sheds new light on gender disparities in science by studying the interplay between research content, gender composition, and multiplex networks. This work, in particular, investigates collaboration and citation networks among scientists concerned with breast and prostate cancer, gender-specific illnesses ranked among the most diagnosed cancers globally, accounting for over 11% and 7% of cases, respectively, in 2022 [8]. Focusing on these two communities as strategic research sites allows this study to investigate whether female scholars are under- or overrepresented according to a fields' research content and how network mechanisms, such as gender homophily, differ between prostate and breast cancer research. Thereby, the study speaks to recent accounts in the Science of Science literature highlighting the context sensitivity of network mechanisms [9-10] and the linkage between research content and the gender of investigators [11-12]. Empirically, the paper analyzes a subsample of the PubMed Knowledge graph comprising over 31 million articles authored by 18 million researchers from 1781 to 2022 [13] with network-analytical tools in combination with machine-learning-based classification of researchers' gender. Preliminary findings are indicative of the importance of gendered research content for the composition of scientific fields: in prostate cancer research, nearly one-third of publications are authored exclusively by men. In comparison, breast cancer research shows a balanced gender distribution, with similar proportions of all-female and all-male teams. Mixed-gender teams account for approximately 50% of publications in both cancers (see Table 1). The next step of the analysis aims to investigate gender homophily in both fields. Figure 1 shows the co-authorship network among prostate cancer researchers, with node colors indicating gender: orange for women, purple for men, grey for unknown gender, and green for androgynous individuals. A prominent homogeneous male cluster is observable. In further analysis, the study will investigate researchers' prominence in citation and collaboration networks, different levels of gender homophily between the two research communities, and how gender disparities developed over time. Thereby, this study will deepen our understanding of gendered knowledge production and contextualize previous findings that focused on overall trends instead of comparing fields with different gender-specific research contents.

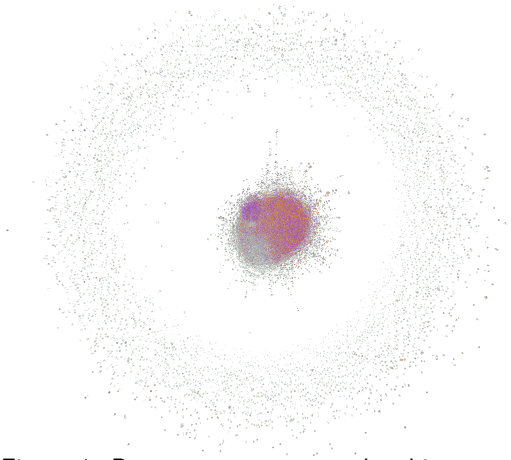

Figure 1: Prostate cancer co-authorship network

observation	breast cancer research	prostate cancer research
gender distribution of authors		
Male authors	35.69 %	51.33 %
Female authors	30.85 %	20.71 %
Others	33.46 %[1]	27.96 %[1]
gender-homogeneous publications		
Male-only	16.91 %	29.41 %
Female-only	10.96 %	4.63 %
Others	72.13 %[2]	65.96 %[2]

Table 1: Gender distribution of authors in cancer research

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[1]Remaining percentages to 100% belong to other gender classifications, namely unknown, mostly male, mostly female and androgynous.
[2]Remaining percentages to 100% belong to other gender-combinations, namely unknown and mixed-gender.