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Journal Packing Density across Subject Disciplines among BRICS Countries : A Study

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ABSTRACT

The study attempts to assess the journal packing density (JPD) of the research journals published across Brazil, Russia, India, China and South Africa (BRICS) countries during 2013-2015. The JPD of the research journals has been computed on the basis of volume. The study covers 27 main subject disciplines and the JPD has been calculated against each individual subject discipline. 2499 research journals were identified as indexed by the Scopus from the BRICS countries, constituting 6.92 per cent of total research journals indexed by the Scopus all across the world. China is the leading country from the BRICS league to have the maximum 914 (36.57%) research journals. The average JPD of the research journals published across BRICS nations is 132.77 research article per journal per volume, which is far greater than the average global JPD of 101.84 research article. On average 92.55 research journal are published across BRICS countries in each subject discipline. Physics and astronomy, engineering, and energy are the three leading subject disciplines among BRICS nations having maximum JPD of 209.52, 191.40, and 190.08 research article per journal per volume. Apart from these, there are various other facts which have come to the fore about the prevailing trend of JPD among BRICS nations.

Keywords: Research journals; Research output; Subject discipline; JPD; BRICS

1. INTRODUCTION

Research has become an integral part of the modern day world and no nation can afford to sustain in the absence of research activities. There is a manifold increase in the research activities undertaken by the developing and the developed countries all across the world, contributing significantly to the advancement of the world in general and their respective country in particular. Given the impetus received by the research activities all across the world, a growing surge can be observed in the number of research articles published in research journals all across the world, which has somewhere inflated the Journal Packing Density (JPD) of research journals.

The concept of JPD is neither new nor old. Researchers in the past have also discussed about the JPD, which directly or indirectly reflects their observation about the increase or decrease in the research activities all across the world. JPD can be worked out at different levels, like at country level, at subject level, at institutional level, at the journal level, at author level and more. Basu[1] in a study related to scientific output of countries has assessed the JPD of research articles at the country level and defined 'Journal Packing Density for a country as the ratio of the number of papers published in a country's own journals to the number of journals published'. Accordingly, in the present study the concept of JPD has been evaluated to assess the number of research articles published in each volume of a research journal in any given subject discipline. Hence JPD can also be defined as 'the average number of research articles published in each issue or each volume of a research journal'.

In the present study, an attempt has been made to work out the JPD of the research journals published across the BRICS nations. BRICS is known as a league of fastest developing nations, having Brazil, Russia, India, China and South Africa as its member countries. The league came into being in 2001 and originally comprised of four members, excluding South Africa, which was included as the fifth member in the league in 2010. BRICS nations is not only the league of the fastest developing industrial nations of the world, but the fact is these five countries are also the home of worlds 3.6 billion people, which constitutes around 40 per cent of the global population[2]. In view of above factors the BRICS league of nations is supposed to serve as an ideal universe for study. An attempt has been made to determine the average number of research articles published in each volume of a research journal at the subject level among BRICS nations to that of the rest of BRICS. If we go by the research contribution of BRICS countries as reported in SCImago in its 2015 dataset, then of the total 30,11,688 research article published across the world from 231 country, 6,76,027 (22.44 %) research articles were contributed by BRICS countries[3]. This signifies the growing research prowess of BRICS nations. It is being projected that

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by the end of the 2025, the research contribution of BRICS nations to the world would be 44.7 per cent[4].

2. LITERATURE REVIEW

Researchers all across the world have undertaken a good number of studies which discuss and deliberate about the scientific output of countries, subject disciplines, regions, institutions, individuals etc. and to measure this scientific output, research journals are the only medium to undertake such studies. Accordingly, the concept of JPD is associated with the research output, whereby a researcher computes the average number of research articles published in each volume of a research journal[5]. The JPD can be calculated against any subject discipline, country, region, institution, etc. In the same way, the research output published in the research journals published from a particular country cannot be considered as the research output of that particular country.

China is being seen as one of the fastest growing research country in the world in almost all the subject areas in general and social sciences research in particular[6]. The researchers, however, remarked that Chinese research has yet to make its impact at the global level. The manifold growth in the research activities in China was also observed by[1] recording the country's scientific output in terms of JPD . The researcher found that the JPD of the Chinese research journals is almost double the average JPD of research journals at the global level. Though it is not necessary that the scientific output published in the Chinese research journals is entirely the scientific output of the Chinese researchers, as researchers from other countries do prefer to publish their research results in the research journals published from different countries. Researchers have observed a considerable surge in the research articles published by Chinese researchers[7], which is being seen more as a quantitative expansion, as country's research suffers with low impact in terms of citation threshold. There are some subject areas in which China has superseded the US research supremacy like nanotechnology and the trend may sooner be witnessed in other subject areas as well[8].

The scientific output of India is equally laudable, as the country is gradually marching to show its research prowess at the global level. The scientific output published by the country's research community in the Scopus indexed journals reveals that India has consolidated its position from 13th largest research country in the world in 1996 to 6th largest in 2015, which is a growth of 116 per cent during the last 16 year[9].

Kumar and Asheulova[4] assessed the scientific output of BRICS countries from 1981-2009 observed that there is a steady and constant increase in the research output of the BRICS countries. The researchers observed that during 1981 the research contribution of BRICS countries at the global level was 2.4 per cent, which has increased to 20.1 per cent by the end of 2009, which is an increase of 737 per cent. The research contribution of china during the period increased from 0.2 per cent in 1981 to 13.7 per cent by 2009 a significant increase of 6,750 per cent. The research contribution of Brazil, India and Russia did not increase to that significant level the way it has increased in China. In a similar study[10] to find out the publishing pattern of BRICS countries the researchers observed that Brazil, China and Russia are not close to a core cluster of countries that are more diversified, except India which is having more diversified publishing patterns.

In a study to analyse the growth of research articles to that of research journals[11] , the researchers studied the OA journals indexed by DOAJ and found that research articles from 2000 through 2009 grew at 30 per cent annually, while as research journals grew annually at 18 per cent. There may be numerous reasons for the increased JPD of research journals, but to have a sustained JPD it is imperative that research journals should grow at constant pace so as to handle the pressure of publishing of increased research activities.

The journals indexed by the commercial databases like ISI and Ulrich's Periodical Directory[12] on average publish 111 research articles per year, which is far more than the non ISI-indexed journals, which on average publish 26 research article per year.

3. SCOPE AND METHODOLOGY

The study is based on secondary data retrieved from the SCImago Journal and Country Ranking on January 25, 2017 and is accessible at http://www.scimagojr.com/[3]. The data upon retrieval was not in accordance to the need of the study. However, to suit the requirements of the study, data were structured as per the objectives of the study. Although the study could have been performed by retrieving the data for one year period like 2015 or so, but in order to make the findings more accurate, authentic, and reliable and to make data more representative, the data were retrieved for the period 2013 to 2015. The three years data have been summed up together and thereafter average or mean has been drawn by dividing the total sum by three, which represents the average figures per year. Data analysis has been undertaken individually for each individual BRICS Nation under each individual subject discipline. Journal Packing Density in each table has been drawn by working out the number of research articles published in each subject discipline in each year and then dividing the figures with the number of journals published.

Since most of the research journals complete one volume in one calendar year[5], as such, it is presumed that all the journals under study complete one volume in one calendar year. Accordingly the average journal packing density (JPD) has been computed for each journal on annual basis viz., JPD per journal per volume. The JPD against each subject discipline under each table against each BRICS country has been computed by applying the following method

Methodology for computing JPD[5]

SJ = Total research journals published in a Subject

SA = Total research articles published in a Subject

C = Time period (three year)

D = Average research articles published in a Subject one year

$$D = \frac{SA}{C} \; ; \; JPD = \frac{D}{SJ}$$

To understand from the Table 1, we have to compute the JPD of Environmental Sciences from Brazil[5]

SJ = Total research journals published in Environmental

Sciences (EVS) = 18

SA = Total research articles published in EVS from 2013-15 (3 year) = 3093

C = Time period (three year) or C= 3 years

D = Average research articles published in EVS in one year from Brazil

$$D=\frac{SA}{C}=\frac{3093}{3}=1031\left(\text{Research articles per year}\right)$$

Therefore, average number of research articles published in each journal of EVS in one year = 1031 research article

$$\text{JPD of EVS in Brazil } =\frac{D}{SJ}=\frac{1031}{18} \text{ research articles}$$

Therefore, average JPD of EVS in Brazil = 57.28 research article per journal per volume. The above method has been applied in all tables across all subject disciplines against each BRICS country in the present study.

4. OBJECTIVES

- To compute the JPD of research journals published across BRICS countries in different subject disciplines against each individual country.
- To draw a comparison between the average JPD of the research journals published across BRICS countries to that of research journals published across rest of the BRICS.

5. DATA ANALYSIS

The data analysis has been undertaken across different tables by performing simple mathematical computations. The common expressions like drawing share percentage and drawing average were performed by putting data in the MS excel. Percentage at most of the places has been rounded off and the expressions have been drawn up to two decimal places.

In all, 95567 research article were published in 440 journal indexed by Scopus across 26 subject disciplines from Brazil during 2013-2015, at an average of 1225.21 research article in each subject discipline in each year. On average, 31855.67 research article were published in 440 research journal across Brazil in each year at an average of 72.40 research article per journal, per volume. Immunology and microbiology is the leading subject discipline from the Brazil, which has average JPD of 138 research article per volume. On average, 16.92 research journal are published in each subject discipline from Brazil. Of the total scientific research output published across the research journals from Brazil per cent has been published alone in the medicine. Similarly, of the 440 research journal indexed by SCImago from Brazil, 89 (20.23 %) are published in medicine, 70 (15.91 %) in social sciences and 68 (15.45 %) in agricultural and biological sciences. These three leading subject disciplines together constituting 51.59 per cent share of the total journals indexed from Brazil.

A total of 360 research journal are indexed by Scopus from Russia across 24 subject disciplines at an average of 15 research journal across each subject discipline. In all 107381 research article were published in 360 research journal published from Russia at an average of 4474.20 research article in each subject discipline. On average 35793.67 research article were published in 360 research journal across Russia at an average JPD of 99.43 research article per volume per journal. Medicine is the leading subject discipline from the Russia in which maximum 54 (15 %) journal are indexed. However, physics and astronomy, medicine and chemistry are the three most sought areas of research in the Russia with their individual research share of 15.92 per cent, 15.90 per cent and 12.09 per cent article respectively. Health profession, energy and chemistry are the three leading subject disciplines which have the maximum average JPD of 200, 155.17, and 149.26 research article per volume per journal.

During the period of study, 192267 research article were published in 659 research journal published across India at an average of 2373.66 research article in each subject discipline each at an average JPD of 97.25 research article in each volume of the journal. On average 24.40 research journal are indexed by SCOPUS in each subject discipline from India. Of the total journals indexed, 156 (23.67 %) are published in medicine, 64 (9.71 %) in pharmacology, toxicology and pharmaceutics and 58 (8.80 %) agricultural and biological sciences research journals. in terms of research share, medicine leads the table with share percentage of 22.52 per cent. Chemistry is the leading subject discipline which has the maximum JPD of 192.59 research article per journal per volume. Given the average JPD density of each individual subject discipline, it can also be inferred that subject discipline which have more than the average JPD of the country face shortage of research journals, which are not published in proportion to the research output.

In all 585104 research article were published in 914 research journal published across China from 2013-15 across 25 major subject disciplines, at an average of 23404.16 research article in each subject discipline. On average 7801.38 research article were published in each subject discipline in each year at an average JPD of 213.39 research article in each volume of each research journal. Physics and astronomy, pharmacology, toxicology and pharmaceutics and environmental sciences are the three leading subject disciplines, which have the maximum JPD of 311.51, 258.06, and 249.19 research article per volume per journal respectively. Engineering 196 (21.44 %), medicine 127 (13.89) and earth and planetary sciences 74 (8.10) are the three leading subject disciplines to publish maximum number of research journals in China. A total of 914, research journal are indexed by Scopus from China across 25 main subject disciplines at an average of 36.56 research journal in each subject discipline. In terms of research output, Engineering leads the table with the overall research share of 23.08 per cent.

From the South Africa, 126 research journal are indexed by Scopus across 22 major subject disciplines. Medicine is the leading subject discipline having 27 (21.43 %) journal indexed. On average 5.72 research journal are indexed by Scopus from South Africa against each subject discipline. During the period of study 15073 research article were published in the research journals published across South Africa at an average of 685.13 research article in each subject discipline. On average 228.37 research article have been published in each subject discipline at an average JPD of 39.88 research article per volume per

Table 1. Journal packing density of journals published from Brazil

Subject field	Journals (% share)	Publications (% share)	Publications/Year	Avg JPD/Volume
Immunology and microbiology	5 (1.14)	2070 (2.17)	690.00	138.00
Nursing	7 (1.59)	2873 (3.01)	957.67	136.81
Biochemistry, genetics and molecular biology	12 (2.73)	4916 (5.14)	1638.67	136.56
Chemistry	8 (1.82)	2888 (3.02)	962.67	120.33
Veterinary	14 (3.18)	4958 (5.19)	1652.67	118.05
Physics and astronomy	4 (0.91)	1237 (1.29)	412.33	103.08
Pharmacology, toxicology and pharmaceutics	6 (1.36)	1840 (1.93)	613.33	102.22
Chemical engineering	3 (0.68)	898 (0.94)	299.33	99.78
Multidisciplinary	3 (0.68)	832 (0.87)	277.33	92.44
Medicine	89 (20.23)	23965 (25.08)	7988.33	89.76
Agricultural and biological sciences	68 (15.45)	17444 (18.25)	5814.67	85.51
Neuroscience	8 (1.82)	2000 (2.09)	666.67	83.33
Materials science	9 (2.05)	2229 (2.33)	743.00	82.56
Dentistry	8 (1.82)	1851 (1.94)	617.00	77.13
Health professions	6 (1.36)	1275 (1.33)	425.00	70.83
Engineering	15 (3.41)	2698 (2.82)	899.33	59.96
Environmental science	18 (4.09)	3093 (3.24)	1031.00	57.28
Mathematics	6 (1.36)	972 (1.02)	324.00	54.00
Psychology	19 (4.32)	2502 (2.62)	834.00	43.89
Computer science	3 (0.68)	373 (0.39)	124.33	41.44
Social sciences	70 (15.91)	8548 (8.94)	2849.33	40.70
Business, management and accounting	5 (1.14)	574 (0.60)	191.33	38.27
Earth and planetary sciences	16 (3.64)	1690 (1.77)	563.33	35.21
Arts and humanities	30 (6.82)	3113 (3.26)	1037.67	34.59
Decision sciences	1 (0.23)	92 (0.10)	30.67	30.67
Economics, econometrics and finance	7 (1.59)	636 (0.67)	212.00	30.29
Total (average)*	440 (16.92)*	95567 (3675.65)*	31855.67 (1225.21)*	72.40

Table 2. Journal packing density of journals published from Russia

Subject field	Journals (% share)	Publications (% share)	Publications/year	Avg JPD/ Volume
Health professions	2 (0.56)	1200 (1.12)	400.00	200.00
Energy	4 (1.11)	1862 (1.73)	620.67	155.17
Chemistry	29 (8.06)	12986 (12.09)	4328.67	149.26
Materials science	26 (7.22)	10426 (9.71)	3475.33	133.67
Physics and astronomy	43 (11.94)	17093 (15.92)	5697.67	132.50
Chemical engineering	11 (3.06)	3989 (3.71)	1329.67	120.88
Medicine	54 (15.00)	17069 (15.90)	5689.67	105.36
Dentistry	1 (0.28)	315 (0.29)	105.00	105.00
Engineering	22 (6.11)	6567 (6.12)	2189.00	99.50
Business, management and accounting	3 (0.83)	829 (0.77)	276.33	92.11
Biochemistry, genetics and molecular biology	33 (9.17)	8516 (7.93)	2838.67	86.02
Earth and planetary sciences	27 (7.50)	6300 (5.87)	2100.00	77.78
Agricultural and biological sciences	21 (5.83)	4616 (4.30)	1538.67	73.27
Immunology and microbiology	11 (3.06)	2418 (2.25)	806.00	73.27
Social sciences	15 (4.17)	3177 (2.96)	1059.00	70.60
Mathematics	21 (5.83)	4325 (4.03)	1441.67	68.65
Psychology	3 (0.83)	607 (0.57)	202.33	67.44
Economics, econometrics and finance	2 (0.56)	396 (0.37)	132.00	66.00
Nursing	2 (0.56)	379 (0.35)	126.33	63.17
Environmental science	7 (1.94)	1266 (1.18)	422.00	60.29
Neuroscience	2 (0.56)	336 (0.31)	112.00	56.00
Computer science	8 (2.22)	1296 (1.21)	432.00	54.00
Pharmacology, toxicology and pharmaceutics	3 (0.83)	468 (0.44)	156.00	52.00
Arts and humanities	10 (2.78)	945 (0.88)	315	31.50
Total (Average)*	360 (15)*	107381 (4474.20)*	35793.67 (1491.40)*	99.43

Table 3. Journal packing density of journals published from India

Subject field	Journals (% share)	Publications (% share)	Publications per year	Avg JPD per volume
Chemistry	23 (3.49)	13289 (6.91)	4429.67	192.59
Multidisciplinary	7 (1.06)	3801 (1.98)	1267.00	181.00
Pharmacology, toxicology and pharmaceutics	64 (9.71)	27232 (14.16)	9077.33	141.83
Biochemistry, genetics and molecular biology	51 (7.74)	21450 (11.16)	7150.00	140.20
Veterinary	8 (1.21)	3273 (1.70)	1091.00	136.38
Economics, econometrics and finance	10 (1.52)	3710 (1.93)	1236.67	123.67
Chemical engineering	12 (1.82)	4316 (2.24)	1438.67	119.89
Immunology and microbiology	12 (1.82)	3929 (2.04)	1309.67	109.14
Engineering	33 (5.01)	10733 (5.58)	3577.67	108.41
Energy	5 (0.76)	1527 (0.79)	509.00	101.80
Neuroscience	6 (0.91)	1806 (0.94)	602.00	100.33
Dentistry	7 (1.06)	2052 (1.07)	684.00	97.71
Medicine	156 (23.67)	43293 (22.52)	14431.00	92.51
Agricultural and biological sciences	58 (8.80)	15270 (7.94)	5090.00	87.76
Environmental science	34 (5.16)	8377 (4.36)	2792.33	82.13
Social sciences	36 (5.46)	7532 (3.92)	2510.67	69.74
Physics and astronomy	14 (2.12)	2878 (1.50)	959.33	68.52
Earth and planetary sciences	23 (3.49)	4717 (2.45)	1572.33	68.36
Mathematics	21 (3.19)	4198 (2.18)	1399.33	66.63
Health professions	3 (0.46)	499 (0.26)	166.33	55.44
Materials science	19 (2.88)	2941 (1.53)	980.33	51.60
Nursing	1 (0.15)	116 (0.06)	38.67	38.67
Computer science	12 (1.82)	1345 (0.70)	448.33	37.36
Psychology	5 (0.76)	527 (0.27)	175.67	35.13
Business, management and accounting	23 (3.49)	2330 (1.21)	776.67	33.77
Decision sciences	2 (0.30)	175 (0.09)	58.33	29.17
Arts and humanities	14 (2.12)	951 (0.49)	317.00	22.64
Total (average)*	659 (24.40)*	192267 (7121)*	64089.00 (2373.66)*	97.25

Table 4. Journal packing density of journals published from China

Subject field	Journals (% share)	Publications (% share)	Publications per year	Avg JPD per volume
Physics and astronomy	56 (6.13)	52334 (8.94)	17444.67	311.51
Pharmacology, toxicology and pharmaceutics	18 (1.97)	13935 (2.38)	4645.00	258.06
Environmental science	25 (2.74)	18689 (3.19)	6229.67	249.19
Computer science	42 (4.60)	29456 (5.03)	9818.67	233.78
Chemistry	36 (3.94)	24819 (4.24)	8273.00	229.81
Engineering	196 (21.44)	135050 (23.08)	45016.67	229.68
Biochemistry, genetics and molecular biology	38 (4.16)	25834 (4.42)	8611.33	226.61
Agricultural and biological sciences	33 (3.61)	21845 (3.73)	7281.67	220.66
Materials science	77 (8.42)	50490 (8.63)	16830.00	218.57
Medicine	127 (13.89)	81417 (13.91)	27139.00	213.69
Energy	42 (4.60)	26168 (4.47)	8722.67	207.68
Immunology and microbiology	7 (0.77)	4138 (0.71)	1379.33	197.05
Multidisciplinary	16 (1.75)	9113 (1.56)	3037.67	189.85
Mathematics	33 (3.61)	17991 (3.07	5997.00	181.73
Chemical engineering	41 (4.49)	21602 (3.69)	7200.67	175.63
Earth and planetary sciences	74 (8.10)	38596 (6.60)	12865.33	173.86
Neuroscience	7 (0.77)	2845 (0.49)	948.33	135.48
Veterinary	1 (0.11)	379 (0.06)	126.33	126.33
Arts and humanities	8 (0.88)	2389 (0.41)	769.33	99.54
Social sciences	22 (2.41)	6093 (1.04)	2031.00	92.32
Nursing	3 (0.33)	666 (0.11)	222.00	74.00
Business, management and accounting	6 (0.66)	806 (0.14)	268.67	44.78
Dentistry	1 (0.11)	120 (0.02)	40.00	40.00
Economics, econometrics and finance	4 (0.44)	282 (0.05)	94.00	23.50
Health professions	1 (0.11)	47 (0.01)	15.67	15.67
Total (average)*	914 (36.56)*	585104 (23404.16)*	195034.67 (7801.38)*	213.39

Table 5. Journal packing density of research journals published from South Africa

Subject field	Journals (% share)	Publications (% share)	Publications per year	Avg JPD per volume
Materials science	1 (0.79)	356 (2.36)	118.67	118.67
Nursing	1 (0.79)	348 (2.31)	116.00	116.00
Biochemistry, genetics and molecular biology	2 (1.59)	390 (2.59)	130.00	65.00
Medicine	27 (21.43)	4689 (31.11)	1563.00	57.89
Immunology and microbiology	2 (1.59)	344 (2.28)	114.67	57.33
Veterinary	2 (1.59)	275 (1.82)	91.67	45.83
Earth and planetary sciences	6 (4.76)	808 (5.36)	269.33	44.89
Chemistry	1 (0.79)	126 (0.84)	42.00	42.00
Engineering	5 (3.97)	558 (3.70)	186.00	37.20
Agricultural and biological sciences	15 (11.90)	1670 (11.08)	556.67	37.11
Psychology	3 (2.38)	298 (1.98)	99.33	33.11
Environmental science	7 (5.56)	693 (4.60)	231.00	33.00
Arts and humanities	15 (11.90)	1455 (9.65)	485.00	32.33
Computer science	1 (0.79)	95 (0.63)	31.67	31.67
Energy	1 (0.79)	95 (0.63)	31.67	31.67
Health professions	1 (0.79)	88 (0.58)	29.33	29.33
Social sciences	22 (17.46)	1868 (12.39)	622.67	28.30
Pharmacology, toxicology and pharmaceutics	3 (2.38)	240 (1.59)	80.00	26.66
Business, management and accounting	3 (2.38)	236 (1.57)	78.67	26.22
Economics, econometrics and finance	5 (3.97)	296 (1.96)	98.67	19.73
Decision sciences	1 (0.79)	55 (0.36)	18.33	18.33
Mathematics	2 (1.59)	90 (0.60)	30.00	15.00
Total (average)*	126 (5.72)*	15073 (685.13)*	5024.33 (228.37)*	39.88

Table 6. Overall journal packing density of research journals published from BRICS countries

Subject field	Journals (% share)	Publications (% share)	Publications per year	Avg JPD per volume
Physics and astronomy	117 (4.68)	73542 (7.39)	24514.00	209.52
Engineering	271 (10.84)	155606 (15.63)	51868.67	191.40
Energy	52 (2.08)	29652 (2.98)	9884.00	190.08
Chemistry	97 (3.88)	54108 (5.44)	18036.00	185.94
Multidisciplinary	26 (1.04)	13746 (1.38)	4582.00	176.23
Materials science	132 (5.28)	66442 (6.67)	22147.33	167.78
Computer science	66 (2.64)	32565 (3.27)	10855.00	164.47
Pharmacology, toxicology and pharmaceutics	92 (3.68)	43823 (4.40)	14607.67	158.78
Chemical engineering	67 (2.68)	30805 (3.09)	10268.33	153.26
Biochemistry, genetics and molecular biology	136 (5.44)	61106 (6.14)	20368.67	149.77
Medicine	453 (18.13)	170433 (17.12)	56811.00	125.41
Earth and planetary sciences	146 (5.84)	52111 (5.24)	17370.33	118.97
Veterinary	25 (1.00)	8885 (0.89)	2961.67	118.47
Environmental science	91 (3.64)	32118 (3.23)	10706.00	117.65
Immunology and microbiology	37 (1.48)	12899 (1.30)	4299.67	116.21
Mathematics	83 (3.32)	27576 (2.77)	9192.00	110.75
Agricultural and biological sciences	195 (7.80)	60845 (6.11)	20281.67	104.01
Neuroscience	23 (0.92)	6987 (0.70)	2329.00	101.26
Nursing	16 (0.64)	4274 (0.43)	1424.67	89.04
Dentistry	17 (0.68)	4338 (0.44)	1446.00	85.06
Health professions	13 (0.52)	3109 (0.31)	1036.33	79.72
Economics, econometrics and finance	28 (1.12)	5320 (0.53)	1773.33	63.33
Social sciences	165 (6.60)	27218 (2.73)	9072.67	54.99
Psychology	30 (1.20)	3934 (0.40)	1311.33	43.71
Business, management and accounting	40 (1.60)	4775 (0.48)	1591.67	39.79
Arts and humanities	77 (3.08)	8853 (0.89)	2951.00	38.32
Decision sciences	4 (0.16)	322 (0.03)	107.33	26.83
Total (average)*	2499 (92.55)*	995392 (36866.37)*	331797.33 (12288.79)*	132.77

Table 7. Journal packing densities of the research journals published across the rest of BRICS

Subject field	Journals (% share)	Publications (% share)	Publications per year	Avg JPD per volume
Chemistry	703 (2.09)	585876 (5.84)	195292	277.79
Multidisciplinary	84 (0.25)	66289 (0.66)	22096.33	263.04
Physics and astronomy	852 (2.54)	664601 (6.63)	221533.70	260.01
Chemical engineering	469 (1.40)	274701 (2.74)	91567.00	195.23
Materials science	985 (2.93)	563909 (5.62)	187969.70	190.83
Biochemistry, genetics and molecular biology	1721 (5.12)	883751 (8.81)	294583.70	171.17
Energy	317 (0.94)	147772 (1.47)	49257.33	155.38
Immunology and microbiology	473 (1.41)	210546 (2.10)	70182.00	148.37
Neuroscience	476 (1.42)	187624 (1.87)	62541.33	131.38
Medicine	5902 (17.57)	2095178 (20.89)	698392.70	118.33
Pharmacology, toxicology and pharmaceutics	632 (1.88)	219620 (2.19)	73206.67	115.83
Engineering	2201 (6.55)	751052 (7.49)	250350.70	113.74
Agricultural and biological sciences	1692 (5.04)	541988 (5.40)	180662.70	106.77
Veterinary	189 (0.56)	59780 (0.60)	19926.67	105.42
Environmental science	1094 (3.26)	327037 (3.26)	109012.30	99.64
Dentistry	152 (0.45)	40343 (0.40)	13447.67	88.46
Earth and planetary sciences	899 (2.68)	230074 (2.29)	76691.33	85.30
Health professions	450 (1.34)	112769 (1.12)	37589.67	83.53
Nursing	556 (1.66)	134449 (1.34)	44816.33	80.60
Computer science	1267 (3.77)	306182 (3.05)	102060.70	80.55
Decision sciences	294 (0.88)	52673 (0.53)	17557.67	59.71
Psychology	1014 (3.02)	164636 (1.64)	54878.67	54.12
Economics, econometrics and finance	794 (2.36)	115725 (1.15)	38575.00	48.58
Business, management and accounting	1112 (3.31)	148202 (1.48)	49400.67	44.42
Social sciences	4903 (14.60)	515319 (5.14)	171773.00	35.03
Arts and humanities	3181 (9.47)	310344 (3.09)	103448.00	32.52
Mathematics	1170 (3.48)	317290 (3.16)	105763.30	9.03
Total (average)*	33582 (1243.77)*	10027730 (371397.40)*	3342576.67 (123777.13)*	99.53

journal. Medicine (31.11 %), social sciences (12.39 %) and agriculture and biological sciences (11.08 %) are the three leading subject disciplines, which have recorded the maximum research output from South Africa during the period of study, hence can also be inferred as the most sought research subjects in the South Africa. Material Sciences is the leading subject discipline from the South Africa, which has the maximum JPD of 118.67 research article per volume per journal. The reasons for high JPD in material sciences and nursing discipline can be owed to the fact that only 01 research journal in each subject discipline are indexed by Scopus.

In all, 2499 research journal were found indexed by Scopus from the BRICS countries across 27 different subject disciplines at an average of 92.55 research journal against each subject discipline. During the period of study, 995392 research article were published across the research journals in the BRICS countries at an average of 36866.37 research article in each subject discipline. On average 12288.79 research article were published in every subject discipline during each year at an average JPD of 132.77 research article per volume per journal. Physics and astronomy, engineering and energy are the three leading subject disciplines among BRICS nations having an average JPD of 209.52, 191.40 and 190.08 research article per journal per volume. The above average JPD of these subject disciplines also indicates that the research journals indexed in these subject disciplines by SCOPUS are not in proportion to their scientific output, which leads to their increased JPD. Medicine 453 (18.13 %), engineering 271 (10.84 %) and agriculture and biological sciences 195 (7.80 %) are the three leading subject disciplines in which maximum number of journals are published across BRICS nations. While as, in terms of scientific output, medicine with share of 17.12 per cent, engineering 15.63 per cent and physics and astronomy 7.39 per cent lead the table. Compared to BRICS countries, a total of 33582 research journal are indexed by Scopus and published across rest of the BRICS countries at an average of 1243.77 research journal in each subject discipline. On average each year 123777.13 research article were published in each subject discipline in rest of the BRICS countries at an average JPD of 99.53 research article in each subject discipline in each journal per volume. Among rest of the BRICS nations, Chemistry is the leading subject discipline to have JPD of 277.79 research article per journal per volume.

6. FINDINGS AND DISCUSSION

Indexing of research journals by good indexes like Web of Science, Scopus, etc has itself become one of the quality parameters, whereby researchers tend to publish their research results in such journals which are indexed by good indexes[5]. Indexing helps a research journal to expand its visibility among the global scientific community, which itself results in journal to gain popularity among the scientific community. The indexing of Latin American research journals in WoS increased from 69 journal to 248 during 2006-2009, which resulted in showing a

considerable impact of LA research at the global level[13]. It is quite understandable that research journals indexed by popular indexes receive lots of manuscripts all across the world, which increases the pressure of publishing on these journals and also inflates their packing density by accommodating more and more research articles.

The average JPD of the research journals published across BRICS countries is 132.77 research article per journal per volume, while as, the average JPD at the global level is 101.84 research article per journal per volume[5]. The average JPD of Brazil is 72.40 research article per journal per volume, Russia 99.34 research article, India 97.25 research article, China 213.39 research article and the South Africa has the lowest JPD of 39.87 research article per journal per volume. The JPD of Brazil, Russia, India and South Africa is below the average global JPD, while as China is the only country among BRICS which has more than double the average global JPD.

The JPD of individual subject disciplines varies considerably among BRICS countries. Immunology and Microbiology is the leading subject discipline from Brazil having JPD of 138 research article per journal per volume. Similarly, health profession from Russia has the JPD of 155.17 research article; chemistry has the highest JPD of 192.59 research article per journal per volume in India. Physics and astronomy from China has the maximum JPD of 311.51 research article per journal per volume. Accordingly, material sciences have the maximum JPD of 118.67 research article from South Africa.

Compared to average JPD of research journals published all across the world and the rest of BRICS viz., 101.84 and 99.53 research article per journal per volume, the average JPD of research journals published from the BRICS countries is 132.77 research article per journal per volume. Physics and Astronomy is the leading subject discipline among BRICS countries to have the maximum JPD of 209.52 research article per journal per volume, while as chemistry is the leading subject both at the global level and among the rest of BRICS to have the maximum JPD of 266.66 and 277.79 research article per journal per volume respectively. The higher average JPD of research journals published from BRICS countries is an indicator of the fact that research journals published from BRICS countries face more pressure of publishing.

Medicine is the most sought research area in Brazil, India and South Africa, having research share of 20.23 per cent, 22.52 per cent and 31.11 per cent research article, respectively. While as, Physics and Astronomy is the most sought research area in Russia having a share of 15.92 per cent and Engineering in China had the maximum 23.08 per cent research share. Nevertheless, medicine is the second leading research subject in Russia and China, which signifies that medicine is the most sought research areas among the BRICS countries.

Of the 2499 research journal indexed by SCOPUS from BRICS countries, Brazil has a share of 17.60 per cent, Russia 14.40 per cent, India 26.37 per cent, China 36.57 per cent and South Africa 5.04 per cent. Of the 995392 research article published by BRICS countries during the period of the study, 9.60 per cent research article have been published in the research journals published from Brazil, 10.78 per cent from Russia, 19.31 per cent from India, 58.78 per cent from China and meager 1.51 per cent from South Africa. China dominates in the research output among BRICS countries, which is distantly followed by India at the second place. China is the only country among BRICS nations, which has a research share more than its journal share while as, the rest of BRICS have a lesser research share than their journal share.

If we look at the journal distribution at the subject level, then of the 2499 research journal published across BRICS nations, 453 (18.13 %) are published alone in the subject discipline of medicine, followed by engineering with 271 (10.84 %) journal and agricultural & biological sciences with 195 (7.80 %). While as the share of research journals in medicine among the rest of BRICS is 17.57 per cent, engineering 6.55 per cent and agriculture and biological sciences 5.04 per cent. decision science has only 04 (0.16 %) research journal indexed from the BRICS nations, which is lowest among all the subject disciplines. On average, 92.55 research journal are published in each subject discipline among the BRICS countries, while, among rest of the BRICS countries, on average 1243.77 research journal are published against each subject discipline.

Apart from decision science, dentistry, health profession, neuroscience, nursing and veterinary sciences are the other subject disciplines in which less than 1 per cent research journal are published across BRICS nations. Similarly, arts and humanities, business, management & accounting, decision science, dentistry, economics, econometrics and finance, health profession, neuroscience, nursing, psychology and veterinary sciences are the subject disciplines, which have less than 1 per cent research share among BRICS nations.

7. CONCLUSIONS

Journal packing density of the research journals indexed by popular indexes like WoS or Scopus is bound to increase all across the world and so holds true about the BRICS countries. Keeping in view the number of research journals indexed by the Scopus from the rest of BRICS, the number of BRICS journals is quite low than it should have been, give the formidability of the BRICS league of nations. The lower number of research journals indexed from BRICS countries questions the quality parameters of the research journals published in these countries. Even the research contribution of the BRICS nations at the global level is not healthy. There is urgent need that research journals published from the BRICS nations should maintain a better quality and should try to index more and more research journals with indexes like WoS and Scopus, which will help give more visibility to the research results produced from these countries, and will also help in maintaining the JPD of research journals in some key subject disciplines among few countries at par with the JPD at the global level.

The scientific output of India, Russia and Brazil is considered as formidable, compared to China. Researchers have shown apprehensions over the scientific output of the China, which is unable to make a considerable impact at the global level. The scientific output of China is being seen more as quantitative and less as qualitative. The lesser JPD of the research journals published from Brazil, Russia, India, and South Africa speaks of their research pace, which is almost

same as the rest of the world. India and China are being seen as the countries which have the potential to meet out the requirements of global human resource, but it is the quality skill of the human resource which will make the difference and needless to say that again quality research will always play the key role in imparting quality training.

The research output published in the research journals from a particular country by no means can be considered as the scientific output of that particular country alone. Researchers all across the world publish their research results in different research journals[5], irrespective of the country the research journals are published from.

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Contribution in the current study, is writing and drafting the layout.