Association of ResearchGate research influence score with other metrics of top cited sports biomechanics scholars

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Abstract

Study aim: Scientific networking sites are increasingly popular in connecting researchers and providing influence metrics, however the research on measures like the ResearchGate Research Influence Score (RG RIS) are limited. This study documented the associations between RG RIS, usage, and prestige metrics from Google Scholar (GS), RG, and Scopus for top cited scientists in sports biomechanics.

Material and methods: Research usage (total citations: C), prestige (Hirsch index: h), and RG RIS metrics were extracted from GS, RG, and Scopus for the top sixty cited scholars that used either the label “sports biomechanics” or “sport biomechanics” in their GS Profile.

Results: RG RIS was strongly correlated ($r = 0.796–0.895$) with all usage and prestige metrics. There were very strong correlations among the three citation metrics ($r = 0.929–0.967$) and among the three $h$ indexes ($r = 0.960–0.974$).

Conclusions: The recent RG RIS does not provide unique scientific influence information about sport(s) biomechanics researchers beyond common citation metrics. The RG RIS was strongly associated with total citation and $h$-index values from GS, RG, and Scopus for top 60 cited sport(s) biomechanics researchers based on GS Profiles. The scientific usage and prestige factors previously reported in bibliometric research was supported by very strong associations among the three C and among the three $h$ index values from these two scientific networking and one database service.

Keywords: Altmetric – Citation – Evaluation – Impact – Prestige

Introduction

Academic/scientific networking sites like Academia.edu, Google Scholar Citations, and ResearchGate (RG) strive to connect researchers, promoting collaboration and impact metrics services [29, 34, 35]. With millions of documents and thousands of users worldwide, RG has become one of the largest academic networking sites [20, 29]. Therefore, the altmetric (e.g., views, downloads, recommendations, questions & answers) and citation measures (e.g., citations, $h$ index, research interest score) RG provide are potentially influential interest and reputation measures at the institutional, journal, and author levels.

Well-known biases in citation metrics complicate and may even invalidate their use in evaluating research at national, institutional, and journal levels [2, 30, 31, 37]. Given large differences in citation patterns across disciplines, bias from indexing, and variation in metric calculation; the consensus of bibliometric evidence supports careful use of multiple citation metrics as proxy measures to supplement to expert peer evaluation of research at the author or article level [12, 27, 38]. Qualitative evaluation of scientific merit by experienced scholars in a discipline is the gold standard of research evaluation [4], however concerns about subjectivity and bias [19] fuel continued interest in use of metrics as proxy indicators [11] of quality to supplement peer evaluation of research at the author or article level.

RG initially calculated and reported an RG Score to evaluate the scientific impact of individual authors with RG Profiles. Weaknesses in this score [28] resulted in RG recently changing to a Research Interest Score (RG RIS). RG describes the RG RIS as a metric weighting four measures: Citations at 50%, Recommendations at 25%, full-text reads at 15%, online reads as 5%, and 5% unspecified. Calculation of RG RIS is automatic; however the whole calculation and data are not transparent because authors cannot replicate their RG RIS using the four measures noted [5].
Initial research on RG RIS is limited to a couple samples of scientists with RG profiles. Memisevic [25] correlated numerous metrics including RG RIS for 88 scholars from the University of Sarajevo. He reported that RG RIS was strongly ($r = 0.84$ to $0.90$) associated with total citations in Google Scholar (GS), Scopus, and Web of Science (WoS), but RG RIS was only moderately ($r = 0.50$ to $0.54$) associated with the Hirsch index ($h$) for these three bibliometric databases. The high correlations with citations, regression analysis, and Principal Component Analysis all indicate that the RG RIS is likely dominated by citations and full-text reads [5, 26] and may not provide meaningful information beyond citations. Copiello [6] also reported this little additional information beyond citations was provided by a similar weighted metric (Altmetric Attention Score) from Altemetric.com. Given the increasing interest in collaborative research and citation metrics for coauthors on grant applications, more research is needed on RG RIS and other scholar citation metrics.

Given the limited research on RG RIS beyond samples from a few disciplines and award winners, the current study expanded on this work to include research in biomechanics. In addition, this study differentiates two factors/dimensions of the body of work of researchers: Usage and prestige that are not usually, explicitly identified. Studies using factor analysis, principal component analysis, and correlation indicate that citation metrics primarily align with either usage or prestige [3, 8, 14, 21, 40]. To date, this two-factor structure of research quality is a consistent result; within a diverse sea of poorly defined and inconsistently used research quality concepts like contribution, impact, importance, influence, interest, and prestige common in bibliometric/informetric/scientometric research [1, 11, 22, 33].

The purpose of this study was to document the associations between RG RIS, usage, and prestige metrics from GS, RG, and Scopus for top cited scientists in sports biomechanics. It was hypothesized that there would be very strong associations of RG RIS with usage metrics, but moderate associations with prestige metrics. This study expands our understanding of RG RIS, usage and prestige metrics for individual researchers; as well as the initial work on citation patterns of biomechanics scholars across academic rank [15] and related to prestigious awards [16, 17, 18].

**Material and methods**

A sample of highly cited researchers in sports biomechanics was identified using GS Profiles. The author extracted data on the top scholars that used either the label “sports biomechanics” or “sport biomechanics” in their GS Profile (e.g., GS search “label:sports_biomechanics”). Searches of GS Profiles are returned approximately in order of total citations. After eliminating a redundant profile and sorting by total citations, a final top 60-researcher sample was identified. The sample size of about twice what was necessary for a bivariate normal correlation study was selected in order compensate for anticipated positive skew in the citation data. Use of G*Power 3.1.9.7 (Universitat Kiel, GDR) software calculated an $a$ priori minimum sample size of 37 to detect a Pearson correlation with a 0.5 effect size, a type I error $p < 0.01$, and statistical power with $p > 0.8$. The highly skewed nature of citation metrics means that bibliometric studies usually focus on the top percentiles of citation distributions.

Research usage and prestige metrics for each of the researchers were extracted from two open scientific networking sites (GS and RG) and one the largest curated bibliometric database (Scopus) subscribed to by the investigator's university. Scientific usage was estimated by the total citations ($C$) for each research from these sites. The Hirsch index ($h$) approximated the prestige for each researcher from these sites. The RG RIS was examined for potential association with these usage and prestige metrics in sports biomechanics researchers. Data from GS and RG were collected by December 20, 2022. Data from Scopus for researchers with a Scopus Author Identifier were extracted before December 23, 2022.

Data were analyzed with JMP Pro 14 (SAS Institute, Cary, NC). Descriptive data were calculated, and non-normality and large positive skew of the data confirmed (Table 1). Given the skew of the data, Kendall’s tau ($\tau$) was calculated to document associations between metrics, as it is the best measure of association for skewed data with outliers [7]. Statistical significance was accepted at $p < 0.01$. The examination of the strength of associations and comparison to previous studies was facilitated by converting $r$ to Pearson $r$ [36]. Strength of associations were classified based on $r$ as either weak/low ($\pm 0.30$–$0.49$), moderate ($\pm 0.50$–$0.69$), strong/high ($\pm 0.70$–$0.89$), or very strong/high ($\pm 0.90$–$1.0$).

**Results**

Seventy-three percent of the top 60 cited GS Profiles used the label “sports biomechanics” and sixteen percent “sport biomechanics”. Most researcher profiles were from Europe (60%) and the Americas (20%), with 15% from Asia/Australia/New Zealand, and 5% from the Middle East. Most all (90%) of the top 60 cited sport(s) biomechanics researchers based on GS Profiles also had an RG Profile and all 60 researchers had a Scopus Author ID. All publication usage and prestige metrics were not normally distributed because of very high ($\gamma > 2.3$) positive skews, so median and interquartile range data are reported in Table 1.
Research influence in sports biomechanics

All twenty-one of the pairwise Kendal \( \tau \) values showed significant \((p < 0.0001)\) positive associations between the metrics. The proxy measures of scientific usage (C) of the research of these sports biomechanics researchers were very strongly associated with each other. The proxy prestige metrics (h index) also had very strong associations with each other, however the RG RIS had similar large associations with both usage and prestige in the sports biomechanics researchers. Kendal’s tau values converted to Pearson \((r)\) are listed in Table 2.

### Discussion

The study hypothesis of very strong associations of RG RIS with the usage metrics was not supported, as the RG RIS of top sports biomechanics researchers were strongly associated \((r^2 = 63 \text{ to } 80\%)\) with both usage and prestige metrics. The associations observed between RG RIS and citations in the present study were similar to those reported by Memisevic \((r = 0.84 \text{ to } 0.90)\) for GS, Scopus, and WoS in a diverse disciplinary sample of University of Sarajevo faculty [25]. The smaller, moderate associations \((r^2 = 25 \text{ to } 29\%)\) between RG RIS and prestige metrics \((h)\) in the Memisevic study was not apparent in top cited sports biomechanics scholars. It is possible the small field of sports biomechanics has unique citation patterns that do not lead to clear separation of usage and prestige from citation data. This supports the contention by Copiello [5], at least in sports biomechanics, that the RG RIS may provide little unique information beyond citation totals or other citation-based metrics.

The GS citation values in the current study (Table 1) were consistent with previous bibliometric research in biomechanics and sports biomechanics. The median GS C in the present study (1,794) was similar to the median GS C for professor rank biomechanics faculty worldwide [15]. The median 2,784 GS C in the current study also corresponds to about the 70–80% percentile of international biomechanics scholars with GS Profiles [15] and the median estimated GS C (3,000 to 5,000) at the time of receipt of national or international career awards in sports biomechanics [18].

The prestige metric \((h)\) is based on citation data, so a similar trend of decreasing median \(h\) values from GS to RG, and then Scopus was seen in both C and h. The decrease in C from GS to RG and Scopus were larger (32\% & 51\% respectively) than for the prestige variable \(h\) (14\%
and 29% respectively). These larger citation metrics from GS compared to RG [32]. Scopus and WoS are a consistent finding in most disciplines [23, 24] and the greater coverage of GS [10]. The absolute values of these metrics cannot be compared across databases because of large differences in coverage, indexing error, and other factors [32], so the database and date for specific metrics should be reported.

Median prestige (h) of the top cited sports biomechanics scholars (15 to 21) were consistent with previous studies of senior biomechanics scholars. The median GS h for a sample of national and international sports biomechanics winners was 30 to 36 [18] and this would be at or above the 75th percentile in the current study (Table 1). The median WoS h for a similar size sample of associate professor and professor rank biomechanists from top biomedical engineering departments in the US and Europe were also higher (20 to 32) than the 75th percentile in the current study using GS h. Prestige estimated by GS h and RG h will likely higher than h estimates from Scopus or WoS.

The study had limitations due to the systematic sample, single time point, and differences in the bibliometric source data. The sample of sports biomechanics researchers was limited by scholar self-selection to create a GS Profile and use sport(s) biomechanics as a label for their research area. Researchers are allowed to select up to five labels for their GS Profile and there is likely variation in how these are selected across researchers. It is likely that there are numerous sport(s) biomechanics researchers that have not established and curated a GS Profile and if sport(s) is a primary or minor area of research emphasis. While GS provides the most complete indexing of peer-reviewed research for citation analysis, the GS Citations and Profile features may have more archiving errors than the smaller, curated databases and their profile features. GS and RG Profiles have the potential for good accuracy if the researcher corrects errors in the automatic indexing of peer-reviewed publications. It is unknown, however, how many biomechanics scholars with common names “clean” their GS Profile of publications and subsequent citations that are not to their research. Many GS and RG metrics continuously increase over time, and with limited reporting functions make it difficult to perform longitudinal studies. All databases, however, have limitations from errors and inconsistencies in indexing, author identity, and bibliometric subject categories. Given the consistency of these weaknesses in all previous bibliometric research and the consistency of several of the current results with bibliometric studies on biomechanics, this study likely provides accurate estimates of associations between these common author-level publication metrics in sports biomechanics. Future research should expand this study using other author-level metrics and additional databases. Subsequent work should focus on several proxy metrics of either usage (C, CiteScore, Impact Factor, Source-

Normalized Impact per Paper, etc.) or prestige factors (Eigenfactor Score, Hirsch Index, ScImago Journal Rank, etc.) of research quality.

Conclusions

The recent RG RIS does not provide unique scientific influence information about sport(s) biomechanics researchers beyond common citation metrics. The RG RIS was strongly associated with total citation and h-index values from GS, RG, and Scopus for top 60 cited sport(s) biomechanics researchers based on GS Profiles. The scientific usage and prestige factors previously reported in bibliometric research was supported by very strong associations among the three C and among the three h index values from these two scientific networking and one database service.

Conflict of interest: Authors state no conflict of interest.

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Received 04.01.2023
Accepted 15.02.2023
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