Annals of Library and Information Studies
Vol. 69, March 2022, pp. 13-27

Scrutinising uncitedness and few h-type indicators of selected Indian physics and astronomy journals

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Received: 13 August 2021; revised: 09 January 2022; accepted: 26 January 2022

The uncitedness of twelve Indian physics and astronomy journals over twelve years (2009-2020) time span is analysed here. Besides Uncitedness Factor (UF), three other indicators are discussed, viz., Time-normalized Citation per paper (CY), H-core Density (HD) and Time-normalised H-index (TH). The journal-wise variational patterns of these four indicators, i.e., UF, CY, HD and TH and the relationships of UF with the other three indicators are analysed. The calculated numerical values of these indicators are observed to formulate seven hypotheses, which are tested by the F-Test method. The average annual rate of change of uncited paper is found to be 67% of the total number of papers. The indicator CY is found temporally constant. The indicator HD is found to be nearly constant journal-wise over the entire time span, while the indicator TH is found to be nearly constant for all the journals. The UF inversely varies with CY and TH for the journals and directly varies with TH over the years. Except for a few Indian journals in physics and astronomy, the majority of the other journals face the situation of uncitedness. The uncitedness of Indian journals in this field is higher by 12% as compared to foreign journals in the same field, which indicates a possible poor circulation of the journals.

Keywords: Uncitedness; Uncited Paper; Citation Analysis; h-Index; h-type Indicator; Indian Physics Journal; Indian Astronomy Journal; Scientometrics: India; Bibliometrics: India; Scientometrics of Physics: India

Introduction

Scientometrics or bibliometrics studies generally focus on highly cited items. Poorly and uncited works are not generally studied. The literal meaning of the word 'uncited' is 'not quoted' or 'not cited', which is just opposite to 'cited'. The story of uncitedness has its roots that trace back to more than half a century ago. Perhaps the article entitled *Cybernetics, homeostasis and a model of disease* by Gerson Jacobs[1] (1964) was the first work to discuss the concept of uncitedness.

Despite many reprint requests shortly after the publication of this article, the same was indexed neither in any bibliography nor in *Science Citation Index*, as stated by the author seven years later in the *Journal of American Medical Association*[2]. Jacobs further pointed out five probable reasons for the same[2], though he identified the first one as the dominating factor, which states that 'the article is too profound and difficult to understand for the present generation of scientists.

The second reason stated that the 'article is a threat to the establishment', while the third reason stated it is 'not radical chic to cite an article that has never been cited'. The second reason, however, says a pertinent cause of negative citation. The third reason unveils the actual cause behind the very centripetal nature of citation accumulation, which is the basis for the well-known Preferential Attachment Model or Mathew Effect. This reason emphasises the fact that citation always has a tendency to follow some precursors resulting in the common feature of citation attracting citation. This centripetal nature of citation, in turn, explains why articles remain uncited over the years.

Jacob, the author, put forth an exciting suggestion here, that is, the Science Citation Index should establish a section "The never cited index". This will allow the truly relevant scientist to search out the literature of the revolutionary and suppressed literature. The phrase 'radical chic' in the third reason came from the famous 1970's book by Tom Wolfe entitled *Radical Chic & Mau-Mauing the Flak Catchers*[3]. This phrase has entered into the socio-political and socio-cultural glossary to describe the approval of radical or quasi-radical causes by members of the elite class society. It seems Jacobs used this phrase bit sarcastically in the third reason indicating elitism behind the receiving of citations.

Jacob's letter was criticised by Garfield[4], where he directly alleged that Jacob was mistaken on two points.

Firstly, his article was abstracted in *The Journal,* and its citations appeared in the *Science Citation Index* of 1964. Secondly, his idea of a Never-Cited Index or *Index Oblivionis* was not an original concept. Garfield pointed out that information on uncitedness first appeared in *Genetics Citation Index*[5] in 1963. The first explicit use of the word 'Uncited' was by Garfield[6] in 1970.

In this paper, Garfield opined that many uncited papers might be an excellent source of material for graduate students. In another contemporary paper[7], Garfield opined that obsolescence was the relatable reason for the continuous growth of uncitedness of research articles. He said, "I am constantly frustrated by the fact that citation indexes in most fields are not yet available for the first sixty years of the Twentieth Century". This saying pondered the discipline-wise non-uniformity amongst the citation-accumulation patterns. Garfield, in this paper, reminded us it is the duty of the librarians to assist the stakeholders in the selection of their thesis and dissertation topics by identifying interesting but hitherto uncited articles and bringing them to the focal point subsequently.

Review of literature

Ghosh[8,9] studied the uncitedness of 222 articles published in the *Journal of the American Chemical Society* from January to February 1965 and concluded that, on average, 14.7% of articles remained uncited during any given year. Lawani[10] showed that the rate of uncitedness declined with the increasing quality of articles for cancer literature. Stern[11] identified some bibliographic characteristics that distinguished cited papers from uncited papers. Sengupta and Henzler[12] analysed time lag between publications, average citation time, and uncitedness of cancer literature.

Szava-Kovats[13] analysed the nature and phenomenology of non-SCI eponymous citedness of physics literature. Hamilton[14] reported that on average, 47.4%, 74.7%, and 98% of articles remain uncited over five years in the disciplines of science, social science, and arts & humanities, respectively. He also pointed out the wide variations of uncitedness for different subjects even within a discipline. For instance, only 9.2% of articles remained uncited in the field of atomic, molecular, and chemical physics, followed by virology (14.0%), physics (16.7%), organic chemistry (18.6%), etc. While in acoustics, the percentage of uncitedness was 40.1%, followed by optics (49.1%), developmental biology (61.5%), and electrochemistry (64.6%). In engineering science, every subject field showed high rates of uncitedness, with civil engineering being highest at 78.0% and biomedical engineering (59.1%) figured the lowest.

Hamilton[15] pointed out that these figures of uncitedness were obtained from the statistics of Garfield's Institute for Scientific Information (ISI), while ISI's database then covered some 4500 (only 6%) out of nearly 74,000 scientific journal titles listed in Bowker/Ulrich's database. However, Pendlebury[16] explained the high percentage of uncitedness of SCI-journals. The SCI journals contained not only articles but also other forms of documents like reviews, notes, meeting abstracts, editorials, obituaries, letters, etc., which were, by and large, remained uncited. Pendelbury[16] defined uncitedness from the viewpoint of ISI's journal coverage. Garfield[17], however, differed from Hamilton's explanation of uncitedness and opined that *due to the cumulative character of science and scholarship, a great deal of the literature is cited but once*. Garfield coined the term *Onesies* to indicate the once-cited papers and found out in a study for the years 1945-88 that nearly 56% of publications remained *Onesies*.

Schwartz[18] found out the large-scale uncitedness percentage for library and information science, which figured 72%. Van Dalen and Kene[19] found that after ten years, 24% of the demography articles were still uncited, with an average number of citations per article figured seven. Small[20] introduced a normative theory of citation, viewing the same as symbolic payment of intellectual debts. He coined the term *citationology* as a subject domain to embrace all aspects of studies related to citedness and uncitedness within its periphery. Leeuwen, Thed and Moed[21] et al. showed the inter-relations among the journal impact factor, degree of uncitedness, citation frequency distribution, and output of a volume.

Van Dalen, Hendrik and Henkens[22] studied 1371 articles published in 17 demography journals during 1990-92 and concluded that the state of uncitedness did not affect the future probability of being cited. Egghe[23] showed the impact factor as a decreasing function of the uncitedness factor. Onyancha[24] compared the performance of 13 library and information science journals using their citedness and uncitedness along with other indicators like the number of citations, h-index and g-index, etc. Wallace, Vincent and Yves[25] proposed a simple model based on a random selection process to explain the "uncitedness" phenomenon and its decline over the years based on the Web of Science.

Egghe[26] found out the functional relation between the impact factor and the uncitedness factor based on Central Limit Theorem. Egghe, Guns and Rousseau[27] presented an interesting finding that the Nobel laureates and Fields medallists in the fields of physics, chemistry, physiology, or medicine and mathematics (field medallists) have a rather large fraction (10% or more) of uncited publications. The most remarkable result here was a positive correlation between the h-index and the number of uncited articles. Hsu and Ding-Wei[28] derived scaling relation between the impact factor and the uncited percentage by a random mechanism based on the cumulative advantage process.

Burrell[29] argued that Egghe's27 results might, at first sight, seem to be surprising but still explainable in a stochastic framework. Burrel[30] raised questions and discussed some of the arguments of Hsu's28 and Egghe's23,32 articles. Heneberg[31] analysed the uncitedness among two independent groups of highly visible scientists, which included Fields medallist mathematicians and Nobel laureate researchers in physiology or medicine. The result revealed that over 90% of the uncited database records of highly visible scientists could be explained by the inclusion of research output other than articles, i.e., editorial materials, meeting abstracts, letters to the editor, etc. and also by the errors of omission and commission of the Web of Science database and of the citing documents.

Egghe[32] presented a heuristic proof of the relation between the impact factor (IF) and the uncitedness factor (U), the fraction of the uncited papers, i.e., $U = \frac{1}{1+IF}$. Law, Andy and Norman[33] analysed the uncited articles published in the *Asia Pacific Journal of Tourism Research* and the *Journal of Travel & Tourism Marketing* during the period 1996-2005. Garg and Kumar[34] analysed 35,640 papers published by Indian scientists in 2008, indexed by Science Citation Index-Expanded (SCI-E), which revealed that 6231 (17.5%) papers remained uncited during 2008-2013. The highest proportion of uncited papers was in the discipline of agricultural sciences, followed by multidisciplinary and mathematical sciences. Lou and He[35] collected uncited papers from 24 journals in six subjects from WoS and found that there is a significant correlation between affiliation reputation and uncitedness. Arsenault and Vincent[36] found a correlation between the uncitedness factor and alphabets in the authors' names.

Liang, Zhong and Rousseau[37] studied three types of uncitedness in Library and Information Science journals, viz., uncitedness for articles, authors, and topics. Gopalakrishnan, Bathrinarayanan and Tamizhchelvan[38] carried out a bibliometric study of uncited publications in "micro-electromechanical systems" literature. Elango[39] discussed the characteristics of uncitedness of literature on tribology and compared it with cited papers. The results showed there was a significant difference in characteristics between cited and uncited papers.

Zewen and Yishan[40] identified seven major points, i.e., research hotspots and novel topics, research topics similar to one's work, high quality of content, reasonable self-citation, highlighted title, prestigious authors, and academic tastes and interests similar to one's own, that usually facilitate the easy citation of papers. Zewen, Yishan and Jianjun[41] considered the mutual relations and closeness degree between the non-citation factors and different influencing factors and found out that three variables, i.e. the average number of authors per paper in the journal, the average number of references per paper in the journal, and issues of the journal did not exert an influence on the decline of percentages of never-cited papers in the citation time window.

Zewen, Yishan and Jianjun[42] used a survey-based structural equation model and established that three observed variables of 'academic status of the journal' including 'public praise of journal', 'impact factor of the journal', and 'member of SCI, EI, and Scopus Journals', showed the highest values of indirect effect on the non-citation rate. Yeung[43] found relationships among various citation metrics in the field of neuroimaging. Nowroozzadeh and Salehi-Marzijarani[44] analysed uncitedness in the top-ranked medical journals. Nicolaisen and Tove[45] showed large variation in uncitedness ratios between subject areas and also between document types in seven subject-area and seven document types.

Baruch, Fabian and Abdul-Rahman[46] found from the analysis of a sample of 2777 papers in management studies that the rate of uncitedness is quite low, only 6.5% in this field. Dorta-González, Rafael and María[47] analysed three factors for journals, conference proceedings and book series, i.e. the subject field, the access modality (open access vs paywalled) and the visibility of the source. They found no strong correlation between open access and uncitedness, but lower uncited rates of open access journals.

Research Gap

Hamilton[14] noticed an average of 47.4%, 74.7%, and 98% uncitedness in the disciplines of science, social science and arts & humanities respectively in 1991, while the picture has still remained unchanged even after 30 years. Lloyd and Ordorika[48] pointed out in 2021 that in Scopus, 49% of citations are of publications in the life sciences and medicine, followed by the natural sciences (27%) and engineering and technology (17%). The social sciences and arts & humanities represent just 6% and 1% of citations. It is not only the discipline-wise large variation of uncitedness, but the uncitedness factor also shows the acute non-uniform pattern over journals, institutes, and even countries as reflected from the literature review.

The notable point here is that the country-wise study of uncitedness is very few as found from the literature review. It is also noticed that only two articles[34,38] discussed the uncitedness of Indian scientists. The former[34] article highlighted the uncitedness of Indian scientists, while the later[38] one showed that 31.44% of Indian articles on micro-electro-mechanical systems (MEMS) remained uncited. Although the uncitedness of Indian journals in almost all major disciplines is a key issue today, no research in this domain has yet been observed that created a research gap.

This paper analyses the Uncitedness Factor (UF) of major Indian physics and astronomy journals, which according to Egghe[23], is defined as the ratio of the number of uncited papers (U) to the total number of papers (P) of the respective journals in a particular year. The UF thus figures out the fractional change in uncited papers with respect to the total number of papers, i.e.,

$$UF = \frac{U}{P} \quad \dots (1)$$

Besides Uncitedness Factor (UF), other three h-type indicators viz. CY, HD, and TH are discussed here, and their correlations with Uncitedness Factor (UF) are tested.

h-type Indicators

Time-Normalized Citation-per-Paper (CY)

Let 'P' number of articles published in a journal in the year 'Y' have received 'C' number of citations in the current year, Y_c. Then Time-Normalized Citation-per-Paper, denoted by 'CY', is defined as,

$$CY = \frac{C}{P(Y_C - Y)} \quad \dots (2)$$

h-Core Density (HD)

Let 'P' number of articles published in the concerned journal in the year 'Y' has received 'C' number of citations in the current year, Y_c, the value of h-index is h, say, and C_h denotes the number of h-core citations. The h-core Density, denoted by 'HD' is defined as,

$$HD = \frac{C_h}{C} \quad \dots (3)$$

Time-Normalized h Index (TH)

Time-dependent h-index or year-based h-type indicators were discussed by Mahbuba and Rousseau[49]. Here it is defined as the ratio of the h-index of a journal in a year to the age of the journal, where the age of the journal is indicated by the difference between the current year, i.e., 2021 and the concerned h-index' year. Let 'P' number of articles published in the concerned journal in the year 'Y' with the value of h-index is 'h' in the current year Y_C (say). The Time-Normalised h-Index, denoted by 'TH', is defined as,

$$TH = \frac{h}{(Y_C - Y)} \quad \dots (4)$$

Objectives of the study

- To observe how do the citations influence the uncitedness of Indian physics and astronomy journals;
- To observe how h-core citation and h-index influence uncitedness of Indian physics and astronomy journals;
- To find out the numerical values of UF, CY, HD, and TH for 12 Indian physics and astronomy journals over 12 years (2009-2020); and
- To represent the empirical relation between UF and either of CY, HD and TH in terms of the functional equation from the calculated data.

Hypotheses

The following seven null hypotheses (H_0) have been formulated for this study. The first four hypotheses are about the constancy factor of the four indicators, while the last three hypotheses state the relationships of UF with the other three indicators. The fundamental axioms forming the basis of these hypotheses are as follows:

Axiom 1

The preferential attachment or cumulative advantage model[50,51,52] of the citation accumulation process by any item (article, journal, author or

institution) is the foremost axiom. This model explains wealth or credit distribution among several individuals or objects according to how much they already have so that the wealthy ones or haves receive more than the have-nots. Similarly, the citation always tends to accrue around the cited papers. The higher cited papers usually attract more citations, but most uncited papers are seldom cited highly.

Axiom 2

The citation accumulation process is a function of time, i.e., citations gradually amass to an article as time passes on.

Axiom 3

The h-index is the solution of the equation: $r = C(r)$, where C(r) is the number of citations of the r^{th} publication from the ranked list or articles of the researcher[53]. The h-core citation is thus a dependent function of total citation, as citation determines the rank.

Hypothesis 1) $H_0(1)$:

The total number of papers is directly proportional to the number of uncited papers in a journal in any year, i.e.

$$P \propto U, \text{or UF (Uncitedness Factor)} = \frac{U}{P}$$
$$= \text{Constant both over the years and over the journals as well . (Equation (1))}$$

Hypothesis 2) $H_0(2)$:

The number of citations (C) is directly proportional to the total number of papers (P) in a journal/ by an author, and directly proportional to the years spent after publication $(Y_C - Y)$, where Y_C and Y are the current year and the year of publication respectively.

$$\text{Hence, } C \propto P, \text{when } (Y_C - Y) \text{ is constant}$$
$$C \propto (Y_C - Y) \text{ , when P constant}$$
$$C \propto P(Y_C - Y), \text{when both vary}$$

The Time-Normalized Citation-per-Paper or $CY = \frac{C}{P(Y_C - Y)} = \text{Constant}$ factor both over the years and over the journals as well.

Hypothesis 3) $H_0(3)$:

The h-core citations (C_h)is directly proportional to the total number of citations (C) for a journal in any year, i.e.$C_h \propto C$, or $\frac{C_h}{C} = h - \text{core Density} =$ constant over the years and over the journals as well.

Hypothesis 4) $H_0(4)$:

As citation accumulation is a function of time or years spent, h-index increases with years passing on. Hence, $h \propto (Y_C - Y)$; or $\frac{h}{(Y_C - Y)} = \text{Constant}$, or TH is constant over the years and over the journals as well.

Hypothesis 5) $H_0(5)$:

UF is inversely proportional to CY, or $UF \propto \frac{1}{CY}$, or UF*CY =Constant over the years and over the journals as well.

Hypothesis 6) $H_0(6.1)$:

UF is inversely proportional to TH, or $UF \propto \frac{1}{TH}$, or UF*TH = Constant over the journals and **H_0 (6.2):** TH is directly proportional to UF, or $TH \propto UF$, or TH/UF = Constant over the years.

Hypothesis 7) $H_0(7)$:

HD is directly proportional to UF, or $HD \propto UF$, or HD/UF = Constant over the years and over the journals as well.

Scope and methodology

The values of the four indicators, viz., UF, CY, HD and TH are calculated for twelve Indian physics and astronomy journals from 2009 to 2020 (Appendix: Table A1 to Table A4) based on the available primary data (Appendix: Table A8). The average value in each year calculated journal-wise and the average value of each journal calculated year-wise, represented by Mean (Y) and Mean (J) respectively are furnished in the bottom-most row and extreme right column of Table A1 to Table A7. Of the twelve journals, seven journals belong to the core domain of physics and astronomy (S. No. 2, 4, 5, 6, 8, 11 and 12), while remaining five journals belong to allied areas of physics but publish articles on physics regularly (S. No. 1, 3, 7, 9 and 10).

Proceedings of the Indian National Science Academy (PINSA) belongs to the natural science discipline and publishes physics articles on a regular basis. The list of the twelve Indian journals selected for this study is given below:

1) *Defence Science Journal (DSJ)*
2) *Indian Journal of Biochemistry and Biophysics (IJBB)*
3) *Indian Journal of Engineering and Materials Sciences (IJEMS)*
4) *Indian Journal of Physics (IJP)*
5) *Indian Journal of Pure & Applied Physics (IJPAP)*

6) *Journal of Astrophysics and Astronomy (JAA)*
7) *Journal of Earth System Science (JESS)*
8) *Journal of Medical Physics (JMP)*
9) *Journal of Scientific and Industrial Research (JSIR)*
10) *Proceedings of the Indian National Science Academy (PINSA)*
11) *Pramana - Journal of Physics (PJP)*
12) *Proceedings of the National Academy of Sciences India Section A - Physical Sciences (PNASI)*

The primary data furnished in Table A8 have been collected from *Scopus* database. The search strategy followed in *Scopus* under 'Advanced Search' was, "SUBJAREA (PHYS) AND AFFIL COUNTRY (INDIA) AND (EXACTSRCTITLE (DEFENCE SCIENCE JOURNAL))". The period was set from 2009 to 2020. The same strategy was repeated for the other eleven journals as listed above and the number of papers, number of uncited papers and total number of citations in each of the journals from 2009 to 2020 as retrieved from Scopus are presented in Table A8.

The h-index and h-core citations for each of the journals are calculated from the retrieved data. The year-wise and journal-wise breakup of the values of the indicators along with their relationship with UF are presented in Table A1 to Table A7. The seven hypotheses formulated are tested by F-Test method and the results are presented.

The six statistical parameters, viz., Mean, Median, Range, Standard Deviation, Coefficient of Variation and Kurtosis of the four indicators, along with the relations between UF and the remaining three indicators are also presented.

Results and analysis

The primary data obtained from twelve journals listed above is furnished in Table A8 (Appendix). The total number of papers published in the respective journals (P) along with the number of uncited papers (U), total number of citations (TC) and h-index for twelve journals are listed here.

In all, 13,567 papers are published in 12 journals from 2009 to 2020, which received 67,365 citations with 5 citations per paper on an average. Of the entire publications, 3,884 papers received no citations comprising 28.6% of uncited papers. The year-wise and journal-wise variations of percentage of cited and uncited papers together are presented in Figure 1 and Figure 2 respectively. The variation of total number of citations for the twelve journals is presented in Figure 3. The yearwise variation of total number of citations and normalised citations is presented in Figure 4.

The year-wise and journal-wise variations of total number of papers along with number of cited and

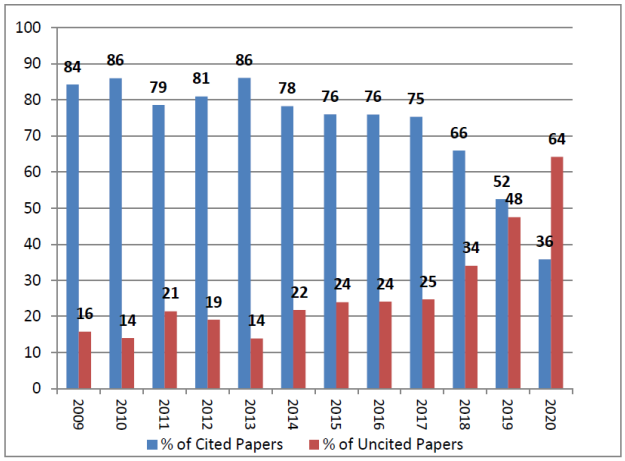

Fig. 1 — Year-wise variation of percentage of cited papers and uncited papers

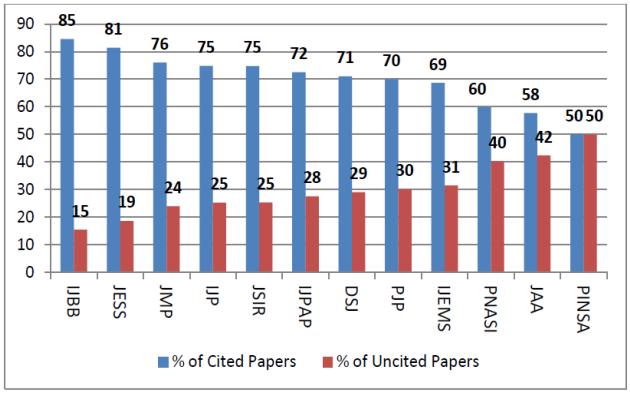

Fig. 2 — Journal-wise variation of percentage of cited papers and uncited papers

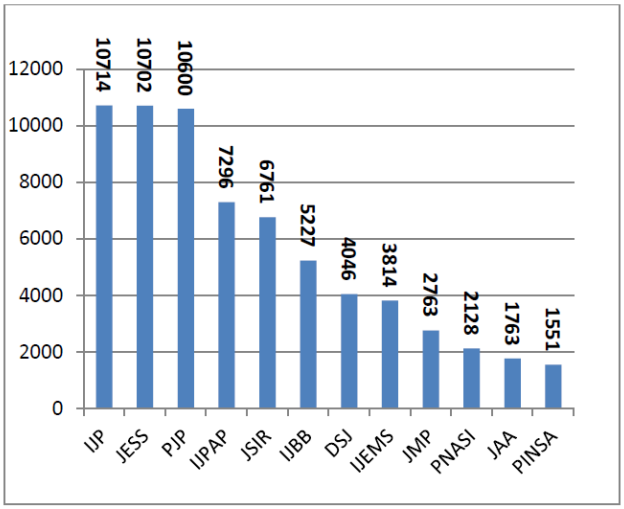

Fig. 3 — Journal-wise variation of Total number of Citations (TC)

uncited papers are presented in Figure 5 and Figure 6 respectively. The largest number of 2368 papers were published in *Indian Journal of Physics*, followed by *Pramana-Journal of Physics* (2356), *Journal of Earth System Science* (1540) and *Indian Journal of Pure and Applied Physics* (1348) (Figure 6). These four journals published 56% of entire publications. The highest citation was received by *Indian Journal of Physics* (10714) followed by *Journal of Earth System Science* (10702), *Pramana-Journal of Physics* (10600) and *Indian Journal of Pure and Applied Physics* (7296) (Figure 3). It is worthwhile to mention that *Indian Journal of Physics*, started in 1925 and is the oldest continuing Indian physics journal.

These four journals altogether received 39312 citations, i.e., almost 59% of total (67365) citations. The average citation per paper is highest for *Indian Journal of Biochemistry and Biophysics* (8), followed by *Journal of Earth System Science* (7) and *Journal of Medical Physics & Journal of Scientific and Industrial Research* (6 each). The highest number of uncited papers is found in *Pramana-Journal of Physics* (709), followed by *Indian Journal of Physics* (597) and *Proceedings of the Indian National Science Academy* (382) (Figure 6). In terms of percentage of uncited papers, *Proceedings of the Indian National Science Academy* ranked first, where 50% papers remained uncited, followed by *Journal of Astrophysics and Astronomy* (42%), *Proceedings of the National Academy of Sciences India Section A - Physical Sciences* (40%), *Indian Journal of Engineering and Materials Sciences* (31%). The journal *Indian Journal of Biochemistry and Biophysics* has lowest uncited percentage (15%) followed by *Journal of Earth System Science* (19%) and *Journal of Medical Physics* (24%) (Figure 2). The three highly reputed journals, viz., *Indian Journal of Physics*, *Indian Journal of Pure and Applied Physics* and *Pramana-Journal of Physics* found uncited percentages figured 25%, 28% and 30% respectively.

The year-wise result shows, the lowest and highest numbers of papers were found in 2009 (976) and 2020 (1508) with several intermittent fluctuations over the time span (Figure 5). Also, the lowest and highest numbers of normalised citations were found in 2019 (560) and 2020 (1058), the crest-trough pair occurred just in consecutive years (Figure 4). The lowest numbers of uncited papers were found in 2010 and 2013 that figured 141, i.e., 14% of total number of papers published in respective years. On the contrary, the largest number of uncited papers was found in 2020 (968), i.e., 64% of total papers of the year

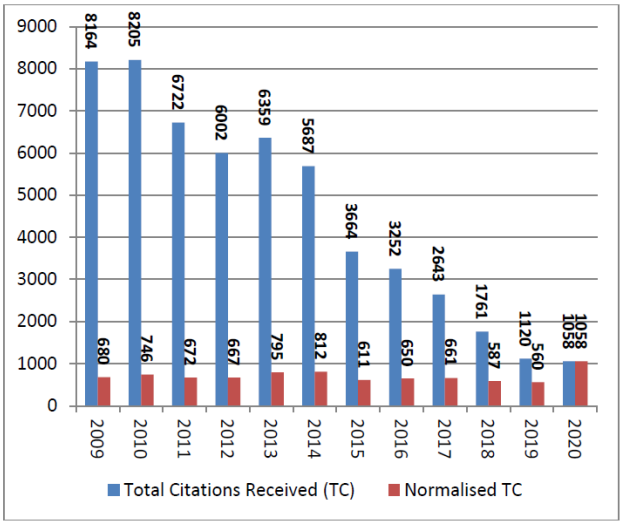

Fig. 4 — Year-wise variation of Total number of Citations (TC) and Time-Normalised Citations

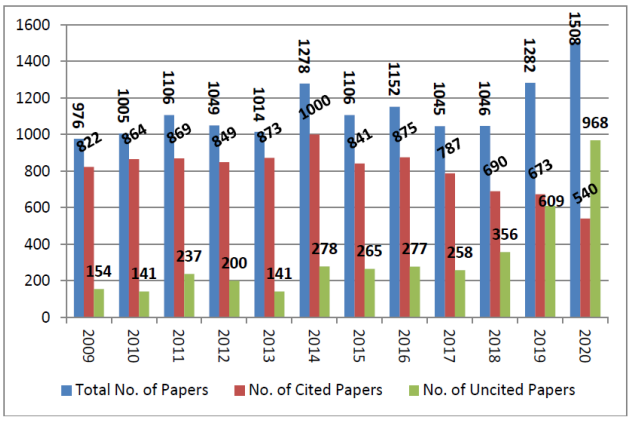

Fig. 5 — Year-wise variation of total number of papers and number of cited and uncited papers

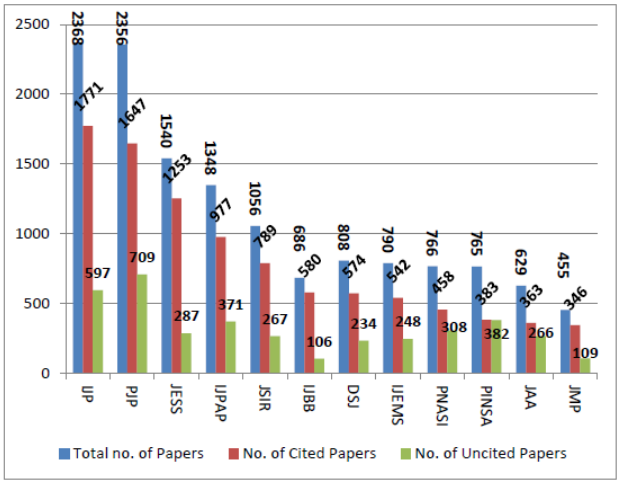

Fig. 6 — Journal-wise variation of total number of papers and number of cited and uncited papers

(Figure 1 and Figure 5). The number of uncited papers gradually enhanced with years as citation accumulation is a function of time or age of a journal. The average uncited papers in twelve journals are 30%. It shows that around one-third of Indian physics and astronomy research articles published in Indian journals remains uncited.

The Uncitedness Factor (UF) does not show steadiness either for the journals or over the years as $H_0(1)$ is rejected both for the journals (Table 1) and for the years (Table 2). The journal *Proceedings of the Indian National Science Academy* possessed highest average UF (0.47) followed by *Journal of Astrophysics and Astronomy* (0.38) and *Proceedings of the National Academy of Sciences India Section A - Physical Sciences* (0.37). Also, the highest value of the UF has been observed in the year 2020 (0.68) followed by 2019 (0.51), 2018 (0.37), 2017 (0.25), 2016 (0.24) and so on. The steady decreasing trend of the UF with years in reverse chronological order accords the negative power model, i.e. $UF = 0.67 * t^{-0.6}$, Coefficient of Determination (R^2) = 0.931 and 't' indicates time in years. The Coefficients of Variation (CV) of UF for journals and years figure 33.3% and 57.7% respectively, which are pretty high showing far from constancy tendency. Also the Kurtosis values for $(UF)_{Journal}$ and $(UF)_{Year}$ that figured 0.049 and 2.766 respectively show skewed patterns, particularly high positive value of $(UF)_{Year}$ shows highly skewed pattern (Table 3 and Table 4).

The Time-Normalized Citation-per-paper (CY) shows the variational pattern for the journals, as $H_0(2)$ is rejected for the journals (Table 1), but shows

Table 1 — Testing of hypothesis for population means of indicators' values for the journals

F_C = 1.86: At 5% level of significance (α = 0.05; df (bg): 11; df (wg): 132)

Indicators	F_O	P	Observation	Inference: Null Hypothesis (H_0)is
UF	2.82	0.0025	$F_C < F_O$; $P < \alpha$	$H_0(1)$ is Rejected
CY	5.93	$8.7*10^{-08}$	$F_C < F_O$; $P < \alpha$	$H_0(2)$ is Rejected
HD	2.14	0.022	$F_C < F_O$; $P < \alpha$	$H_0(3)$ is Rejected
TH	3.61	0.0002	$F_C < F_O$; $P < \alpha$	$H_0(4)$ is Rejected
UF*CY	1.27	0.25	$F_C > F_O$; $P > \alpha$	$H_0(5)$ is Accepted
UF*TH	0.90	0.54	$F_C > F_O$; $P > \alpha$	$H_0(6.1)$ is Accepted
HD/UF	4.66	$5.6*10^{-06}$	$F_C < F_O$; $P < \alpha$	$H_0(7)$ is Rejected

F_C - $F_{Critical}$; α - Level of Significance Value;F_O - $F_{Observed}$; P - P-Value; H_0 - Null Hypothesis; df(bg) - Degrees of Freedom (Between groups) = 11; df(wg) - Degrees of Freedom (Within groups) = 132

Table 2 — Testing of hypothesis for population means of indicators' values for the years

F_C = 1.86: At 5% level of significance (α = 0.05; df (bg): 11; df (wg): 132)

Indicators	F_O	P	Observation	Inference: Null Hypothesis (H_0)is
UF	15.96	$1.7*10^{-19}$	$F_C < F_O$; $P < \alpha$	$H_0(1)$ isRejected
CY	0.35	0.97	$F_C > F_O$; $P > \alpha$	$H_0(2)$ isAccepted
HD	3.03	0.001	$F_C < F_O$; $P < \alpha$	$H_0(3)$ isRejected
TH	7.48	$6.9*10^{-10}$	$F_C < F_O$; $P < \alpha$	$H_0(4)$ isRejected
UF*CY	13.03	$1.7*10^{-16}$	$F_C < F_O$; $P < \alpha$	$H_0(5)$ isRejected
TH/UF	1.11	0.361	$F_C > F_O$; $P > \alpha$	$H_0(6.2)$ isAccepted
HD/UF	2.75	0.003	$F_C < F_O$; $P < \alpha$	$H_0(7)$ isRejected

Table 3 — Statistical parameters of the indicators' values for the journals

	Mean	Median	Range	Standard Deviation (SD)	Coefficient of Variation (CV)	Kurtosis	Correlation Coefficient (R)
UF	0.28	0.28	0.33	0.093	0.333	0.049	---
CY	0.76	0.78	0.89	0.228	0.300	1.010	---
HD	0.26	0.26	0.08	0.028	0.108	-1.172	---
TH	1.86	1.69	2.00	0.691	0.371	-0.106	---
UF*CY	0.18	0.16	0.17	0.050	0.277	2.349	R_{UF-CY} =-0.93
UF*TH	0.58	0.52	0.79	0.236	0.407	1.416	R_{UF-TH} = -0.46
HD/UF	1.79	1.49	4.52	1.206	0.674	6.567	R_{UF-HD} = 0.52

Table 4—Statistical parameters of the indicators' values for the years

	Mean	Median	Range	Standard Deviation (SD)	Coefficient of Variation (CV)	Kurtosis	Correlation Coefficient (R)
UF	0.28	0.22	0.52	0.162	0.577	2.766	---
CY	0.76	0.77	0.22	0.070	0.092	-0.903	---
HD	0.26	0.26	0.11	0.032	0.123	-0.190	---
TH	1.86	1.58	3.29	0.890	0.480	8.330	---
UF*CY	0.18	0.12	0.39	0.116	0.644	4.256	R_{UF-CY} =-0.16
UF*TH	0.58	0.30	2.63	0.742	1.279	8.074	R_{UF-TH} = 0.93
TH/UF	11.82	10.16	15.65	4.681	0.396	-0.52	
HD/UF	1.80	1.89	2.90	0.993	0.552	-1.240	R_{UF-HD} = -0.76

constancy for the years, as $H_0(2)$ is accepted for the years (Table 2). The *Journal of Earth System Science* possessed highest average CY (1.22) followed by *Indian Journal of Biochemistry and Biophysics* (0.99), *Pramana- Journal of Physics* (0.90) and *Indian Journal of Physics* (0.85). The CY remained almost constant over the years with an average of 0.76 (Table 4). The Coefficients of Variation (CV) of CY for journals and years figure 33.3% and 9.2% respectively, where the former is high showing non-constancy and the latter is quiet small. The Kurtosis values of 1.01 and -0.903 for $(CY)_{Journal}$ and $(CY)_{Year}$ respectively show skewed pattern of the former one, while the negative Kurtosis value of the later indicates the flat distribution with thin tail revealing constancy. The h-core density (HD) is not constant either for journals or for the years, as $H_0(3)$ is rejected in both cases (Table 1 and Table 2).

The values of CV and Kurtosis of HD are 0.108 & -1.172 (Table 3) for the journals, and 0.123 & -0.190 (Table 4) for the years. The low CV values and negative Kurtosis values, however point out the near constancy of HD both for the journals and years, which is also accorded by close proximity of F_0 (2.14 (journals) & 3.03 (years)) and F_C (1.86). The Time-normalised h-index (TH) also is not constant for both journals and years as $H_0(4)$ is rejected in both cases. The values of CV and Kurtosis of TH are 0.371 & -0.106 (Table 3) for the journals, and 0.480 & 8.330 (Table 4) for the years. The TH over the years is highly fluctuating, as evident from the high Kurtosis value (8.33, Table 4), while the same for journals is relatively stable as clear from its negative kurtosis value (-0.106, Table 3).

The Uncitedness Factor (UF) for journals is inversely proportional to CY and TH, as $H_0(5)$ and $H_0(6.1)$ for journals are accepted, but it holds no mathematical relationship with HD as $H_0(7)$ is rejected (Table 1). Also, UF is directly proportional to TH over the years, as $H_0(6.2)$ is accepted (Table 2). The Correlation Coefficient (R) between UF and CY is -0.93 (Table 3), which is strong negative correlation. But, the R of UF with TH and HD are -0.46 and 0.52 respectively (Table 3) showing weak negative and weak positive correlations. The R of UF with CY, TH and HD over the years are -0.16, 0.93 and -0.76 respectively (Table 4). The UF hasa strong positive correlation with TH over the years, while weak and strong negative correlations with CY and HD respectively.

Conclusion

The Uncitedness Factors of selected Indian physics and astronomy journals are derived here from different aspects. The 12% more uncitedness of Indian physics and astronomy research communication compared to global uncitedness of the same indicates lack of circulation and timely reach of Indian research communication to the pertinent audience. The UF for journals is found to vary inversely with the product of CY and TH, which means an enhance in citation potential (CY) and time-normalised h-index (TH) will reduce the uncitedness factor. The uncitedness factor can be reduced only when the citation becomes scattered or tends to scatter over entire corpus of publications. The scattering nature of citation accelerates coverage of citation, which in turn hastens speed of citation accumulation in accordance with cumulative advantage model. The CY or citation potential and TH or time-normalised h-index depicts the centralised nature of citation distribution. This centralised nature endorses the cumulative advantage model, i.e., success breeds success, that may be viewed here as citation breeds citation, encouraging eventually citation accumulation around highly cited items only. Findings of the study also suggest that centralised citation accumulation escalates the citation scattering also, which ultimately reduces uncitedness. Hence, it may be concluded that despite higher than global uncitedness, the citation picture of Indian physics journals is dynamic and widespread, but still needs improvement.

Acknowledgement

This work is executed under the research project entitled Design and development of comprehensive database and scientometric study of Indian research output in physics and space science since independence sponsored by Department of Science and Technology, Govt. of India under NSTMIS scheme, (Vide F. No. DST/NSTMIS/05/252/2017-18 dated 11/01/2018).

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Appendix

Scrutinising uncitedness and few h-type indicators of selected Indian physics and astronomy journals

Table A1 — Uncitedness Factor (UF)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Mean(J)
DSJ	0.11	0.20	0.21	0.12	0.22	0.11	0.11	0.19	0.35	0.28	0.53	0.73	0.26
IJBB	0.07	0.00	0.07	0.08	0.04	0.04	0.28	0.25	0.31	0.24	0.27	0.37	0.17
IJEMS	0.13	0.08	0.08	0.00	0.11	0.10	0.16	0.26	0.33	0.64	0.74	0.87	0.29
IJP	0.15	0.13	0.27	0.05	0.08	0.12	0.19	0.15	0.20	0.28	0.49	0.54	0.22
IJPAP	0.13	0.08	0.11	0.23	0.11	0.18	0.26	0.25	0.33	0.40	0.75	0.84	0.30
JAA	0.07	0.35	0.42	0.37	0.33	0.58	0.11	0.26	0.29	0.49	0.56	0.76	0.38
JESS	0.07	0.03	0.02	0.02	0.04	0.04	0.07	0.06	0.13	0.21	0.43	0.54	0.14
JMP	0.10	0.13	0.09	0.14	0.11	0.12	0.13	0.34	0.20	0.40	0.50	0.79	0.25
JSIR	0.11	0.08	0.10	0.12	0.16	0.12	0.26	0.20	0.07	0.25	0.35	0.81	0.22
PINSA	0.29	0.39	0.45	0.37	0.33	0.34	0.55	0.45	0.35	0.63	0.67	0.79	0.47
PJP	0.21	0.20	0.23	0.40	0.22	0.37	0.31	0.30	0.25	0.21	0.34	0.56	0.30
PNASI	0.53	0.43	0.63	0.18	0.23	0.28	0.26	0.20	0.18	0.41	0.49	0.62	0.37
Mean(Y)	0.16	0.17	0.22	0.17	0.17	0.20	0.22	0.24	0.25	0.37	0.51	0.68	

Table A2 — Citation-per-Paper-per-Year (CY)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Mean(J)
DSJ	1.07	0.98	0.77	0.85	0.64	0.84	0.67	0.98	0.62	0.89	0.48	0.42	0.77
IJBB	1.49	1.42	1.22	1.07	1.18	0.89	0.54	0.33	0.45	0.74	0.83	1.68	0.99
IJEMS	0.55	0.98	1.06	0.93	0.99	0.72	0.70	0.83	0.52	0.34	0.19	0.23	0.67
IJP	0.48	0.59	0.56	0.77	0.98	0.92	0.73	0.88	0.96	1.13	0.72	1.54	0.85
IJPAP	0.69	1.03	0.82	0.68	0.76	0.80	0.69	0.76	0.64	0.66	0.31	0.26	0.68
JAA	0.47	0.23	0.37	0.39	0.73	0.20	0.69	0.49	1.15	0.48	0.56	0.45	0.52
JESS	1.41	1.53	1.37	1.54	1.55	1.19	1.35	1.12	1.20	0.82	0.57	1.02	1.22
JMP	0.87	1.49	0.83	0.90	1.00	0.94	0.73	0.73	0.89	0.40	0.44	0.25	0.79
JSIR	1.46	1.28	0.81	0.72	0.77	0.86	0.51	0.54	0.93	0.76	0.68	0.42	0.81
PINSA	0.20	0.30	0.12	0.42	0.17	0.75	0.28	0.39	0.45	0.24	0.25	0.39	0.33
PJP	0.59	0.52	0.58	0.55	0.87	0.39	0.65	0.76	1.11	1.23	1.47	2.12	0.90
PNASI	0.11	0.18	0.10	0.51	0.25	0.74	0.62	0.89	0.89	0.80	1.41	1.16	0.64
Mean(Y)	0.78	0.88	0.72	0.78	0.82	0.77	0.68	0.72	0.82	0.71	0.66	0.83	

Table A3 — h-Core Density (HD)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Mean(J)
DSJ	0.21	0.31	0.30	0.31	0.33	0.27	0.29	0.28	0.24	0.20	0.23	0.23	0.27
IJBB	0.31	0.32	0.27	0.29	0.32	0.27	0.18	0.23	0.28	0.23	0.16	0.18	0.25
IJEMS	0.28	0.33	0.35	0.39	0.26	0.27	0.35	0.33	0.20	0.26	0.25	0.35	0.30
IJP	0.21	0.25	0.25	0.19	0.19	0.18	0.25	0.23	0.28	0.21	0.18	0.23	0.22
IJPAP	0.25	0.25	0.26	0.28	0.26	0.26	0.23	0.21	0.25	0.21	0.13	0.21	0.23
JAA	0.46	0.21	0.33	0.37	0.28	0.22	0.25	0.25	0.37	0.23	0.29	0.31	0.30
JESS	0.33	0.26	0.30	0.30	0.24	0.19	0.25	0.21	0.22	0.15	0.09	0.19	0.23
JMP	0.29	0.16	0.34	0.21	0.29	0.37	0.28	0.30	0.22	0.33	0.32	0.14	0.27
JSIR	0.24	0.22	0.26	0.29	0.20	0.20	0.17	0.24	0.48	0.29	0.12	0.15	0.24
PINSA	0.49	0.21	0.23	0.34	0.40	0.31	0.27	0.26	0.25	0.18	0.17	0.24	0.28
PJP	0.23	0.23	0.26	0.28	0.27	0.14	0.19	0.16	0.21	0.19	0.20	0.29	0.22
PNASI	0.25	0.29	0.41	0.28	0.15	0.41	0.28	0.28	0.27	0.21	0.16	0.14	0.26
Mean(Y)	0.29	0.25	0.30	0.29	0.27	0.26	0.25	0.25	0.27	0.22	0.19	0.22	

Table A4 — Time-Normalised h-Index (TH)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Mean(J)
DSJ	1.08	1.18	1.20	1.22	1.38	1.43	1.33	2.00	1.75	2.00	2.00	3.00	1.63
IJBB	1.67	1.55	1.40	1.44	1.88	1.57	0.83	0.60	1.00	1.67	2.00	5.00	1.72
IJEMS	0.92	1.36	1.40	1.33	1.50	1.57	1.83	1.60	1.25	1.33	1.00	3.00	1.51
IJP	1.17	1.55	1.70	1.67	2.13	2.14	2.17	2.60	3.50	3.67	4.00	11.0	3.11
IJPAP	1.42	1.82	1.60	1.78	1.75	1.71	1.67	1.80	2.00	2.00	1.50	2.00	1.75
JAA	0.50	0.27	1.20	0.56	0.88	0.86	1.17	1.00	2.75	1.67	2.00	2.00	1.24
JESS	1.50	1.55	1.90	2.33	2.38	2.14	2.67	2.60	3.00	2.33	2.50	6.00	2.57
JMP	0.92	0.91	1.00	0.89	1.13	1.43	1.17	1.40	1.50	1.33	1.50	1.00	1.18
JSIR	1.83	1.64	1.50	1.33	1.25	1.57	1.17	1.40	1.25	2.00	2.00	3.00	1.66
PINSA	0.42	0.36	0.30	1.00	0.50	1.71	1.17	1.60	1.25	1.00	1.00	3.00	1.11
PJP	1.42	1.55	1.70	2.00	2.25	1.29	2.00	2.40	3.25	3.67	5.50	10.0	3.08
PNASI	1.67	1.55	1.40	1.44	1.88	1.57	0.83	0.60	1.00	1.67	2.00	5.00	1.72
Mean(Y)	1.21	1.27	1.36	1.42	1.57	1.58	1.50	1.63	1.96	2.03	2.25	4.50	

Table A5 — UF*CY

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Mean(J)
DSJ	0.12	0.20	0.16	0.10	0.14	0.09	0.07	0.19	0.22	0.25	0.25	0.31	0.17
IJBB	0.10	0.00	0.08	0.09	0.05	0.04	0.15	0.08	0.14	0.18	0.22	0.62	0.15
IJEMS	0.07	0.08	0.08	0.00	0.11	0.07	0.11	0.21	0.17	0.22	0.14	0.20	0.12
IJP	0.07	0.08	0.15	0.04	0.08	0.11	0.14	0.13	0.20	0.32	0.35	0.83	0.21
IJPAP	0.09	0.08	0.09	0.15	0.09	0.14	0.18	0.19	0.21	0.26	0.23	0.22	0.16
JAA	0.03	0.08	0.16	0.14	0.24	0.11	0.07	0.13	0.34	0.24	0.31	0.34	0.18
JESS	0.10	0.05	0.03	0.03	0.06	0.05	0.10	0.07	0.16	0.18	0.24	0.55	0.13
JMP	0.09	0.20	0.07	0.12	0.11	0.11	0.09	0.25	0.18	0.16	0.22	0.20	0.15
JSIR	0.17	0.10	0.08	0.09	0.12	0.10	0.13	0.11	0.07	0.19	0.24	0.34	0.14
PINSA	0.06	0.12	0.05	0.15	0.06	0.25	0.15	0.18	0.16	0.15	0.17	0.30	0.15
PJP	0.12	0.10	0.13	0.22	0.19	0.14	0.21	0.23	0.28	0.25	0.50	1.19	0.30
PNASI	0.06	0.08	0.06	0.09	0.06	0.21	0.16	0.18	0.16	0.33	0.69	0.72	0.23
Mean(Y)	0.09	0.10	0.10	0.10	0.11	0.12	0.13	0.16	0.19	0.23	0.30	0.48	

Table A6 — UF*TH

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Mean(J)
DSJ	0.12	0.24	0.25	0.14	0.31	0.16	0.15	0.38	0.61	0.57	1.05	2.19	0.51
IJBB	0.12	0.00	0.09	0.12	0.08	0.07	0.23	0.15	0.31	0.40	0.53	1.83	0.33
IJEMS	0.12	0.11	0.11	0.00	0.17	0.16	0.29	0.41	0.42	0.86	0.74	2.61	0.50
IJP	0.18	0.20	0.46	0.08	0.18	0.25	0.41	0.40	0.71	1.04	1.95	5.94	0.98
IJPAP	0.18	0.14	0.17	0.40	0.20	0.30	0.43	0.46	0.67	0.79	1.12	1.67	0.54
JAA	0.04	0.10	0.51	0.20	0.29	0.50	0.12	0.26	0.80	0.82	1.12	1.52	0.52
JESS	0.10	0.05	0.04	0.04	0.10	0.09	0.19	0.16	0.40	0.50	1.06	3.24	0.50
JMP	0.09	0.12	0.09	0.12	0.13	0.17	0.15	0.48	0.30	0.53	0.75	0.79	0.31
JSIR	0.21	0.13	0.16	0.16	0.20	0.19	0.30	0.28	0.09	0.51	0.69	2.43	0.44
PINSA	0.12	0.14	0.14	0.37	0.17	0.58	0.64	0.73	0.43	0.63	0.67	2.36	0.58
PJP	0.29	0.31	0.39	0.80	0.50	0.48	0.63	0.73	0.81	0.75	1.86	5.61	1.10
PNASI	0.18	0.19	0.25	0.14	0.06	0.48	0.35	0.37	0.41	0.83	1.46	3.11	0.65
Mean(Y)	0.15	0.14	0.22	0.21	0.20	0.29	0.32	0.40	0.50	0.69	1.09	2.77	

Table A7 — HD/UF

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Mean(J)
DSJ	1.89	1.57	1.44	2.65	1.48	2.43	2.64	1.46	0.68	0.71	0.43	0.32	1.47
IJBB	4.46	0	4.02	3.52	7.96	6.46	0.64	0.92	0.88	0.94	0.61	0.50	2.58
IJEMS	2.05	4.19	4.64	0	2.27	2.66	2.23	1.29	0.60	0.41	0.34	0.40	1.92
IJP	1.42	1.93	0.94	4.07	2.30	1.59	1.34	1.48	1.37	0.73	0.36	0.43	1.50
IJPAP	1.93	3.22	2.41	1.23	2.30	1.50	0.90	0.82	0.75	0.53	0.18	0.25	1.34
JAA	6.38	0.59	0.79	1.01	0.84	0.38	2.36	0.94	1.25	0.46	0.51	0.41	1.33
JESS	4.80	8.61	13.19	15.87	5.81	4.51	3.52	3.36	1.66	0.71	0.22	0.35	5.22
JMP	2.89	1.22	4.00	1.57	2.54	3.04	2.25	0.89	1.12	0.83	0.64	0.18	1.77
JSIR	2.12	2.88	2.53	2.47	1.26	1.68	0.67	1.20	6.73	1.12	0.36	0.19	1.93
PINSA	1.72	0.53	0.51	0.94	1.20	0.91	0.50	0.57	0.72	0.28	0.26	0.30	0.70
PJP	1.10	1.15	1.16	0.69	1.20	0.38	0.61	0.53	0.83	0.94	0.61	0.51	0.81
PNASI	0.47	0.69	0.66	1.53	0.67	1.46	1.07	1.40	1.51	0.52	0.32	0.22	0.88
Mean(Y)	2.60	2.21	3.02	3.23	2.49	2.25	1.56	1.24	1.51	0.68	0.40	0.34	

Table A8 — The primary data for calculation of indicators presented in Tables 1 to 4

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Defence Science Journal													
No. of papers (P)	64	50	63	52	72	62	54	74	83	67	74	93	808
No. of uncited papers (U)	7	10	13	6	16	7	6	14	29	19	39	68	234
Total citation (TC)	818	539	485	396	368	365	218	362	207	178	71	39	4046
h-index (h)	13	13	12	11	11	10	8	10	7	6	4	3	
Indian Journal of Biochemistry and Biophysics													
No. of papers (P)	72	58	59	61	74	71	43	24	32	50	60	82	686
No. of uncited papers (U)	5	0	4	5	3	3	12	6	10	12	16	30	106
Total citation (TC)	1291	908	719	585	697	443	139	39	58	111	99	138	5227
h-index (h)	20	17	14	13	15	11	5	3	4	5	4	5	
Indian Journal of Engineering and Materials Sciences													
No. of papers (P)	67	63	53	44	71	88	82	47	60	59	42	114	790
No. of uncited papers (U)	9	5	4	0	8	9	13	12	20	38	31	99	248
Total citation (TC)	439	676	560	368	562	445	342	195	124	61	16	26	3814
h-index (h)	11	15	14	12	12	11	11	8	5	4	2	3	
Indian Journal of Physics													
No. of papers (P)	160	181	204	169	189	190	154	171	183	172	254	341	2368
No. of uncited papers (U)	24	23	55	8	16	22	29	26	37	49	124	184	597
Total citation (TC)	920	1178	1146	1167	1484	1219	670	750	706	584	364	526	10714
h-index (h)	14	17	17	15	17	15	13	13	14	11	8	11	
Indian Journal of Pure and Applied Physics													
No. of papers (P)	138	142	121	150	124	97	105	102	99	86	111	73	1348
No. of uncited papers (U)	18	11	13	34	14	17	27	26	33	34	83	61	371
Total citation (TC)	1150	1605	989	917	755	546	433	388	255	171	68	19	7296
h-index (h)	17	20	16	16	14	12	10	9	8	6	3	2	
Journal of Astrophysics and Astronomy													
No. of papers (P)	14	17	116	19	30	118	47	42	72	75	50	29	629
No. of uncited papers (U)	1	6	49	7	10	69	5	11	21	37	28	22	266
Total citation (TC)	79	43	431	67	175	162	195	102	331	109	56	13	1763
h-index (h)	6	3	12	5	7	6	7	5	11	5	4	2	
Journal of Earth System Science													
No. of papers (P)	59	66	88	106	121	140	127	143	135	131	235	189	1540
No. of uncited papers (U)	4	2	2	2	5	6	9	9	18	28	100	102	287
Total citation (TC)	996	1108	1204	1473	1503	1163	1026	799	649	322	266	193	10702
h-index (h)	18	17	19	21	19	15	16	13	12	7	5	6	

(Contd.)

Table A8 — The primary data for calculation of indicators presented in Tables 1 to 4 — (*Contd*.)

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Journal of Medical Physics													
No. of papers (P)	40	38	35	37	35	41	40	44	45	40	32	28	455
No. of uncited papers (U)	4	5	3	5	4	5	5	15	9	16	16	22	109
Total citation (TC)	418	624	292	301	279	270	174	161	161	48	28	7	2763
h-index (h)	11	10	10	8	9	10	7	7	6	4	3	1	
Journal of Scientific and Industrial Research													
No. of papers (P)	114	103	106	76	81	101	94	76	14	55	95	141	1056
No. of uncited papers (U)	13	8	11	9	13	12	24	15	1	14	33	114	267
Total citation (TC)	2002	1447	857	492	496	607	287	207	52	126	129	59	6761
h-index (h)	22	18	15	12	10	11	7	7	5	6	4	3	
Proceedings of the Indian National Science Academy													
No. of papers (P)	21	23	33	63	30	89	108	128	55	71	46	98	765
No. of uncited papers (U)	6	9	15	23	10	30	59	58	19	45	31	77	382
Total citation (TC)	51	77	39	236	40	467	180	249	100	51	23	38	1551
h-index (h)	5	4	3	9	4	12	7	8	5	3	2	3	
Pramana - Journal of Physics													
No. of papers (P)	178	222	188	234	174	213	191	237	184	170	201	164	2356
No. of uncited papers (U)	37	44	43	94	39	79	60	72	46	35	68	92	709
Total citation (TC)	1260	1268	1093	1161	1205	582	748	899	818	628	591	347	10600
h-index (h)	17	17	17	18	18	9	12	12	13	11	11	10	
Proceedings of the National Academy of Sciences India Section A - Physical Sciences													
No. of papers (P)	49	42	40	38	13	68	61	64	83	70	82	156	766
No. of uncited papers (U)	26	18	25	7	3	19	16	13	15	29	40	97	308
Total citation (TC)	64	85	39	174	26	352	227	285	296	168	231	181	2128
h-index (h)	4	5	4	7	2	12	8	9	9	6	6	5	