



Dysgraphia: A Scientometric Assessment of Global Publications Output during 2007-16

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Abstract

The study examines 493 global dysgraphia research papers indexed in Scopus database during the last 10 years from 2007 to 2016. These publications registered an annual average growth rate of 4.02% and citation impact per paper averaged to 7.90. Among the 64 countries participating in dysgraphia global research, the top 10 most productive countries contributed individually global share from 3.04% to 20.69%, with USA contributing the largest global publication share of 20.69%, followed by Italy (11.76%), U.K. (11.36%), Japan (8.32%), etc. The cumulative global publication share of the top 10 most productive countries accounted for 81.34% global publication share and 96.74% global citation share during 2007-16. Four out of 10 countries have scored relative citation index above the world average of 1.19: Canada (2.85), USA (1.51), U.K. (1.46) and Israel (1.39) during 2007-16. The share of international collaborative publications of top 10 most productive countries varied from 7.32% to 39.13% in dysgraphia research during 2007-16. Medicine, among subjects, contributed the largest publication share to dysgraphia research (72.41%), followed by neurosciences (36.51%), psychology (30.53%) etc. during 2007-16. The top 15 and 10 most productive organizations and authors together contributed 22.92% and 13.18% global publication share and 33.50% and 17.27% the global citation share during 2007-16. Among the total journal output of 381 papers (which constitute 26.68% of total journal



output), the top 10 journals contributed 26.68% publications share to the global journal output during 2007-16. Only the top 17 highly cited publications registered citations from 42 to 191 and they together received 1242 citations with 73.06 citations per paper. These 15 highly cited papers involved the participation of 106 authors and 77 organizations and are published in 13 journals, of which 6 papers were published in Cortex and 1 paper each in other journals.

Keywords: Dysgraphia research, Neurological disorder, Global publications, Scientometrics, Bibliometrics

1. Introduction

The dysgraphia is a neurological disorder causing writing disabilities or impaired letter writing by hand, leading to a person's writing to be distorted or incorrect. Impaired handwriting can interfere with learning to spell words in writing. Dysgraphia is a Greek word. The base word graph refers both to the hand's function in writing and to the letters formed by the hand. The prefix dys indicates that there is impairment. Graph refers to producing letter forms by hand. The suffix ia refers to having a condition.

In children, the disorder generally emerges when they are first introduced to writing. They make inappropriately sized and spaced letters, or write wrong or misspelled words, despite thorough instruction. Children with the disorder may have other learning disabilities; however, they usually have no social or other academic problems. Cases of dysgraphia in adults generally occur after some trauma. In addition to poor handwriting, dysgraphia is characterized by wrong or odd spelling, and production of words that are not correct (i.e., using "boy" for "child"). The cause of the disorder is unknown, but in adults, it is usually associated with damage to the parietal lobe of the brain (International Dyslexia Association [IDA], 2009; OMICS International, n.d.).

Children with impaired handwriting may also have attention-deficit disorder (ADHD)—inattentive, hyperactive, or combined inattentive and hyperactive subtypes. Children with this kind of dysgraphia may respond to a combination of explicit handwriting instruction plus stimulant medication, but appropriate diagnosis of ADHD by a qualified professional and monitoring of response to both instruction and medication are needed. Dysgraphia may occur alone or with dyslexia (impaired reading disability) or with oral and written language learning disability (OWL LD, also referred to as selective language impairment, SLI) (International Dyslexia Association [IDA], 2009; OMICS International, n.d.). Dysgraphia is often, but not always, accompanied by other learning differences such as dyslexia or attention deficit disorder and this can impact the type of dysgraphia a person might have. There are three principal subtypes of dysgraphia that are recognized; (i) Dyslexic dysgraphia; (ii) Motor dysgraphia; and (iii) Spatial dysgraphia (NINDS, n.d.).



2. Literature Review

There is no quantitative study so far on the bibliometric assessment of dysgraphia, a neurological disorder) publication output, both at national and international level. However, a number of bibliometric studies had been undertaken in the past on the assessment of research in other neurological disorders, such as Alzheimer's disease (Gupta et al. 2017), autism (Gupta & Bala, 2013), dementia (Gupta et al., 2012), epilepsy (Gupta & Bala, 2013), migraine (Gupta, 2016), Parkinson's disease (Gupta & Bala, 2013), etc. Bibliometric studies had also been carried out in the past on quantitative assessment of overall research output in neurosciences (covering all disorders) (Bala & Gupta, 2010a, 2010b, 2010c).

3. Objectives

The objectives of this study are to study the performance of global dysgraphia research during 2007-16, based on literature indexed in Scopus database. The study major focus had been on aspects, such as growth characteristics, contribution of top 10 most productive countries, the citation impact of global research, share of international collaboration, distribution of global research output by broad subject areas, identification of significant keywords, publication and citation profile of top organizations and authors, leading communication mode and the characteristics of top high cited publications.

4. Methodology

The ten year global publications output on dysgraphia research during 2007-16 were retrieved and downloaded from the Scopus database (<http://www.scopus.com>), using a well-defined search strategy. In this search strategy, keyword "dysgraphia" was searched in the "keyword tag" as well as in "Article Title tag", and in addition incorporated in this search string the period '2007-16' within "date range tag". The search string was subsequently refined, using analytical provisions available in Scopus database, by "subject area tag", "country tag", "source title tag", "journal title name" and "affiliation tag", to get publication data on the distribution of publications output by subject, collaborating countries, author-wise, organization-wise and journal-wise, etc. For citation data, citations to publications were also collected from date of publication till 29 July 2017.

(KEY(Dysgraphia) OR TITLE(Dysgraphia)) AND PUBYEAR > 2006 AND PUBYEAR < 2017

5. Analysis

The global publications on dysgraphia research cumulated to 493 publications, as indexed in Scopus database during the last 10 years from 2007 to 2016. Its annual output increased from 28 in the year 2007 to 20 publications in the year 2016, with highest publications of 65 in 2012, registering 4.02% growth per annum. The cumulative global dysgraphia research output in 5

years 2007-11 increased from 225 during 2007-11 to 268 during 2012-16 registering 19.11% growth. 77.28% (381) of the global publications output was published as articles, followed by 7.51% (37) as reviews, 4.67% (23) as conference papers, 4.06% (20) as articles, articles in press, 0.20% (71) as book chapters and the rest as 2.23% (11) as editorials, 1.83% (9), as book chapters, 1.62% (8) as notes, and the rest as articles in press and short surveys (2 each). The citation impact per paper of global dysgraphia research publications averages to 7.90, which decreased from 12.65 to 3.92 from 2007-11 to 2012-16 (Table 1).

Table 1
World Publication Output in Dysgraphia, 2007-16

Publication Period	World		
	TP	TC	CPP
2007	28	576	20.57
2008	43	490	11.40
2009	36	607	16.86
2010	60	510	8.50
2011	58	663	11.43
2012	65	436	6.71
2013	62	231	3.73
2014	63	245	3.89
2015	58	108	1.86
2016	20	30	1.50
2007-11	225	2846	12.65
2012-16	268	1050	3.92
2007-16	493	3896	7.90

TP=Total Papers; TC=Total Citations;
CPP=Citations Per Paper

5.1. Contribution and Citation Impact of Top 10 Most Productive Countries

The global research output in the field of dysgraphia research had originated from as many as 64 countries in the world during 2007-16. Top 10 most productive countries in dysgraphia research had contributed 15 to 102 publications each during 2007-16 (Table 2). Of the 64 countries, 51 contributed 1-10 papers each, 11 countries 11-50 papers each and 3 countries 56-102 papers each. Top 10 most productive countries in dysgraphia research accounted for 81.34% global publication share and 96.74% global citation share during 2007-16. Their five-yearly output accounted for 81.78% global publication share during 2007-11 which declined to 80.97% during succeeding 5-year period 2012-16. Each of top 10 countries accounted for 3.04% to 20.69% global publication share during 2007-16, with USA accounting for the highest publication share (20.69%), followed by Italy and U.K. (11.76% and 11.36% share), Japan (8.32%), France (6.29% share), India and Israel (5.27% share each), Australia and Germany (4.67% share each)

and Canada (3.04% share) during 2007-17. The global publication share in five years increased by 2.84% in Italy, followed by 1.27% in USA, 1.22% in Australia and Germany and 0.94% in France, as against decrease by 2.56% each in Israel and India, 1.87% in Japan, 1.18% in U.K. and 0.13% in Canada from 2007-11 to 2012-16. Four of top 10 countries scored relative citation index above the world average *i.e.* more than 1.19: Canada (2.85), USA (1.51), U.K. (1.46) and Israel (1.39) during 2007-16 (Table 2).

Table 2
Global Publication Share of Top 10 Most Productive Countries
in Dysgraphia Research during 2007-16

S. No	Name of the Country	Number of Papers			Share of Papers			TC	CPP	ICP	%I CP	RC I
		2007-11	2012-16	2007-16	2007-11	2012-16	2007-16					
1	USA	45	57	102	20.00	21.27	20.69	1219	11.95	26	25.49	1.51
2	Italy	23	35	58	10.22	13.06	11.76	418	7.21	20	34.48	0.91
3	U.K.	27	29	56	12.00	10.82	11.36	648	11.57	16	28.57	1.46
4	Japan	21	20	41	9.33	7.46	8.32	210	5.12	3	7.32	0.65
5	France	13	18	31	5.78	6.72	6.29	250	8.06	6	19.35	1.02
6	India	15	11	26	6.67	4.10	5.27	106	4.08	2	7.69	0.52
7	Israel	15	11	26	6.67	4.10	5.27	286	11.00	6	23.08	1.39
8	Australia	9	14	23	4.00	5.22	4.67	147	6.39	9	39.13	0.81
9	Germany	9	14	23	4.00	5.22	4.67	147	6.39	9	39.13	0.81
10	Canada	7	8	15	3.11	2.99	3.04	338	22.53	3	20.00	2.85
	Total of 10 countries	184	217	401	81.78	80.97	81.34	3769	9.40	100	24.94	1.19
	World	225	268	493	100.00	100.00	100.00	3896	7.90			
	Share of 10 Countries in World Total	81.78	80.97	81.34				96.74				

5.2 International Collaboration

The international collaborative share of top 10 countries in dysgraphia a research in their respective national output varied from 7.32% to 39.13%, with average share of 24.94%. Five countries registered ICP share above their average of 24.94%: Australia and Germany (39.13% each), Italy 34.48%, U.K. (28.57%) and USA (25.49%) during 2007-16.

5.3 Distribution of Research Output by Broad Subjects

The global dysgraphia research output published during 2007-16 is distributed across five sub-fields (as identified in Scopus database classification), with medicine accounting for the highest publications share (72.41%), followed by neuroscience (36.51%), psychology (30.53%), arts & humanities (10.95%), social sciences (10.14%) and health profession (5.48%) during 2007-16. The activity index, which computes change in research activity in a discipline over time 2007-11 to 2012-16 (world average activity index of a given subject is taken as 100), witnessed increase in medicine (from 95.75 to 103.57) and arts & humanities (from 68.98 to 126.04), as against decline of research activity in neurosciences (from 108.34 to 93.00), psychology (from 106.67 to 94.4), social sciences (from 109.56 to 91.98) and health profession (from 105.5 to 95.38) from 2007-11 to 2012-16. Neurosciences, among five sub-fields, registered the highest citation impact per paper of 10.81, followed by health profession (9.37), psychology (9.03), medicine (7.61), social sciences (6.86) and arts & humanities (5.19) during 2007-16 (Table 3).

Table 3
Subject-Wise Breakup of Global Publications in Dysgraphia Research during 2007-16

S.No	Subject*	Number of Papers (TP)			Activity Index		TC	CPP	%TP
		2007-11	2012-16	2007-16	2007-11	2012-16	2007-16	2007-16	2007-16
1	Medicine	156	201	357	95.75	103.57	2717	7.61	72.41
2	Neuroscience	89	91	180	108.34	93.00	1946	10.81	36.51
3	Psychology	74	78	152	106.67	94.40	1373	9.03	30.83
4	Arts & Humanities	17	37	54	68.98	126.04	280	5.19	10.95
5	Social Sciences	25	25	50	109.56	91.98	343	6.86	10.14
6	Health Profession	13	14	27	105.50	95.38	253	9.37	5.48
	World Output	225	268	493	100.00	100.00			

There is overlapping of literature covered under various subjects
TP=Total Papers; TC=Total Citations; CPP=Citations Per Paper

5.4 Contribution, Citation Impact and International Collaborative Share of Top 15 Most Productive Organizations

About 211 organizations participated in global dysgraphia research, of which 188 organizations published 1-5 papers, 13 organizations 5-9 papers and 1 organization 15 papers. In global dysgraphia research, the productivity of 15 most productive global organizations varied from 5 to 15 publications and together they contributed 22.92% (113) publication share and 33.5% (1350) citation share to its cumulative publications output during 2007-16. The scientometric profile of these 15 organizations is presented in Table 4. Four of these organizations registered publications output greater than the group average of 7.53: John Hopkins University, USA (15 papers), University of Manchester, U.K. and La Sapienza University of Rome, Italy(9 papers each) and University of Washington, Seattle, USA(8 papers) during 2007-16.Five organizations registered impact above the group average of 11.50 citations per publication during 2007-16: V.A. Medical Center, USA (35.9), UCL Institute of Neurology, U.K.(22.3), University of Haifa, Israel (20.7), John Hopkins School of Medicine, USA(17.4) and John Hopkins University, USA (15.9) during 2007-16.Three organizations registered h-index above the group average of 4.33: La Sapienza University of Rome, Italy (9), John Hopkins University, USA (8) and V.A. Medical Center, USA (5) during 2007-16. Seven organizations contributed international collaborative publications share above the group average of 32.74%: John Hopkins School of Medicine, USA (80.0%), University of Hong Kong (66.67%), Hong Kong Polytechnic University (57.14%), L Institute of Neurology, U.K. (50.0%), John Hopkins University, USA (46.67%), La Sapienza University of Rome, Italy and University College of London, U.K. (33.33% each) during 2007-16. Five organizations registered the relative citation index above the group average (1.46) of all organizations: V.A. Medical Center, USA (4.54), UCL Institute of Neurology, U.K.(2.83), University of Haifa, Israel (2.62), John Hopkins School of Medicine, USA (2.2) and John Hopkins University, USA(2.02) during 2007-16.

Table 4
Scientometric Profile of Top 15 Most Productive Global Organizations
in Dysgraphia Research during 2007-16

S.No	Name of the Organization	TP	TC	CPP	HI	ICP	%ICP	RCI
1	John Hopkins University, USA	15	239	15.9	8	7	46.67	2.02
2	University of Manchester, U.K.	9	68	7.6	4	1	11.11	0.96
3	La Sapienza University of Rome, Italy	9	78	8.7	9	3	33.33	1.10
4	University of Washington, Seattle, USA	8	61	7.6	4	1	12.50	0.97
5	University of Haifa, Israel	7	145	20.7	4	1	14.29	2.62
6	Tel Aviv University, Israel	7	43	6.1	4	2	28.57	0.78
7	Hong Kong Polytechnic	7	32	4.6	3	4	57.14	0.58



	University							
8	V.A.Medical Center, USA	7	251	35.9	5	0	0.00	4.54
9	Macquarie University, Australia	7	41	5.9	3	2	28.57	0.74
10	University of Birmingham, U.K.	7	40	5.7	4	2	28.57	0.72
11	Aix Marseille University, France	7	34	4.9	4	1	14.29	0.61
12	University of Hong Kong	6	16	2.7	2	4	66.67	0.34
13	UCL Institute of Neurology, U.K.	6	134	22.3	4	3	50.00	2.83
14	University College of London, U.K.	6	36	6.0	4	2	33.33	0.76
15	John Hopkins School of Medicine, USA	5	87	17.4	3	4	80.00	2.20
	Total of 15 organizations	113	1305	11.5	4.33	37	32.74	1.46
	Total of World	493	3896	7.9				
	Share of top 15 organizations in World total output	22.92	33.50					

TP=Total Papers; TC=Total Citations; CPP=Citations Per Paper; HI=h-index;
ICP=International Collaborative Papers; RCI=Relative Citation Index

5.5 Contribution, Citation Impact and International Collaborative Share of Top 10 Most Productive Authors

In the field of global dysgraphia research, the research productivity of top 10 most productive authors varied from 4 to 12 publications. About 244 authors participated in global dysgraphia research, of which 237 organizations published 1-5 papers, 6 authors' 6-7 papers and 1 author 12 papers. Together they contributed 13.18% (65) global publication share and 17.27% (373) citation share during 2007-16. The scientometric profile of these 10 authors is presented in Table 5. Four authors registered publications output above the group average of 6.5: B. Rapp (12 papers), N. Friedmann, S. Rosenblum and J.L. Velay (7 papers each) during 2007-16. Three authors registered impact above the group average of 10.35 citations per publication: S. Rosenblum (20.71), B. Rapp (17.83) and V. Berninger (15.25) during 2007-16. Six authors registered h-index above the group average of 3.8 of all authors: B. Rapp (7), S. Rosenblum, V. Berninger, N. Friedmann, J. Danna and J.L. Velay (4 each) during 2007-16. Three authors contributed international collaborative publications share above the group average of 26.15% of all authors: B.S. Weekes (80.0%), B. Rapp (41.67%) and N. Friedmann (28.57%) during 2007-16. Three authors registered the relative citation index above the group average (1.31) of all authors: S. Rosenblum (2.62), B. Rapp (2.26) and V. Berninger (1.93) during 2007-16.

Table 5
Scientometric Profile of Top 10 Most Productive Authors
in Dysgraphia Research during 2007-16

S.No	Name of the Author	Affiliation of the Author	TP	TC	CPP	HI	ICP	%ICP	RCI
1	B. Rapp	John Hopkins University, USA	12	214	17.83	7	5	41.67	2.26
2	N. Friedmann	Tel Aviv University, Israel	7	43	6.14	4	2	28.57	0.78
3	S.Rosenblum	University of Haifa, Israel	7	145	20.71	4	1	14.29	2.62
4	J.L. Velay	Aix-Marseille University, France	7	34	4.86	4	1	14.29	0.61
5	J. Danna	Aix-Marseille University, France	6	34	5.67	4	1	16.67	0.72
6	S. Karande	LTM Medical College & General Hospital, Mumbai	6	40	6.67	3	0	0.00	0.84
7	L. Nickels	Macquarie University, Australia	6	39	6.50	3	1	16.67	0.82
8	S. Kohnen	Macquarie University, Australia	5	39	7.80	3	1	20.00	0.99
9	B.S. Weekes	University of Hong Kong	5	24	4.80	2	4	80.00	0.61
10	V. Berninger	University of Washington, USA	4	61	15.25	4	1	25.00	1.93
		Total of 10 authors	65	673	10.35	3.8	17	26.15	1.31
		Total of World	49	389	7.90				
		Share of top 10 authors in World total output	13. 18	17. 27					

TP=Total Papers; TC=Total Citations; CPP=Citations Per Paper; HI=h-index;
 ICP=International Collaborative Papers; RCI=Relative Citation Index

5.6 Medium of Communication and Identification of Most Productive Journals

Of the total world output in dysgraphia research, 93.51% (381) appeared in journals, 3.04% (15) in conference proceedings, 1.83% (9) in books and 1.62% (8) in book series. Nearly 152 journals participated in global dysgraphia research, of which 139 journals published 1-5 papers, 8 journals 6-10 papers, 4 journals 11-20 papers and 1 journal 22 papers. The top 10 most productive journals contributed 8 to 22 papers each in dysgraphia research and together accounted for 26.68% share (123 papers) of total journal publication output during 2007-16. The publication share of these top 10 most productive journals decreased from 31.67% to 23.49% between 2007-11 and 2012-16. The top most productive journal (with 22 papers) was *Cortex*, followed by *Research in Development Disabilities* (20 papers), *Aphasiology* (14 papers), *Cognitive Neurology* (13 papers), etc. during 2007-16 (Table 6).

Table 6
 Top 10 Most Productive Journals in Dysgraphia Research during 2007-16

S.No	Name of the Journal	Number of Papers		
		2007-11	2012-16	2007-16
1	Cortex	18	4	22
2	Research in Development Disabilities	7	13	20
3	Aphasiology	6	8	14
4	Cognitive Neurology	8	5	13
5	Behavioral Neurology	3	8	11
6	Movement Disorders	2	8	10
7	Neurocase Neurology	3	7	10
8	Journal of Neurology	6	2	8
9	Human Movement Science	2	5	7
10	Neuropsychologia	2	6	8
	Total of 10 journals	57	66	123
	Total global journal output	180	281	461
	Share of top 10 journals in global journal output	31.67	23.49	26.68

5.7 Significant Keywords

Around 31 significant keywords have been identified from the literature, which point to possible trends in dysgraphia computing research. These keywords are listed in Table 8 in the decreasing order of the frequency of occurrence during 2007-16.

Table 8
 List of Significant Keywords in Literature on Dysgraphia Research during 2007-16



S.No	Keyword	Frequency	S.No	Keyword	Frequency
1	Dysgraphia	429	17	Psychomotor Performance	42
2	Dyslexia	139	18	Stroke	42
3	NMR Imaging	117	19	Brain	38
4	Agraphia	115	20	Dysarthria	38
5	Handwriting	96	21	Apraxia	34
6	Magnetic Resonance Imaging	72	22	Motor Dysfunction	34
7	Reading	67	23	Language Disabilities	33
8	Spelling	56	24	Attention Deficient Disorders	30
9	Neuroimaging	53	25	Cerebrovascular Accidents	30
10	Aphasia	51	26	Dementia	28
11	Cognition	48	27	Motor Performance	28
12	Phonetics	48	28	Alzheimer Disease	27
13	Learning Disorders	46	29	Comorbidity	27
14	Cognitive Defeats	43	30	Headache	27
15	Language	43	31	Dyscalculia	26
16	Speech Disorders	43			

5.8 Highly Cited Papers

A total of 17 highly cited papers were identified which received citations from 42 to 191 during 2007-16. These 17 papers together received 1242 citations, which averaged to 73.06 citations per paper. Of the 17 highly cited papers, 1 resulted from the participation of single organization (non-collaborative) and 16 involved the participation of two or more organizations (12 national collaborative and 4 international collaborative). Among international collaborative papers, the largest participation was from USA (6 papers), followed by U.K. and Italy (3 papers each), France, Belgium and Israel (2 papers each) and 1 paper each by Canada, Czech Republic, Finland, Norway, Turkey, Romania, Ireland, Denmark, Greece, Germany, Hungary, Austria, Poland and Netherlands. The 17 highly cited papers involved the participation of 107 authors and 77 organizations. Of the 17 highly cited papers, 12 were published as articles, 4 as review papers



and 1 as note. These 17 highly cited papers were published in 13 journals, of which 6 papers were published in *Cortex* and 1 paper each in Child Neuropsychology, Developmental Medicine and Child Neurology, Drug Safety, European Journal of Neurology, Frontier in Psychology, Journal of Autoimmunity, Health Technology Assessment, Human Movement Science, Movement Disorders, Neurology, Stereotactic and Functional Neurosurgery and Trends in Neurosciences.

6. Findings and Conclusion

Using the Scopus database, this study provides a quantitative and qualitative description of the development of the research in dysgraphia over a period of 10 years. From 2007 to 2016 the scientific literature related to dysgraphia research registered a low growth of 4.02% per annum. However, compared to quantitative performance, qualitative performance of dysgraphia research literature measured in terms of citation impact is averaged to 7.90 citations per paper in 10 years period, which decreased from 12.65 to 3.92 from 2007-11 to 2012-16.

Each of top 10 most productive countries in global dysgraphia research accounted for 3.04% to 20.69% global publication share during 2007-16, with USA accounting for the highest publication share (20.69%), followed by Italy and U.K. (11.76% and 11.36% share), Japan (8.32%), France (6.29% share), India and Israel (5.27% share each), Australia and Germany (4.67% share each) and Canada (3.04% share) during 2007-17. Top 10 most productive countries together in dysgraphia research accounted for 81.34% global publication share and 96.74% global citation share during 2007-16. Top 10 countries five-yearly global publication share decreased from 81.78% to 80.97% from 2007-11 to 2012-16. Four of top 10 most productive countries performed comparatively better in qualitative terms, scoring relative citation index above the world average of 1.19: Canada (2.85), USA (1.51), U.K. (1.46) and Israel (1.39) during 2007-16 during 2007-16.

Medicine, among subjects, contributed the largest publication share (72.41%), followed by neurosciences (36.51%), psychology (30.53%), arts & humanities (10.95%), social sciences (10.14%) and health profession (5.48%) during 2007-16. The research activity showed increase in medicine and arts & humanities, as against decline in neurosciences, psychology, social sciences and health profession from 2007-11 to 2012-16. Neurosciences, among five sub-fields, registered the highest citation impact per paper of 10.81, followed by health profession (9.37), psychology (9.03), medicine (7.61), social sciences (6.86) and arts & humanities (5.19) during 2007-16 (etc. during 2007-16).

The top 15 and 10 most productive organizations and authors together contributed 22.92% and 13.18% respectively as their share of global publication output and 33.50% and 17.27% respectively as their share of global citation output during 2007-16. The leading organizations in



terms of research productivity were John Hopkins University, USA (15 papers), University of Manchester, U.K. and La Sapienza University of Rome, Italy (9 papers each), University of Washington, Seattle, USA (8 papers), etc. during 2007-16. The leading organizations in terms of citation impact per paper were V.A. Medical Center, USA (35.9), UCL Institute of Neurology, U.K.(22.3), University of Haifa, Israel (20.7), John Hopkins School of Medicine, USA (17.4), John Hopkins University, USA (15.9), etc. during 2007-16. The leading authors in terms of research productivity were B. Rapp (12 papers), N. Friedmann, S. Rosenblum and J.L. Velay (7 papers each), etc. during 2007-16. The leading authors in terms of citation impact per paper were S. Rosenblum (20.71), B. Rapp (17.83), V. Berninger (15.25), etc. during 2007-16.

About 93.51% of the total global output in dysgraphia research appeared in journals. Nearly 152 journals participated in global dysgraphia research. The top 10 most productive journals together accounted for 26.68% share of total journal publication output during 2007-16, which decreased from 31.67% to 23.49% from 2007-11 and 2012-16. *Cortex* was the most productive journal with 22 papers, followed by *Research in Development Disabilities* (20 papers), *Aphasiology* (14 papers), *Cognitive Neurology* (13 papers), etc. during 2007-16.

Of the total global dysgraphia research output, only 17 publications registered high citations, in the range of 42 to 191 citations per paper, and collectively these 17 highly cited papers received a total of 1242 citations, averaging to 73.06 citations per paper. The 17 highly cited papers involved the participation of 107 authors and 77 organizations and were published in 13 journals, of which 6 papers were published in *Cortex* and 1 paper each in *Child Neuropsychology*, *Developmental Medicine and Child Neurology*, *Drug Safety*, *European Journal of Neurology*, *Frontier in Psychology*, *Journal of Autoimmunity*, *Health Technology Assessment*, *Human Movement Science*, *Movement Disorders*, *Neurology*, *Stereotactic and Functional Neurosurgery* and *Trends in Neurosciences*.

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