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Research Trends in Genetics: Scientometric Profile of Selected Asian Countries

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ABSTRACT

The present paper is an attempt to assess the research output of genetics research based on the distribution of publications in different sub-specialities of genetics. The study compares the research priorities of 16 sub-specialities of genetics in 10 Asian countries for two time-spans; 1992-2001 and 2002-2011, using PubMed database. Since the raw publication counts are confounded by the size of the countries and the size of the subject specialities, cross-national comparison is made using a relative indicator-Research Priority Index.

Keywords: Genetics, scientometrics, relative priority index, human genetics, molecular genetics, PubMed

1. INTRODUCTION

Genetics, the study of heredity in general and of genes in particular, though a youngest subject has grown at an explosive rate because of the scientific work carried out throughout the world. Also, given that genes are universal to living organisms, genetics can be applied to the study of all living systems, from virus to bacteria, through plants and animals, to humans. So, in the last few decades, the science of genetics has pervaded all aspects of biology assuming a central position of great significance in biology as a whole. Genetics, in fact, provides the modern paradigm for whole of biology. Consequently today every biologist should be a bit of a geneticist.

Scientometric research plays a vital role in the growth and development of subject(s) both qualitatively and quantitatively. This change in the trend can be traced by generating numerical data on the basis of the empirical evidence available in the process of identifying the trends in research priorities in a field. In the recent past, studies dealing with the assessment of scientific research in genetics by different nations have been reported in literature. So far no work has been undertaken on the studies dealing with the 16 sub-specialities of genetics. The present study seeks to assess the contribution of 10 major Asian countries to genetics literature as reflected by the coverage of publications in PubMed during 1992-2011. Some of the notable studies in the field are: Garag[1,2], Varaprasad[3], and Sangam[4,5].

2. REVIEW OF LITERATURE

In this section a review of related papers have been carried out namely, Laurens[7], *et al.*, studied the field of genomics and suggested that hybrid methods can efficiently retrieve a corpus of relevant literature, even in complex and emerging fields. Jonkers[8], explore the concentration in the global plant molecular life science research output. Bala & Gupta[9] analyse the research output in India in neurosciences during the period 1999-2008. Patil[10], *et al.*, studied seventeen classical swine fever virus isolates recovered from India to nucleotide sequencing available either in the GenBank or published literature. Sangam[11], *et al.*, describe the application of growth models as suggested by Egghe and Ravichandra Rao, in the field of liquid crystals research in India and China. Garg[1], *et al.*, analysed the papers published by Indian scientists during 1991-2008 with highest output in the sub-field of molecular genetics. Pradhan[12], *et al.*, presents the

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Indian Genetic Disease Database (IGDD) release 1.0—an integrated and curated repository of growing number of mutation data on common genetic diseases afflicting the Indian populations. Pouris & Pouris[13], identified the state of pandemic HIV/AIDS related research in South Africa vis-a-vis the rest of the world using evaluative scientometrics. Gupta & Bala[14], analysed the research output of India in asthma during the period from 1999 till 2008. Cruz & Dierig[15], analysed the bibliographic records on eight new crop species from different databases for historical and recent trends. Eghbal[16], *et al.*, have used bibliometric indicators to compare the research productivity in endodontics between Iran and 28 selected Asian countries. Medical Subject Headings keyword-searching of PubMed up to 2012 is conducted. Manimekalai & Amsaveni[17], analysed the growth of research publications and the authorship pattern on Genetics and other related subject for the data taken from the articles listed in Web of Science covering the period 1998 to 2011. Asgary[18], *et al.*, illustrates statistical information about published articles in PubMed-index journals vis-à-vis the various aspects of this biomaterial. Maisonobe[19], *et al.*, explains the current state of 'DNA Repair studies' global geography by focusing on the genesis of the community.

3. METHODOLOGY

The data has been collected from PubMed database[6]. The study compares the research priorities of 16 sub-specialities of genetics in 10 countries for two time-spans; 1992-2001 and 2002-2011. Comparative analysis is carried out based on the distribution of publications in different sub-specialities of genetics. Since the raw publication counts are confounded by the size of the countries and the size of the subject specialities, national comparison is made using a relative indicator-Research Priority Index. To download records from pubmed, sub-specialities along with field tag were used in advanced search. The field tag used was AD for country with year of publication. In this way, records pertaining to all Asian countries for a particular year was downloaded, out of which 10 major countries were selected for the study. The results were analysed on the basis of their sub-fields.

4. PUBLICATION OUTPUT OF THE WORLD IN 16 SUB-SPECIALITIES OF GENETICS

Publication output of world in 16 sub-specialities of genetics is indicated in Table 1. From the Table 1, it is evident that, Molecular Genetics and Human Genetics accounts for 68 % of the total output in 1992-2001 and 60 % in 2002-2011. Molecular Genetics alone accounts for the largest output 38 % in 1992-2001 and Human Genetics 30 % in 2002-2011 block periods. Ecological Genetics accounts for the smallest output of 0.1 % in 1992-2001 and Genetics of Intelligence 0.2 % in 2002-2011. The table clearly indicates the importance of trends in all the 16 branches which has increased or decreased over a period of twenty years.

Table 1. Publication output of world in 16 sub-specialities of genetics

Sub-specialities	1992-2001	2002-2011
	No. of publications (%)	No. of publications (%)
Behavioural Genetics	5836 (0.63 %)	14224 (0.84 %)
Classical Genetics	6128 (0.66 %)	12821 (0.76 %)
Developmental Genetics	30800 (3.32 %)	62457 (3.7 %)
Conservation Genetic	6458 (0.7 %)	12854 (0.76 %)
Ecological Genetics	1000 (0.11 %)	6775 (0.4 %)
Evolutionary Genetics	9861 (1.06 %)	31090 (1.84 %)
Genetic Engineering	54710 (5.9 %)	88720 (5.26 %)
Genetics of Intelligence	1420 (0.15 %)	3067 (0.18 %)
Genomics	8928 (0.96 %)	59080 (3.5 %)
Human Genetics	277028 (29.88 %)	498481 (29.56 %)
Medical Genetics	109206 (11.78 %)	198939 (11.8 %)
Microbial Genetics	12787 (1.38 %)	33730 (2 %)
Molecular Genetics	350537 (37.81 %)	506201 (30.02 %)
Population Genetics	35015 (3.78 %)	91761 (5.44 %)
Psychiatric Genetics	2790 (0.3 %)	6916 (00.41 %)
Quantitative Genetics	14632 (1.58 %)	59160 (3.51 %)
Total	**927136**	**1686276**

Research focus seems to be on Molecular Genetics in world during both the block periods. The reason for such output in molecular genetics is the availability of sophisticated equipments and technologies which has enabled the researchers to analyse the science of inheritance at the molecular level. Also the primary aim of the HGP being to identify the different human diseases governed by gene mutations and to develop the molecular kits for easy diagnosis and drugs to overcome the problems. Another reason for highest growth in Molecular Biology might be due to molecular approach for the final conclusion of all different fields of biological sciences.

5. PUBLICATION OUTPUT AND SHARE OF PUBLICATIONS OF MAJOR ASIAN COUNTRIES

The publication output and share of publications of major nations of Asian continent is shown in Table 2. Among fifty Asian countries, Japan alone accounts for about 66 % among Asian output in

1992-2001 and Japan and China 65 % in 2002-2011. The decline during 2002-2011 may be due to decline in share of Japan from 66 % to 38 %. Whereas, China's share has increased from 5 % in 1992-2001 to 27 % in 2002-2011. Other 40 Asian countries contributing 4.1 % in 1992-2001 has also increased to 7.39 % in 2002-2011. Among 10 countries selected for the present study, Japan leads with 155628 articles followed by China 73229; India 19108; Israel 18592; Taiwan 18152; Georgia 9701; Turkey 6467; Russia 6398; South Korea 6194, and Hong Kong 6121.

Table 2. Publication output and share of major Asian countries

Country	1992-2001 No. of publications (%)	2002-2011 No. of publications (%)
China	4943 (5.32 %)	68286 (27.44 %)
Georgia	3679 (3.96 %)	6022 (2.42 %)
Hong Kong	1487 (1.6 %)	4634 (1.86 %)
India	3286 (3.54 %)	15822 (6.36 %)
Israel	6668 (7.2 %)	11924 (4.79 %)
Japan	61099 (65.7 %)	94529 (37.98 %)
Russia	1818 (1.96 %)	4580 (1.84 %)
South Korea	1002 (1.1 %)	5192 (2.09 %)
Taiwan	4091 (4.4 %)	14061 (5.65 %)
Turkey	1054 (1.1 %)	5413 (2.18 %)
Other 40 countries	3824 (4.1 %)	18402 (7.39 %)
Total	**92951 (100 %)**	**248865 (100 %)**

6. PUBLICATION PERFORMANCE OF MAJOR COUNTRIES

The distribution of publications of major countries in different sub-specialities of genetics for 1992-2001 and 2002-2011 is presented in Table 3 and 4 respectively. The publications in different countries are arranged in the form of a matrix where the rows represent the countries and columns the sub-specialities.

Table 3 covers articles published in different branches of genetics during the block period 1992-2001. Columns represent 16 branches and the rows 10 different Asian countries. The data reveals that major contribution is from Japan (85801) followed by Israel (11833); China (8669); Taiwan (6197); Georgia (5875), India (4951); Russia (2345); Hong Kong (1581); Turkey (1208); and South Korea (1201).

Maximum number of articles published during this block period among the branches of genetics is from Molecular Genetics (46867) followed by Human Genetics (41683). Which indicates the importance of the branch Molecular genetics, as molecular approach is needed for the final conclusion in all the fields of biological sciences. And same trend has been observed with world as seen in Table 1.

The data in Table 4 reveals articles published in 16 branches, represented in different columns and 10 countries in rows during 2002-2011. In the present block period also, it is Japan which has maximum number of articles published (130060) however, it is followed by China (115689); India (26456); Israel (22033); Taiwan (21970); Georgia

Table 3. Branch-wise publication output of major countries in Genetics for the block period 1992-2001

Sub-specialities	Countries										Total
	China	Georgia	Hong Kong	India	Israel	Japan	Russia	S Korea	Taiwan	Turkey	
Behavioural Genetics	8	46	3	24	58	198	10	5	7	1	**360**
Classical Genetics	22	19	11	38	73	272	19	4	28	13	**499**
Developmental Genetics	122	138	56	103	328	2376	33	40	73	17	**3286**
Conservation Genetic	35	48	9	30	66	277	25	4	24	0	**518**
Ecological Genetics	5	9	0	8	10	66	13	0	3	0	**114**
Evolutionary Genetics	47	105	6	46	90	587	57	7	42	2	**989**
Genetic Engineering	520	262	64	414	559	4370	129	119	284	41	**6762**
Genetics of Intelligence	0	8	0	5	18	29	4	0	9	3	**76**
Genomics	40	27	8	28	63	554	6	2	11	0	**739**
Human Genetics	2842	1470	613	1180	3914	28353	466	341	2046	458	**41683**
Medical Genetics	1810	784	24	693	2644	12139	180	81	1133	335	**19823**
Microbial Genetics	59	154	32	176	94	1181	38	29	82	16	**1861**
Molecular Genetics	2648	2466	560	1846	3318	32037	1218	519	2053	202	**46867**
Population Genetics	369	267	135	301	436	2133	121	34	300	105	**4201**
Psychiatric Genetics	4	8	2	7	35	98	2	1	27	4	**188**
Quantitative Genetics	138	64	58	55	127	1131	24	15	75	11	**1698**
Total	**8669**	**5875**	**1581**	**4954**	**11833**	**85801**	**2345**	**1201**	**6197**	**1208**	**129664**

Table 4. Branch-wise publication output of major countries in Genetics for the block period 2002-2011

Sub-specialities	Countries										Total
	China	Georgia	Hong Kong	India	Israel	Japan	Russia	S Korea	Taiwan	Turkey	
Behavioural Genetics	256	131	10	68	186	728	71	32	61	23	**1566**
Classical Genetics	489	53	30	194	133	505	50	18	71	53	**1596**
Developmental Genetics	3386	295	167	460	788	5196	131	198	381	99	**11101**
Conservation Genetic	1018	53	34	296	139	501	55	21	105	19	2241
Ecological Genetics	374	66	7	92	59	298	21	17	19	6	**959**
Evolutionary Genetics	1399	209	69	345	406	1330	190	38	193	26	**4205**
Genetic Engineering	7276	479	282	1687	886	7633	280	444	1202	296	**20465**
Genetics of Intelligence	133	34	14	45	56	119	13	7	30	18	**469**
Genomics	3719	359	240	1371	384	2407	163	189	681	42	**9555**
Human Genetics	33472	2420	2046	6190	6963	41505	1236	2155	7496	2698	**106181**
Medical Genetics	18601	1201	122	3104	4769	17444	452	625	4037	1650	**52005**
Microbial Genetics	2475	228	126	893	225	2543	98	177	502	176	**7443**
Molecular Genetics	31287	3037	2073	9026	5486	40328	2635	2007	5325	1333	**102537**
Population Genetics	6356	541	352	2069	945	4684	310	343	1049	775	**17424**
Psychiatric Genetics	121	19	9	58	97	274	12	30	110	41	**771**
Quantitative Genetics	5327	296	387	558	511	4565	115	197	708	157	**12821**
Total	**115689**	**9421**	**5968**	**26456**	**22033**	**130060**	**5832**	**6498**	**21970**	**7412**	**351339**

(9421); Turkey (7412); South Korea (6498); Hong Kong (5968); and Russia (5832).

Branch-wise contribution indicates maximum growth in the field of Human Genetics with the major contribution of 106181 articles during this block period, followed by Molecular Genetics (102537). During both block periods Genetics of Intelligence has lesser number of articles output.

The increase in the number of articles in Human Genetics may be due to the complexity of the human genome. The Human Genome Project (HGP) is producing a wealth of new information on genetics. The project began in October 1990 and was initially headed by Ari Patrinos, head of the Office of Biological and Environmental Research in the US Department of Energy's Office of Science. Francis Collins directed the National Institutes of Health and National Human Genome Research Institute efforts. A working draft of the genome was announced in 2000 and a complete one in 2003, with further, more detailed analysis still being published.

7. PRIORITY PROFILES OF MAJOR COUNTRIES

The raw count alone does not convey much information as these figures are confounded by the size of the countries and the size of the subject specialities. Hence, an index called Relative Priority Index (PI) is computed for cross national comparison using formula as suggested by Nagpaul[7].

$$(\mathrm{PI})_{(i,j)} = \frac{n_{ij}/n_{i.}}{n_{.j}/n_{..}} \text{ X } 100$$

where, n_{ij} = number of publications of i^{th} country in j^{th} sub-field;

$n_{i.}$= number of publications of i^{th} country in all sub-fields;

$n_{.j}$ = number of publications of all countries in j^{th} sub-field;

$n_{..}$ = number of publications of all countries in all sub-fields.

The value PI=100 indicates that the research priority of a country for a given sub-speciality corresponds precisely to the average of all countries, i.e., average priority; PI>100 reflects higher-than-average priority, and PI<100 lower-than-average priority. It has to be kept in view that (by virtue of the definition of PI) no country can have high priority in all sub-specialities.

The profile of research priorities of major countries are presented in Table 5 and 6 for two time-spans- 1992-2001 and 2002-2011. These tables indicate the differences in the priority accorded to different sub-specialities by different countries. From the values of PI, one can compare:

(i) The research priorities of a country for different sub-specialities of genetics in a given time span;

(ii) The research priorities of different countries for a given sub-speciality in a given time span; and

Table 5. Profile of research priorities (PI) of major Asian countries (1992-2001)

Type	Countries										Total
	China	Georgia	Hong Kong	India	Israel	Japan	Russia	S Korea	Taiwan	Turkey	
Behavioural Genetics	33	282	68	174	177	83	154	150	41	30	**1192**
Classical Genetics	66	84	181	199	160	82	211	87	117	280	**1467**
Developmental Genetics	56	93	140	82	109	109	56	131	47	56	**879**
Conservation Genetic	101	205	143	152	140	81	267	83	97	0	**1269**
Ecological Genetics	66	174	0	184	96	88	631	0	55	0	**1294**
Evolutionary Genetics	71	234	50	122	100	90	319	76	89	22	**1173**
Genetic Engineering	115	86	78	160	91	98	106	190	88	65	**1077**
Genetics of Intelligence	0	232	0	172	260	58	291	0	248	424	**1685**
Genomics	81	81	89	99	93	113	45	29	31	0	**661**
Human Genetics	102	78	121	74	103	103	62	88	103	118	**952**
Medical Genetics	137	87	10	92	146	93	50	44	120	181	**960**
Microbial Genetics	47	183	141	248	55	96	113	168	92	92	**1235**
Molecular Genetics	85	116	98	103	78	103	144	120	92	46	**985**
Population Genetics	131	140	264	188	114	77	159	87	149	268	**1577**
Psychiatric Genetics	32	94	87	98	204	79	59	57	301	228	**1239**
Quantitative Genetics	122	83	280	85	82	101	78	95	92	70	**1088**
Total	**1245**	**2252**	**1750**	**2232**	**2008**	**1454**	**2745**	**1405**	**1762**	**1880**	**18733**

Table 6. Profile of research priorities (PI) of major Asian countries (2002-2011)

Type	Countries										Total
	China	Georgia	Hong Kong	India	Israel	Japan	Russia	S Korea	Taiwan	Turkey	
Behavioural Genetics	50	312	38	58	189	126	273	110	62	70	**1288**
Classical Genetics	93	124	111	161	133	85	189	61	71	157	**1185**
Developmental Genetics	93	99	89	55	113	126	71	96	55	42	**839**
Conservation Genetic	138	88	89	175	99	60	148	51	75	40	**963**
Ecological Genetics	118	257	43	127	98	84	132	96	32	30	**1017**
Evolutionary Genetics	101	185	97	109	154	85	272	49	73	29	**1154**
Genetic Engineering	108	87	81	110	69	101	82	117	94	69	**918**
Genetics of Intelligence	86	270	176	127	190	69	167	81	102	182	**1450**
Genomics	118	140	148	191	64	68	103	107	114	21	**1074**
Human Genetics	96	85	113	77	105	106	70	110	113	120	**995**
Medical Genetics	109	86	14	79	146	91	52	65	124	150	**916**
Microbial Genetics	101	114	100	159	48	92	79	129	108	112	**1042**
Molecular Genetics	93	111	119	117	85	106	155	106	83	62	**1037**
Population Genetics	111	116	119	158	87	73	107	106	96	211	**1184**
Psychiatric Genetics	48	92	69	100	201	96	94	210	228	252	**1390**
Quantitative Genetics	126	86	178	58	64	96	54	83	88	58	**891**
Total	**1589**	**2252**	**1584**	**1861**	**1845**	**1464**	**2048**	**1577**	**1518**	**1605**	**17343**

(iii) The research priorities of a country for a given sub-speciality at different time span.

In Table 5 and 6, the PI value for each variable in the Tables 3 and 4 is computed using PI formula, i.e., for both the block period 1992-2001 and 2002-2011. The priority index of different countries is arranged again in the form of a matrix where the rows represent the countries and columns the sub-specialities. So, the row vector represents the priority profiles of countries, whereas the column vectors geographical profiles of sub-specialities.

For example, Georgia has given maximum priority to BG and minimum priority to HG during both block periods, i.e., 1992-2001 as well as 2002-2011. Israel has given minimum priority to Microbial

Genetics during both block periods. Similarly, Taiwan has given maximum priority to Psychiatric Genetics during both block periods.

8. PRINCIPLE COMPONENT ANALYSIS (PCA)

The relationship between different countries and sub-specialities of genetics on the basis of citability profiles is carried out by using PCA.

The Principal component analysis (PCA) is carried out by using the SPSS software. The PCA is a statistical procedure that uses orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components. The number of principal components is less than or equal to the number of original variables.

In this analysis, first covariance matrix for all 16 sub specialties of Genetics was calculated. Then Eigen values of the co-variance matrix were calculated and hence the corresponding Eigen vectors. Each Eigen value represents the total variance explained by the corresponding sub specialties of Genetics.

The data for the study consists of 16 sub-specialities of genetics and 10 Asian countries for two time spans 1992-2001 and 2002-2011. The PCA seeks the linear combination of the original variable, which has maximal variance. The examination of this might seek sensible a large variance 'separates out' the countries. The countries can then be ranked with respect to this Standard Linear Combination (SLC).

More generally, PCA looks for a few linear combinations which can be used to summarise the data losing in process as little information as possible. The attempt reduces the dimensionality of the field.

In the cited profiles of different sub-specialities of genetics for two spans 1992-01 and 2002-11, all the16 sub-specialities are extracted. Except three sub-specialities remaining shows 26 % for both block periods (Table 7). Therefore it is necessary to consider only three sub-specialities, which explains more than 74 % of the total variance during 1992-2001 and 2002-2011.

The PCA analysis (Table 7) carried out by using SPSS package indicates three groups of sub-specialities based on correlation (Table 8). During 1992-01, data reveals that out of 16 sub-specialities of genetics, Behavioural Genetics, Ecological Genetics, Molecular Genetics, Microbial Genetics, Evolutionary Genetics, Human Genetics and Conservation Genetics are correlated forming a group indicating the interrelationship among the subspecialties of Genetics. However, the second cluster includes Genetics of Intelligence, Quantitative Genetics, Medical Genetics, Developmental Genetics, Psychiatric Genetics and Genomics which exhibits their uniqueness and divergence from the first group. The third cluster includes Population Genetics, Classical Genetics and Genetic Engineering. During the second block period 2002-11, Molecular Genetics, Genomics, Human Genetics, Psychiatric genetics, Conservation Genetics, Medical Genetics and Ecological Genetics constitute first group. However, the second group includes Behavioural Genetics, Evolutionary Genetics,

Table 7. Total variance among the 16 fields

Factors	Rotation sums of Squared Loadings (1992-2001)			Rotation sums of Squared Loadings (2002-2011)		
	Total	% of variance	cumulative %	Total	% of variance	cumulative %
1	5.31	33.20	33.20	5.03	31.43	31.43
2	3.66	22.88	56.10	4.01	25.07	56.50
3	2.88	18.02	74.10	2.87	17.93	74.42
4	-	-	-	-	-	-
5	-	-	-	-	-	-
6	-	-	-	-	-	-
7	-	-	-	-	-	-
8	-	-	-	-	-	-
9	-	-	-	-	-	-
10	-	-	-	-	-	-
11	-	-	-	-	-	-
12	-	-	-	-	-	-
13	-	-	-	-	-	-
14	-	-	-	-	-	-
15	-	-	-	-	-	-
16	-	-	-	-	-	-

Table 8. Factor loadings/grouping of sub-specialities

Varimax rotation 1992-2001				Varimax rotation 2002-2011			
Components	**Factor 1**	**Factor 2**	**Factor 3**	**Components**	**Factor 1**	**Factor 2**	**Factor 3**
Evolutionary Genetics	0.953	-	-	Molecular Genetics	0.841	-	-
Human Genetics	-0.923	-	-	Genomics	0.839	-	-
Conservation Genetic	0.897	-	-	Human Genetics	-0.829	-	-
Ecological Genetics	0.889	-	-	Psychiatric Genetics	-0.800	-	-
Molecular Genetics	0.815	-	-	Conservation Genetic	0.771	-	-
Behavioural Genetics	0.704	-	-	Molecular Genetics	-0.709	-	-
Microbial Genetics	0.469	-	-	Ecological Genetics	0.586	-	-
Quantitative Genetics	-	0.844	-	Behavioural Genetics	-	0.815	-
Medical Genetics	-	-0.815	-	Evolutionary Genetics	-	0.751	-
Developmental Genetics	-	0.786	-	Genetics of Intelligence	-	0.750	-
Genetics of Intelligence	-	-0.771	-	Classical Genetics	-	0.738	-
Psychiatric Genetics	-	-0.579	-	Genetic Engineering	-	-0.696	-
Genomics	-	0.480	-	Quantitative Genetics	-	-0.540	-
Population Genetics	-	-	0.934	Developmental Genetics	-	-	-0.906
Classical Genetics	-	-	0.855	Population Genetics	-	-	0.878
Genetic Engineering	-	-	-0.588	Microbial Genetics	-	-	0.646

Genetics of Intelligence, Classical Genetics, Genetic Engineering and Quantitative genetics. The third group has Developmental genetics, Population genetics and Microbial Genetics.

PCA reveals that, Evolutionary Genetics and Behavioural Genetics which were in the first group in the first block period 1992-2001 along with Human Genetics, Conservation genetics, Evolutionary Genetics, Molecular Genetics and Microbial genetics have moved to the second group forming correlation with Genetics of Intelligence, Classical Genetics, Genetic Engineering, Quantitative Genetics and Microbial Genetics to the third group correlating with Developmental Genetics and Population Genetics in the second block period which exhibits their preferences.

The sixteen factors in Table 7 are 16 sub specialties of Genetics. The Three factors in Table 8 are the 3 groups formed by correlated variables:

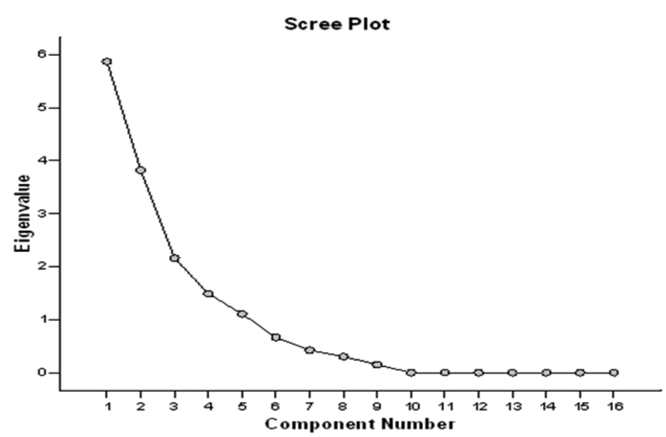
Factor 1 includes the components: EvG, HG, CG, EG, MOG, BG, and MiG;

Factor 2 includes the components: QG, MG, DG, GI, PG, and G;

Factor 3 includes the components: PoG, and ClG;

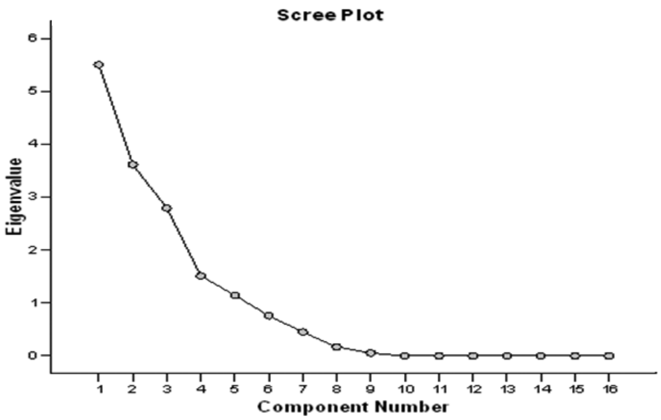
Column sum of squared loadings for a factor, i.e., the latent root. It conceptually represents that amount of variance accounted for by a factor.

Medical Genetics, Psychiatric Genetics and Genomics which were in correlation with Quantitative Genetics, Developmental Genetics and Genetics of Intelligence forming the second group of the first block period have moved to the first group of the second block period and Developmental Genetics to the third group of the second block period correlating with Population Genetics and Microbial Genetics. However, Classical genetics and Genetic Engineering which formed the third group of the first block period along with Population genetics have moved to the second group of the second block period. This study reveals the preferential interrelationship between different subspecialties of the subject Genetics during two different block periods 1999-2001 and 2002 to 2011. Further percentage variations for two block periods are shown in Fig. 3 (a) and (b).



(a)

Figure 3(a). Percentage variation for block period 1992-2001.



(b)

Figure 3(b). Percentage variation for block period 2002-2011.

9. CONCLUSIONS

Genetics, the most rapidly growing area of research has relevance to many aspects of human life and society, including health, behaviour, food production, forensics and even politics. If used wisely, the new information promises to enhance our quality of life. Science indicators are used for both descriptive as well as analytical purposes to identify trends, make comparisons and as an aid for theoretical understanding of casual structure related to science and technology systems.

On the basis of the analysis the following conclusions may be drawn:

(1) Among the 10 major Asian countries, Japan accounts for the largest output of genetics literature. It alone accounts for 66 % of the Asian output in 1992-2001 and 38 % in 2002-2011.

(2) Among 50 Asian countries, India occupies 3rd position in contributing to the genetics research.

(3) Among sub-specialities, Molecular genetics accounts for the largest output of 38 % in 1992-2001and 30 % in 2002-2011.

(4) The sub-speciality, Genetics of Intelligence accounts for the lowest output of 0.2 % during both block periods.

(5) PCA analysis indicates three groups of sub-specialities based on correlation among them.

It can be observed from the present study that R&D trends are more active and are gaining importance. Though, to some extent each field (among the 16 sub fields) overlaps with the other fields of genetics. The variation in the number of articles in Molecular Genetics indicates that the research in this area has gained more importance compared to other sub-specialities of genetics.

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