Two-year citations of JAPPL original articles: evidence of a relative age effect

Claudio Gil Soares de Araújo,1,2 Bruno Ribeiro Ramalho de Oliveira,1 Leticia Vargas de Oliveira Brito,1 Thiago Torres da Matta,1 Bruno Ferreira Viana,1 Cintia Pereira de Souza,1 Renato de Carvalho Guerreiro,1 Fabian Antonio Slama,1 and Eduardo da Matta Mello Portugal1

1Exercise and Sport Sciences Graduate Program-Gama Filho University and 2Clinimex-Exercise Medicine Clinic, Rio de Janeiro, Brazil

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Araújo CG, Oliveira BR, Brito LV, Matta TT, Viana B, Souza CP, Guerreiro RC, Slama FA, Portugal ED. Two-year citations of JAPPL original articles: evidence of a relative age effect. J Appl Physiol 112: 1434–1436, 2012. First published March 1, 2012; doi:10.1152/japplphysiol.01491.2011.—Several indicators have been used to analyze scientific journals, with the impact factor and the number of citations in a 2-yr calendar time frame (2-YRC) being the most common factors. However, considering that the Journal of Applied Physiology (JAPPL) appears monthly and that calculations of these indicators are based on citations of papers published in previous years, we hypothesized that articles published at the beginning of the year would be cited more in the 2-YRC compared with those appearing in the last issues of the year, a phenomena known as a relative age effect. Our objective was to confirm the existence of a relative age effect in the 2-YRC for original articles published in JAPPL. From 2005 to 2008, a total of 1,726 original articles were published, according to the Web of Science, and 9,973 citations in 2-YRC, varying from 0 to 45, with a mean of 5.78 for individual papers. Although there were no differences in the number of original articles published in a given month (P = 0.99), the 2-YRC varied considerably throughout the year, being higher for those earlier issues of the year, as shown by the linear regression analysis (r^2 = 0.76; P < 0.001). The 2-YRC began at 6.62 during the first 3 mo of the year, dropping by 10% at each 3-mo period. In summary, the longer an article has been out there, the more citations it collects. The relative age effect is a potential confounding variable for the assessment and interpretation of 2-YRC (using calendar years) from JAPPL original articles.

impact factor; scientometrics; bibliometrics; indexing

TRIGGERED BY GARFIELD’S (10) proposal for counting of article citations in 1955, several indicators have been applied to quantify the scientific production (1, 5, 9, 24, 25, 28, 33). The main indicator is the number of citations in a 2-yr calendar time frame citation (2-YRC) and its derived measurement—the impact factor—representing the frequency with which the average article is cited (8). In fact, some of the merit of these indicators and related issues have been the subject of publications from the American Physiological Society (4, 7, 27, 32) and from other journals (11, 15, 16, 20, 24). Interestingly, there is a relationship between winning a Nobel Prize and the researcher’s citation data (12); being a laureate as well brings an almost immediate citation data boost (18).

Considering the fact the 2-YRC calculation encompasses articles published in all issues published in a given calendar year, it could be speculated that in the subsequent year, those articles appearing in the first issues of the year would be available and exposed for a longer period of time compared with those published in the last issues of the year. Were this premise true, the month of publication would significantly affect the article’s 2-YRC, that is, a relative age effect. Relative age is considered as the chronological age difference between individuals (in this particular case, articles rather than individuals) within annually age-grouped cohorts (19, 26) and has been regarded as positively influential in many settings (3, 30), especially in most athletic performances (2, 17, 21, 26), but not for all (6, 14, 31). So, our purpose was to confirm the existence of a relative age effect in the 2-YRC, as assessed by calendar years, for original articles published in the Journal of Applied Physiology (JAPPL).

METHODS

Sample and 2-YRC. To obtain a more representative sample, we searched all the JAPPL issues from January 2005 to December 2008, retrieving a total of 1,726 original articles. The number of citations made of the original article in the 2 yr following its publication was identified by using the “times cited” searching tool function of the Web of Science database (ISI/Thomson-Reuters). The 2-YRC was obtained by simply adding the first and second year citation results, as described above.

Statistical analysis. The articles retrieved were grouped for the month of publication, and descriptive statistics for numbers of both original articles published and citations received were then calculated for the 12 mo of publication. A linear regression analysis was carried out between results of the 2-YRC and the sequence of months of publication (1 to January to 12 for December). Prism 5.04 statistical software (GraphPad) was used for calculations, and probability was set at 5% for significance.

RESULTS

Between 29 and 40 original articles were published (mean of 36) per issue. The 1,726 original articles published in the 2005–2008 period were evenly distributed among the 12 issues of the year. The Web of Science’s search retrieved a total of 9,973 citations for the 1,726 original articles—mean 2-YRC of 5.78. A total of 100 articles (5.8%) was not cited in the two 2-YRC.

Average values for 2-YRC during each one of the four 3-mo periods of the year were: 1st, 6.62; 2nd, 6.00; 3rd, 5.46; and 4th, 4.96, corresponding to successive drops of ~10%. Anal-
ysis of the 2-YRC data indicated that there was a clear time effect as expressed by the equation $2\text{-YRC} = 6.96 - 0.18 \times \text{month of publication (January} = 1; \text{December} = 12) \left( r^2 = 0.76; S_{xy} = 0.38; P < 0.001; \text{Fig. 1} \right)$.

**DISCUSSION**

The scientometrics debate is far from over (32). Despite being strongly criticized, even when used to evaluate a journal’s quality (22, 29, 33), these indicators have been widely used by the academic community (23). Our study discusses the relative age effect as a potential bias to the meaning and the calculation of 2-YRC. According to our data, if the publication of an issue occurs in the first day or in the last day of the month it could potentially affect the 2-YRC. In addition, some editors, knowing the occurrence of a relative age effect in the 2-YRC, could make decisions regarding what accepted articles to publish in the extreme months of the year—December and January—according their interest in the journal’s impact factor calculations for a given year.

To confirm the existence of a relative age effect in the 2-YRC, we chose JAPPL, in which articles are mostly original and which has a relatively high citation rate. It is also interesting to note that analyzing 2008’s citation data for four other prestigious journals—Chest, Medicine and Science in Sports and Exercise, European Respiratory Journal, and American Journal Physiology-Heart and Circulatory Physiology—there is a similar relative age effect trend, with 2-YRC presenting negative slopes ranging from 0.11 to 0.44 for the 12 mo of publication.

The concept of relative age effect is not new (19) and has recently been popularized (13). Original articles published in 2006 could be collectively considered to be 1 yr old in 2007, but, in reality, because they could have been published during any one of the months of the year, differences in relative age up to 11 mo could be seen. Although this uneven exposure time will diminish toward the end of the year, for the 2-YRC calculation, the articles published in the first month of the year will accumulate 36 mo of exposure vs. only 25 mo for those published in December’s issue, a 40% difference. So, it was not surprising that the relative age effect influenced the 2-YRC, with higher results for the articles published earlier in the year. A very regular drop of ~10% was seen in the 2-YRC for each subsequent 3-mo period of the year. It is interesting to note that despite all theoretical limitations of 2-YRC, the influence of a relative age effect was clearly identified for this rather crude and imprecise measurement.

There are some limitations to our data analysis. Recently, manuscripts accepted for publication are almost immediately posted on the journal’s website, Articles in Press, occurring months ahead of final printed version. Although it is known that some articles can be read and cited by this earlier electronic publication, we have not purposely controlled for this question, because the exact time of prepublication is difficult to standardize. In the same line of thinking, we declined to value the citations received in the same year of publication, which quite often happens and would have reflected an advantage for articles published earlier in the year.

Summarizing, analysis of the 2-YRC pattern for original articles published by JAPPL (2005–2008) confirmed the existence of a relative age effect, in which articles published at the beginning of the year were more cited in the two subsequent calendar years compared with those published in the last issues of the year. The presence of a relative age effect is a potential confounding variable when interpreting citation data for a given article or for a scientific journal. If an unbiased comparison of citation data is to be made, a more specific and precise time frame rather than subsequent calendar years should be used. The presence of a relative age effect adds another limitation to a journal’s impact factor and an article’s 2-YRC interpretation.

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**DISCLOSURES**

No conflicts of interest, financial or otherwise, are declared by the authors.

**AUTHOR CONTRIBUTIONS**


**REFERENCES**