Brief Communication

Predictors of citation rates for research publications in Neurosciences

Hasan Z. Jamjoom, MBBS, MBCP, Abdulhadi Y. Gahtani, SBNS, FRCS(SN), Abdulhakim B. Jamjoom, FRCS, FRCS(SN),

ABSTRACT

Objectives: To identify the predictors of citation rates for research publication in Neurosciences.

Methods: All original articles including meta-analyses (MAs) and systematic reviews (SRs) that were published in Neurosciences during 2011 to 2019 were reviewed. The impact of several predictors on citation rates was assessed using correlation coefficient and mean difference tests.

Results: This study examined 231 articles. The mean article citation number was 11.6. The correlation analysis showed a significant association between citation rates and duration from publication in years ($p<0.0001$), sample size ($p<0.0001$), study design ($p=0.0353$), and level of evidence (LOE) ($p=0.03$). The comparative analysis showed significantly more citations for articles that were published 6-10 years ago ($p<0.0001$), had a sample size $>91$ ($p=0.0359$), were randomized controlled trials ($p=0.0353$), MAs and SRs ($p<0.0001$), and level of evidence (LOE)-I ($p=0.0004$). Retrospective case series had significantly lower citations. The higher and lower citation numbers for publications from Iran and rehabilitation, respectively, may have been influenced by the duration from publication.

Conclusion: The most significant predictors of citation rates for Neurosciences publications were the age of articles, population size, study design, and LOE. Awareness of the predictors of citation rates may help researchers enhance the academic impact of their work.

Neurosciences 2022; Vol. 27 (2): 116-120 doi: 10.17712/nsj.2022.2.20210145

Disclosure. Authors have no conflict of interests and the work was not supported or funded by any drug company.
two of the authors conducted independent analysis. The 2 lists were compared, and any discrepancies were resolved by consensus. The article citation numbers were determined using Google Scholar. In view of the regular changes in the citation numbers with time, the search findings on a single day (September 15, 2021) were used for the analysis in this study.

The following data were collected: duration from publication in years, sample size, study design [randomized controlled trials (RCTs), prospective, MAs and SRs, experimental, cross-sectional, survey questionnaire, case-control, and retrospective case series], study level of evidence (LOE) [I-IV], study field [clinical, or non-clinical], publishing specialty [neurology, neurosurgery, psychiatry, pediatric neurology, rehabilitation, basic neuroscience, and miscellaneous], publishing country [KSA, Turkey, Iran, China, and miscellaneous], authors academic affiliation [university, or non-university], number of authors, number of centers, and number of references. The LOE was ranked according to Oxford’s LOE scale\(^2\) as follows: I: RCTs and MAs of RCTs, II: prospective studies and SRs of prospective studies, III: case-control studies, IV: cross-sectional, retrospective case series and SRs of case series, and undetermined: experimental and survey questionnaire studies. The publishing specialty, country, and authors’ academic affiliations were based on the corresponding author’s data.

The data were analyzed by correlating articles’ citation numbers with various predictors’ findings using the Pearson correlation coefficient test in Social Sciences Statistics.\(^3\) The data were analyzed further by comparing the different predictors’ subgroups using the mean difference test in MedCalc.\(^4\) The median was

---

| Table 1 - Findings relating to several citation rate predictors in the selected Neurosciences publications. |
|---------------------------------------------------------------|
| Factors/Features                                              | Articles (%) |
| Duration from publication                                    |             |
| 10 years                                                     | 29(12.6)    |
| 9 years                                                      | 26(11.3)    |
| 8 years                                                      | 24(10.4)    |
| 7 years                                                      | 22(9.5)     |
| 6 years                                                      | 24(10.4)    |
| 5 years                                                      | 25(10.8)    |
| 4 years                                                      | 23(10)      |
| 3 years                                                      | 28(12.1)    |
| 2 years                                                      | 30(13)      |
| Study design                                                  |             |
| RCTs                                                         | 10(4.3)     |
| Prospective                                                  | 17(7.4)     |
| MAs and SRs                                                  | 12(5.2)     |
| Experimental                                                 | 27(11.7)    |
| Cross-sectional                                              | 65(28.1)    |
| Survey questionnaire                                          | 15(6.5)     |
| Case control                                                 | 14(6.1)     |
| Retrospective case series                                     | 71(30.7)    |
| Study level of evidence (LOE)                                 |             |
| I                                                            | 15(6.5)     |
| II                                                           | 18(7.8)     |
| III                                                          | 14(6.1)     |
| IV                                                           | 144(62.3)   |
| Undermined                                                   | 42(30.7)    |
| Study field                                                  |             |
| Clinical                                                     | 204(88.3)   |
| Non-clinical                                                 | 27(11.7)    |
| Publishing specialty                                          |             |
| Neurology                                                    | 77(33.3)    |
| Neurosurgery                                                 | 34(14.7)    |
| Psychiatry                                                   | 24(10.4)    |
| Pediatric neurology                                          | 19(8.2)     |
| Rehabilitation                                               | 20(8.7)     |
| Basic neuroscience                                            | 30(13)      |
| Miscellaneous*                                               | 27(11.7)    |
| Publishing country                                           |             |
| KSA                                                          | 91(39.4)    |
| Turkey                                                       | 48(20.8)    |
| Iran                                                         | 33(14.3)    |
| China                                                        | 25(10.8)    |
| Miscellaneous**                                              | 34(14.7)    |
| Authors academic affiliation                                  |             |
| University                                                   | 182(78.8)   |
| Non-university                                                | 49(21.2)    |

\(^*\)Miscellaneous specialties (27 articles) [Medicine (others): 7, Family and Community Medicine: 6, Radiology: 6, Public Health: 2, Anaesthesia: 2, Epidemiology: 2, Dentistry: 1, Nursing: 1].\(^**\)Miscellaneous countries (34 articles) [Iraq: 7, Jordan: 6, India: 3, Kuwait: 2, Pakistan: 2, Egypt: 2, Brazil: 2, Oman: 1, Tunisia: 1, Morocco: 1, Nigeria: 1, Rwanda: 1, USA: 1, Canada: 1, Malaysia: 1, Taiwan: 1, Thailand: 1]

---

| Table 2 - Correlation analysis between citation numbers and findings relating to several predictors using Pearson correlation coefficient (R). |
|---------------------------------------------------------------|
| Predictors                                                   | R-value | P-value |
| Duration from publication                                    | 0.3423  | <0.0001* |
| Sample size                                                 | 0.467   | <0.0001* |
| Study design                                                 | -0.1408 | 0.0353* |
| Study Level of Evidence                                      | -0.1428 | 0.03*    |
| Study field                                                  | -0.0593 | 0.3696   |
| Publishing specialty                                         | 0.0414  | 0.5313   |
| Publishing country                                           | 0.0161  | 0.8077   |
| Authors academic affiliation                                  | 0.0158  | 0.8112   |
| Number of authors                                            | -0.0141 | 0.8312   |
| Number of centers                                            | 0.0489  | 0.4595   |
| Number of references                                         | 0.0676  | 0.3063   |

\(^*\)p-values ≤0.05 are significant
Citation rates for publications in Neurosciences … Jamjoom et al

Results. A total of 231 Neurosciences publications were selected. At the time of the analysis, the articles had a total of 2,669 citations. The mean (±SD) article citation number was 11.6 (±14.2). The median (range) article citation number was 7 (0-129). Ten (3.8%) articles did not receive any citations, while 153 (66.2%) articles received ≤10 citations. The articles citation distribution was skewed with 4 (1.7%) receiving 335 (12.6%) citations, 17 (7.4%) receiving 825 (30.9%) citations, and 78 (33.8%) receiving 1,954 (72.3%) citations. All articles except 2 were published by one country; hence, the number of countries was not included as a citation rate predictor. The median (range) findings were duration from publication: 6 (2-10) years, sample size (reported in 222 studies only): 91 (5-6,777), number of authors: 5 (1-17), number of centers: 1 (1-8), and number of references: 25 (5-61).

Table 1 summarizes the findings relating to the other predictors. Table 2 summarizes the correlation analysis results. A significant correlation was observed between citation rates and the duration from publication in years (R=0.3423) (p<0.0001), sample size (R=0.467) (p<0.0001), study design (R=-0.1408) (p=0.0353), and study LOE (R=-0.1428) (p=0.03). None of the other predictors (study field, publishing specialty, publishing country, authors academic affiliation, number of authors, centers, and references) reached significance.

Table 3 summarizes the comparative analysis results. Significantly higher citation rates were observed in articles that were published 6-10 years ago, compared to 2-5 years ago (16.4 versus (vs.) 5.8) (p<0.0001), had sample size >91 compared to ≤91 (13 vs. 9.1) (p=0.0359), reported RCTs compared to other study designs (20.9 vs. 11.1) (p=0.0353), reported MAs and SRs compared to other study designs (28.8 vs. 10.6) (p=<0.0001), had LOE-I compared to other LOE (24.1 vs. 10.6) (p=0.0004), and publications from Iran compared to those from other countries (21.2 vs. 10) (p<0.0001). Furthermore, significantly lower mean citation rates were observed in retrospective case series compared to other study designs (10 vs. 15.9) (p=0.0327) and publications by rehabilitation compared to those by other specialties (4.7 vs. 12.2) (p=0.0261). The influence of the age of the paper on the abovementioned findings was assessed. A significantly higher mean duration from publication was noted in articles published by rehabilitation compared to other specialties (7.6 vs. 5.7 years) (MD=1.9) (p=0.0002). Further, a significantly lower mean duration from publication was noted in articles published by rehabilitation compared to other specialties (3.5 vs. 6.2 years) (MD: 7.5) (p<0.0001). The difference in mean duration from publication between all other subgroups did not reach significance.

Discussion. The SJR index expresses the number of citations articles received in a selected year by the number of documents published in the journal in the previous three years. In 2020, the SJR index for Neurosciences was 0.235. The journal was ranked 284th and 11th among clinical neuroscience journals in the world and the Middle East, respectively. It is generally accepted that article citation rates correlate well with the publishing journal IF. In this study, Neurosciences publications had mean citations of 11.6 and total citations of 2,669.

The distribution of citations was skewed, with a small percentage (1.7%) of articles receiving a disproportionately high portion of total citation numbers (12.6%). The unequal distribution of citation numbers for Neurosciences publications is not unusual and has been reported by other journals. We observed a significant age effect on citation numbers for Neurosciences publications. The post-publication period here (median 6 years) was relatively longer than those of other reports (3-5 years). In general, older papers have longer exposure and are likely to receive more citations. However, the number of citations per year an article receives rises quickly in the first few years and decreases as time passes. This suggests that the exact post-publication duration may be relevant in determining the impact of the article's age on citation numbers. A significant correlation with sample size was observed confirming it as a definite predictor of citation rates for Neurosciences publications. Similar findings were reported by others. The most frequent study designs were retrospective case series and cross-sectional studies, while the most frequent LOE was IV. A significant correlation between citation numbers and study design, and LOE was observed. This is in agreement with reports that identified high LOE and study designs such as RCTs and MAs, as strong predictors of citation counts.

The majority of selected articles were linked to clinical fields, and the most frequently publishing specialties were neurology, neurosurgery, and psychiatry. No significant correlation was observed between citation rates and publishing specialty or study field. In the comparative analysis, however, the mean citation number for articles published by rehabilitation was significantly lower than those published by others. This may be related to the fact that the rehabilitation papers were significantly younger than those from other specialties (mean age...
Table 3 - Comparative analysis of the mean citation numbers (± SD) between the various subgroups in several predictors using mean difference (MD) test

| Predictors/Variables | Articles Number | Mean Cites (±SD) | MD | P-value |
|----------------------|-----------------|------------------|----|---------|
| **Duration from publication (years)** | | | | |
| 2-5 years | 106 | 5.8(±5.7) | 10.6 | <0.0001* |
| 6-10 years | 125 | 16.4(±17.5) | | |
| **Sample size** | | | | |
| ≤91 | 110 | 9.1(±8.8) | -3.9 | 0.0359* |
| >91 | 112 | 13(±17.3) | | |
| **Study design** | | | | |
| RCTs | 10 | 20.9(±14.3) | -9.8 | 0.035* |
| Other designs | 221 | 11.1(±14.3) | | |
| Prospective | 17 | 6.8(±8) | 5.1 | 0.1621 |
| Other designs | 214 | 11.9(±14.8) | | |
| MAs and SRs | 12 | 28.8(±37.6) | 18.2 | <0.0001* |
| Other designs | 219 | 10.6(±11.5) | | |
| Experimental | 27 | 9.8(±9.3) | 2 | 0.5003 |
| Other designs | 204 | 11.8(±15) | | |
| Cross-sectional | 65 | 11.2(±10.7) | 0.5 | 0.8136 |
| Other designs | 166 | 11.7(±15.7) | | |
| Survey questionnaire | 15 | 13.8(±11.5) | -2.4 | 0.534 |
| Other designs | 216 | 11.4(±14.6) | | |
| Case-control | 14 | 14(±20.5) | -2.6 | 0.5146 |
| Other designs | 217 | 11.4(±14) | | |
| Retro-case series | 71 | 8.5(±10) | 4.4 | 0.0327* |
| Other designs | 160 | 12.9(±15.9) | | |
| **Study level of evidence (LOE)** | | | | |
| I | 15 | 24.1(±31.5) | -13.5 | 0.0004* |
| Other levels | 216 | 10.6(±12) | | |
| II | 18 | 7.1(±7.9) | 4.9 | 0.1671 |
| Other levels | 213 | 12(±14.8) | | |
| III | 14 | 14(±20.5) | -2.6 | 0.5146 |
| Other levels | 217 | 11.4(±14) | | |
| IV | 144 | 10.6(±11.8) | 2.6 | 0.1849 |
| Other levels | 87 | 13.2(±17.9) | | |
| Undetermined | 42 | 11.2(±10.2) | 0.4 | 0.8718 |
| Other levels | 189 | 11.6(±15.3) | | |
| **Study field** | | | | |
| Clinical | 204 | 11.8(±15) | 2 | 0.5003 |
| Non-clinical | 27 | 9.8(±9.3) | | |
| **Publishing specialty** | | | | |
| Neurology | 77 | 12(±17.6) | -0.6 | 0.7673 |
| Other specialties | 154 | 11.4(±12.7) | | |
| Neurosurgery | 34 | 8.9(±7.8) | 3.1 | 0.2496 |
| Other specialties | 197 | 12(±15.3) | | |
| Psychiatry | 24 | 13(±10.8) | -1.6 | 0.6081 |
| Other specialties | 207 | 11.4(±14.8) | | |
| Pediatric neurology | 19 | 13.8(±12.4) | -2 | 0.5636 |
| Other specialties | 212 | 11.4(±14.6) | | |
| Rehabilitation | 20 | 4.7(±4) | 7.5 | 0.0261* |
| Other specialties | 211 | 12.2(±14.9) | | |
| Basic neurosciences | 30 | 11.5(±9.7) | 0.1 | 0.9718 |
| Other specialties | 201 | 11.6(±15) | | |
| Miscellaneous | 27 | 16.4(±21.6) | -5.5 | 0.0635 |
| Other specialties | 204 | 10.9(±13.2) | | |
| **Publishing country** | | | | |
| KSA | 91 | 11.4(±14.5) | 0.2 | 0.9185 |
| Other countries | 140 | 11.6(±14.5) | | |
| Turkey | 48 | 8.5(±10) | 3.9 | 0.0956 |
| Other countries | 183 | 12.4(±15.3) | | |
| Iran | 33 | 21.2(±23.4) | -11.2 | <0.0001* |
| Other countries | 198 | 10(±11.7) | | |
| China | 25 | 9(±7.7) | 2.9 | 0.343 |
| Other countries | 206 | 11.9(±15) | | |
| Miscellaneous | 34 | 8.8(±16.8) | 3.2 | 0.2353 |
| Other countries | 197 | 12(±15.4) | | |
| **Authors academic affiliation** | | | | |
| University | 182 | 11.7(±15.3) | -0.5 | 0.8308 |
| Non-university | 49 | 11.2(±11.1) | | |
| **Number of authors** | | | | |
| ≤5 | 150 | 11.8(±15.6) | -0.8 | 0.6889 |
| >5 | 81 | 11(±12.1) | | |
| **Number of centers** | | | | |
| 1 | 214 | 11.5(±14.7) | 1.1 | 0.7655 |
| >1 | 17 | 12.6(±11.4) | | |
| **Number of references** | | | | |
| ≤25 | 117 | 10.2(±10.5) | 2.8 | 0.1422 |
| >25 | 114 | 13(±17.6) | | |

*p-values ≤0.05 are significant

3.5 vs. 6.2 years). Nevertheless, citation rates may vary considerably between different subjects and topics of a discipline. The chance of being cited correlates with the number of papers published in different subjects. Therefore, papers from small fields may achieve fewer citations than those from more general fields.

The most frequently publishing countries were KSA and Turkey. No significant correlation was observed between citation rate and publishing country. In the comparative analysis, however, the mean citation number for articles published from Iran was significantly higher than those from other countries. This could be related to papers from Iran being significantly older than others (mean age 7.6 vs. 5.7 years). The variation could also be related to the well-recognized high country self-citation rate for Iran, which was reported as 36.57% (ranked...
3rd in the world during 1996-2017). The disparity in citation rates of articles published in different countries is well-known. Authors who are affiliated with certain countries achieve more citations than others. Privileged countries with strong scientific backgrounds and adequate financial support can conduct high-quality research that gets published in high-IF journals and receives more citations.

The association between the authors’ academic rank and citation rates is not supported in the literature. In this study, authors’ university affiliations had no significant effect on citation rates. This could reflect quality research contributions by health care facilities that are not affiliated with universities. The citation numbers of Neurosciences publications were not impacted by the numbers of authors, centers, countries, and references, which is in agreement with the findings of previous research. However, few publications identified the number of authors, number of organizations, and number references as factors that could influence citation rates.

The study has several limitations. First, the study was reliant on the accuracy of the Neurosciences website. The citation numbers were taken from Google Scholar which is arguably less comprehensive than the Scopus or Web of Science databases. Article citations were taken at a certain point that is likely to change. The number of selected articles could be considered small. The exclusion of review articles and other reports could be interpreted as selection bias. The wide study duration may have influenced citations in favor of older papers. There may have been potential errors in the subgrouping of the study design and LOE. Defining the specialty and academic affiliation based on the corresponding author may not reflect all authors of multi-disciplinary papers. The impact of self-citation on the citation numbers was not examined.

In conclusion, citation rates for Neurosciences publications were significantly impacted by the age of the paper, sample size, study design, and LOE. The citations were not affected by the study field, specialty, publishing country, author academic affiliation, number of authors, centers, or references. The citation rates for articles from Iran and concerning rehabilitation may have been influenced by their duration from publication. Awareness of the factors that influence citations may be help researchers enhance the impact of their work.

Received 28th December 2021. Accepted 15th March 2022.

From the Department of Medicine (Jamjoom H), Hillingdon Hospital, Uxbridge, London, UK, and from Section of Neurosurgery (Gahtani, Jamjoom A), King Abdulaziz Medical City and King Saud bin Abdulaziz University for Health Sciences, Jeddah, Kingdom of Saudi Arabia. Address correspondence and reprint requests to: Prof. Abdul Hakim Jamjoom, King Khalid National Guard Hospital, Jeddah, Kingdom of Saudi Arabia. E-mail: jamjoomah@gmail.com

ORCID ID: https://orcid.org/0000-0001-8604-7835

References

1. Tahamtan I, Safipour Afshar A, Ahamdandezh K. Factors affecting number of citations: a comprehensive review of the literature. Scientometrics 2016; 107: 1195-1225.
2. Oravec CS, Frey CD, Berwick BW, Villela L, Aschenbrenner CA, Wolfe SQ, et al. Predictors of Citations in Neurosurgical Research. World Neurosurg 2019; 130: e82-e89. doi:10.1016/j.wneu.2019.05.226.
3. Yom KH, Jenkins NW, Parrish J M, Brundage TS, Hryniewycz NM, Narain AS, et al. Predictors of Citation Rate in the Spine Literature. Clin Spine Surg 2020; 33: 76-81.
4. Bhandari M, Busse JF, Devereaux PJ, Montori VM, Swiontkowski M, Tornetta P, et al. Factors associated with citation rates in the orthopedic literature. Can J Surg 2007; 50: 119-123.
5. Diaz-Ruiz A, Orthe-Artega U, Rios C, Roldan-Valadez E. Alternative bibliometrics from the web of knowledge surpasses the impact factor in a 2-year ahead annual citation calculation: Linear mixed-design models' analysis of neuroscience journals. Neurot India 2018; 66: 96-104.
6. Asaad M, Kallarackal AP, Meaikie J, Rajesh A, de Azevedo RU, Tran NV. Citation Skew in Plastic Surgery Journals: Does the Journal Impact Factor Predict Individual Article Citation Rate? Aesthet Surg J 2020; 40: 1136-1142.
7. Willis DL, Bahler CD, Neuberger MM, Dahm P. Predictors of citations in the urological literature. BJU Int 2011; 107: 1876-1880.
8. Alabousi M, Zha N, Patlas MN. Predictors of Citation Rate for Original Research Studies in the Canadian Association of Radiologists Journal. Can Assoc Radiol J 2019; 70: 383-387.
9. Jamjoom AMA, Gahtani AY, Jamjoom AB. Predictors of Citation Rates in High Impact Glioblastoma Trials. Cureus 2021; 13: e19229.
10. Neurosciences Journal [Accessed on 1st October 2021]. Available at: https://www.nsj.org.sa
11. Scimago Journal and Country Rank [Accessed on 1st October 2021]. Available at: https://www.scimagojr.com
12. Oxford Center for Evidence-Based Medicine: Levels of Evidence [Accessed on 1st October 2021]. Available at: https://www.cebm.ox.ac.uk
13. Social Sciences Statistics [Accessed on 1st October 2021]. Available at: https://www.socscistatistics.com
14. MedCalc web site [Accessed on 1st October 2021]. Available at: https://www.medcalc.org
15. Yaminfirooz M, Tirgar A. Self-citation in Iran in comparison with other countries. Acta Inform Med 2019; 27: 259-262.