

Open Access Availability of India's Scientific Research Funded by National and International Agencies

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ABSTRACT

Funding has become the most significant element of supportive action for research that has served the research community in numerous ways to improve the advancement and development of society. Scientific research in India is funded by many public and corporate sector institutions and autonomous organisations, NGOs, and regional and international agencies. However, access to publicly funded scientific research literature has been an essential issue of debate among the advocates of the Open Access (OA) movement during the last two decades. This study maps OA availability to India's research publications funded by national and international agencies. The study applied a scientometric approach using the Scopus database to identify funding research publications available in the OA domain. The findings revealed that 570320 research articles were published by the Indian researchers during 2016-to 2020, of which 150638 (26.41 %) were produced with the financial support of different national and international funding agencies, of the funded research publications, 44166 (29.32 %) articles were freely available OA to the public with no or fewer restrictions for reuse. Most of the funded research literature is available via green routes of OA, followed by gold and bronze OA. The study also showed that Horizon 2020 and the Ministry of Science, ICT, and future planning are the primary funding sources for researchers in India during study period. The study's findings are helpful for researchers and policymakers to promote OA availability of funded research to researchers for advancing the country's scientific progress.

Keywords: Funded research; Scientific publications; Funding agencies; Open access

1. INTRODUCTION

Scientific research is a continuous process that the academic community values for its many benefits¹. Scientific research is created, published, and disseminated through scholarly communication, generally reported in peer-reviewed journals and books. Ball² was the first to use the phrase "scientific publication" with the emergence of research techniques at the turn of the twentieth century. Scientific research is constantly employed to search for information, transfer skills, and create innovative theories and procedures for bridging the gap between economic stagnation and social progress³. The development and restoration of society are impossible without meaningful research. Policymakers also require research to formulate new policies or improve pragmatic recommendations for implementation in any industry, service, or organisation that has the potential to influence nations or the global population⁴. Various countries, regions, and organisations have contributed to research that has resulted in significant transformations and advances in people's life values and expectations⁵.

Scientific research in India is funded by many public and corporate sector institutions and autonomous organisations, NGOs, and regional and international agencies. The Department of Science and Technology (DST), the Department of

Scientific and Industrial Research (DSIR), and the Department of Biotechnology (DBT) have been entrusted with Rs 14,794 crore grants by the Ministry of Science and Technology of India for 2021-22 for promotion and improvising with latest innovative research⁶. However, India lacks adequate funding for high-quality research^{7,8}. The Scopus database includes 1,922,648 articles produced by Indian authors, with 3,87,842 (20 %) being funded research articles. Only 26 per cent of the funded research articles were available through Open Access (OA) routes, including green and gold OA (Elsevier, B.V., 2022)⁹. Thus, a significant proportion of India's research is being published in paywall journals that need subscription either by researchers or their institutions⁹. However, advocates of the OA movement argue that research produced with the support of public funds should be available free of cost to the public¹⁰. OA is a platform for scientific research publication that diminishes the barriers to free accessibility regardless of any restriction, available equally to all the interested viewers. Furthermore, several national and international funding agencies have mandated that the outcome of funded research should be made available to OA to reach as many interested audiences as possible¹¹.

Funding has become the most engraving troop of supportive action for an investigation that has benefitted the research community in countless ways to enhance the

advancement and development of society. Whether national or international, various funding bodies that support the specialised field of multidisciplinary subjects are always aimed at providing funds to the most disadvantaged researchers for conducting impactful research assessments. This study looks into the OA availability of Indian research publications funded by national and international agencies.

2. LITERATURE REVIEW

Several studies have been carried out to investigate the funding landscape in a particular subject or across disciplines, institutions, and countries¹²⁻²⁶. Some studies have compared the citation impact of funded and non-funded research²⁷⁻²⁸. A few studies have also examined the OA availability and policy of funded research²⁸⁻³⁶.

Shueb, *et al.*¹² analysed the Web of Science data to map the funding status of COVID-19 research. Funded publications accounted for 32 per cent of the total publications published on COVID-19. China was the leading producer of COVID-19-funded research, followed by the United States, England, Italy, Germany, and Canada. The United States had a central position in the collaboration network with the highest articles. The Chinese National Natural Science Foundation primarily funds COVID-19 research, followed by the US Department of Health and Human Services (DHHS) and the National Institute of Health (NIH) in the United States. On the other side, China's National Key Research and Development Program has the highest citation impact for the publications it funded. China's Huazhong University of Science and Technology and Wuhan University were among the top institutions which published funded publications. Most COVID-19-funded research is OA, mainly through the green and bronze routes.

Ralaidovy *et al.*¹³ investigated the situation of research funding in biomedical science by analyzing research grants data from ten major funders of health research. According to the findings, the National Institutes of Health of the United States of America funded the most biomedical research grants (76 %) in 2016 and had the most prolonged average grant duration. Low-income nations received only 0.2 per cent of all funding. Non-communicable diseases received over three-quarters of all funds (72 %), followed by communicable, maternal, perinatal, and nutritional illnesses (20 %) and injuries (6 %). Only 1.1 percent of the grants went to neglected tropical diseases and only 0.4 per cent to diseases on the WHO's list of highly contagious diseases.

Wang *et al.*¹⁴ examined the impact of government funding on research output by analyzing 500,807 SCI papers published in 2009 in 10 countries. According to the findings, 70.34 percent of papers in China were supported by some part of research funding, with 89.57 percent coming from China's National Natural Science Foundation (NSFC). Average grants per funding-supported paper in China is 2.95, when in the USA the number is 2.93 and in Japan it is 2.40. The findings of the funding agency study demonstrate that a single funding agency operates in China, Germany, and Spain. In contrast, two funding agencies dominate the United States, Japan,

Canada, and Australia, while the funding sources in the United Kingdom, France, and Italy are diversified.

Huang and Huang¹⁵ examined journal articles by authors from the G9 countries published between 2009 and 2014 to determine the distribution of research funding and funding agencies in these countries. China had the highest proportion of funded articles among its total published articles, while Italy had the lowest proportion of funded articles. China and the United States were among the top funders of articles authored by other countries. China has a sponsorship surplus with all other G9 countries, and the United States has a sponsorship surplus with seven other countries except China. Furthermore, in the G9 countries, government agencies were the major sponsors of funded articles. The field of life sciences had the most significant percentage of funded papers among the other disciplines. In terms of funding agencies, each G9 country's top three funding agencies were predominantly domestic agencies, and a significant amount of the funds they provided went to domestic research projects.

Wang and Shapira¹⁶ compared nanotechnology funding policies and programmes in selected countries and examined their impacts on scientific output by analyzing funding acknowledgment data from 91,500 nanotechnology articles published worldwide during 12 months in 2008-2009. According to the study's findings, about 67 per cent of papers include funding acknowledgments, and the funding is nationally-oriented; internationalisation and knowledge exchange occurs when researchers collaborate across borders.

Morillo²⁸ examined publications from two different disciplines in the WoS databases to test hypotheses about the presence of funding acknowledgments, collaboration, and citations. The finding related to the general distribution of publications revealed that collaborative and funded research yields a higher proportion of cited papers, which increases in the case of OA publications. The findings also demonstrated that EU funding, international collaboration, and citations considerably increase the likelihood of discovering an OA publication in the SCIE discipline. The Bronze OA and Green OA publications boost their probability of citations if they contain funding acknowledgments.

Zhi and Meng²² studied how the Matthew Effect of funding allocation at the institutional and city levels impacts scientific research activity on the dataset of life science from the National Natural Science Foundation of China during the 11th Five-Year Plan i.e. 2006-2010. Based on the Gini coefficient evaluation, the study depicted that the units of measurement of funding allocation in the institutions have increased from 0.61 to 0.67 and concluded the possible motives of the inverted U-shape pattern and its policy consequences.

McManus, & Baeta Neves²³ examined Brazilian authors' citations of funded research in the Incites® database. Almost 70 per cent of the documents in this analysis were funded by one of ten Brazilian agencies, the most common of which were Capes, CNPq, and FAPESP. Although federal agencies (Capes and Cnpq) are significant throughout the country, funding agency from São Paulo state exerted a national impact, owing to collaboration between researchers from other states and universities in So Paulo. These agencies had a more negligible

impact than those funded mainly through North American and European sources. Manufacturing and pharmaceutical companies have also witnessed funding research in Brazil, despite none of them being Brazilian.

Zhou, Cai and Lyu²⁴ studied to ascertain the funded and collaborated publications in the developing and developed country's focal funding agencies i.e., National Natural Science Foundation of China (NSFC), the US National Science Foundation (NSF), German Research Foundation, the Netherlands Organisation for Scientific Research (NWO), National Research Foundation of South Africa (NRF), and National Council for Scientific and Technological Development of Brazil (CNPq) which highlights that developing countries have substantially benefited by the international collaboration and the majority of publications are initiated by NSFC and CNPq which also have similarities in highest funded publications.

Hirv²⁵ looked into the impact of country size, funding level, funding type, and collaboration methods on scientific publishing output regarding the number of papers published and citations in the scientific literature across national research systems. The study refutes the idea that the function of scientific production demonstrates growing returns to scale based on actual evidence. The study discovered that transnationally coordinated research initiatives significantly impact each country's number of publications and citations. Furthermore, the study found that the percentage of competitive project-based funding does not affect the number of articles published. It does have a U-shaped relationship with research impact

per article, indicating two alternative financing strategies for maximizing impact based on high or low funding.

Sanusi *et al.*²⁶, based on the systematic review, identified the indicators to evidence the impact of university research grants within the databases, i.e., Web of Science (WoS) and Scopus, through which four themes and 24 sub-themes displaying scholarly production impact, research advancement impact, policy implication, and health and economic impact have been identified.

In India, a few studies have also been conducted to investigate the funding opportunities for research^{7,37}, restricted access to publications from funded research¹⁰, funding landscape in Health Science research³⁸⁻³⁹, and funding and organisation of agricultural research⁴⁰. Since most funding agencies have mandated their researchers to make funded research freely accessible to the public, it is essential to investigate the extent to which Indian research funded by different funding agencies is accessible to the public. Although previous studies have examined the funding landscape in a specific subject or across disciplines, institutions, and countries, it is evident that no study has investigated the current scenario of OA availability to India's funded research. Therefore, this study will undoubtedly fill the research gap in this area.

3. RESEARCH QUESTIONS

This study aims to map the OA availability of India's research funded by national and international agencies. The specific questions addressed in the study are:

- Funding landscape for scientific research in India?

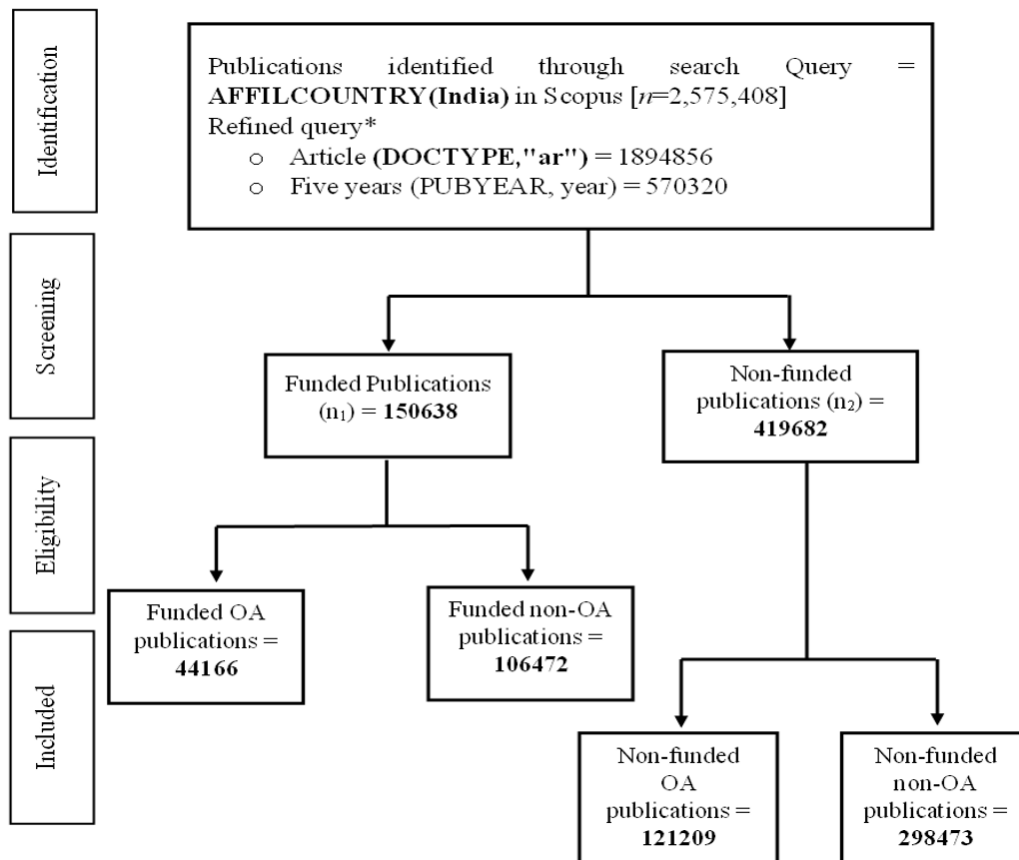


Figure 1. Flow diagram of data retrieval and filtration.

- Status of India's funded research through various OA routes?
- The leading funding agencies that encourage OA research?
- Research institutes and journals fund research in the OA domain?
- Scientific disciplines that have OA publications?

4. METHODOLOGY

Scientometrics methods were applied in the present study to investigate the OA availability of India's funding research. The publication data was retrieved from the Scopus database on 15 September 2021.

The following search query was formulated in the Scopus database:

- AFFILCOUNTRY: "India"
- Retrieve results were further refined by:
 - DOCTYPE: "Article"
 - PUBYEAR: "2016-2020"
 - FUND-SPONSOR: "Funding Agency Name."
 - OPEN ACCESS: "Open Access types"

A total of 570320 publications authored by Indian researchers between 2016 and 2020 were retrieved using the above search strategy. The retrieved results were further refined using the 'FUND-SPONSOR' and 'OPEN ACCESS' refining options for final analysis. 150638 articles were identified as funded publications, of which 44166 (29.32 %) were OA publications. Publication data was downloaded in Microsoft Excel. Figure 1 demonstrates the procedure and filtration techniques used to extract the study's required data. MS-excel was then used to organise the extracted dataset according to the specified uniform sequences. Descriptive statistics were used for analysing, organizing, summarizing, and presenting data in a meaningful way.

5. RESULTS

5.1 Overall Landscape of Funding Research in India

Figure 2 depicts the overall funding landscape of Indian research. Funding for research is collaborated by various agencies, organisations, and institutions for fruitful research investigation. Of the total 570320 publications published during 2016-2020, 150638 (26.41 %) were produced with the financial support of different national and international

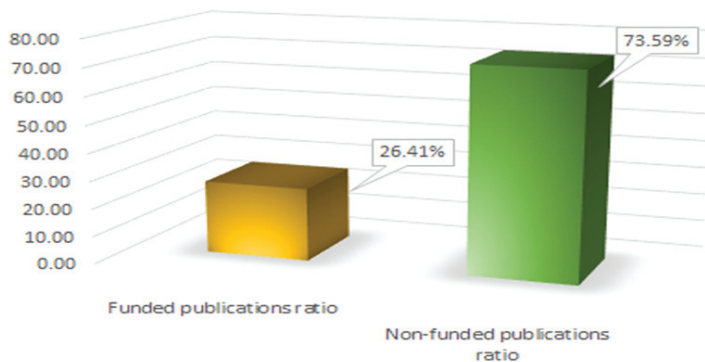


Figure 2. Funding landscape of Indian research.

funding agencies. At the same time, remaining 419682 (73.59 %) publications were identified as non-funded articles. The ratio for non-funded research in India is much higher than the funded research.

5.2 Distribution of Funded Publications by OA and Non-OA Routes

Figure 3 depicts the ratio of OA availability to funded and non-funded research. Only 44166 (29.32 %) of the total funded publications were OA. At the same time, 121209 (28.88 %) of the total non-funded publications were OA. Although most funding agencies in India have mandated OA to funded research, most publicly funded research is kept behind a paywall since the ratio of OA to funded and non-funded research is nearly equal.

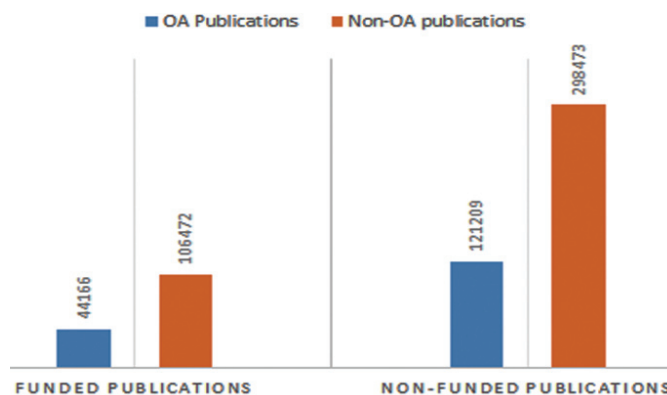


Figure 3. Ratio of OA availability to funded and non-funded publications.

5.3 Growth of Overall Funded Publications and Funded OA Publications

Funding for scientific research in India has an enormous influence on innovation and upgrading into modernisation. Figure 4 shows the growth of overall funded publications and OA funded publications. There is a substantial growth of overall funded publications and OA-funded publications from 2016 to 2020. With a growth rate of around 103 per cent, the overall funded publications increased from 19763 in 2016 to 40087 in 2020. On the other hand, OA-funded publications also increased to 11420 in 2020 from 5513 in 2016, showing a 107 percent growth rate. The data relating to the growth rate of OA and non-OA-funded publications indicate no significant impact of the mandates of research funders on the adoption of OA publishing among Indian researchers. Researchers in India are reluctant to make funded research openly available to the public.

5.4 Distribution of Funded Publications via Different OA Routes

OA routes are significant ways to make the research outcomes accessible publicly. Figure 5 shows different routes through which the funding publications might have been openly accessible to the viewers and whichever route is subsequently more induced by the contributors for their research work. Here, in the chart, the bar's colour signifies the different routes of OA publishing and has different meanings

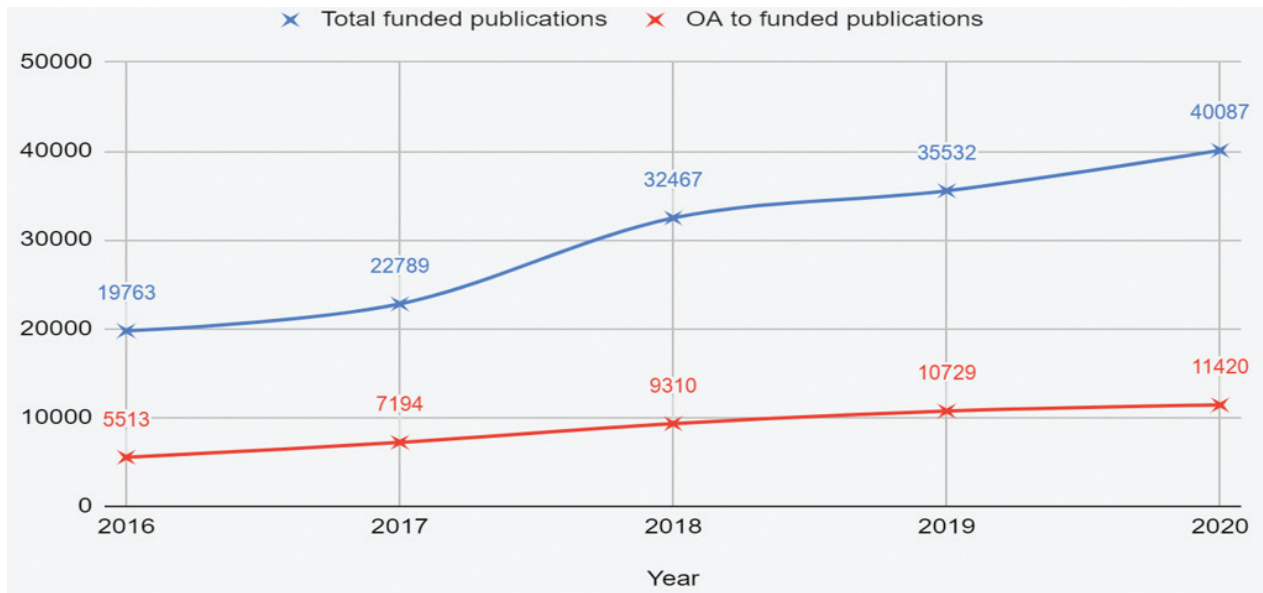


Figure 4. Yearly growth of overall funded publications and OA-funded publications.

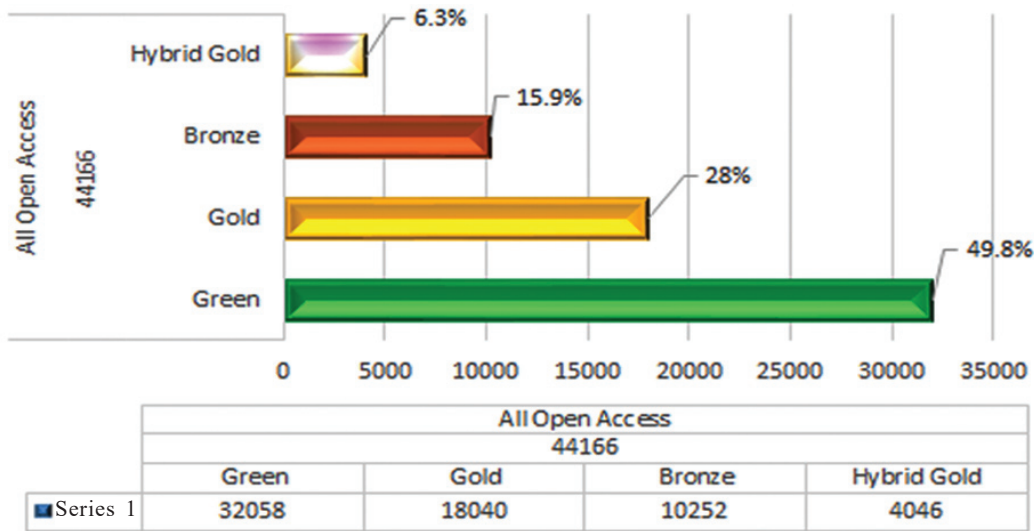


Figure 5. Access to funded publications via different OA routes.

for each colour. Around 50 per cent of funded publications were available for access via the green route of OA, followed by the gold bronze routes; however, it seems to have a massive gap in the number of publications between each route of OA. However, the data analysis shows that most of the funding publications are available for access via green and gold routes of OA. It manifests that author publish their research work in OA journals or self-archive published or accepted versions in an institutional or subject repository.

5.5 Distribution of Publications by National and International Funding Agencies

Funding agencies can be government and private organisations that provide research grants for scientific research in various subject areas such as science and technology, social sciences, and humanities. Many funding agencies undoubtedly offer grants to support multiple scientific or medical research

programmes to enhance scientific productivity and encourage innovations.

International collaboration has always heightened the significant research trends by transitioning from a favourable opportunity to a preferable accomplishment in science and technology and other research areas. Researchers in India have received grants for research from different National and International funding bodies or organisations. As seen in Figure 6, Indian funding bodies funded almost 60 per cent of all funded publications. In contrast, international funding bodies funded the remaining 40 per cent, indicating a robust collaborative nature and global visibility of India's research. A significant gap can be observed in the ratio of OA availability to funded publications between international and national funding bodies. Around 61 per cent of funded publications by international funding agencies were OA, compared to 39 per cent of the funded publications by Indian funding bodies.

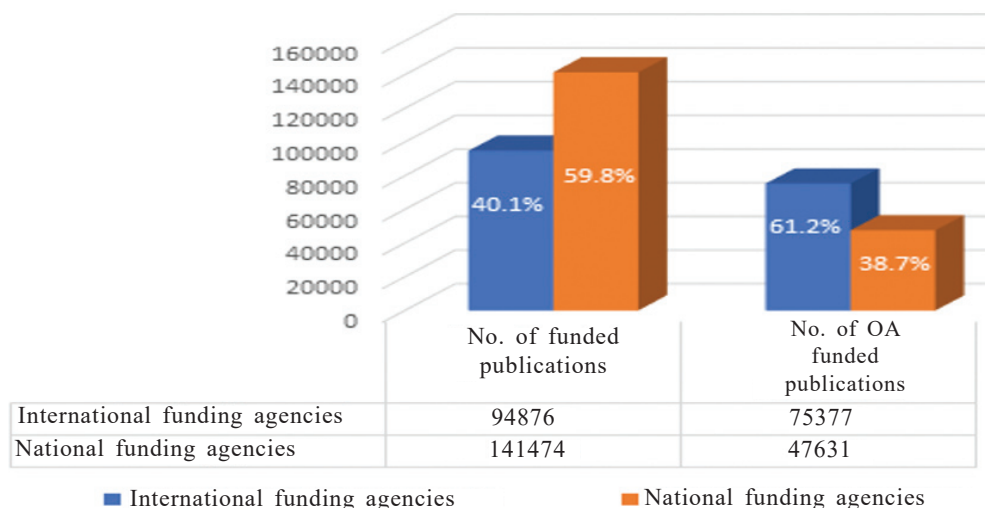


Figure 6. Distribution of publications by national and international funding agencies.

Table 1. Ranking of top 10 international funding agencies

Funding agency	Location	No. of funded publications	Funded publication ratio	No. of funded OA publications	Share of funded OA publications	Rank*
Bangladesh Council of Scientific and Industrial Research	Dhaka (Bangladesh)	6604	6.96	1591	24.09	1 st
National Science Foundation	Alexandria, Virginia (U.S.)	4521	4.77	3475	76.86	2 nd
National Natural Science Foundation of China	Beijing (China)	3812	4.02	2043	53.59	3 rd
National Institutes of Health	Maryland (U.S.)	3790	3.99	3132	82.64	4 th
National Research Foundation of Korea	Daejeon (South Korea)	3205	3.38	1414	44.12	5 th
European Commission	Brussels (Belgium)	2749	2.90	1827	66.46	6 th
US Department of Health and Human Services	Washington D.C. (U.S.)	2568	2.71	2009	78.23	7 th
US Department of Energy	Washington D.C. (U.S.)	2271	2.39	1802	79.35	8 th
Japan Society for the Promotion of Science	Tokyo (Japan)	2213	2.33	1339	60.51	9 th
Deutsche Forschungsgemeinschaft	Bonn (Germany)	2007	2.12	1530	76.23	10 th
Other International funding agencies (86)		61136	64.44	55215	90.32	

Note(s): *Ranking is based on Funded Publication ratio (P_r)

5.5.1 Ranking of the International Funding Agency

One of the study's objectives was to identify the leading funding agencies that provide research grants to Indian researchers. Funding agencies (International and national) were ranked according to the funding publication ratio. The formulation used to calculate the funding publication ratio (F_r) for each funding agency is adopted from a study by Xu, *et al.* (2015)²¹:

$$P_r = (R / R_f) \times 100$$

Where R is the number of funded publications by individual funding agencies, and R_f denotes total funded publications by international funding bodies.

Table 1 shows the ranking of the top ten international funding agencies that enormously provided research grants to the research community in India and depicts the immersion of OA-funded publications. Based on the funded publication ratio (P_r), the Bangladesh Council of Scientific and Industrial Research has funded maximum research projects (6.96 %) to the Indian research community. In contrast, the United States has a high involvement with India in terms of research amongst the top ten international funding agencies, most of the funding agencies are from the United States, including the National Science Foundation (4.77 %), National Institutes of Health (3.99 %), U.S. Department of Health and Human Services

Table 2. Ranking of top ten funding governmental bodies

Funding agencies	Location	No. of Funded publications	Funded publication ratio	No. of Funded OA publications	Share of OA funded publications	Rank*
Department of Science and Technology, India	New Delhi	38005	26.86	14103	37.11	1 st
Council for Scientific and Industrial Research	New Delhi	20017	14.15	4511	22.54	2 nd
Science and Engineering Research Board	New Delhi	19448	13.75	4536	23.32	3 rd
University Grants Commission	New Delhi	19297	13.64	6924	35.88	4 th
Department of Biotechnology, Ministry of Science and Technology	New Delhi	7018	4.96	4743	67.58	5 th
Ministry of Human Resource Development	New Delhi	5904	4.17	1193	20.21	6 th
Indian Council of Medical Research	New Delhi	5647	3.99	2151	38.09	7 th
Department of Atomic Energy, Government of India	Mumbai	4913	3.47	1536	31.26	8 th
Indian Council of Agricultural Research	New Delhi	4488	3.17	1158	25.80	9 th
Defence Research and Development Organisation	New Delhi	2316	1.64	393	16.97	10 th
Other Governmental funding bodies (20)		17225	12.18	16739	97.18	

Note(s): *Ranking is based on the funded publication ratio (P_f)

Table 3. Ranking of top 10 Institutional funding agencies

Institutional funding agencies	State	No. of funded publications	Funded publication ratio	No. of OA funded publications	Share of OA funded publications	Rank*
Indian Institute of Technology Bombay	Maharashtra	1753	1.24	359	20.48	1 st
Indian Institute of Science	Karnataka	1565	1.11	502	32.08	2 nd
Banaras Hindu University	Uttar Pradesh	1072	0.76	201	18.75	3 rd
Indian Institute of Technology Madras	Tamil Nadu	1031	0.73	200	19.40	4 th
Indian Institute of Technology Delhi	New Delhi	1022	0.72	181	17.71	5 th
Indian Institute of Technology Kharagpur	West Bengal	997	0.70	156	15.65	6 th
University of Delhi	New Delhi	970	0.69	236	24.33	7 th
Indian Institute of Technology Mandi	Himachal Pradesh	883	0.62	134	15.18	8 th
VIT University	Tamil Nadu	860	0.61	166	19.30	9 th
Indian Institute of Science Education and Research Mohali	Punjab	732	0.52	255	34.84	10 th
Other Institutional funding agencies (7)		3811	2.69	860	22.57	

Note(s): *Ranking is based on funded publication ratio (P_f)

(2.71 %) and U.S. Department of Energy (2.39 %). Other 86 international funding agencies supported 61136 research publications with 64.44 funded publication ratio.

Most of the publications (82.64 %) produced from the funding of the National Institutes of Health are available OA, followed by the U.S. Department of Energy (79.35 %) and the U.S. Department of Health and Human Services (78.23 %). Altogether, there is a significant gap between OA-funded and non-OA-funded publications between international funding agencies.

5.5.2 Ranking of National – Governmental Funding Bodies

A government grant is monetary support given by the national, regional, or local authorities for a meritorious enterprise⁴¹. The Government of India always encourages new investigations and innovation made by the research community. In 2018, India had a commission of around 0.69 per cent of domestic gross income for the research and development in the country for innovation and investigation⁴². Table 2 lists the top ten Indian government funding agencies. The variation of grants commissioned is proven through the production of funded publications of each funding agency.

As shown in Table 2, the Department of Science and Technology, the Council for Scientific and Industrial Research, and the Department of Science and Technology have actively supported scientific research in India. These funding bodies funded 26.86, 14.15, and 13.75 per cent of research publications. However, the University Grants Commission has also provided financial support (13.64 %) for institutional and university-level research enhancement. However, the Department of Biotechnology (67.58 %) and the Indian Council of Medical Research (38.09 %) have covered their funded publications to a minimum range in OA-funded publications. Other 20 governmental funding bodies supported 17225 research publications with 64.44 funded publication ratio.

5.5.3 Ranking of Institutional Funding Agencies

Institutional-based research funding also plays a vital role in developing the nation's R&D innovativeness. Table 3 shows

the ranking of the top ten institutional funding bodies. IIT Bombay (1.24 %), IIT Madras (0.73 %), IIT Delhi (0.72 %), IIT Kharagpur (0.70 %), IIT Mandi (0.62 %), and IISc (1.11 %) have a significant role in the nation's research and developmental activities by providing research grant. Universities such as Banaras Hindu University (0.76 %), University of Delhi (0.69 %), and VIT University (0.61 %) have also led the way by attaining positions in the ranking. Other 20 institutional funding agencies supported 3811 research publications with 2.69 funded publication ratio.

The adoption of OA mode of publication has influenced the academic community to gain excessive exposure. Indian Institute of Science Education and Research Mohali (34.84 %) and the Indian Institute of Science (32.08 %) have a significant share of OA-funded publications compared to other institutional funding agencies.

Table 4. Subject-wise distribution of funded publications

Subjects	No. of funded publications	Funded publication ratio	No. of funded OA publications	Share of OA funded publications
Chemistry	40124	26.64	6652	16.58
Materials Science	35168	23.35	5200	14.79
Physics and Astronomy	34372	22.82	10820	31.48
Engineering	27550	18.29	4884	17.73
Biochemistry, Genetics and Molecular Biology	27346	18.15	8801	32.18
Chemical Engineering	18660	12.39	4249	22.77
Agricultural and Biological Sciences	17106	11.36	5374	31.42
Medicine	13982	9.28	7008	50.12
Environmental Science	13815	9.17	3318	24.02
Earth and Planetary Sciences	9080	6.03	3504	38.59
Energy	8575	5.69	976	11.38
Mathematics	8559	5.68	3095	36.16
Computer Science	8328	5.53	2276	27.33
Pharmacology, Toxicology and Pharmaceutics	8297	5.51	1855	22.36
Immunology and Microbiology	6487	4.31	2746	42.33
Multidisciplinary	4396	2.92	3701	84.19
Social Sciences	2687	1.78	849	31.60
Neuroscience	2116	1.40	932	44.05
Economics, Econometrics and Finance	1584	1.05	186	11.74
Business, Management and Accounting	1307	0.87	217	16.60
Veterinary	1188	0.79	284	23.91
Decision Sciences	1004	0.67	244	24.30
Health Professions	680	0.45	146	21.47
Nursing	626	0.42	254	40.58
Psychology	596	0.40	224	37.58
Arts and Humanities	407	0.27	129	31.70
Dentistry	141	0.09	69	48.94

5.6 Subject-Wise Distribution of Funded Publications

Table 4 portrays the distribution of disciplines that has received research grants from different funding agencies. Subject-wise distributions of funded publications were calculated using the following formulation:

$$P_1 = (P / P_0) \times 100$$

Where P is the number of funded publications in a particular subject and P₀ is the number of total funded publications.

As shown in Table 4, subjects under natural science disciplines like Chemistry (26.64 %), Physics and Astronomy (22.82 %), Mathematics (5.68 %) have received maximum funding from various funding agencies. Medicine (9.28 %), Pharmacology, Toxicology, Pharmaceutics (5.51 %), Immunology, and Microbiology (4.31 %) are among the subjects that have received funding from various funding bodies. However, the agencies have commissioned the fewest

grants in the fields of social sciences (1.78 %), psychology (0.4 %), and arts and humanities (0.27 %). OA to funded publications is more widespread in the sciences and technology than in the social sciences and humanities.

5.7 Ranking of Institutions

Figure 7 shows that the top ten institutions that have received grants from various funding agencies have produced reasonable publication and their involvement in OA publishing is remarkable. The ranking of the institutions has been done based on the number of funded publications. Indian Institute of Science produced the maximum number of funded publications (5,999). Indian Institute of Science is followed by the Academy of Scientific and Innovative Research AcSIR (5,028). IITs have gained countless sponsorships from various agencies since IITs are renowned technical institutes that produce numerous scientific productions. While regular universities should be more prone to

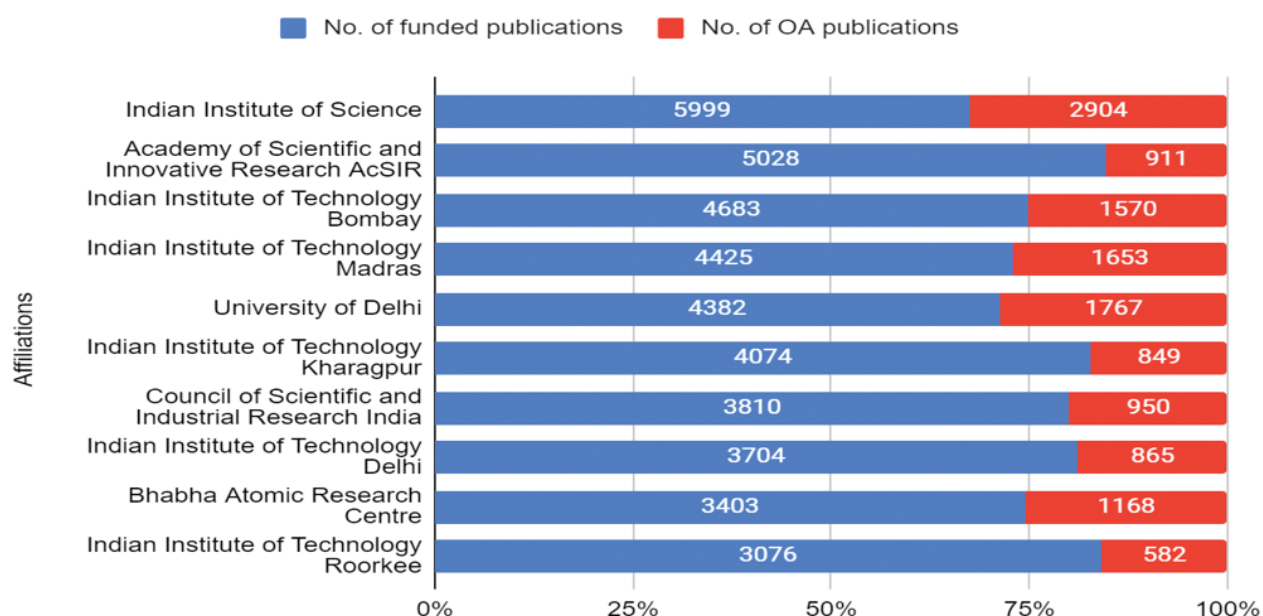


Figure 7: Top 10 institutions based on funded publications.

Table 5. Leading journals based on the publication of funded research

Journals	No. of funded publications	Funded publication ratio (%)	CiteScore (CS)	Impact Factor (IF)	Rank*
Scientific Reports	2002	1.33	7.1	5.133	1 st
Chemistryselect	1653	1.10	3.1	2.109	2 nd
Rsc Advances	1366	0.91	5.9	3.36	3 rd
New Journal of Chemistry	1212	0.80	5.3	3.591	4 th
International Journal of Biological Macromolecules	1155	0.77	8.5	6.953	5 th
ACS Omega	1053	0.70	3.9	3.512	6 th
Journal of Alloys and Compounds	1038	0.69	8.9	4.175	7 th
Journal Of Materials Science Materials in Electronics	1035	0.69	4	2.195	8 th
Physical Review D	983	0.65	8.9	4.833	9 th
Plos One	853	0.57	5.3	3.24	10 th

receive grants from funding agencies since only the University of Delhi (4,382), a central university stands out in the ranking. The IITs and research centers have eventually adopted the OA publishing policies to support the academic community.

5.8 Leading Journals that Published Funding Research Work

Table 5 depicts prolific journals that published funded research based on the percentage of funded publications. 'Scientific Reports' published the maximum funded publications (1.33 %) contributed by the research community, followed by 'Chemistryselect' journal and 'Rsc Advances' share 1.10 per cent and 0.91 per cent publications share, respectively. Among the top ten sources, 'The International Journal of Biological Macromolecules' has maximum IF and CiteScore, but it ranked fifth according to the funded publication rate (0.77 %). Another fact derived from this analysis is that most funded research publications published in OA journals have IF and CS between 2-5. Likewise, it is observed that the funded publication ratio is not proportioned either with the CiteScore or Impact factor; however, it can be underlined that the funded publications are being published in recognised and impactful journals with quality checking.

6. CONCLUSION

The objective of the present study was to examine the overall funding landscape of Indian research and OA availability to scientific-funded publications. India is currently ranked third in the world in terms of scientific publication⁴³. Of the total Indian publications published during 2016-2020, around 26 per cent were funded research publications. Of the total funded publications, only 29 per cent of publications were OA. The inflexibility of the process of granting a research project or rigidity of externally funded research, may be a factor for less funding of research work⁴⁴. In contrast, a significant proportion of funded publications are published via non-OA platforms. Yet the funded publications ratio in India has continuously been improved in numbers with time, so are the OA-funded publications as reflected in Fig. 4. However, the funded publications are mainly available via the green and gold routes of OA.

Research funded by international funding agencies is available more openly than those by national funding agencies. Concerning subject-wise funding of research, it has been observed that subjects like Natural Science, Life Science, and Medicine got more research grants than the social sciences during the same time frame. The insufficient support for the social science discipline is due to the less extensive innovations and non-reflective social changes⁴⁵. The research community or institutions that received the maximum grants are the Indian Institute of Science and the Academy of Scientific and Innovative Research (AcSIR) where most of the institutes were IITs which uphold the findings published in an article back in 2018 in *The Print* stating that IITs, IIMs and NITs receives 50 per cent of government funds⁴⁶. 'Scientific Reports' and 'Chemistryselect' are the leading journals where funded research are reported. Though the association of publishing funded publications is not proportioned to the CiteScore or Impact factor, they are

published in renowned and quality journals. The institutions that receive grants need greater exposure for the public to know about their constant development in every discipline and to enhance socio-economic development. As research funding becomes increasingly multinational, there is a greater need for collaboration at the institutional, national, and international levels.

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