

A leading bibliometric author does not have a dominant contribution to research based on the CJAL score

Bibliometric analysis

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Abstract

Background: A total of 22,367 bibliometric articles have been indexed by Web of Science (WoS). The most significant contribution to the field has not yet been identified through bibliometric analysis. A comparison of individual research achievements (IRAs) and trend analysis of article citations are required after extracting bibliometric articles. The study aimed to confirm whether the leading author has a dominant RA and which articles are worth reading for readers using trend analysis.

Methods: We identified authors with at least 100 articles related to bibliometrics in the WoS core collection. A total of 399 articles were collected to cluster author collaborations. Co-word analysis and chord diagrams were used to match chief authors in clusters with Keywords Plus in WoS core collection. The category, journal impact factor, authorship, and L-index (CJAL) score and the absolute advantage coefficient (AAC) were used to compare IRAs and identify the leading author who dominated the field significantly beyond the next 2 authors. In addition to network charts and chord diagrams, 4 visualizations were used to report study results, including a Sankey diagram, a dot plot, a temporal trend graph, and a radar plot. The temporal bubble graph was used to select articles that deserve to be read.

Results: The top 3 authors were Lutz Bornmann, Yuh-Shan Ho, and Giovanni Abramo, with CJAL scores of 176.22, 176.02, and 112.06, respectively, from Germany, Italy, and Taiwan. Based on the weak dominance coefficient (AAC = 0.20 < 0.70), it is evident that the leading bibliometric author has no such significant power beyond the next 2 leading authors in IRAs. A trend analysis of the last 4 years was used to illustrate the 2 articles that deserve to be read.

Conclusion: Three leading authors were identified through a co-word analysis of bibliometrics. There was no evidence of an author who possessed a dominant position due to a lower AAC on the leading author. The CJAL score and the AAC can be applied to many bibliographical studies in the future rather than being limited to bibliometric studies that evaluate the leading authors in a field, as we did in this study.

Abbreviations: AAC = absolute advantage coefficient, CJA = category, journal impact factor, and authorship, CJAL = category, journal impact factor, authorship, and L-index, JIF = journal impact factor, IRA = individual research achievement, TBG = temporal bubble graph, WoS = Web of Science.

Keywords: absolute advantage coefficient (AAC), bibliometric analysis, CJAL score, co-word analysis, individual research achievements (IRAs), Web of Science (WoS)

1. Introduction

Publications related to bibliometrics have increased significantly in PubMed based on a year-based trend (by x) using the equation $y = 2.0002 x^2 - 30.398 x$ ($R^2 = 0.9144$).^[1] It is necessary to conduct investigations on authors who have made the greatest contribution to the field of bibliometrics.

Several metrics (e.g., author impact factor (IF), author IF = citations/publications, number of citations to the top or 10th most cited publication, number of publications with at least 10 citations) have been proposed to evaluate author research achievements (RAs).^[2] As part of the evaluation of the RAs for authors, some bibliometric indices (e.g., the h - g - x - Y - hT - L -category, journal IF (JIF), and authorship [CJA]-category, journal impact

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The datasets generated during and/or analyzed during the current study are publicly available.

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Key points

- The authors assigned major keywords to match up respective clusters based on co-word analysis, a modern and novel approach.
- 2. The CJAL score and absolute advantage coefficient were used to determine whether an author possessed a dominant position over the next two leading authors.
- 3. Future relevant studies should include six visualizations to facilitate understanding of the results.

factor, authorship, and L-index [CJAL]-index^[3-10]) took into account both the number of citations and the number of publications. However, these indices should be constructed on the basis that all articles have been collected beforehand based on a specific criterion (e.g., the number of articles or citations over 100 on a topic or in a discipline).

1.1. Authors with >100 articles versus >100 citations

A sharp rise in 100 top-cited articles has also been observed^[11] in the past 10 years (i.e., [18, 12, 11, 24, 29, 37, 57, 80, 90, and 102] by count between 2013 and 2022). In contrast to those research articles examining author contributions based on top-cited articles only,^[11] no studies were found using authors with at least 100 publications to identify the leading authors on a topic or in a discipline and/or using citation trends to select articles that deserve reading.

Higher RAs are generally associated with more articles written by an author, regardless of the metric used to compute these indices (e.g., h-/g-/x-/Y-/hT-/L-/CJA-/CJAL-index^[3-10]). Based on the Kano model for the x-index,^[12-14] publications are more closely associated with these indices than citations. Thus, it is necessary to screen out articles by author publications first and then to evaluate their RAs later on.

1.2. A single bibliometric author dominates the field (1st question)

The drawbacks of these indices (e.g., h-/g-/x-/hot-/L-index^[3-5,7,8]) are that authorship, journal prestige, and document type are not taken into account. The Y-index^[6] is based on publications in first and corresponding authors only. The CJA score^[9] lacks article citations. The CJAL score^[10] considers 4 factors contributing to RAs, including the category (C; e.g., review, original article, case report, etc), the journal “quality” (J; e.g., IF, or ranking of the journal), the authorship order denoted by A), and article citation using the L-index.^[8] Compared to other counterparts, the CJAL has the disadvantage of not taking the dominance (hegemony) extent into account. RA can be evaluated using the absolute advantage coefficient (AAC)^[15] in contrast to revealed comparative advantage (or Balassa Index),^[16] which is used to evaluate the relative advantage or disadvantage of a country in a certain class of goods or services, as indicated by trade flows, in international economics. Therefore, it is necessary to verify that the leading author has a dominant RA in the bibliometric field using AAC.

The first research question is the identification of the leading bibliometric author who has a dominant RA beyond their counterparts.

1.3. Articles worth reading required for readers (2nd question)

In terms of bibliometric analysis,^[17] documents can be grouped by topic (e.g., bibliometrics) for a specific feature

(e.g., citations and publications).^[18] Researchers can use the new bibliometric method to gain a better understanding of the landscape of a research topic and to determine the direction of future research.^[19] An understanding of trends in articles has been fundamental to bibliometrics, such as the top 11 references with the strongest bursts of citations^[20] and a temporal bar graph (TBG) using the CiteSpace package (College of Computing and Informatics, Drexel University).^[21] There are 2 drawbacks to CiteSpace’s TBG: articles are cited references instead of active articles that are relevant to the current research, and no articles that deserve reading are included in the TBG based on the citation trend over the last few years. The challenge is to select articles for reading based on recent citation trends rather than total citations that are too old to be useful to readers, such as in those 100 top-cited articles.^[11]

The second research question is the identification of articles that are worth reading based on articles written by bibliometric authors who have at least 100 articles that have been cited at least 100 times in their author research career.

1.4. Study aims

The aim of this study is to confirm whether the leading author has a dominant RA and what articles deserve reading for readers using trend analysis. It is therefore necessary to verify the 2 hypotheses in this study.

2. Methods

2.1. Data sources

We searched the keywords (TS = bibliometric*) in the Web of Science (WoS) core collection based on authors who have at least 100 articles. A total of 399 articles were downloaded and analyzed; see Supplemental Digital Content1, <http://links.lww.com/MD/I277> and the link.^[22]

As this study did not involve the examination or treatment of patients or review of patient records, it was exempt from review and approval by our research ethics committee.

2.2. Two major indicators used in this study

2.2.1. The CJAL score. The CJAL score^[10] comprises 4 components, including document type (Ci), journal impact (Ji) based on Science Citation Index/Social Science Citation Index-indexed papers,^[9] authorship (Ai), and the L-index^[8] based on article citations via equations 1 to 3. The criteria and thresholds are displayed in Figure 1.

$$CJA\ score = \sum_{i=1}^n C_i \times J_i \times A_i \tag{1}$$

$$CJAL\ score = \sum_{i=1}^n C_i \times J_i \times A_i \times L - index_i \tag{2}$$

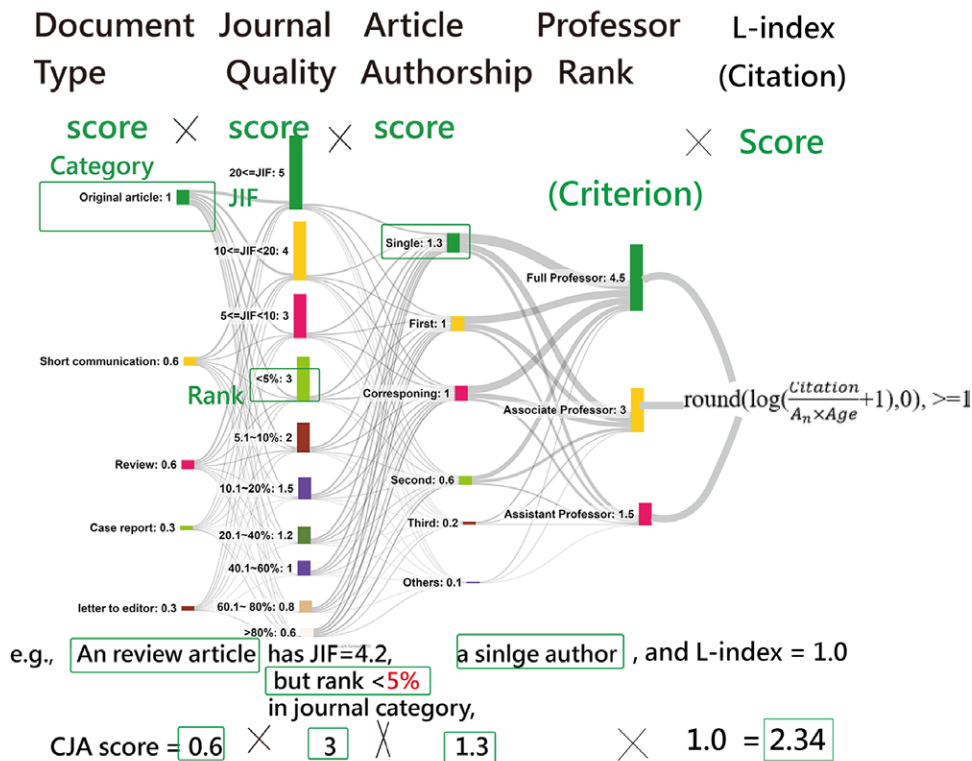
$$L - index = \text{round} \left(\log \left(\frac{Citation}{A_n \times Age} + 1 \right), 0 \right), \geq 1 \tag{3}$$

2.2.2. The AAC. The AAC is determined by the 3 consecutive numbers of values (e.g., RA in descending order denoted by A1, A2, and A3 in equations 4–6).^[15]

$$AAC = (R_{12}/R_{23}) / (1 + (R_{12}/R_{23})), \tag{4}$$

$$R_{12} = A1/A2, \tag{5}$$

How to compute the CJAL score for an article



Decision: Assistant professor if having one article only

Figure 1. The CJAL score used to compare author RAs. CJAL = category, journal impact factor, authorship, and L-index, RAs = research achievement.

$$R_{23} = A2/A3, \tag{6}$$

The AAC ranged from 0 to 1.0, representing the strength of dominance for the top one when compared to the next 2 counterparts in RAs. Through the computation of AAC, the dominance strength in RA can be measured and judged by the effect size, with criteria of <0.5, between 0.5 and 0.7, and not <0.7 as the small, medium, and large effect sizes, respectively.^[115]

2.3. Four approaches applied to this study

2.3.1. Author collaborations and keyword co-occurrences. Using social network analysis^[23,24] with the Pajek package (in Koeln; Pajek Man in Osoje [Ossiach, Austria]),^[25] co-word analysis was conducted on author collaborations and keywords. The weighted number of articles within and between clusters was displayed using a box plot. In this study, the higher the weighted centrality degree, the more articles exist in each entity (e.g., author and keyword). In an article, each author (or keyword) has an equal weight (=1/L, where L is the number of elements in the article).^[26-28]

We assigned keywords to each cluster of authors based on the data arrangement within each article by a string using co-word analysis (e.g., [chief author in a cluster, keyword1, keyword2..., keywordL] for each article). A chord diagram^[29] was used to display the top major keywords with the highest weighted centrality degree corresponding to each chief author in the network.

2.3.2. Comparison of RAs for leading bibliometric authors. We used a radar plot to display a comparison of the mean values of the 4 components of the CJAL score and the overall CJAL among

authors using one-way analysis of variance and the AAC. The significance level of type I error is set at $\alpha = 0.05$.

A Sankey diagram^[15,18,30] was used to display the CJAL scores for each article entity (document year, author cluster, WoS subject category, country of origin, author, research institute, and journal denoted by nodes) and their relationship (denoted by edge) evaluated by AAC.

2.3.3. Article worth-reading selected by TBG. To compute the growth trend, we selected the top cited articles with at least 100 citations, which were divided into 5 growth types denoted by increasing, ready to rise, slowdown, and declining. In the TBG, the citation trends of the worth-reading articles were displayed and highlighted based upon highly cited articles (>100) over the last few years. The growth types have been identified in previous studies.^[10,31,32]

2.3.4. Articles belonging to leading authors displayed on a dot plot. Articles belonging to leading authors were displayed on a dot plot (namely, the impact beam plot^[33]). The method for drawing the dot plot is described in Supplemental Digital Content 2, <http://links.lww.com/MD/I278>.

2.4. Creating dashboards on Google Maps

All graphs were drawn by author-made modules in Microsoft Excel (Microsoft Corp). We created pages of HTML used for Google Maps. The TBG can be zoomed in and out with a link to the website.^[34,35] The method of how to draw the TBG in R is deposited with a PDF file in Supplemental Digital Content2, <http://links.lww.com/MD/I278>. The study flowchart is shown in Figure 2.

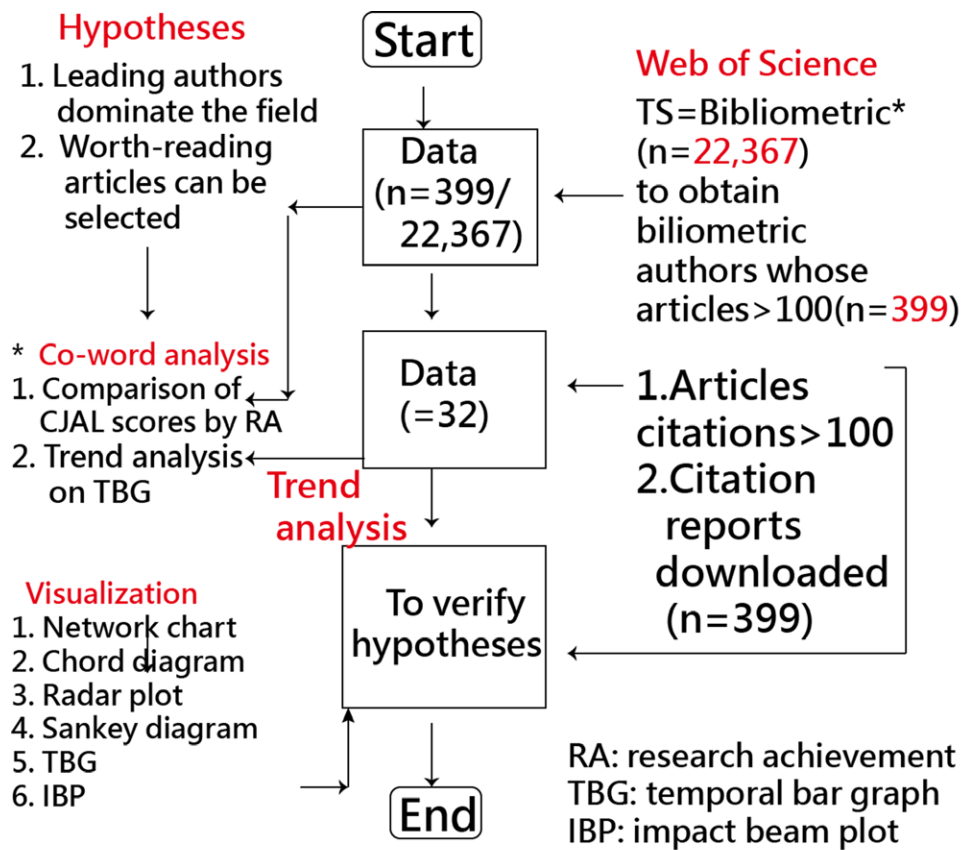


Figure 2. Study flowchart.

3. Results

3.1. Author collaborations and keyword co-occurrences

Four authors have at least 100 bibliometric articles in WoS. Only 3 clusters were extracted by social network analysis^[23-25] (i.e., the author Ciriaco Andres D'angelo is coauthored in an identical cluster with Giovanni Abramo). The top authors were Lutz Bornmann, Yuh-Shan Ho, and Giovanni Abramo (from Germany, Italy, and Taiwan, respectively) in each cluster using co-word analysis, as shown in Figure 3.

The major keywords along with leading authors are displayed in the chord diagram (Fig. 4). We can see that each author cluster has their features denoted using keywords. For example, Giovanni Abramo is closely associated with impact, science, research evaluation, and indicators; Yuh-shan Ho with scientometrics, journals, WoS, and publications; and Lutz Bornmann with altmetrics, medicine, and citation impact.

3.2. Comparison of RAs for leading authors

As shown in Figure 5, the mean values of the 5 components of the CJAL score are compared for the 3 leading authors. CJAL consists of 4 elements: article type, JIF, authorship, and citation. Although differences in mean values were found in these 4 components, no significant difference was found in the overall CJAL using one-way analysis of variance. Alternatively, based on AAC, all components in the CJAL are weak (<0.70). It is evident that the leading author (i.e., Dr Abramo) in the IRA with AAC ($=0.20 = [R_{12}/R_{23}]/(1 + [R_{12}/R_{23}])$) via equation 4, where $R_{12} = 107.06/102.62$ and $R_{23} = 102.62/24.2$) has no

such significant power beyond the next 2 influential authors (Fig. 6).

Regarding the WoS subject category, the AAC ($=0.79$) is large, indicating that a dominant role exists in Computer Science, Interdisciplinary Applications ($=243.38$), significantly more than the other 2 in CJAL ($=45.7$ and 32.32 , respectively), as shown in Figure 6.

3.3. Articles worth reading selected by TBG

A trend analysis of article citations in the last 4 years was used to select articles that deserve reading with an increasing trend in green on the right side in Figure 7. Two articles^[36,37] indexed in PubMed (i.e., belonging to the research area of biomedicine) are suggested to read for readers with citations of 131 and 119, respectively.

3.4. Articles in leading authors displayed on a dot plot

Articles in leading authors were displayed on a dot plot (namely, the impact beam plot^[33]), as shown in Figures 8–10. The red dot indicates articles with citations >100. Readers are invited to scan the QR code in Figures and click on the dot of interest to see the article abstract on the website.

3.5. Online dashboards shown on Google Maps

All the QR codes in Figures are linked to the dashboards.^[38-42] Readers are suggested to examine the displayed dashboards on Google Maps.

1. Adm Headquarters Max Planck Soc
Div Sci & Innovat Studies, Munich,
(Germany)

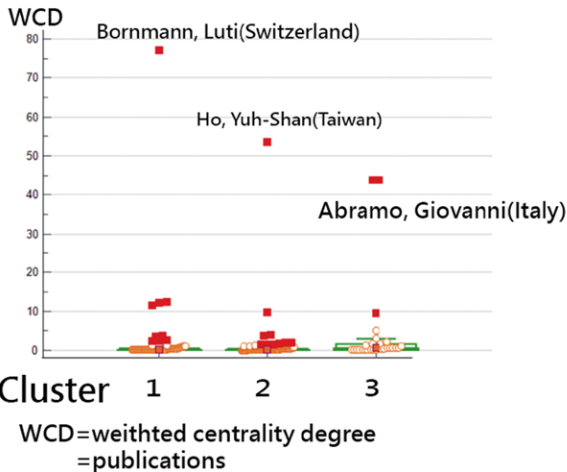
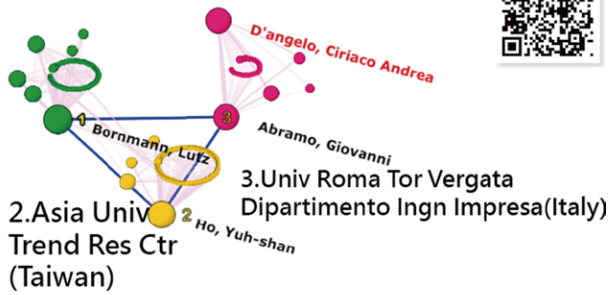


Figure 3. Three leading authors in bibliometrics clustered by co-word analysis.

4. Discussion

4.1. Principal findings

We observed that the top 3 authors were Lutz Bornmann, Yuh-Shan Ho, and Giovanni Abramo, with CJAL scores of 176.22, 176.02, and 112.06, respectively, from Germany, Italy, and Taiwan. Based on the weak dominance coefficient ($AAC = 0.20 < 0.70$), it is evident that the leading author in the IRA has no such significant power beyond the next 2 influential authors. A trend analysis of artoc; e-citations in the last 4 years was used to select articles that are worth reading.

Accordingly, the 2 hypotheses that the leading bibliometric author does not have a dominant RA and that articles worth reading can be selected by the TBG using citation-trend analysis have been confirmed.

4.2. Additional information

This study reveals that the leading authors in bibliometrics have published at least 100 articles in WoS. Reviewing 4 productive authors (Lutz Bornmann, Yuh-Shan Ho, Giovanni Abramo, and Ciriaco Andrea D'angelo) with >100 bibliometric articles in WoS, the 4 authors have a mean citation of 37.6 and a median citation rate of 19.^[1] Nonetheless, there were no articles entitled with 100 top-cited articles found in their publications, indicating that the 100 top-cited articles regarding bibliometrics have fewer citations than other bibliometric articles.^[1]

Combining existing knowledge in new ways is seen as a prerequisite for important research that can inspire further research. The 2 articles^[36,37] indexed in PubMed are suggested to read for readers, which aligns with the criteria for selecting articles that deserve reading based on recent increases in citations, as we did in this study.

Furthermore, since novelty refers to the combination of existing knowledge in an unconventional manner, it has been applied

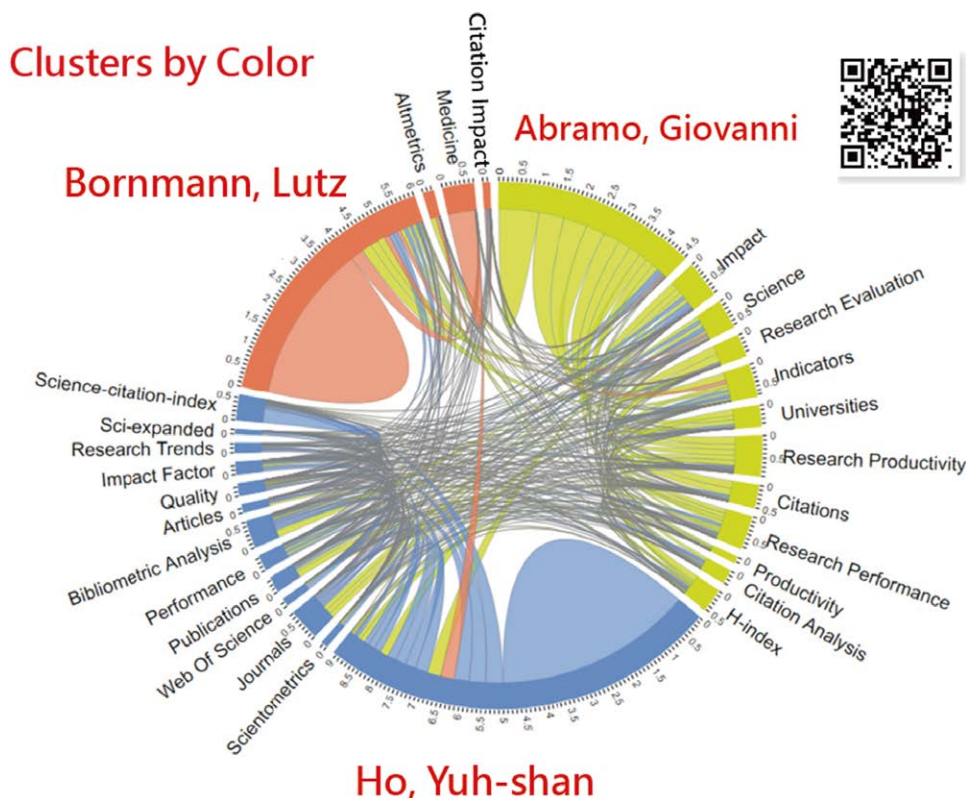


Figure 4. Relationship between elements using chord diagram to display.

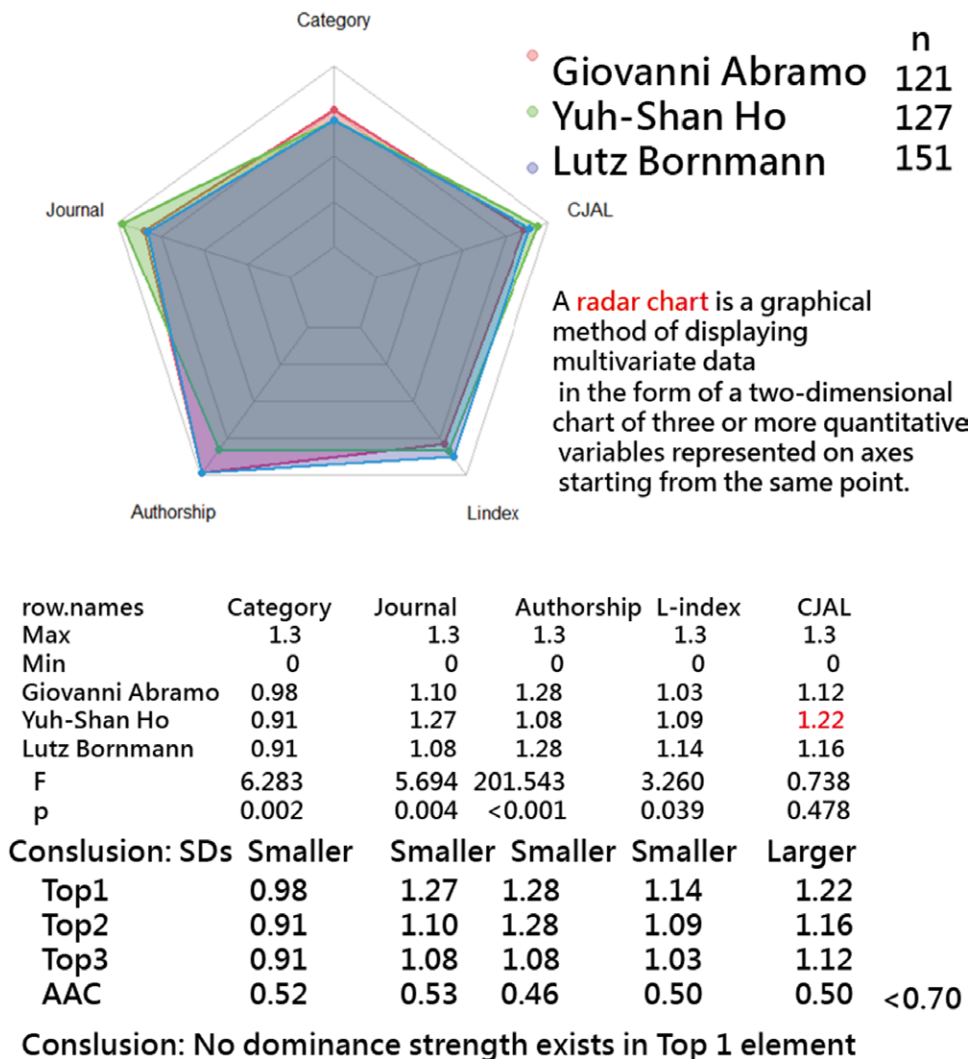


Figure 5. Comparison of CJAL scores among leading authors. CJAL = category, journal impact factor, authorship, and L-index.

to bibliometrics based on citations (as proxies for existing knowledge in archives^[43]). It is of particular interest to the field of research evaluation to develop a new area of novelty indicators since this focuses on new breakthroughs in research.^[44] However, research assessment is very challenging because scientific progress is driven by important, infrequent discoveries that are difficult to identify and quantify.^[45]

One of the advantages of this study is that it provides a comprehensive indicator of CJAL,^[10] which consists of 4 components: document type, JIF, authorship, and article citation. Although CJAL is more comprehensive than other metrics (including the h-/g-/x-/Y-/hT-/L-/CJA-/CJAL-index^[3-10]), its computation is somewhat complex. Moreover, the AAC^[15] was applied to evaluate the hegemony in the field, which has rarely been addressed in the literature. Consequently, the hypothesis that the leading bibliometric author has a dominant RA is not supported in this study.

RA can be evaluated using the AAC^[15] in contrast to revealed comparative advantage (or Balassa Index^[16]), which is used to evaluate the relative advantage or disadvantage of a country in a certain class of goods or services, as indicated by trade flows, in international economics. AAC has also been applied to other fields, such as inflection points in the coronavirus disease 2019 pandemic^[30,46-48] and the detection of unidimensional scales.^[49,50]

The TBG was applied to citation trends of articles (Fig. 6), distinctly different from the traditional TBG solely applied to

keywords in CiteSpace (College of Computing and Informatics, Drexel University).^[21] As such, the second hypothesis that articles worth reading can be selected by the enhanced TBG used in this study has been confirmed.

4.3. Most worth-reading articles

The article (PMID = 27,472,663)^[36] cited 131 times was authored by Lutz Bornmann, (Germany) et al and published in 2016, with citations of (41,196) in the last 4 years. This bibliometric study of a large publication set dealing with research on climate change presents quantitative data on the growth of the overall publication output and some major subfields. The study is based on 222,060 papers published between 1980 and 2014. This shows that climate change research has become an issue for disciplines beyond the natural sciences. The USA dominates research on climate change, followed by the UK, Germany, and Canada. The UK has produced the largest proportion of high-impact papers. The term climate change comes forward with time, and the term impact arises. The term model and related terms prominently appear independent of time.

Another article (PMID = 27472663)^[37] cited 119 times was authored by Yuh-Shan Ho (Taiwan) et al and published in 2010, with citations of (0,6,11,11) in the last 4 years. This study investigated current research trends in lung cancer in Japan using the Science Citation Index database from 1991 to 2008. The results

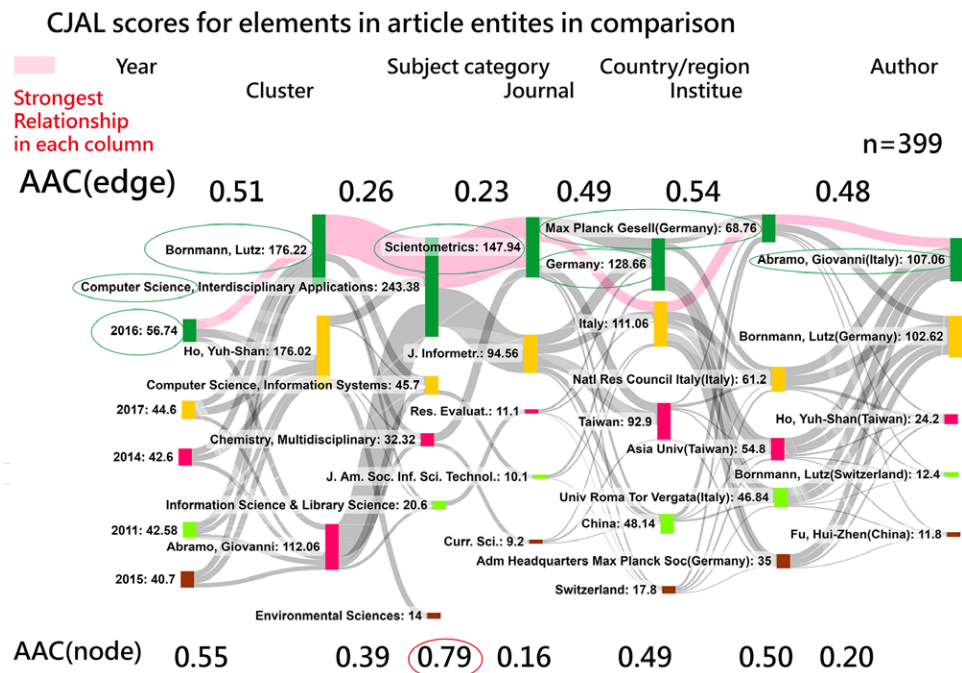


Figure 6. Comparison of CJAL scores and AACs for each node and edge on the Sankey diagram. AAC = absolute advantage coefficient, CJAL = category, journal impact factor, authorship, and L-index.

Top 37 with the strongest bursts in citations (>100), but 12 articles worth reading

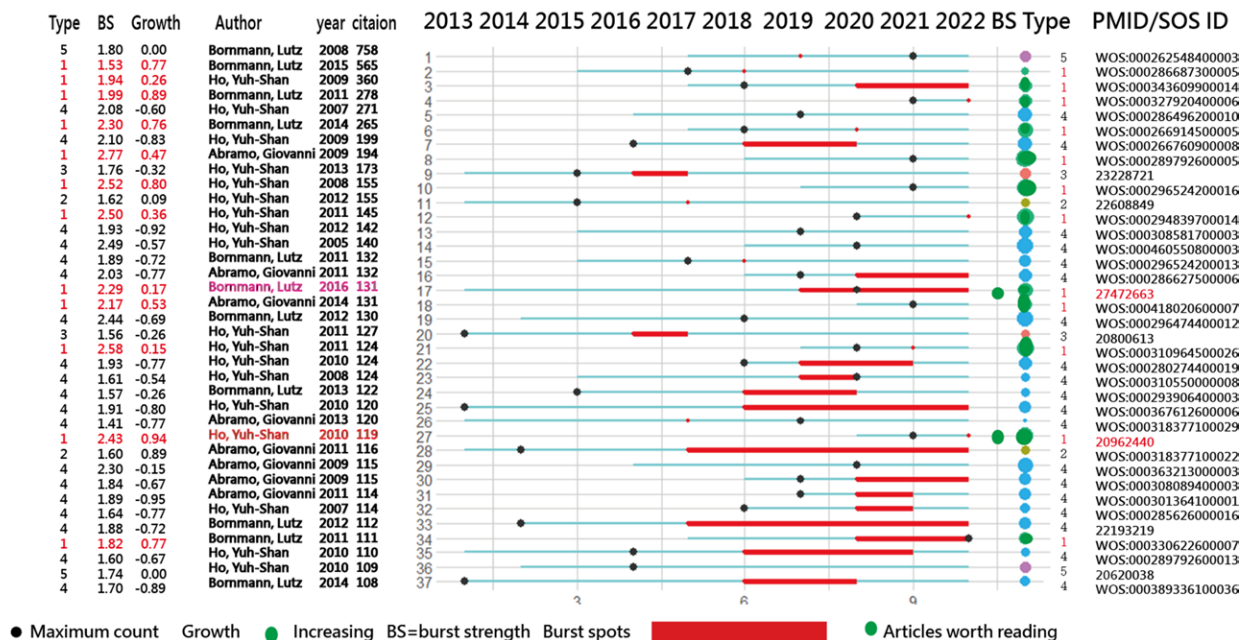


Figure 7. Trend analysis of articles with >100 citations shown on TBG (maximum count in black dot, increasing trend in green). TBG = temporal bubble graph.

indicated that there has been a strategy to connect molecular biology with clinical practice.

4.4. Implications and changes

A chord diagram^[29,51] was used to visualize dynamics related to contraceptive use and to bring data into practice. The dashboards

(e.g., in Fig. 3^[39]) provide an easy way to visualize the relationship between keywords and the leading authors. As a result of chord diagrams, we gain a clear understanding of the relationship between elements in article entities (e.g., the keywords and clusters shown in Fig. 3), which is rare in bibliometric analysis. Supplemental Digital Content2, <http://links.lww.com/MD/I278> provides the R code for reproducing the chord diagram.

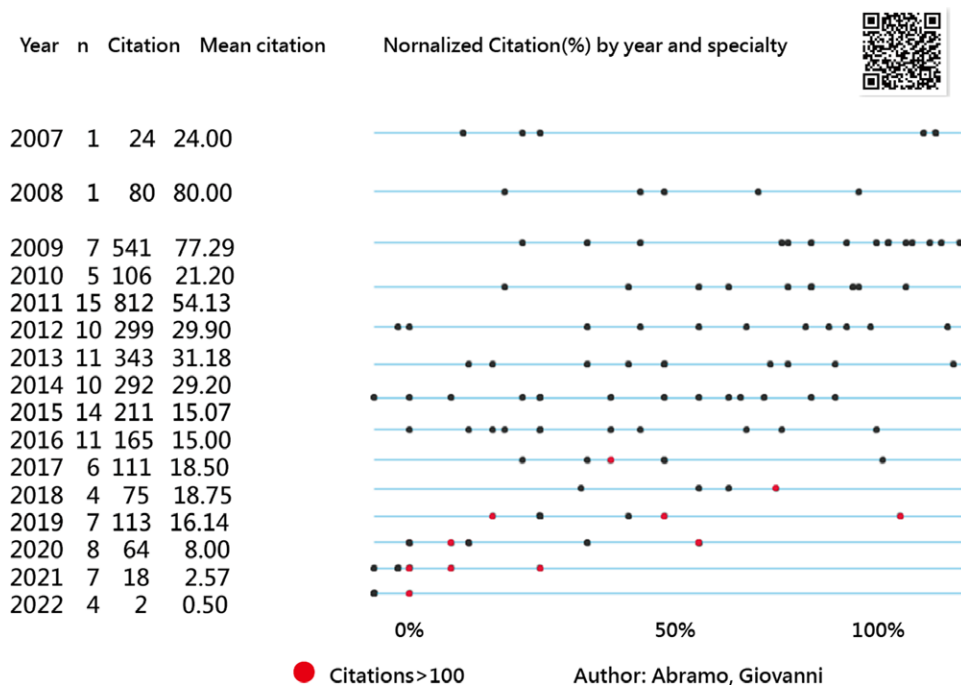


Figure 8. Articles by Lutz Bornmann on the IBP. IBP = impact beam plot.

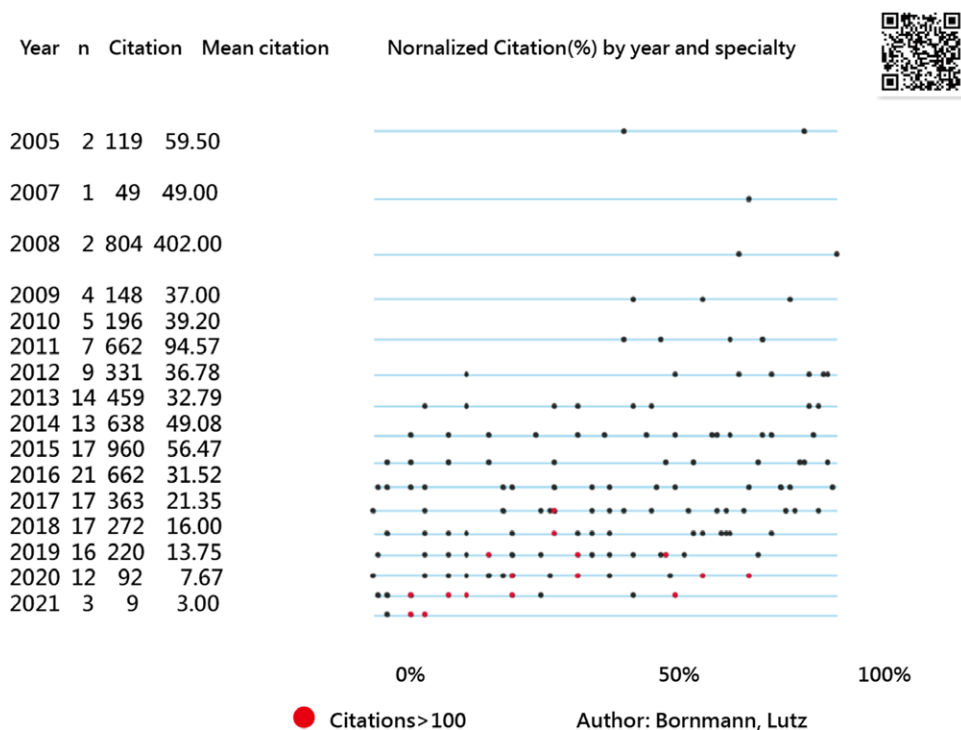


Figure 9. Articles by Giovanni Abramo on the IBP. IBP = impact beam plot.

In addition, chord diagrams^[29,51] could be used by network diagrams to clearly illustrate their network relationships, with more effective representations than the traditional displays using the network chart, as illustrated at the top of Figure 2.

There are 4 factors that contribute to the CJAL score,^[10] including subject category, JIF, authorship in positions on the article byline, and article citations. Although the evaluation of individual RAs has traditionally been based on bibliometric metrics (e.g., the h-g-/x-/Y-hT-/L-/CJA-/CJAL-index^[3-10]), these

metrics have a number of disadvantages, such as assuming that all co-authors contributed equally to the article, regardless of the type of document or JIF. The CJAL score^[10] bridges the gap between publications and citations when evaluating RA beyond bibliometric metrics.^[3-9]

As seen from the CJAL score in Figure 6, Germany dominates the bibliometric studies. This study differs from many traditional bibliographical studies in that the publications are computed based on the first and corresponding authors rather

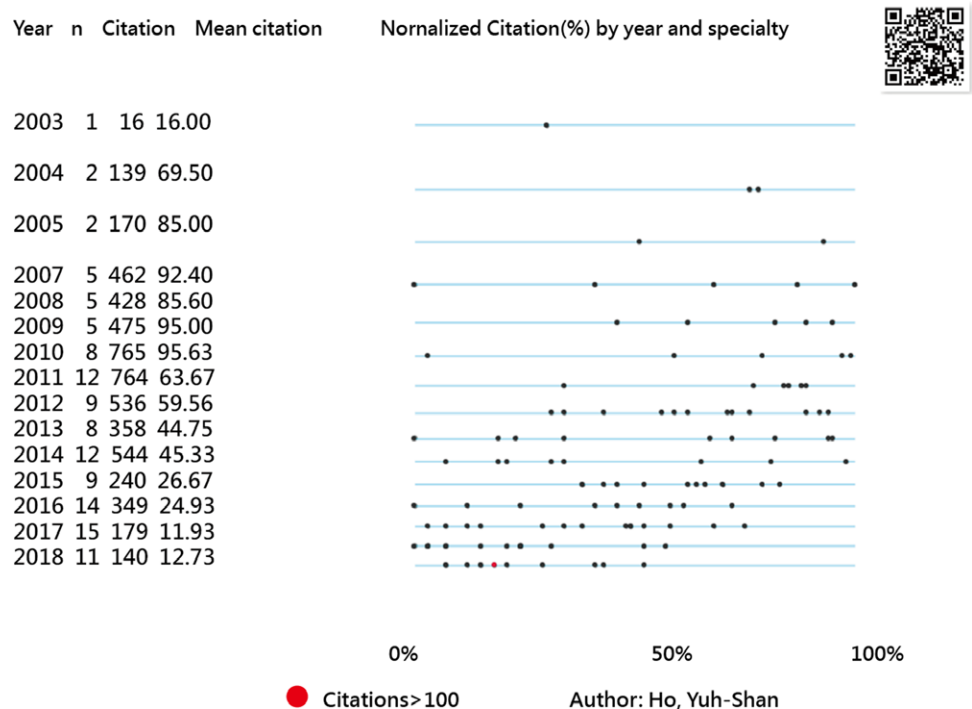


Figure 10. Articles by Yuh-Shan Ho of the IBP. IBP = impact beam plot.

than just the first author, as in traditional bibliometric studies. In this study, the dominant entities in bibliometrics were limited to the 3 leading authors. The year 2016 (56.74), the research institute of Max Planck Gesell (Germany) (68.76), the author of Giovanni Abramo (Italy) (107.06), the journal of *Scientometrics* (147.94), and the WoS subject category of Computer Science, Interdisciplinary Applications (243.38) are shown in the Sankey diagram (Fig. 6). It is therefore recommended that the CJAL score^[10] be used to measure RAs in bibliometric research, particularly when using the Sankey diagram to condense information at a glance.

4.5. Limitations and suggestions

A number of issues need to be examined in further research. The first concern is that the data and leading authors were retrieved from WoS core collection. It is possible that publications in other major citation databases, such as Scopus, PubMed, and Google Scholar, have been overlooked and the number of citations underestimated.

Second, the dashboards in Figures are displayed on Google Maps. It is not free to use Google Maps with the application programming interface and a paid project key. In the absence of such an application programming interface, the dashboard limitations are not publicly accessible.

Third, when measuring the RAs using the CJAL score, we assume that contributions are equally weighted by the first and corresponding authors. If the authors are not placed in either the first or corresponding position, the CJAL score and AAC may differ from the results: the leading author may not have a dominant RA in the field of bibliometrics.

Fourth, calculating the CJAL score requires considerable computational effort. Developing this technology on computer programming will require dedicated software in the future. As a result of the JIF and the journal ranking in Journal Citation Reports on WoS, the CJAL is suitable only for articles that relate to WoS.

Fifth, as a result of the time effect, there may be biases in study results resulting from article citations, which may impact CJAL scores in some way. Since we analyzed articles published as of the end of 2022, some recently published but important

literature may have received fewer citations and may even have been omitted.

Sixth, the definition of articles worth reading is based on citation trends over the last 4 years and the contributions of authors across all fields. There may be more articles in the area of informatics and mathematics than those relating to medicine in general and internal medicine. Nevertheless, the 2 articles illustrated in section 4.3 are related to biomedicine and are recommended for authors to read.

Finally, a summary of the articles of the 3 leading authors can be found in Figures 8–10. Other types of articles belong to them (e.g., informatics, mathematics) since the study does not focus solely on biomedicine.

5. Conclusion

It was achieved by confirming the 2 hypotheses that the leading author has a dominant RA and recent worth-reading articles can be selected by the TBG using trend analysis. The study approaches used in this study, such as visualizations, the CJAL score, the AAC, and the TBG, can be replicated in other fields or on other topics in the future and are not restricted to bibliometrics alone.

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Author contributions

HP and WT initiated the research, collected data, conducted the analysis, and wrote the manuscript. WC contributed to the design of the study and provided critical reviews of the manuscript. WC and TWC contributed to the interpretation of the results.

Conceptualization: Hon-Pheng Tam, Wan-Ting Hsieh.

Investigation: Willy Chou.

Methodology: Tsair-Wei Chien.

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