# Factors affecting citations: A Bibliometric study of highly productive authors of Pakistan

**Nazia Wahid**
Fatima Jinnah Woman University, Rawalpindi, Pakistan. Email:naziasiff@gmail.com
**Muzammil Tahira***
University of Education, Lahore, Pakistan. Email:mtahira@ue.edu.pk
**Muhammad Nauman**
University of Engineering and Technology, Peshawar, Pakistan. Email:mrnauman1999@gmail.com

The study aimed to investigate the citation patterns of the most productive Pakistani authors. It also examined the factors influencing citation behavior and counts. A quantitative study design and Bibliometric approach were employed to attain the study objectives. One hundred of the most productive authors were identified from ten years of publication data of the top Ten Pakistani Universities ranked in the Web of Science (WoS).

The bibliographic details of their publications and related citation data were extracted and descriptive and inferential statistics were performed to analyze the data. It was found that the authors have published 10907 publications, obtaining widely scattered 198636 citations. One-tenth of the publications were not cited, and some just had one citation. The findings of the statistical tests for the difference in citation counts by different types of publications revealed a significant difference between academic ranks, single and collaborated publications, collaboration types, journal quartile, journal impact factor, different document types, funded and non-funded publications, and publications in local and foreign journals. Moreover, funded publications, publications in foreign journals, international collaborated publications, and review papers received more citations. The study contributes to the literature by highlighting valued factors of scholarly productivity. Keeping these factors under consideration may help researchers, HEIs, and policymakers when revising academic research policies.

**Keywords**: Citation Analysis, Bibliometric Analysis, Research Performance Evaluation, Influencing factors, Collaboration.

***Corresponding Author***


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## INTRODUCTION

Annually, a large number of research publications are produced in a wide range of academic fields. This publishing frequency has been progressively increasing over time. As researchers strive for recognition and acknowledgement, it is essential to assess this scientific communication. Research publications and citation counts are the main tools used for measuring the research performance of individuals. These are key indicators of the ranking criteria and garner great attention due to their weightage in Journal Impact Factor (JIF), h-index, and other performance evaluation indices. Citations are used as a prevalent impact indicator to assess the outcomes of research (Bai, Zhang & Lee, 2019). They support the scholars' efforts and contribute toward acknowledging their commitment to the subject. Citing reliable sources increases an author's credibility and integrity. Citation counts are significant measures commonly used to evaluate the research impact (Abramo, D'Angelo, & Costa, 2011; Bornmann, Schier, & Daniel, 2012; Bai et al., 2019).

Publications and citations are primary data sources used to evaluate research performance (Gul et al., 2015). Citations, in particular, have increased in importance as significant indicators of research performance in the evaluation process. The increasing importance of citations as performance measures has given rise to examining the citation patterns of elite researchers to explore their productivity levels. Furthermore, H-index (Hirsch, 2005), g-index (Egghe, 2006), and many other indices have also been proposed to evaluate the researchers' performance.

Several studies have explored the research productivity of trauma surgeons (Elkbuli et al., 2020), researchers in Saudi universities (Ghabban et al., 2019), agricultural scientists (Veldandi Babu, Naik, & Sagar, 2022), academic staff at the University in Vietnam (Phuong, Chi, Quang, & Diew, 2022), and academics in Malaysian universities (Muhammad et al., 2023), and have attempted to identify the factors affecting their citations. The citations are subjected to several determining characteristics. Scholarly research has exposed various determinants influencing research productivity and impact. These characteristics are generally related to authors, journals, and publications (Amara, Landry, & Halilem., 2015; Tahamtan, Afshar, & Ahamdzadeh, 2016; Wahid, Warraich, & Tahira, 2022). A research paper's impact is affected by the number of contributing authors and the availability of financial support. Funding plays a significant role in increasing the impact of researchers and decreasing the number of uncited papers in different fields (Asubiaro, 2019; Zhao, Yu, Tan, Xu, & Yu., 2016). Research papers supported by more funding agencies achieve a higher impact. Asubiaro (2019) has found funding and international collaboration to be the influencing determinants of citation counts. Several studies have revealed that collaboration increases the number of citations (Kyvik & Aksnes,


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2015; Bosquet & Combes, 2013). International research collaboration was found to be one of the most influential correlates of high research productivity among researchers in European countries (Kwiek, 2016). Moreover, research articles published in high-impact factor journals received more citations than those articles, published in other journals. Various authors have explored this characteristic of many citations in their studies (Adusumilli et al., 2005; Vanclay, 2013).

The growing significance of citations as performance measures has created interest in exploring the citation patterns of Pakistani researchers. Knowing the factors that enhance citations offers various benefits, ranging from personal career improvement to contributing to the overall knowledge within a specific profession. The research productivity and its characteristics are consequential for individuals and institutions in developing countries. The study findings would be helpful for the individuals to improve their productivity and for the policymakers to implement those policies at the institutional level to improve rankings. The current research study has used the bibliometric approach for citation analysis of the highly productive Pakistani authors and explored the factors increasing their research publication productivity and impact.

**Research Questions**

a. What are the citation patterns of the highly productive authors?
b. What is the pattern of collaboration of highly productive authors?
c. Which collaboration pattern of the authors receive the maximum citation counts?
d. How do the funding status and academic rank affect the citation counts?
e. How does the journal type and journal quartile affect the citations?

## METHODOLOGY

Citation data of the research articles of highly prolific Pakistani authors has been analyzed using bibliometric techniques. One hundred most prolific authors have been recognized from ten years of publication data (2007-2016) of the top ten Pakistani Universities ranked in the Web of Science (WoS) (Wahid, Warraich, Tahira, 2024). An advanced search option for the field country (CU) in the WoS database was conducted, and the data was filtered for the ten years from 2007-2016 and articles, proceedings papers, reviews, and corrections were selected. The 56,873 documents retrieved had been published by authors from more than 100 universities. Considering the research study's objectives and the representation of authors from more universities, the top ten most productive universities were selected from the retrieved data. Each university's top ten highly productive authors were selected based on retrieved data,


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and others were excluded. Citation data sets were extracted for these authors until 2018, considering the two-year citation window. After retrieving the data, each author's academic rank (professor, associate professor, and assistant professor) was checked using the affiliation website (Pagel & Hudetz, 2011; Amara et al., 2015). Descriptive and inferential statistics were performed to analyze the quantitative data. Kruskal Wallis and Mann-Whitney tests were applied to detect the significant difference between different types of publications. Numerous studies have employed these tests to analyze the citations (Ibanez, Bielza, & Larranaga, 2013; Ni & An, 2018; Asubiaro, 2019; Fan, Wang, Ding, & Qi, 2020).

## Results

Demographic analysis (Table 1) of the data showed that out of total authors 87 were males, while other 13 were females. Majority of the authors were associated with the discipline of physical science and the fields of life sciences and biomedicine. Only four authors belonged to the area of technology. Most of these most productive authors were on the position of professors, followed by associate professors and assistant professors, respectively.

**Table 1**

*Demographic Information of 100 Highly Productive Authors*

| Demographic | Frequency |
|---|---|
| ***Gender*** | |
| Male | 87 |
| Female | 13 |
| ***Discipline*** | |
| Life Sciences and Biomedicine | 44 |
| Physical Science | 52 |
| Technology | 4 |
| ***Academic Rank*** | |
| Professors | 61 |
| Associate Professors | 26 |
| Assistant Professors | 13 |

Figure 1 below reveals the annual distribution of Total Publications (TP) and Total Citations (TC), depicting the tremendous growth during the period. 10907 articles were published by these highly prolific Pakistani authors, and these publications obtained 198636 citations until 2018. On the other hand, 1003 publications remained not cited, with some with just one citation. Conversely, half of the cited publications received ten or less than ten citations. Twenty-one publications received more than 500 citations, and eight received more than 1000. The majority of the publications were collaborative


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works of many authors. There were a minimal number of solo-authored publications (Figure 2). The citation counts of the co-authored publications (99.13%) was higher than those of solo-authored publications (0.86%). The findings revealed that the citations per publication for multi-authored research papers were higher than that of solo and double-authored research papers.

**Figure 1**

*Year-Wise Distribution of Citations*

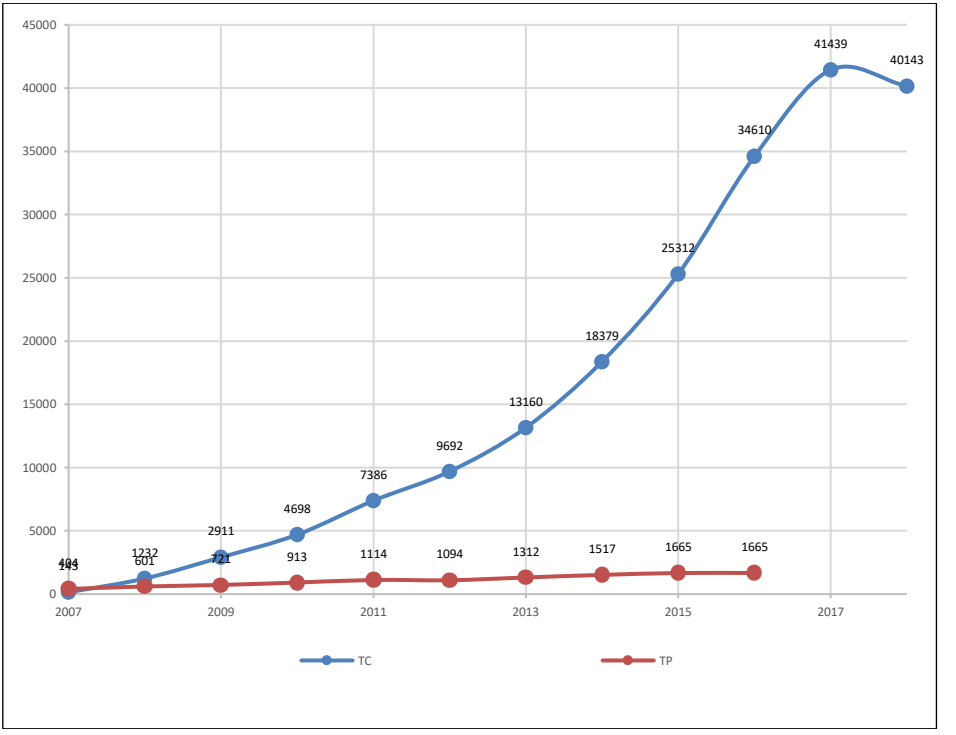



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**Figure 2**

*Publications and Citations for Single, Double and Multi-authored Articles*

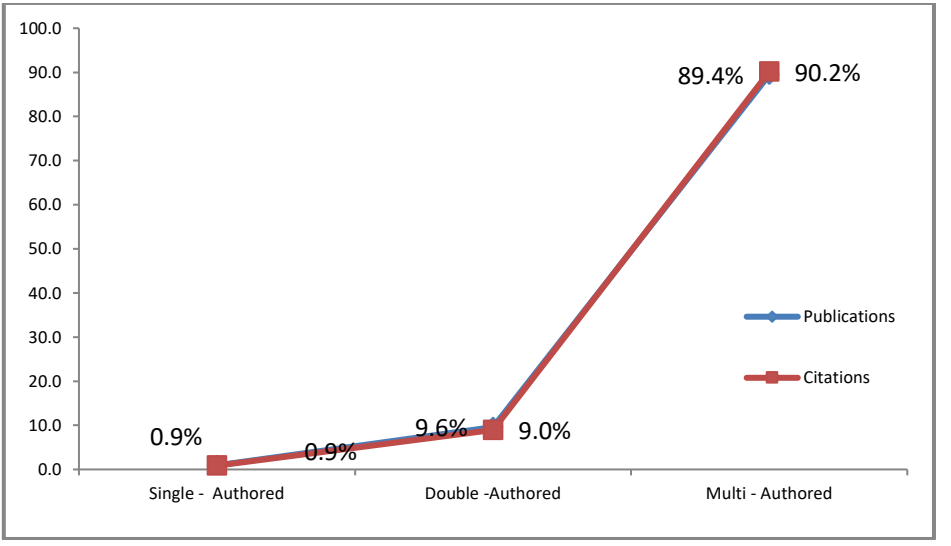
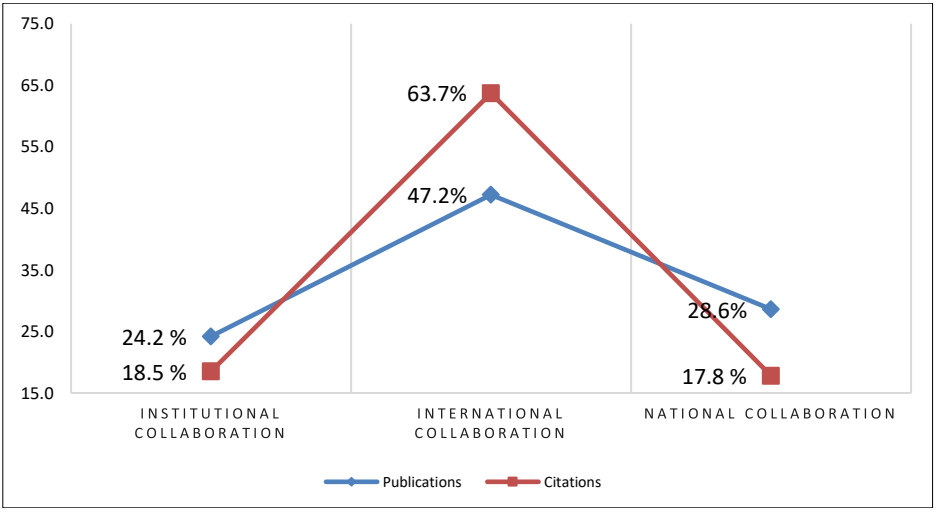



**Figure 3**

*Publications and Citations for Institutional, International and National Collaborated Articles*





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Moreover, the number of citations per publication of international and national collaborated publications was higher than that of institutional and national collaborated publications (Figure 3). Citations per document type review were also remarkably higher than for other document types. Original articles received more citations (16.6 citations per publication) than proceeding papers (10.6 citations per publication). Most of these authors' publications were funded. Citations for funded publications were more than the citations for non-funded publications.

To find out the observed differences in publication trends of the top productive authors regarding the total number of citations and the citation patterns of these highly productive authors, some statistical examination was carried out for funded and non-funded publications, national and international journals, collaborated publications at the institutional, national and international levels, academic ranks, and journal impact metrics. The following hypotheses were designed and tested using Mann-Whitney U and Kruskal-Wallis statistical tests

**Total Citations and Funded and Non-Funded Publications**

A statistical test was conducted to assess whether significant differences existed between funded and not-funded publications regarding the total number of citations. Mann- Whitney U results from Table 2 show a significant difference between the publications having funding and without funding publications in terms of the total citation counts. Therefore, our first hypothesis that there is no statistical difference between funded and non-funded publications for total citations is rejected, with $p<0.05$. The mean rank shows that the publications having funding received more citations than the publications without funding.

**Table 2**

*Statistical Test for Funding Status and Total Citations*

| | Description | N | Mean Rank | Sum of Ranks |
|---|---|---|---|---|
| Total citations | Funded Publications | 5540 | 5551.52 | 30755399.00 |
| | Not Funded Publications | 5367 | 5353.34 | 28731379.00 |
| | Total | 10907 | | |
| | Mann-Whitney U | | | 14326351.000 |
| | Asymp. Sig. (2-tailed) | | | .001 |


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**Total Citations and National and International Journals Publications' Citations**

A statistical test was conducted to identify whether significant differences exist between the publication trends towards foreign and local journals regarding the total number of citations. Mann-Whitney U results from Table 3 shows a significant difference between the national and international journal publications' citations in terms of the total number of citations. Therefore, our second hypothesis that there is no statistical difference between national and international publications for total citations is rejected, with $p<0.05$. Mean rank shows that the publications in foreign journals received more citations as compared to the local journal publications

**Table 3**

*Statistical Test for Journal Types and Total Citations*

| Description | | N | Mean Rank | Sum of Ranks |
|---|---|---|---|---|
| Total citations | International journal publications citations | 9471 | 5733.84 | 54305185.00 |
| | National journal publications citations | 1436 | 3608.35 | 5181593.00 |
| | Total | 10907 | | |
| | Mann-Whitney U | | | 4149827.000 |
| | Asymp. Sig. (2-tailed) | | | .000 |

**Total Citations and Collaborated Publications' Citations**

A statistical test was conducted to recognize whether significant differences existed between single and collaborated publications regarding the total number of citations. Mann-Whitney U results from Table 4 depicts a significant difference in the total citation counts between the single and co-authored publications. Therefore, the third hypothesis that there is no statistical difference between single and collaborated publications for total citations is rejected, with $p<.05$. Mean rank shows that collaborated publications received more citations as compared to single-authored publications.


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**Table 4**

*Statistical Test for Collaboration and Total Citations*

| | Description | N | Mean Rank | Sum of Ranks |
|---|---|---|---|---|
| Total citations | Single-authored publication's citations | 103 | 5448.50 | 561195.50 |
| | Collaborated publication's citations | 10804 | 6030.93 | 65153522.00 |
| | Total | 10907 | | |
| | Mann-Whitney U | | | 496982.500 |
| | Asymp. Sig. (2-tailed) | | | .047 |

**Total Citations and Different Collaboration Types of Publications' Citations**

A statistical test was conducted to find out the significant differences between different collaboration types of publications regarding the total number of citations. Kruskal-Wallis results from Table 5 reveal that there were significant differences between at least two types of collaboration regarding the total citation counts. Therefore, the hypothesis that there is no statistical difference between different collaboration types for total citations is rejected, with $p<0.05$. This infers the significant differences between international, external-institutional, and internal-institutional collaborative publications.

**Table 5**

*Statistical Test for Collaboration Types and Total Citations*

| | Description | N | Mean Rank |
|---|---|---|---|
| Total Citations | International | 5096 | 5924.62 |
| | External – Institutional | 3095 | 4683.39 |
| | Internal – Institutional | 2613 | 5236.00 |
| | Total | 10804 | |
| | Chi-Square | | 315.559 |
| | Df | | 2 |
| | Asymp. Sig. | | .000 |

Three Mann-Whitney U statistical tests were applied for collaboration types to identify the significantly different means between the pairs of variables. The results of all three tests are presented in Table 6 which shows that all the hypotheses were rejected with $p<.05$. It implies that international collaborated publications (mean


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rank=4450) received more citations than external-institutional collaborated publications (mean rank=3512), internal-institutional collaborated publications (mean rank=3015) received more citations than external-institutional collaborated publications (mean rank=2718) and international collaborated publications (mean rank=4022) received more citations than internal-institutional collaborated publications (mean rank=3527)

**Table 6**

*Statistical Test for Collaboration Types and Total Citations*

| Description | | N | Mean Rank | Sum of Ranks | Mann-Whitney U | Asymp. Sig. (2-tailed) |
|---|---|---|---|---|---|---|
| Total Citations | International | 5096 | 4450.4 | 22679065 | 6080212 | .000 |
| | External - Institutional | 3095 | 3512.5 | 10871272 | | |
| | Total | 8191 | | | | |
| Total Citations | External - Institutional | 3095 | 2718.9 | 8414896 | 3623836 | .000 |
| | Internal -Institutional | 2613 | 3015.2 | 7878591 | | |
| | Total | 5708 | | | | |
| Total Citations | International | 5096 | 4022.8 | 20499937 | 5803068 | .000 |
| | Internal -Institutional | 2613 | 3527.8 | 9218259 | | |
| | Total | 7709 | | | | |

**Academic Rank and Total Citations**

A statistical test was conducted to find out whether significant differences existed between different academic ranks of authors concerning the total number of citations. Kruskal-Wallis results from Table 7 reveal that there were significant differences between at least two types of academic ranks in terms of the total number of citations. Therefore, $H_6$, that there is no statistical difference between different academic ranks for total citations, is rejected, with $p<0.05$. This concludes the significant differences between professors, associate professors, and assistant professors.


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**Table 7**

*Statistical Test for Academic Ranks and Total Citations*

| Description | | N | Mean Rank |
|---|---|---|---|
| Total citations | Assistant Professor | 1093 | 6162.47 |
| | Associate Professor | 2141 | 5205.54 |
| | Professor | 7673 | 5422.41 |
| | Total | 10907 | |
| | Chi-Square | | 69.611 |
| | Df | | 2 |
| | Asymp. Sig. | | .000 |

Three Mann-Whitney U statistical tests were applied for academic ranks to explore the significantly different means between the sets of variables. The results of all three tests are presented in Table 8, which shows all the hypotheses were rejected with $p<.05$. This implies that publications of assistant professors (mean rank=1806) received more citations than publications of professors (mean rank=1521); publications of assistant professors (mean rank=4903) received more citations than publications of associate professors (mean rank=4309), and publications of professors (mean rank=7673) received more citations than publications of associate professors (mean rank=2141).

**Table 8**

*Statistical Test for Collaboration Types and Total Citations*

| Academic Rank | | N | Mean Rank | Sum of Ranks | Mann-Whitney U | Asymp. Sig. (2-tailed) |
|---|---|---|---|---|---|---|
| Total citations | Assistant Professor | 1093 | 1806.3 | 1974278 | 963706 | .000 |
| | Associate Professor | 2141 | 1521.1 | 3256717 | | |
| | Total | 3234 | | | | |
| Total citations | Assistant Professor | 1093 | 4903.2 | 5359173 | 3625287 | .000 |
| | Professor | 7673 | 4309.5 | 33066588 | | |
| | Total | 8766 | | | | |
| Total citations | Associate Professor | 2141 | 4755.4 | 10181356 | 7888345 | .005 |
| | Professor | 7673 | 4949.9 | 37980850 | | |
| | Total | 9814 | | | | |


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**Journal Quartile and Total Citations**

A statistical test was conducted to find out whether significant differences existed between different journal quartiles concerning the total number of citations. Kruskal-Wallis results from Table 9 show that there were significant differences between at least two journal quartiles in terms of the total number of citations. Therefore, the hypothesis that there is no statistical difference between journal quartiles for total citations is rejected, with $p<0.05$. This deduces the significant difference between journal quartiles 1, 2, and 3..

**Table 9**

*Statistical Test for Journal Quartiles and Total Citations*

| | Journal Quartile | N | Mean Rank |
|---|---|---|---|
| Total citations | Quartile 1 | 2212 | 7550.92 |
| | Quartile 2 | 2319 | 6537.68 |
| | Quartile 3 | 2545 | 5339.08 |
| | Quartile 4 | 3831 | 3654.61 |
| | Total | | 10907 |
| | Chi-Square | | 2517.577 |
| | Df | | 3 |
| | Asymp. Sig. | | 000 |

## DISCUSSION

The study was limited to 100 highly prolific authors from the top Ten Pakistani Universities based on the selection criteria from the WoS. Only ten highly productive faculty members from each selected university were taken for the study to analyze their publication data over ten years (2007-2016) and citation data over twelve years (2007-2018). A firm increase in the citations of entire productive authors was detected throughout the twelve years. The citation counts of the review papers were found much more than the citation counts of the research articles. Reviews of these productive authors gathered more citations as compared to other document types. This finding is consistent with previous studies (Aksnes, 2003; Ruano-Ravina & Alvarez-Dardet, 2012; Trapp, 2016), where researchers have claimed a high probability of citations for review articles of journals. Annalingam, Damayanthi, Jayawardena, and Ranasinghe (2014) have also claimed that systematic reviews significantly enhanced the number of citations. The citation counts of the co-authored publications were found higher than those of the solo-authored publications. The citation count of the international collaborated publications was also found to be higher than the other two types of publications. Overall, the citations of the internationally collaborated


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publications were two times higher than those of nationally collaborated publications. Citations of publications of male authors were higher than those of female authors. Another study finding is the high visibility of the research produced by these authors, as reflected in the low proportion of uncited publications. Most of the publications of these authors (193) were cited, while zero-citation publications were minimal in numbers.

The study findings highlight a significant difference between the funded and non-funded publications in terms of the total number of citations. The funded publications were more highly cited than the non-funded publications, and the difference was found to be significant, supporting the results of Asubiaro (2018), who has reported that funded publications of biomedical science were more cited than others. However, the study also found that the funding status was a non-significant predictor of the visibility of the publications. Moreover, Asubiaro (2019) implied that the funded publications of Library and Information Sciences and internationally collaborated publications produced a higher number of citations. The current study found a significant difference among the national and international journal publications regarding the total number of citations. Findings have shown that the foreign journals publications received more citations than the local journal publications.

The findings of the study have also exposed that a significant difference exists among the single and collaborated publications concerning total number of citations. The single-authored publications received fewer citations as compared to the collaborated publications. Gazni and Didegah (2011) and Puuska (2010) believed that the quality of the collaborated works tended to be higher than single-authored publications. In contrast to these findings, Parker, Allesina, and Lortie (2013) and Medoff (2003) claimed that collaborative propensity had less influence on the citation frequency for scientists belonging to the environmental sciences and economics, respectively. Significant differences were observed between at least two types of collaborations, international, external-institutional and internal-institutional collaboration publications, concerning the total citation counts. It was found that internationally collaborated publications received more citations than external and internal-institutionally collaborated publications.

However, internal-institutional collaboration publications were found to be more cited among national collaborated publications than external-institutional collaboration publications. Statistically significant differences were observed between at least two types of publications (articles, reviews, proceeding papers, and corrections) regarding the total (196) number of citations. Findings exposed that at least two types of academic ranks (professors, associate professors, and assistant professors) were statistically significantly different regarding the total number of citations. Findings


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revealed that assistant professors received more citations for their publications than the citations of professors and associate professors. In contrast, Pagel and Hudetz (2011) and Amara et al. (2015) argued that the professors were more productive regarding the citations than other lower academic ranks and that the professors' publications received more citations than those of associate professors.

## CONCLUSION

It is concluded that collaboration, funding, and publishing in foreign journals have a greater influence on a researcher's impact. Moreover, the visibility of research is increased if the researchers are involved in international collaboration for their research. International collaboration, getting funding for the projects, and publications in international journals brought in more citations. The study contributes to the literature by highlighting the valued factors of scholarly productivity. Considering these factors may help researchers, HEIs, and policymakers when revising the policies for academic research. International cooperation ought to be promoted because it can raise recognition of research. This study would make a worthwhile contribution to the literature from theoretical and practical perspectives. The results provide valuable intuitions into the characteristics affecting the research productivity and impact that may play an integral part in the career trajectory of researchers. Furthermore, the findings would enable policymakers and the administrators of Higher Education institutes to design or modify their policies to improve research productivity and impact.


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