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Gender Variations in Research Productivity: Insights from Scholarly Research

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Abstract

The variations in research productivity available in the scholarly world, between men and women, have always attracted the interest of many researchers across the globe. The present study aims to identify the differences in research productivity, patent creation, funding, collaboration, citation and impact between men and women across regions and disciplines over a period of time. After the comprehensive literature survey, results of various studies were correlated in a systematic manner for further analyses to reveal the findings and draw conclusions. The findings clearly depict that comparatively, males have a higher average productivity than females for all the performance indicators especially research productivity, patent creation, funding and collaboration across regions and disciplines; however, the gap is narrowing with the passage of time. The researchers have noted many factors, personal as well as academic, responsible for the limited productivity of women in research. Age, marriage, children and domestic workload are some personal factors badly affecting research productivity of women whereas less representation of women in higher education, low academic ranks, and fewer research funds are some of the academic factors affecting the research productivity negatively. In order to eliminate the gender differences in research productivity, some recommendations have been provided.

Keywords

Gender Variation; Gender Differences; Research Productivity; Research Performance; Research Output; Research Funding; Gender Bias; Research Impact

Introduction

The world has been dominated by men since its inception. However, the advocacy of women empowerment has taken a strong movement all over the world. Policies on women's empowerment exist at the international, national, state, and local levels in many sectors, including education, employment, health, and politics. However, there are significant gaps between policy advancements and their actual implementation at the ground level. The women participation in all these fields is still limited.

Research Design

Purpose of the study

The variations in research productivity between men and women available in the scholarly world have always attracted interest of researchers across the globe. The present study aims to identify the differences in research productivity, patent creation, funding, collaboration, citation and impact between men and women across regions and disciplines over a period of time.

Although females are improving their position in the academic and scholarly world, their contribution needs to be studied at regular intervals to pinpoint the change. The study is a step forward in this regard.

Methodology

The comprehensive literature survey was conducted in various online databases and search tools like Web of Science, Taylor and Francis Online, Jstor, Google Scholar etc. to observe the trend in order to reveal the findings. However, few articles were also collected offline from current and back volumes of journals.

Gender Variations in Research

a) Women Representation

Men researchers are significantly higher than women in all the research fields especially Engineering (**Glover 2002; Kulis, Sicotte & Collins, 2002**), Technology (**Mauleo'n & Bordons 2010**), Math-intensive fields (**Ceci & Williams 2010**) and Nano Science and Technology (**Sotudeh & Khoshian, 2013**). Women represent one-third of research workers in European nations raised from one-sixth of research workers in 2006 He further pointed out that the number of female heads of higher education institutions rose from 15.5 % in 2010 to 20 % in 2014 (**European Commission, 2016**). More and more, European women are excelling in higher education, and yet, there is clearly still a long way to go before we reach gender equality in European research and innovation professions. **Schiffbänker (2009)** more recently depicted that on management and executive boards; less than 6% of the positions are held by women, while on scientific boards, only 10% are female researchers. The women representation in higher education institutions is not satisfactory. Many reasons are responsible for their under-representation. **Oliveira & Carvalho (2009)** found that there are lower percentages of women with PhDs in most of the countries and therefore, have less chance to be recruited in the higher educational institutions. More recent data showed that the performance gap has been closed for Ph.D. students (**Ceci et al. 2014**).

There is also an issue of gender bias in academic recruitment and selection, leading to lower success rates of female applicants (**Van den Brink, Brouns, & Waslander, 2006; Van den Brink 2009**). **Zinovyeva & Bagues (2010)** confirmed not only men-against-women but women-against-women discriminations. They argued that the presence of female evaluators at promotion committees for choosing applicants qualified for associate/professor positions was likely to reduce female applicants' chances, while increasing the possibility of males' success. **Long & Fox (1995)** observed that in the academic setting, women in research universities occupy lower academic ranks. **Ginther & Kahn (2006)** revealed that women succeed less often in getting tenure or promote to a professor. **Danell & Hjerm (2012)** found out that in spite of policies aiming to increase the proportion of Swedish female professors, they are still disproportionate to males in achieving a professorship, and their situation is not improving over time. Female researchers have a slower career, and on average end at lower positions; women are still underrepresented in the higher academic positions and men outnumber women in positions of formal power (**Van den Besselaar & Sandstrom, 2015**). However, the share of women in academia is gradually increasing especially in developed countries. Female students nowadays even outnumber male students, with 55 % in the UK and USA and with 59 % in the Scandinavian countries (**OECD 2010**). Indeed we have witnessed increased performance of girls in the educational system, and at all levels, girls are outperforming boys (**Buchmann, DiPrete, & McDaniel 2008; Pekkarinen 2008**). This less

representation of women's in academic and research institutions is also a serious issue that needs to be resolved. Although females are improving their position in the academic and scholarly world but still few steps are mandatory for their better representation in the scholarly world. It is, thus, recommended that women should achieve higher degrees in education so that they will get absorbed in higher educational and research institutions. Moreover, the bias and favoritism (wherever evident) in recruitment needs to be avoided so that women will get equal chances of selection in research institutions. The reservation policy for women in academic positions can also be helpful to eradicate the problem completely. Further, few research institutions need to be established exclusively for females with all modern facilities and services to improve their research performance.

b) Research Productivity

The research productivity gap between male and female researchers is evident from 1980s till date, with men on average publishing more papers than female researchers (**Cole & Zuckerman, 1984; Zuckerman, 1991; Lemoine, 1992a/b; Long, 1992; Xie & Shauman, 1998; Nakhaie, 2002; Prpic, 2002; Sax et al., 2002; Stack, 2004; Penas & Willett, 2006; Symonds et al., 2006; Taylor, et al., 2006; Ledin, et al., 2007; Abramo, D'Angelo, & Caprasecca, 2009a; Pudovkin et al., 2012 Frandsen, et al., 2015 and Ebadi & Schiffauerova, 2016**). The lesser productivity of females has been established in many studies of diverse countries and disciplines, spanning decades and using a wide variety of measures (**Fox, 1983; Cole & Zuckerman, 1984; Long 1987**). In 1991, **Zuckerman (1991)** found that women published, on average, 40 to 50% fewer articles than men. Later, **Xie & Shauman, (1998)** reported that there was a gap of approximately 30% in research productivity between men and women. **Prpic (2002)** and **Fox (2005)** revealed that women publish between 70-80% as many articles as men. In the same lines, **Symonds et al. (2006)** and **Erin (2006)** found that there is a clear difference in the number of publications produced by males and females, with men publishing on average almost 40% more papers than women. **Erin (2006)** confirmed that the gender difference in research output is large and statistically significant as men on average publish sixteen (16) papers and women ten (10). **Lariviere, et al. (2011)** also found that male researchers in the field of health published, on average, 19 articles from 2000–2008 whereas their female counterparts published approximately 12 articles. In Natural Science and Engineering, there is a 20% difference (19 vs.13 articles) and in Social Science and Humanities a 40% difference (32 vs. 23 articles). In more recent studies, **Frandsen, et al. (2015)** and **Ebadi & Schiffauerova (2016)** depicted that the average total number of publication is slightly higher for men than for women.

In spite of the increase in women's publications, there still exists a gender gap in terms of scientific production (**Sax et al., 2002**). **Ebadi & Schiffauerova (2016)** focused on the Canadian researchers who are active in Science and engineering and evaluate the gender role in scientific production, funding, and research. The results revealed that male researchers have published almost five (5) times more than their female counterparts. The findings of Venezuelan researchers (**Lemoine, (1992a)**); Indian Scientists (**Lemoine, (1992b)**); Indian psychologists (**Goel, 2002**); Italian researchers (**Abramo, D'Angelo, & Caprasecca, 2009a**); social psychologists (**Cikara, Rudman, & Fiske, 2012**); German medical researchers (**Kretschmer, Pudovkin & Stegmann, 2012**); Spanish psychologists (**Barrios, Villarroya, & Borrego, 2013**); Italian scientists (**Baccini, Barabesi, Cioni, & Pisani, 2014**); Swedish physicians (**Fridner et al., 2015**) and German cardiologists (**Bohm, Papoutsis, Gottwik, & Ukena, 2015**) are confirmed by the Canadian scholars (**Ebadi & Schiffauerova, 2016**) in recent study providing a clear evidence of a gender gap in research performance documenting women researchers to be less productive than men.

According to few recent studies, women's scientific and social research shows improvements (**Mendlowicz et al. 2011; Van Arensbergen, Van der Weijden, & Van den Besselaar, 2011; Kretschmer, Pudovkin & Stegmann, 2012; Vela, Caceres, & Caverio 2012**), though performance gap isn't completely disappeared. **Gonzales-Brambila & Veloso, (2007)** reported that only minimal gender variations were found in the productivity of the Mexican scientists. **Mendlowicz et al. (2011)** estimated that women's total share of publications in the Brazilian psychiatric journals has been increasing during 2001–2008. **Van Arensbergen, Van der Weijden, & Van den Besselaar (2011)** found that the gendered performance differences seem to be disappearing in the youngest generation of researchers. **Mauleon et al. (2012)** also concluded that a gender gap favoring men in all these categories, though the gap was found to be diminishing over the years in most areas.

However, findings of few studies aren't in tune with the above results. **Shrum, (1997)** revealed that there is no noticeable gender differentiation in the international visibility of the publications of researchers in Ghana, Kenya and the Indian State of Kerala. **Gupta, Kumar & Aggarwal (1999)** found that the average productivity of Indian female and male scientists in the physical sciences, biology and engineering sciences was not significantly different. Further, no significant gender differentiation was found in the publication productivity of Brazilian astronomers, immunologists, and oceanographers (**Leta & Lewison, 2003**). **Bordons et al. (2003)** investigated the scientific productivity of researchers in Natural Resources and Chemistry in Spain based on their gender and professional ranks. They found no significant differences between women and men in their scientific productions. **Van Arensbergen, Van der Weijden, & Van den Besselaar (2011)** found that in the new generation researchers, the gender gap wasn't only gradually fading away, but also young female researchers were even outperforming their male peers. The performance gap is one of the most consistent findings in research productivity even in developed countries and irrespective of the disciplinary barriers. However, while correlating the facts, the performance gap varies; majority found the gap statistically significant while few insignificant. The overall trend shows that research gap has narrowed with the passage of time and isn't as wide as found in the early 1980s.

Overall, the available literature on gender variations in research productivity indicates that gender inequality in research production is visible in all disciplines and countries. The results clearly depict that comparatively, males have average research productivity than females. Many factors are responsible for the limited productivity of women in research. Age, marriage, children and domestic workload are some personal factors badly affecting research productivity of women whereas less representation of women in higher education, low academic ranks, and fewer research funds are some of the academic factors affecting the research productivity negatively. **Kyvik & Teigen (1996)** and **Ginther & Kahn (2006)** find that family conditions affect males and females' scientific prospects in different ways. While pregnancy and childbirth prevent women from promoting to higher ranks e.g. postdoctoral studies, being married and having children help men in their scientific progress. **Martinez et al. (2007)** found that in the United States, family engagements, especially having children and having to spend time with them and other members of the household were of main hindering factors in this regard. **Schiffbänker (2009)** reports that women describe employment interruption after childbirth and maternity leave as the main effect on their career and research output (**Frandsen, et al. 2015**). Women generally publish less than their male counterparts, with mother researchers being expectedly even less productive during pregnancy and child-rearing periods. The females' parental roles, though vital to human life and survival in their natures, are unfortunately underestimated and used against women, resulting in

wide-spread sexual biases throughout the world (**Ginther 2003; Villaroya et al. 2008; Zinovyeva & Bagues 2010**). Moreover, the menstruation cycle cuts the month from 30 to 26 days for women may also be one of the factors responsible for their less research performance. During these tough times, the women researchers need extra support from their families and institutions. Families must provide a helping hand to the women's at this juncture. Academic and research institutions have to show interest and flexibility in these matters as marriage and childcare are not an individual but a social concern which needs to be addressed jointly.

c) Patent Creation

The research gap in filing patents is also confirmed by a good number of studies e.g. **Naldi & Parenti (2002); (Ding, Murray, & Stuart, 2006); and Busolt & Kugele (2009)**. **Naldi & Parenti (2002)** found that women inventors are underrepresented in all European member states.

Ding, Murray & Stuart (2006) reported that men seem to apply for more patents than women. More recently **Busolt & Kugele (2009)** revealed that women are considerably underrepresented among inventors in Europe as only 8% of all European inventors are female and 92% are male, which indicates that approximately one in twelve inventors is a woman. There is a huge gap among the inventions made by men and women and the patent filed.

d) Authorship Patterns

As early instances, **Cole & Zuckerman (1984)** and **Long (1992)** affirmed females' low scientific productivity and underrepresentation among prolific authors. **Lemoine (1992a)** found that more males are star scientists as compared to females. **Guerrero-Bote et al. (2009)** depicted that women are disproportionately lower in number as the first authors. In recent studies, the researchers e.g. **Sotudeh & Khoshian (2013), Mauleon et al. (2012), Mendlowicz et al. (2011)** women were increasingly found to be the first author, signifying the start of a movement towards elimination of the gender gap in the first authorship patterns. Moreover, the gap between men and women in the prolific authors and star scientists is wider as the women authors haven't made any visible progress in this regard. However, with the diminishing gap in the research productivity and patent creation, more women authors and scientists may find the place in prolific authors and star scientists.

e) Citations and Impact

The majority of the studies revealed that men receive more citations than females (**Cole & Zuckerman, 1984; Xie & Shauman, 1998; Nakhaie, 2002; Campion & Shrum, 2004; Hakanson 2005; Lewison & Markusova 2011; Pudovkin et al. 2012**). A few studies even found a higher citation score for women than for men (**Long, 1992; Symonds et al. 2006; Powell, et al., 2009; Sandstrom, 2009**) while few declared that there is no gender gap in citations of publications (**Leta & Lewison 2003; Penas & Willett, 2006; Tower, Plummer & Ridgewall, 2007; Borrego et al. 2008; Abramo, D'Angelo & Caprasecca, 2009b**). In a large-scale study of Norwegian researchers in all areas of knowledge, **Aksnes et al. (2011)** found out that female researchers are slightly less cited than their male peers. Thus, it is very difficult to derive a general pattern of the genders' impacts to interpret the findings as the results of various studies don't show the same trend over a period of time.

f) Research Funding

The studies confirmed that there are clear variations in research funding support between the men and women scholars. Women receive less support and mentoring than men (**Landino & Owen 1988; Fuchs, Von- Stebut & Allmendinger 2001; Leta & Lewison 2003; Lariviere et al. 2011**).

Wenneras & Wold (2000) believed that women's poor scientific activity and slow progress was rooted in fact in the unbalanced distribution of budgets among women and men. **Leta & Lewison (2003)** reveal that women were less likely to win scholarships. **Lariviere et al (2011)** show that on average, women professors in Canada receive less funding for research than men. **Van Dijk, Manor, & Carey, (2014)** revealed that men become principal investigator of research projects more often than women. The equal distribution of research grants and special research grants for women can positively influence the research productivity of women researchers.

g) Restrictive Collaborative Networks

Women have more restricted collaboration networks, less academic ranks and fewer editorial assignments and meager academic grants that badly affect their research production. Research has also provided evidence that men and women's networks differ (**Moore, 1990**). Female researchers have a less developed international collaboration and co-authoring network (**Allison & Long 1990; McNamee et al. 1990; Grant & Ward 1991; Dundar & Lewis 1998; Renzulli, Aldrich & Moody 2000; Prpic 2002; Lee & Bozeman 2005; Bland et al. 2006; Carayol & Matt 2006; Leahey 2006; Taylor et al., 2006; Puuska 2010**) which all affects performance and career in a negative way. Male researchers generally have better networks than female researchers (**Kanter 1977; Kyvik & Teigen 1996; Burt 1998; Burt 2004; Fuchs, Von-Stebut & Allmendinger, 2001**) and collaboration influences performance (**Lee & Bozeman 2005**). Men's wider and more diverse professional networks may allow them to find collaborators and build strong networks for their research benefits. Female academicians also show resistance to visit abroad especially in developing countries that also affects their collaboration with their peers. Moreover, less percentage of women participation in social networking sites that also hinders their growth rate in connecting with the scholars outside their institutions. Besides, **Vela, Caceres, & Caverio (2012)** found that women are considerably less frequent as editorial board members in the field. Women have to actively engage themselves in academic networks in order to be in touch with fellow academicians and peers. The modern technology especially social networking sites can be helpful in this regard. Women's connections with larger academicians can also be helpful for them in getting editorial assignments in reputed journals as well.

Conclusion

In nutshell, men, comparatively throughout their careers, remain more productive than women in research. However, the positive trend derived from the literature is that despite the continued existence of the gender differences in research productivity, patent creation, funding, and collaboration, women's research activity has been clearly improving, and gender gap in research is gradually disappearing with the passage of time, though not completely eradicated as many obstacles hinders their performance. All these problems need to be addressed through national policies.

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