

Vitiligo: A quantitative analysis of the world research output during 2001-2012

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ABSTRACT

The study aimed to evaluate vitiligo research carried out in different countries of the world during 2001-2012 using bibliometric indicators. Data of the present study has been obtained from Scopus (<http://www.scopus>) database using the keywords "Alopecia universalis", "onychodystrophy", "Schranter-Stumpel Theunissen Hulsmans syndrome", "Spastic paraplegia", "Pigmentation Disorders", "Hypopigmentation" during the period of study. The study examined the type of documents, country-wise contribution, subject-wise distribution, most productive institutions, most productive authors, highly productive journals and highly cited papers in vitiligo research. A total of 4091 papers were published during 2001-2012 at the annual growth rate of (20.24%). USA is the most productive country which shared (19.41%) of the world publications. India holds 2nd rank with 388 (9.48%) papers. Overall, 50 or more citations have been witnessed to 207 papers. Germany, France, Spain and Japan activity index has been come down during the period of 2007-2012. However, majority of leading institutions are located in developed countries such as USA, UK, France and Germany. Nevertheless, Postgraduate Institute of Medical Education and Research, Chandigarh has been identified the most productive institution in vitiligo research. Besides this, Karin Uta Schallreuter from University of Bradford is found the most productive author who has contributed 45 articles. Journal of the European Academy of Dermatology and Venereology' is identified the most productive journal. In the last two decades considerable progress has been made to cope this affliction, nevertheless scientist are not able to develop a vaccine. It is expected that in near future a vaccine will be available in the market to counter the disease.

Keywords: Activity index, bibliometric study, dermatology, vaccine

INTRODUCTION

Vitiligo is a major skin disease and people are suffering with this worldwide. The major symptoms are the patches of light or discolored skin and sometime de-pigmentation of hair as well as eyes.^[1] The major cause behind the disease is due to loss of functioning melanocytes and melanin from the epidermis. Vitiligo is affecting nearly 2% of the world population. It can

occur at any age, but more prevalent in the age group of 10-30 years. It has more chances of occurrence before the age of 20.^[2,3] Vitiligo has been presented as a disorder of multifactorial etiology which could be associated with environmental, genetic propensity and sometime immunologic factors.^[4] Evidently, it is a part of a broader, genetically determined, autoimmune and auto inflammatory diathesis.^[5]

The cause is a substantial loss of functioning melanocytes in the depigmented patches. The etiology is still unknown and pathogenesis has not been completely understood so far. Several hypotheses have been proposed and one of the hypotheses, i.e. the autocytoxic suggests that melanocyte impairment could be related to increased oxidative stress.^[6] Vitiligo may be inherited and supposed to have genetic basis.^[7] A child affected with vitiligo has significant psychological trauma, which may have long-lasting effects on the self-esteem.^[8]

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Overall, scientists have classified the vitiligo in two categories i.e. (i) non segmental (ii) segmental. The first category is the most common and has been found in 90% of the cases of vitiligo. In non-segmental vitiligo patches appear on both side of the body and these patches are commonly appeared on the body that often comes in contact of sun light. The white patches can occur throughout the patient's life. It can be generalized or localized and distributions of depigmented patches are widespread.^[7] However, segmental vitiligo is known for its early stage and spread quickly. Without treatment, it persists throughout life. However, it stops developing within 2 years.^[9]

Segmental vitiligo is more stable compared with non-segmental and appears in the early age.^[10] The case where whole body has uniform depigmentation is known as albinism. This disease is an idiopathic, depigmentation disorder with prevalence world-wide from 0.1% to 8% respectively.^[11] A range of surgical treatments aimed at repigmentation and therapies for depigmentation are available for patients with recalcitrant.^[12] A study was conducted on vitiligo in context of its prevalence world-wide and reported in the international journal of dermatology in 2012,^[13] but there is no specific bibliometric research carried out on this affliction, rather a report by Canadian Institute of Health Research has submitted a report on skin diseases and bibliometric data has been presented.^[13a] Another bibliometric study was reported in the dermatology journal, but vitiligo was not primary.^[13b] However, bibliometric studies are carried on Bone Marrow,^[14] Stem Cell Research^[15,16] and other diseases such as dementia,^[17] diabetes,^[18,19] arthritis and rheumatism.^[20,21]

Objectives of the Study

The study has the objectives to identify the growth of world-wide literature on vitiligo during the period 2001-2012. The more specific objectives are to analyze the type of publications, county wise contribution, subject-wise distribution, most productive authors, highly productive journals and most productive institutions on vitiligo research. Besides this, highly cited research papers in the field of vitiligo are also identified. Data was also analyzed and presented in tabular form using simple percentage method.

METHODOLOGY

The data source of this study was Scopus (<http://www.scopus.com>) multidisciplinary database and keywords available in the fields title, keyword and abstract was used

to retrieve the bibliographic record on vitiligo during the year 2001-2012. Various subject headings such as Alopecia universalis onychodystrophy, Schrandner-Stumpel, Theunissen Hulsmans syndrome, Spastic paraplegia, Pigmentation Disorders, Hypopigmentation were used to identify the records on vitiligo. The data was analyzed using the various parameters and citations on records were calculated. The citation count was taken as the numbers of citation scored by the article since it has been published.

Data Analysis

Publications types of vitiligo research

The majority of findings have been published in the form of journal article (60.30%), reviews (19.51%) and letter (10.58%) and although conference paper (3.32%), note (2.47%), editorial (1.81%), short survey (1.54%), article in press (0.24%) and erratum (0.22%).

Growth of vitiligo literature

A total of 4091 records have been selected during the period of study. The data has been divided into two groups of 6 years each and growth is compared. One year citation window has been used to count the citations records. There has been a growth of (121.43%) at rate of (20.24%) annual growth during 2001-2006. In comparison to 2001-2006, the literature growth during 2007-2012 has been slow and achieved a growth rate of only (38.3%) with an annual growth rate of (6.4%). Overall growth of the literature over a period of 12 years, it has been noted (218.8%) with an annual growth of (18.2%)/year. Figure 1 presents the overall annual growth of literature (represented dotted line) and cumulative growth (represented as column) during the period of study. The growth of literature has obtained linear, it can be seen by growth curve represented in the equation ($y = 27.717x + 160.76$; $R^2 = 0.9689$). This trend could be possible in future too.

Table 1 shows that total 4091 papers were published during the period of study with an average 341 papers/year. These 4091 papers have witnessed 50931 citations on an average 12.22 citations/paper. During the period 2001-2006, a total of 1564 papers have been published and these records have witnessed 31763 citations on an average 20.30 citations/paper. Interestingly, a significant rise in the publications has been recorded during the period 2007-2012. In between this period, a total of 2527 documents were published on

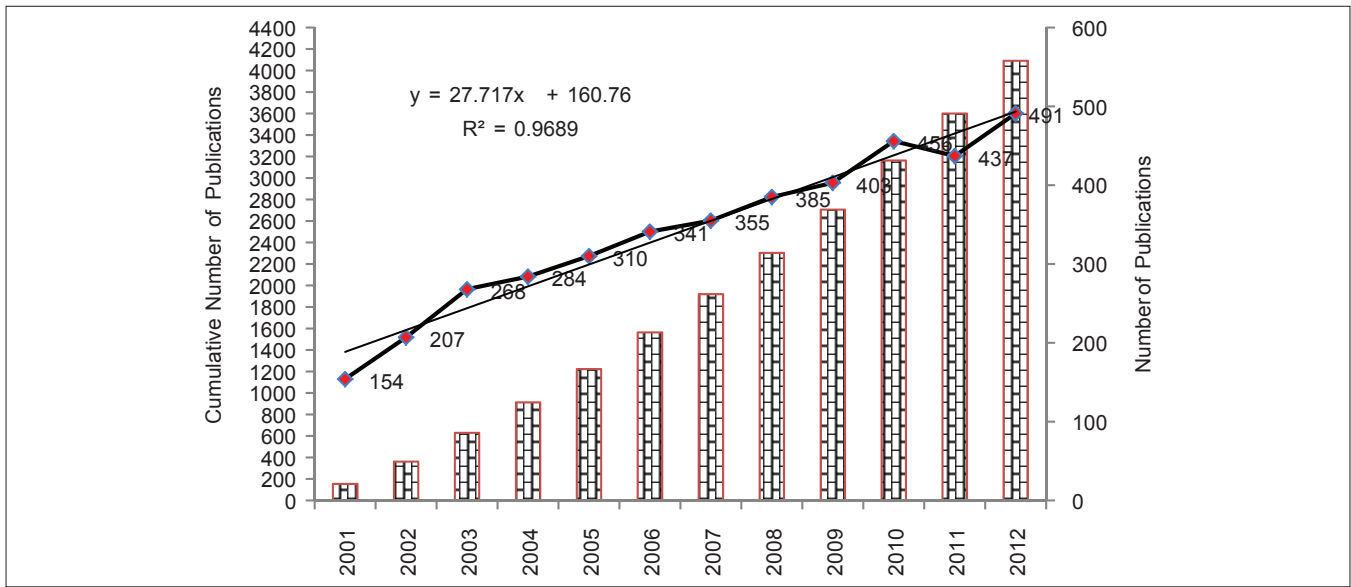


Figure 1: Growth of literature in vitiligo disease

Table 1: Growth of research publications during 2001-2012

Year	No. of papers	TC	ACPP
2001	154	567	3.7
2002	207	795	3.8
2003	268	959	3.6
2004	284	1213	4.3
2005	310	1663	5.4
2006	341	2070	6.1
2007	355	2027	5.7
2008	385	794	2.1
2009	403	1049	2.6
2010	456	2893	6.3
2011	437	1171	2.7
2012	491	1560	3.2

TC=Total citation, ACPP=Average citation per paper

vitiligo. Moreover, a gradual rise of publications has been observed from 2001-2006 to 2007-2012 [Table 1].

World-wide distribution of Vitiligo Literature

Overall, 4091 papers have been published by 95 countries on this affliction. United States (USA) is found the most productive country. USA has contributed 794 (19.4%) papers on vitiligo. The second rank in terms of highest number of contribution hold by India with 388 (9.02%) publications and Italy holds third rank with 275 (5.6%) publications. USA and India have maintained their position in terms of publication from 2001-2006 to 2007-2012 while Italy has improved its ranking from 5th position in 2001-2006 to 3rd position in 2007-2012. Table 2 presents top twenty most

productive countries, their contribution to vitiligo research publication and ranking for period 2001-2006, 2007-2012 and overall ranking for a period of 12 years. As for as citation impact of papers is concerned it is found that the papers published from USA have obtained 20141 citations with an average 25.37 citations/paper. The articles from United Kingdom have obtained 7227 citations with an average of 27.9 citations/paper, while articles published from Germany have obtained 5072 citations with an average 21.22 citations/paper.

Articles from Canada have highest average citation per paper (ACPP), i.e. 35.42. It is found that there are nine countries which have ACPP higher than group average (15.15 citations/paper) while eleven countries have lower average citations per paper than group average. Hence, it can be concluded that the Canadian articles are very often cited when compared to other countries, while Brazilian articles are least cited. In order to compare the relative research between different countries, the activity index (AI) was used as the absolute publication output is affected by the size of the country. An AI score = 100 shows the country’s research effort precisely to the world average. While AI > 100 shows the higher than average effort and AI < 100 reveals a lower than average effort by the country. Following formula was used to calculate the AI:^[22]

$$AI = [(N_{ij}/N_{io}) / (N_{oj}/N_{oo})] \times 100$$

- N_{ij} is the total number of publications of a country in a subfield j

Table 2: Top 20 most productive countries of vitiligo literature, their share of publication and rank

Country	TP and AI		2001-2012	Change in AI 2001-06 2007-12	Share of publication 2001-2012	Rank 2001-2012	TC 2001-12	ACPP 2001-12
	2001-2006	2007-2012						
United States	295 (97.18)	499 (164.39)	794	67.21	19.41	1	20141	25.37
India	141 (95.06)	247 (103.06)	388	8.00	9.48	2	2709	6.98
Italy	87 (6.72)	188 (110.67)	275	27.92	6.72	3	4439	16.14
United Kingdom	103 (6.33)	156 (97.51)	259	-6.51	6.33	4	7227	27.9
Germany	106 (5.84)	133 (90.09)	239	-25.92	5.84	5	5072	21.22
South Korea	82 (5.35)	137 (101.27)	219	3.33	5.35	6	1258	5.74
China	38 (50.46)	159 (130.66)	197	80.21	4.82	7	1063	5.39
Turkey	62 (84.03)	131 (109.88)	193	25.86	4.72	8	1175	6.08
France	74 (104.07)	112 (97.48)	186	-6.58	4.55	9	3462	18.61
Spain	46 (101.97)	72 (98.78)	118	-3.19	2.88	10	1505	12.75
Japan	48 (106.40)	70 (96.04)	118	-10.37	2.88	11	915	7.75
Netherlands	41 (98.39)	68 (101.00)	109	2.61	2.66	12	3297	30.24
Brazil	31 (97.08)	77 (115.42)	108	40.34	2.64	13	520	4.81
Iran	21 (69.53)	58 (118.96)	79	49.33	1.93	14	579	7.32
Belgium	28 (98.97)	46 (100.64)	74	1.66	1.81	15	1433	19.36
Canada	23 (88.47)	45 (107.13)	68	18.66	1.66	16	2409	35.42
Saudi Arabia	18 (81.18)	40 (111.65)	58	30.47	1.42	17	341	5.87
Egypt	12 (58.13)	42 (125.92)	54	67.79	1.32	18	304	5.62
Switzerland	21 (105.64)	31 (96.61)	52	-9.12	1.27	19	1598	29.59
Taiwan	19 (108.04)	27 (95.02)	46	-13.02	1.12	20	502	10.91
Global	1564	2527	4091		100.00			

TP=Total publication, AI=Activity index, TC=Total citation, ACPP=Average citation per paper

- N_i is the total number of publications of the country i in all the subfields
- N_j is the total number of publications for all the countries in the subfield j
- N_{oo} is the total publication output for all subfields for all countries.

It was found that Taiwan (108.04) has registered the highest AI during the period 2001-2006, followed by Japan (106.40), Switzerland (105.6) and France (104.1). The lowest AI was witnessed by South Korea (5.4). In between the period 2007 and 2012, USA (164.4) has registered the highest AI, followed by Egypt (125.9). The Figure 2 shows the change in AI of leading countries in vitiligo research.

Worldwide vitiligo research in terms of different subject areas

The global publication output in vitiligo research during 2001-2012 has been published in context of 23 subjects. the highest number of publication output coming from medicine (3581 articles, 69.8% share), followed

by Biochemistry, Genetics and Molecular Biology (598 articles, 11.66% publications share), Immunology and Microbiology (271 articles, 5.3% share) and Pharmacology, Toxicology and Pharmaceutics (239 articles, 4.66% share). The two subject categories Agricultural and Biological Sciences and Neurosciences have publication share of (1.8%) and (1.0%) respectively. Other all categories have < 1% publication share during the period of study. On analyzing citation impact of the subject it is found that the Biochemistry, Genetics and Molecular Biology related articles have been cited most with 14701 citations with an average 24.58 citations/paper. Medicine related articles have obtained 12885 (average 3.59) citations, Immunology and Microbiology have received 7093 citations (average 26.17) [Table 3].

Research profile of most productive institutions in vitiligo research

The top 15 most productive world institutions involved in Vitiligo research have published 25 or more articles each during 2001-2012. The publication profiles of these 15 institutions along with their research output, citations

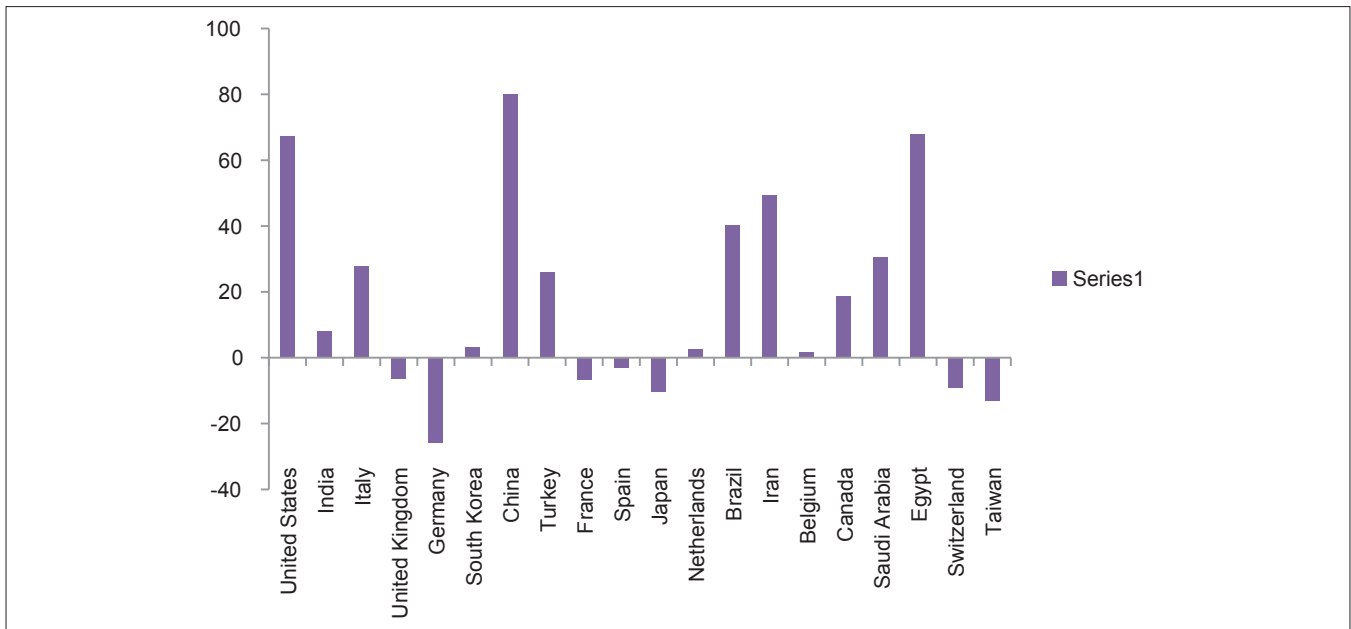


Figure 2: Change in activity index

Table 3: Vitiligo research in context of different subjects

Subject area	Number of papers			% share 2001-12	Activity cell		2001-12	
	2001-06	2007-12	2001-12		2001-06	2007-12	TC	ACPP
Medicine	1306	2275	3581	69.8	99.1	100.6	12885	3.59
Biochemistry, genetics and molecular biology	202	396	598	11.7	91.8	104.9	14701	24.58
Immunology and microbiology	108	163	271	5.3	108.3	95.2	7093	26.17
Pharmacology, toxicology and pharmaceuticals	80	159	239	4.7	91	1.05.3	3958	16.56
Agricultural and biological sciences	51	39	90	1.8	154.1	68.6	2855	31.72
Neurosciences	16	37	53	1.0	82.1	110.5	761	14.35
Chemistry	21	24	45	0.9	126.9	84.5	1090	24.22

TC=Total citation, ACPP=Average citation per paper

received and *h*-index values are given in Table 4. These 15 institutions account for 12.98% share (531 articles) of the total publications output of world with an average output per institution of 35.4. Six institutions have registered higher publications share than the group average. These are Postgraduate Institute of Medical Education and Research, India (67 articles), University of Bradford, UK (46 articles), Academic Medical Centre, University of Amsterdam, Netherland (42 articles), Università degli Studi di Firenze, Italy and University Hospital of Ghent, Belgium (39 articles each) and University of Sheffield, UK (38 articles).

The ACPP registered by the total papers of these 15 institutions is 25.09. Five institutions have registered comparative higher impact than the group average. The highest impact 104.4 citations/paper was scored by the

National Cancer Institute, USA, followed by University of Colorado Health Sciences Center, USA (46.51), University of Bradford, UK (30.17), Istituti Fisioterapici Ospitalieri, Rome (29.62) and University of Sheffield, UK (25.92). A total of 10 leading institutions have scored less than the average citation per publications. Measuring the performance of these institutions on the basis of *h*-index,^[23] eight institutions have achieved a higher *h*-index value than the group average of 11.8. These are University of Colorado Health Sciences Center, USA with *h*-index of 21, University of Bradford, UK and Postgraduate Institute of Medical Education and Research, India with *h*-index of 19, followed by Istituti Fisioterapici Ospitalieri, Rome, University of Sheffield, UK, Ernst-Moritz-Arndt-Universität Greifswald, Germany and University Hospital of Ghent, Belgium (*h*-index × 16 each), while Academic Medical

Table 4: Productivity, citation impact and h index value of top institutions

Name of the institution	TP	TC	ACPP	h index
Postgraduate Institute Of Medical Education and Research, Chandigarh, India	67	936	13.97	19
University of Bradford, UK	46	1388	30.17	19
Academic Medical Centre, University of Amsterdam, Netherland	42	238	5.66	13
Universita Degli Studi di Firenze, Italy	39	405	10.38	11
University Hospital of Ghent, Belgium	39	876	22.46	16
University of Sheffield, UK	38	985	25.92	16
Royal Hallamshire Hospital, UK	33	728	22.06	11
Istituti Fisioterapici Ospitalieri, Rome	32	948	29.62	16
Ernst-Moritz-Armdt- Universität Greifswald, Germany	32	777	24.28	16
University of Colorado Health Sciences Center, USA	31	1442	46.51	21
Tehran University of Medical Sciences, Iran	30	281	9.37	5
Hopital l'Archet, France	26	445	17.11	3
Yonsei University College of Medicine, South Korea	26	82	3.15	5
Kyung Hee University, South Korea	25	286	11.44	2
National Cancer Institute, USA	25	2609	104.4	4
Other (institutions)	3560	38505	10.81	-
Grand total	4091	50931	12.44	-

TP=Total publication, TC=Total citation, ACPP=Average citation per paper

Centre, University of Amsterdam, Netherland have *h*-index value 13. Seven institutions have their *h*-index value less than the group average.

Research profile of most productive authors in vitiligo research

A total of 15 authors have been identified as productive authors who have published 22 or more articles on Vitiligo research. The contribution of these 15 authors together shares a (10.73%) of global publication. The contribution is 439 papers with an average of 29.6 of total output during 2001-12. Seven authors have published higher number of papers than the group average (29.26). The most productive authors on vitiligo research are: Schallreuter, Karin Uta (45 articles); Gawkrödger, David (35 articles); Parsad and Taieb (34 articles each); Picardo, Mauro (32 articles); Lee (31 articles) and Spritz, Richard (30 articles). Considering the quality/impact of papers, these productive authors have received a total of 9060 citations for 439 papers with an average of 20.69 citations/paper. Seven authors have

registered higher impact than the group average. These authors are Dogra (53.59), Spritz, Richard (48.16), Picardo, Mauro (31.71), Weetman, Anthony (29), Kemp (26.85), Schallreuter, Karin Uta (25.73), Taieb (20.82).

Measuring the performance of these authors on the basis of *h*-index, nine authors have achieved a higher *h*-index value than the group average of 13. These are Spritz, Richard (20), Schallreuter, Karin Uta (20), Picardo, Mauro (17), Lee, JooHeung (16), Weetman, Anthony (14), Kemp, (14), Gawkrödger, David (14), Taieb (13) and Parsad (13) [Table 5].

Research profile of most productive journals

The fifteen most productive journals have published 1164 papers on vitiligo, which accounts for (28.5%) of the world total research output during 2001-2012. Table 6 shows the contribution of the most productive journals during the period 2001-2006, 2007-2012 and over all contribution. The cumulative publications share of these 15 most productive journals showed an increasing trend in contribution on Vitiligo Research. Journal of European Academy of Dermatology and Venereology is most productive journal which has published (146 papers) highest number of publications on Vitiligo.

Profile of highly cited papers in vitiligo research

In total, 207 papers have witnessed 50 or more citations. The citation count has been taken as the number of citations received by each paper since these published up to July, 2013. It is found that there were six papers which have citation over 500. Table 7 presents the status of ten most highly cited papers of vitiligo research. Citation pattern of papers was studied and it was found that 59 papers have received more than 100 citations. Total 207 papers have received more than 50 citations. A considerable number of papers, i.e. 148 have witnessed 50-100 citations. Figure 3 shows the citation pattern of papers which have witnessed more than 50 citations.

CONCLUSION

Based on the above study it can be concluded that Vitiligo is a skin disorder which has both psychological as well as physiological effects on human. The disease is found to occur around the globe which has been represented by some of the etiological case studies. Totally 4091 papers have been published during 2001-2012 at an annual growth rate of 20.24%. United States is found to be the most productive

Table 5: Most productive authors and their impact

Name	Organization	TP	TC	ACPP	h index
Schallreuter, Karin Uta	University of Bradford, School of Life Sciences, Bradford, UK	45	1158	25.73	20
Gawkrodger, David	Royal Hallamshire Hospital, Department of Dermatology, Sheffield, UK	35	376	10.74	14
Parsad	Postgraduate Institute of Medical Education and Research, Department of Dermatology, Chandigarh, India	34	458	13.47	13
Taieb	Groupe Hospitalier Pellegrin, Unite de Dermatologie Pediatrique, Bordeaux, France	34	708	20.82	13
Picardo, Mauro	Instituti Fisioterapici Ospitalieri, Rome, Laboratory of Cutaneous Physiopathology and Integrated Center of Metabolomics Research, Rome, Italy	32	1015	31.71	17
Lee	Sungkyunkwan University, School of Medicine, Department of Dermatology, Suwon, South Korea	31	58	1.87	4
Spritz, Richard	University of Colorado Health Sciences Center, School of Medicine, Denver, United States	30	1445	48.16	20
Lotti, Torello	University of Florence, Department of Dermatological Sciences, Florence, Italy	28	196	7	10
Kemp	University of Sheffield, School of Medicine and Biomedical Sciences, Department of Human Metabolism, Sheffield, UK	27	725	26.85	14
Weetman, Anthony	University of Sheffield, Faculty of Medicine, Dentistry and Health, Sheffield, UK	26	754	29	14
Xu	Third People's Hospital of Hangzhou, Department of Dermatology, Hangzhou, China	25	92	3.68	6
Kanwar	Postgraduate Institute of Medical Education and Research, Department of Dermatology, Chandigarh	25	397	15.88	10
Kumar, Bhushan	Postgraduate Institute of Medical Education and Research, Department of Dermatology, Venereology and Leprology, Chandigarh, India	23	448	19.47	12
Lee, Joo Heung	Sungkyunkwan University, School of Medicine, Department of Dermatology, Suwon, South Korea	22	53	2.4	16
Dogra	Postgraduate Institute of Medical Education and Research, Department of Dermatology, Chandigarh, India	22	1179	53.59	12

TP=Total publication, TC=Total citation, ACPP=Average citation per paper

Table 6: Most productive journals in vitiligo research

Title of the journal	Number of papers 2001-12	Percentage	Impact factor	Cited half life
Journal of the European Academy of Dermatology and Venereology	145	3.5	2.98	4.4
International Journal of Dermatology	129	3.2	1.142	8.4
British Journal of Dermatology	118	2.9	3.666	8
Indian Journal of Dermatology, Venereology and Leprology	105	2.6	0.979	4.7
Clinical and Experimental Dermatology	81	2.0	1.198	7.2
Korean Journal of Dermatology	80	2.0	N.A	N.A
Journal of Investigative Dermatology	75	1.8	6.314	8.2
Dermatologic Surgery	75	1.8	N.A	N.A
Journal of Dermatology	62	1.5	1.493	7.3
Archives of Dermatology	52	1.3	3.888	>10.0
European Journal of Dermatology	51	1.3	2.526	5.7
Pigment Cell Research	50	1.2	N.A	N.A
Experimental Dermatology	48	1.2	N.A	N.A
Pediatric Dermatology	47	1.2	1.072	7.4
Indian Journal of Dermatology	46	1.1	0.979	4.7

country on vitiligo research which shared 19.41% of global publications. India holds 2nd rank with 388 papers

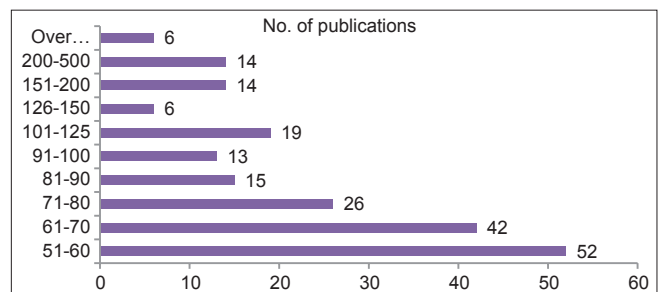


Figure 3: Citation pattern of papers

which is (9.48%). Postgraduate Institute of Medical Education and Research, Chandigarh is identified the most productive institution in vitiligo research. The institution has contributed highest number of publications (67 papers; 936 citations; *h*-index value 19). This study has shown that the research on vitiligo research is being carried out throughout the globe and the scientists are incessant working on this affliction for the welfare of the mankind to develop a better diagnose. India too have shown good quality of research and Indian institute are taking responsibility and contributing toward the discovery of better treatment options for this disease. Moreover, funding agencies should invite proposal in this area to foster the research and developments. India needs to collaborate with developing as well as developed countries to further

Table 7: Highly cited research papers of vitiligo research

Title	Source title	Number of citations
Hodi <i>et al.</i>	New England Journal of Medicine, 363 (8) (2010) 711-723	1311
Nordberg and Arner	Free Radical Biology and Medicine, 31 (11) (2001) 1287-1312	958
Phan <i>et al.</i>	Proceedings of the National Academy of Sciences of the United States of America, 100 (14) (2003) 8372-8377	786
Dudley and Wunderlich	Journal of Clinical Oncology 23 (10) (2005) 2346-2357	767
Banchereau <i>et al.</i>	Cancer Research 61 (17) (2001) 6451-6458	590
Martinon, Mayor and Tschopp	Annual Review of Immunology 27 (2009) 229-265	586
Overwijk and Theoret	Journal of Experimental Medicine 198 (4) (2003) 569-580	423
Gogas <i>et al.</i>	New England Journal of Medicine 354 (7) (2006) 709-718	351
Matsumura and Ananthaswamy	Toxicology and Applied Pharmacology 195 (3) (2004) 298-308	286
Kupper and Fuhlbrigge	Nature Reviews Immunology 4 (3) (2004) 211-222	259

enhance the productivity in vitiligo research. This study can be used as foundation for further research and to look for better coordination and collaborative research with global scientists for the discovery of better treatment options for this affliction.

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