



**CURRENT BIOMEDICAL SCIENTIFIC IMPACT
(2013) OF INSTITUTIONS, ACADEMIC
JOURNALS AND RESEARCHERS
IN THE REPUBLIC OF MACEDONIA**

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Abstract

Aim: To analyse current ranking (2013) of institutions, journals and researchers in the Republic of Macedonia.

Material and Methods: the country rankings of R. Macedonia were analyzed with SCImago Country & Journal Rank (SJR) for subject area Medicine in the years 1996-2013, and ordered by H-index. SCImago Institutions Rankings for 2013 was used for the scientific impact of biomedical institutions in the Republic of Macedonia. Journal metrics from Elsevier for the Macedonian scholarly journals for the period 2009-2013 were performed. Source Normalized Impact per Paper (SNIP), the Impact per Publication (IPP), and SCImago Journal Rank (SJR) were analysed. Macedonian scholarly biomedical journals included in Google Scholar metrics (2013, 2012) were analysed with h5-index and h5-median (June 2014). A semantic analysis of the PubMed database was performed with GoPubMed on November 2, 2014 in order to identify published papers from the field of biomedical sciences affiliated with the country of Macedonia. J ct| lpi ōi"Rwdikuj "qt"Rgtkuj "uqlny ctg'y cu'wugf "hqt author impact analysis and the calculation of the Hirsh-index based on Google Scholar query.

Results: The rank of subject area Medicine of R. Macedonia according to the SCImago Journal & Country Rank (SJR) is 110th in the world and 17th in Eastern Europe. Of 20 universities in Macedonia, only Ss Cyril and Methodius University, Skopje, and the University St Clement of Ohrid, Bitola, are listed in the SCImago Institutions Rankings (SIR) for 2013. A very small number of Macedonian scholarly journals is included in Web of Sciences (2), PubMed (1), PubMed Central (1), SCOPUS (6), SCImago (6), and Google Scholar metrics (6). The rank of Hirsh index (h-index) was different from the rank of number of abstracts indexed in PubMed for the top 20 authors from R. Macedonia.

Conclusion: The current biomedical scientific impact (2013) of institutions, academic journals and researchers in R. Macedonia is very low. There is an urgent need for organized measures to improve the quality and output of institutions, scholarly journals, and researchers in R. Macedonia in order to achieve higher international standards.

Key words: medical science; Scopus database; citation metrics; h-index; Republic of Macedonia.

Introduction

Scientific impact can be measured by citation analysis of the ranks of institutions (countries, upkxgtukguí + "tcnpi "lqwtpcu."tcnpi researchers, and ranking articles (Altmetric). Am-

plification of citations (Scientific networks) can influence the citation-based metrics. In this paper ranking of institutions, journals and researchers are presented, but amplification of citations and altmetrics are not analysed or presented (Fig. 1).

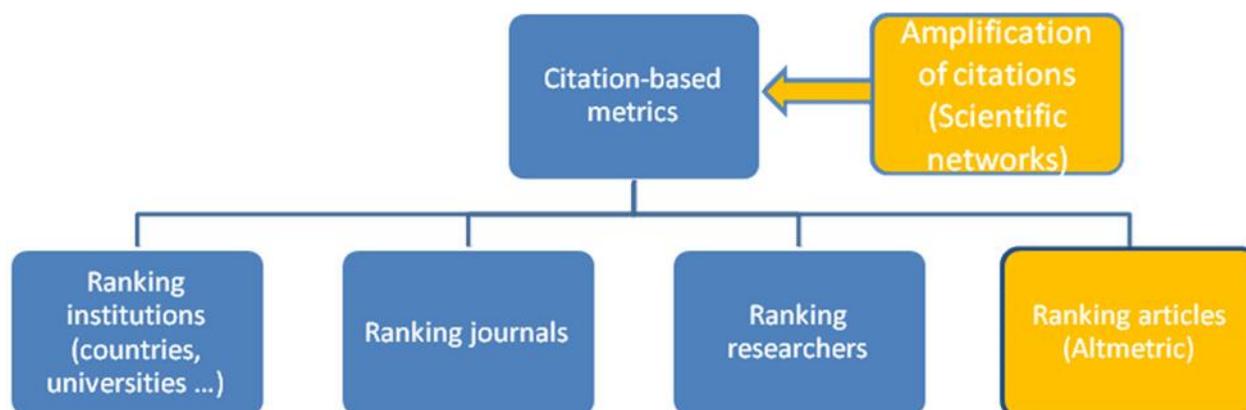


Figure 1 – Using citation analysis to measure research impact

There are several rankings of the universities in the world which use different data for analysis (Table 1). Every year, SCImago Research Group publishes two reports on institutions, the Ibero-American SIR (SCImago Research Group) and the Global SIR (SCImago Research Group). The former usually appears in March and includes all higher education institutions of Ibero-American countries with at least one document published in the Scopus data base during the five-year period. The Global SIR is published in July and it takes into account organizations from any country with at least 100 documents published in the last year of the five-year period. The chronological range extends from 2003 to 2012 and each report represents the five-year period with indicators [1].

At the moment there are five public universities and fifteen private universities, or in total twenty accredited universities, in R. Macedonia (Table 2). The oldest Public University in the Republic of Macedonia is Ss Cyril and Methodius University, Skopje, established in 1949.

The impact factor (IF) of an academic journal is a measure reflecting the average number of citations of recent articles published in the journal [2]. The impact factor was devised by Eugene Garfield, the founder of the Institute for Scientific Information. Impact factors are calculated yearly starting from 1975 for those journals that are indexed in the Journal Citation Reports [3]. Because "the impact factor is not

Table 1

Global rankings of World Universities

- Academic Ranking of World Universities
- Times Higher Education World University Rankings
- Times Higher Education World Reputation Rankings
- G-factor
- Global University Ranking
- HEEACT—Ranking of Scientific Papers
- High Impact Universities: Research Performance Index
- Human Resources & Labor Review
- Leiden Ranking
- Newsweek
- Professional Ranking of World Universities
- QS World University Rankings
- QS Asian University Rankings
- QS Latin American University Rankings
- SCImago Institutions Rankings
- U-Multirank
- University Ranking by Academic Performance
- Webometrics
- Wuhan University

always a reliable instrument", in 2007 the European Association of Science Editors (EASE) issued an official statement recommending "that journal impact factors are used only—and cautiously—for measuring and comparing the influence of entire journals, but not for the assessment of single papers, and certainly not for the assessment of researchers or research programmes" [4]. The International Council for Science (ICSU) Committee on Freedom and Responsibility in the Conduct of Science (CFRS) issued a "statement on publication practices and indices and the role of peer review in research assessment", suggesting many possible solutions – e.g. considering a limited number of pub-

lications per year to be taken into consideration for each scientist, or even penalising scientists for an excessive number of publications per year – e.g. more than 20 [5]. In 2010, the Deutsche Forschungsgemeinschaft (German Research Foundation) published new guidelines to evaluate articles only and no bibliometric information on candidates to be evaluated in all decisions concerning "performance-based funding allocations, postdoctoral qualifications, appointments, or reviewing funding proposals, in which increasing importance has been given to numerical indicators such as the h-index and the impact factor" [6]. This decision follows simi-

lar ones by the National Science Foundation (US) [7] and the Research Assessment Exercise (UK) [8]. In response to growing concerns over the inappropriate use of journal impact factors in evaluating scientific outputs and scientists themselves, the American Society for Cell Biology together with a group of editors and publishers of scholarly journals created the San Francisco Declaration on Research Assessment (DORA). Released in May of 2013, DORA has garnered support from thousands of individuals and hundreds of institutions which have endorsed the document on the DORA website [9].

Table 2

Current list of universities in the Republic of Macedonia (2013)

Public Universities
1. Ss. Cyril and Methodius University, Skopje (UC&M)
2. St. Clement of Ohrid University, Bitola (UCO)
3. Goce Del'ev University, Štip (GDU)
4. St. Paul The Apostle University for Information Science and Technology, Ohrid (UIST)
5. State University of Tetovo (SUT)
Private Universities and Faculties
1. International Balkan University
2. Euro College Kumanovo
3. South East European University, Tetovo
4. International University of Struga
5. FON University, Skopje
6. University American College, Skopje
7. University of Tourism and Management, Skopje
8. Slavic University, Skopje
9. European University-Republic of Macedonia, Skopje
10. EuroCollege University of Studies, "Struga"
11. MIT Faculties, Skopje
12. New York University, Skopje
13. University for Audiovisual Arts – Parisian European Film Academy ESRA – Skopje
14. International Summer University (Skopje)
15. BAS – Business Academy Smilevski – Skopje

There are several metrics of individual impact. Many of these are ranking measures providing quantitative estimates of the relative importance of a scientist [10]. The recently introduced h-index [11], which combines the impact of the papers of a scientist with his/her productivity, is by far the most popular. H-index is a cumulative measure and thus combines all the works of a scientist during his/her whole research career. However, research productivity and impact vary with time, with dif-

ferent scientists having distinct career trajectories. Hence, the Author Impact Factor (AIF) was introduced, which is the extension of the IF to authors [12]. AIF is capable of capturing trends and variations of the impact of the scientific output of scholars in time, unlike the h-index, which is a growing measure taking into account the whole career path.

There are several published papers dealing with biomedical scientific impact in R. Macedonia. We present the state of the current

scientific influence of Macedonian medical journals, their inclusion in medical databases and consequently the influence of Macedonian medical scientists in the world. Macedonian biomedical scientists included in the BiomedExperts Database contribute 0.006% to this database [13]. We found a very limited scientific influence of Macedonian medical journals according to the internationally recognized citation metrics indexes because only one journal (*Prilozi*) was currently indexed in PubMed and Google Scholar [14]. The SCImago database was also used for analysis of country rank, journal rank and H-index in the field of medicine in R. Macedonia. These parameters/indexes are in the range of the other former Yugoslav countries, but again only *Prilozi* and the *Macedonian Journal of Medical Sciences* are included in this database [15]. Mukaetova-Ladinska E and Korneti-Pekevaska K [16] emphasized the fact that undergraduate and postgraduate course organizers have to engage the students as early as possible in their academic career. On the other hand, the academic staff should organize good research in our institutions, and should strive to publish a higher level of peer-reviewed papers [16].

The aim of this study was to analyse current ranking (2013) of institutions, journals and researchers in R. Macedonia.

Material and Methods

Ranking institutions in the Republic of Macedonia

Country rankings of R. Macedonia was analyzed with SCImago Country & Journal Rank (SJR) for subject area Medicine, with all categories of the selected area, with all regions of Eastern Europe, in the years 1996–2013, and ordered by H-index (accessed on October, 2014) [17, 18]. In this report we used SCImago Institutions Rankings for 2013 year [1].

Ranking journals in the Republic of Macedonia

Journal metrics from Elsevier for the Macedonian scholarly journals for the period of 2009–2013 (Scopus data source, July 2014) was performed [19]. Source Normalized Impact per Paper (SNIP) [20], the Impact per Publica-

tion (IPP) [21], and SCImago Journal Rank (SJR) [18] were analysed. Macedonian scholarly biomedical journals included in Google Scholar metrics (2013, 2012) were analysed with h5-index and h5-median [22]. The h5-index of a publication is the largest h number such that at least h articles in that publication were cited at least h times each. For example, a publication with five articles cited by, respectively, 17, 9, 6, 3, and 2, has the h5-index of 3. The h5-median of a publication is the median of the citation counts in its h-core. Scholar Metrics are currently based on our index as it was in June 2014.

Ranking researchers in the Republic of Macedonia

A semantic analysis of PubMed database was performed with GoPubMed on November 02, 2014 in order to identify published papers from the field of biomedical sciences affiliated with the country Macedonia. Additional analysis was performed using PubMed with the terms: "macedonia (republic)" [MeSH Terms] OR "macedonia" [All Fields] AND "republic" [All Fields] OR "macedonia (republic)" [All Fields] OR "macedonia" [All Fields] NOT Greece [Affiliation] [23].

Harzing's Publish or Perish software [24] was used for author impact analysis and calculation of the Hirsh-index based on Google Scholar query.

Results

Ranking institutions in the Republic of Macedonia

Country rank of subject area Medicine in the World (a) and the Eastern Europe region (b) of R. Macedonia for the period 1996–2013 year ordered by Hirsh index (H-index) is shown in Fig. 2. The first three places in the world belongs to United States (H-index = 1053), United Kingdom (H-index = 692), and Canada (H-index = 584). R. Macedonia is in the 110th place with an H-index of 45. From 24 countries grouped in Eastern Europe, R. Macedonia is in the 17th place. Bosnia and Herzegovina and Montenegro have a lower rank than R. Macedonia, but Slovenia, Croatia and Serbia have a higher rank with H-indexes of 108, 102 and 64 respectively (Fig. 2).

a)

	Country	Documents	Citable documents	Citations	Self-Citations	Citations per Document	H index
1	 United States	2.554.598	2.276.467	57.895.780	22.237.666	25,21	1.053
2	 United Kingdom	733.871	618.015	14.802.891	2.700.202	22,11	692
3	 Canada	333.460	300.642	7.421.683	975.981	26,20	584
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81	 Sri Lanka	2.849	2.569	28.810	2.309	14,43	67
82	 Latvia	1.306	1.265	23.919	862	23,96	67
83	 Cameroon	2.938	2.782	31.958	3.376	15,09	64
84	 Serbia	8.685	8.134	35.716	3.896	16,92	64
85	 Zambia	1.695	1.558	26.067	2.734	20,72	64
86	 Jordan	4.602	4.418	32.873	2.183	8,74	62
87	 Nepal	3.956	3.506	28.279	3.047	10,18	62
88	 Panama	886	829	18.021	743	31,47	62
89	 Côte d'Ivoire	1.930	1.815	21.182	2.123	12,68	61
90	 Ecuador	1.748	1.635	21.251	1.682	15,17	61
91	 Ethiopia	3.204	3.081	29.766	3.862	13,75	60
92	 Burkina Faso	1.858	1.771	22.091	2.391	14,49	58
93	 Cyprus	2.021	1.839	19.970	1.349	14,80	58
94	 Gabon	1.001	933	15.165	915	17,90	57
95	 Jamaica	1.964	1.813	21.141	2.103	12,75	57
96	 Guatemala	1.072	1.000	14.229	662	16,66	55
97	 Mozambique	921	870	15.945	1.184	21,62	55
98	 Algeria	1.911	1.806	18.325	818	13,88	53
99	 Bolivia	892	861	13.010	766	16,81	52
100	 Malta	1.120	1.019	14.674	516	19,75	52
101	 Cambodia	1.043	961	15.116	1.335	20,68	51
102	 Papua New Guinea	859	818	12.647	1.263	16,32	51
103	 Sudan	1.834	1.737	16.782	1.708	12,76	50
104	 Botswana	722	659	12.688	496	24,99	49
105	 Mali	1.051	1.013	13.045	847	16,39	49
106	 Trinidad and Tobago	1.408	1.267	14.224	833	11,59	49
107	 Oman	2.751	2.419	16.285	1.330	7,79	47
108	 Georgia	953	881	9.604	316	11,77	45
109	 Monaco	541	471	7.379	214	16,24	45
110	 Macedonia	1.514	1.410	10.753	518	9,13	45
111	 Benin	1.001	952	9.573	1.199	14,18	44
112	 Congo	1.370	1.264	11.693	877	10,28	44
113	 Qatar	2.552	2.339	14.374	1.370	6,73	44

b)

	Country	Documents	Citable documents	Citations	Self-Citations	Citations per Document	H index
1	Poland	95.956	91.611	801.211	97.527	9,67	240
2	Czech Republic	46.929	44.735	412.465	44.294	9,67	192
3	Hungary	29.619	27.881	411.305	32.523	15,26	186
4	Russian Federation	39.090	38.251	360.573	26.818	10,38	173
5	Slovakia	12.476	11.800	109.070	8.213	9,60	113
6	Slovenia	10.901	10.316	120.814	11.343	13,36	108
7	Croatia	19.714	18.599	118.671	17.521	6,88	102
8	Romania	12.127	11.483	86.742	5.474	9,88	98
9	Bulgaria	10.052	9.652	79.047	4.195	8,00	96
10	Estonia	3.832	3.695	67.161	4.284	20,33	95
11	Ukraine	5.079	4.989	55.503	2.751	12,00	87
12	Lithuania	3.595	3.465	48.156	2.057	19,17	84
13	Belarus	1.941	1.906	22.396	1.402	12,18	67
14	Latvia	1.306	1.265	23.919	862	23,96	67
15	Serbia	8.685	8.134	35.716	3.896	16,92	64
16	Georgia	953	881	9.604	316	11,77	45
17	Macedonia	1.514	1.410	10.753	518	9,13	45
18	Bosnia and Herzegovina	1.919	1.828	7.511	780	7,61	36
19	Armenia	781	744	5.288	248	9,19	34
20	Albania	478	448	3.581	147	10,54	29
21	Moldova	274	262	2.028	53	10,10	25
22	Azerbaijan	1.550	1.528	2.931	60	5,23	24
23	Montenegro	226	220	592	12	3,90	12
24	Bouvet Island	1	1	5	0	5,00	1

Figure 2 – Country rank of subject area Medicine in the World (a) and in the Eastern Europe region (b) of the Republic of Macedonia for the period 1996–2013 ordered by Hirsh index (H-index) [2].

The results of SCImago Institutions Rankings (SIR) for R. Macedonia are shown in Fig. 3. From 2009–12 only Ss Cyril and Methodius University in Skopje (UC&M) was included in the SIR with a world rank of 1726 to 1821. The regional rank of UC&M in Eastern Europe was gradually increased from 156th in 2009 to 127th in 2013. In 2013 University St. Clement of Ohrid, Bitola (UCO) was included in SIR for the first time with the world rank of 2737 and regional rank of 333. The results have shown that only two educational institutions from R. Macedonia published at least 100 documents in the last year of the five-year period (Fig. 3).

Index	University	Year	World rank	Regional rank (Eastern Europe)
SIR	UC&M	2009	1813	156
		2010	1814	145
		2011	1803	131
		2012	1821	131
		2013	1726	127
	UCO	2013	2737	333

Figure 3 – The results of SCImago Institutions Rankings (SIR) for Republic of Macedonia [1]

Ranking journals in the Republic of Macedonia

Of all Macedonian biomedical journals only the journal *Prilozi* is included and indexed in PubMed, only the *Balkan Journal of Medical Genetics* is included in PubMed Central, but only the *Macedonian Journal of Chemistry and Chemical Engineering* and *Balkan Journal of Medical Genetics* are included in Web of Science and have an Impact Factor [0.310 and 0.167 (2012–2013), respectively].

The Journal metrics from Elsevier (<http://www.journalmetrics.com/>) for Macedonian scholarly journals for the period 2009–13 (Scopus data source, July 2014) is shown in Table 3. Six medical journals from R. Macedonia are included in the Scopus database (*Macedonian Journal of Chemistry and Chemical Engineering*, *Macedonian Journal of Medical Sciences*, *Balkan Journal of Medical Genetics*, *Prilozi*, *Journal of Special Education and Rehabilitation* and *BANTAO Journal*). All the journals have print ISSN, but only three of them have

electronic ISSN (*Macedonian Journal of Chemistry and Chemical Engineering*, *Macedonian Journal of Medical Sciences*, and *Journal of Special Education and Rehabilitation*). Source Normalized Impact per Paper (SNIP) was calculated for only three journals (*Macedonian Journal of Chemistry and Chemical Engineering*, *Macedonian Journal of Medical Sciences*, and *Balkan Journal of Medical Genetics*) and was gradually increased. Impact per Publication (IPP) was also calculated for the three mentioned journals with a gradual increase in the period of 2009–13. SCImago Journal Rank (SJR) was calculated for four journals (*Macedonian Journal of Chemistry and Chemical Engineering*, *Macedonian Journal of Medical Sciences*, *Balkan Journal of Medical Genetics* and *Prilozi*) with increased values in 2013 for *Macedonian Journal of Medical Sciences* and *Balkan Journal of Medical Genetics*, a decreased value for *Macedonian Journal of Chemistry and Chemical Engineering*, and without a value for *Prilozi* (Table 3).

Table 3

Journal metrics from Elsevier (<http://www.journalmetrics.com/>) for Macedonian scholarly journals for the period 2009–13 (Scopus data source, July 2014)

Scholarly Journal	ISSN		Source Normalized Impact per Paper (SNIP)					Impact per Publication (IPP)					SCImago Journal Rank (SJR)				
	pISSN	eISSN	2009 SNIP	2010 SNIP	2011 SNIP	2012 SNIP	2013 SNIP	2009 IPP	2010 IPP	2011 IPP	2012 IPP	2013 IPP	2009 SJR	2010 SJR	2011 SJR	2012 SJR	2013 SJR
Macedonian Journal of Chemistry and Chemical Engineering	03500136	18575625	0.024	0.344	0.809	0.600	0.557	0.059	0.361	0.909	0.931	0.623	0.108	0.188	0.300	0.286	0.226
Macedonian Journal of Medical Sciences	18575749	18575773	0.057	0.070	0.167	0.177	0.256	0.091	0.045	0.163	0.177	0.269	0.144	0.158	0.136	0.127	0.213
Balkan Journal of Medical Genetics*	13110160	-	0.115	0.109	0.153	0.119	0.185	0.080	0.083	0.246	0.107	0.155	0.116	0.118	0.150	0.115	0.117
Prilozi	03513254	-	-	-	-	-	-	-	-	-	-	-	0.148	0.123	0.145	0.160	-
Journal of Special Education and Rehabilitation	14096099	1857663X	-	-	0.000	0.000	0.119	-	-	0.000	0.000	0.070	-	-	0.101	0.100	0.120
BANTAO Journal	13122517	-	-	-	-	-	0.000	-	-	-	-	0.000	-	-	-	-	0.102

Increase or decrease in comparison with 2009; * currently published by Macedonian Academy of Sciences and Arts, Section of Biological and Medical Sciences.

Table 4

Academic journals from Republic of Macedonia deposited and indexed in SCImago for 2013

Title	Type	SJR	H index	Total Docs. (2013)	Total Docs. (3years)	Total Refs.	Total Cites (3years)	Citable Docs. (3years)	Cites / Doc. (2years)	Ref. / Doc.
Filomat*	J	0.354	9	163	232	3,019	170	231	0.76	18.52
Macedonian Journal of Chemistry and Chemical Engineering**	J	0.226	8	24	63	1,202	48	61	0.45	50.08
Macedonian Journal of Medical Sciences	J	0.213	5	72	174	1,977	59	172	0.30	27.46
Journal of Special Education and Rehabilitation	J	0.120	1	14	66	423	3	54	0.06	30.21
Balkan Journal of Medical Genetics	J	0.117	5	0	73	0	11	72	0.16	0.00
BANTAO Journal	J	0.102	0	0	11	0	0	10	0.00	0.00
Prilozi***	J	0	0	0	0	0	0	0	0.00	0.00

* published by University of Nish, Serbia and erroneously classified as in Macedonia; j, journal;

** published by The Society of Chemists and Technologists of Macedonia and erroneously classified as in Serbia;

*** published by Macedonian Academy of Sciences and Arts, Section of Biological and Medical Sciences, and omitted from Scopus indexation and SCImago analysis in 2013.

The results of academic journals from R. Macedonia deposited and indexed in SCImago for 2013 year are shown in Table 4. The journal *Filomat* is published by the University of Nish, Serbia, and erroneously classified as in Macedonia. The *Macedonian Journal of Chemistry and Chemical Engineering* is published by The Society of Chemists and Technologists of Macedonia and erroneously classified as in Serbia. *Prilozi* is published by the Macedonian Academy of Sciences and Arts, Section of Biological and Medical Sciences, and omitted from Scopus indexation and SCImago analysis in 2013. SCImago Journal Rank (SJR) for 2013 is available for *Macedonian Journal of Chemistry and Chemical Engineering* (SJR = 0.226), *Macedonian Journal of Medical Sciences* (SJR = 0.213), *Journal of Special Education and Rehabilitation* (SJR = 0.120), *Bal-*

kan Journal of Medical Genetics (SJR = 0.117), and *BANTAO Journal* (SJR = 0.102).

H5-index and h5-median for 2013 and 2012 were calculated for six scholarly biomedical journals from R. Macedonia and included in Google Scholar metrics (Table 5). At the top of the biomedical journals from R. Macedonia are *Macedonian Journal of Chemistry and Chemical Engineering* and *Prilozi* with an h5-index of 9 and h5-median of 21 and 13, respectively. The rest of the journals have smaller h5-indexes: *Macedonian Journal of Medical Sciences*: 7, *Balkan Journal of Medical Genetics*: 5, *Journal of Special Education and Rehabilitation*: 3, *Macedonian Journal of Animal Science*: 2. In comparison with 2012, all h5-indexes have increased except for *Macedonian Journal of Animal Science*. Similarly, all h5-mediana have increased in comparison with 2012 except for *Prilozi*.

Table 5

Macedonian scholarly biomedical journals included in Google Scholar metrics (2013, 2012)

Rank	Journal	2013		2012	
		h5-index	h5-median	h5-index	h5-median
1.	Macedonian Journal of Chemistry and Chemical Engineering	9	21	8	14
2.	Prilozi/Makedonska akademija na naukite i umetnostite, Oddelenie za biološki i medicinski nauki= Contributions/Macedonian Academy of Sciences and Arts, Section of Biological and Medical Sciences	9	13 =	8	13
3.	Macedonian Journal of Medical Sciences	7	9	6	8
4.	Balkan Journal of Medical Genetics	5	8	3	4
5.	Journal of Special Education and Rehabilitation	3	4	2	2
6.	Macedonian Journal of Animal Science	2 =	3	2	2

H5 – Index is the h-index for articles published in the last 5 complete years;

h5 – median for a publication is the median number of citations for the articles that make up its h5-index;

, increase or decrease in comparison with 2012.

Ranking researchers in the Republic of Macedonia

The top twenty authors from the R. Macedonia according to abstracts indexed in PubMed semantically analysed with GoPubMed (1628 abstracts identified on November 02, 2014) and Google Scholar Hirsh-index (November 06, 2014) are shown in Table 6. The first place among the top 20 authors belongs to Polenakovic M (180 abstracts and Hirsh-index: 20), followed by Efremov G, Tasic V, Spasovski G, Gucev Z, Popov Z, Sikole A, Grcevska L, Petrusavska G, Stafilov T, Ivanovski N, Bosevski M, Spiroski M, Arsov T, Pop-Jordanova N, Cakalaroski K, Dzikova S, Kocarev L, Georgievska-Ismail L, and Stefova M. According the Hirsh-index, Efremov G is on the first place (Hirsh-index 31) followed by Kocarev L (Hirsh-index = 30, Stafilov T (Hirsh-index: 25), Spasovski G (Hirsh-index: 22), and Polenakovic (Hirsh-index: 20). The rest of the researchers have a Hirsh-index lower than 20 (Table 6).

Discussion

In this paper the results of the current biomedical scientific impact (2013) of institutions, academic journals and researchers in R. Macedonia are presented.

Country rank of subject area Medicine in the world for R. Macedonia for the period 1996–2013 ordered by Hirsh index (H-index) is the 110th place with an H index of 45. Bosnia and Herzegovina and Montenegro have a lower rank than R. Macedonia, but Slovenia, Croatia and Serbia have a higher rank in H-indexes. From 2009–12 only Ss Cyril and Methodius University, Skopje, (UC&M) was included in the SCImago Institutions Rankings (SIR) with a world rank of 1726 to 1821. It is very strange that of 20 accredited universities in R. Macedonia, only two published more than 100 papers per year. This means that the rest of the universities should stimulate authors and journals to publish more papers per year, preferably in journals included in the Scopus database, and it should be a tendency of each journal to reach such a level as a first step towards application for IF. A first analysis of biomedical institutions in R. Macedonia was published in 2009, when twelve Institutes at the Faculty of Medicine in Skopje, R. Macedonia, with 140 authors, were analysed with Harzing's Publish or Perish software [24] for their current scientific impact (August, 2009) [25]. The paper was treated by some researchers as an individual attack on their integrity with an avalanche of reactions,

including the Ethics Committee of the Faculty of Medicine, instead of a positive approach to scientific measurement with motivation and

support for improving scientific publication of researchers from the Institutes at the Faculty of Medicine in Skopje.

Table 6

Top twenty authors from the Republic of Macedonia according to abstracts indexed in PubMed semantically analysed with GoPubMed (1628 abstracts identified on November 02, 2014) and Google Scholar Hirsh-index (November 06, 2014)

Author	PubMed		Google Scholar	
	Number of Abstracts	Rank of Abstracts	Hirsh index	Rank of Hirsh index
"Polenakovic M" OR "Polenankovic M"	180	1	20	5
"Efremov G"	154	2	31	1
"Tasic V"	111	3	17	7
"Spasovski G"	105	4	22	4
"Gucev Z" OR "Guchev Z"	76	5	14	11–12
"Popov Z"	61	6–7	15	8–10
"Sikole A"	61	6–7	15	8–10
"Grcevska L" OR "Grchevska L"	60	8	9	15–17
"Petruvska G" OR "Petrushevska G"	59	9	10	13–14
"Stafilov T"	56	10	25	3
"Ivanovski N"	55	11–12	9	15–17
"Bosevski M"	55	11–12	8	18
"Spiroski M" OR "Spirovski M"	54	13	14	11–12
"Arsov T" NOT "Bulgaria"	46	14	19	6
"Pop-Jordanova N"	43	15	10	13–14
"Cakalaroski K" OR "Chakalaroski K"	37	16	7	19
"Dzikova S"	32	17	9	15–17
"Kocarev L"	29	18	30	2
"Georgievska-Ismail L"	27	19–20	5	20
"Stefova M"	27	19–20	15	8–10

A search of the Scopus database was performed on February 23, 2013 in order to identify published papers from the field of medical sciences affiliated to the country Macedonia. A total number of 967 articles were selected for analysis and the h-index was calculated from these documents. The papers were published in a total of 160 journals. The largest number of papers was published in domestic journals. Two scientists are the top two, with 59–65 published papers, the next group of eight scientists had published 25–44 papers, and the remaining authors had published fewer than 25 papers each. The published papers had been cited 4380 times (mean citation of 4.5 per paper) with the Hirsh index (H-index) of 27 [26].

Six medical journals from R. Macedonia are included in the Scopus database (*Macedonian Journal of Chemistry and Chemical Engineering*, *Macedonian Journal of Medical Sci-*

ences, *Balkan Journal of Medical Genetics*, *Prilozi*, *Journal of Special Education and Rehabilitation* and *BANTAO Journal*). Source Normalized Impact per Paper (SNIP) and Impact per Publication (IPP) were calculated for only three journals (*Macedonian Journal of Chemistry and Chemical Engineering*, *Macedonian Journal of Medical Sciences* and *Balkan Journal of Medical Genetics*). SCImago Journal Rank (SJR) was calculated for four journals (*Macedonian Journal of Chemistry and Chemical Engineering*, *Macedonian Journal of Medical Sciences*, *Balkan Journal of Medical Genetics*, and *Prilozi*). H5-index and h5-median for 2013 and 2012, included in Google Scholar metrics, show that at the top of the biomedical journals from R. Macedonia are *Macedonian Journal of Chemistry and Chemical Engineering* and *Prilozi*, followed by *Macedonian Journal of Medical Sciences*, *Balkan Journal of Medical Genetics*,

Journal of Special Education and Rehabilitation, and *Macedonian Journal of Animal Science*.

The Scopus Journal Analyzer provides a measure of journal performance back to 1996. The Scopus Journal Analyzer includes 3 journal metrics: SNIP (Source Normalized Impact per Paper), measures citation impact by weighting citations based on the total number of citations in a specific subject field [20]; IPP (Impact per Publication) measures the ratio of citations in a year of scholarly papers published in the three previous years divided by the number of scholarly papers published in those same years [21]; and SJR (SCImago Journal Rank) is a prestige measure based on the idea that all citations are not created equal [18]. With SJR, the subject field, the quality and reputation of the journal have a direct effect on the value of a citation [17]. The impact of a single citation is given a higher value in subject areas where citations are less likely, and vice versa [21, 27]. The SJR and SNIP of Macedonian biomedical journals are indicators of the quality of these journals.

A total of 37 medical journals have been published in R. Macedonia since the Second World War, either in printed or electronic version [28]. Data referring to 14 titles of journals were obtained from COBIB.MK, but unfortunately only six of them are indexed in the Scopus database, which is an unacceptably low inclusion. It was concluded that our medical journals should become a school on how medical problems are treated and how to prepare a paper for medical journals. However, the authors concluded that it is necessary to reach the European level of basic and clinical research in medical science in R. Macedonia [28].

The first place of the top 20 authors from R. Macedonia according to the number of abstracts indexed in PubMed semantically analyzed with GoPubMed belongs to M Polenakovic (180 abstracts and Hirsh-index 20), but according to the Hirsh-index G Efremov is in the first place with a Hirsh-index of 31. The rank of Hirsh index (h-index) was different from the rank of number of abstracts indexed in PubMed for the top 20 authors from R. Macedonia.

Researcher's impact was analyzed with H-index for the employees of the Institutes at the Faculty of Medicine in Skopje using the

Scopus database [29], as also for biomedical researchers included and indexed in PubMed [23]. The results show that a very small number of biomedical researchers are among the top 10 or top 20 authors. Ss Cyril and Methodius University, Skopje, started stimulation of researchers, introducing Top 10 Authors for the previous year. Unfortunately, the cumulative number of published papers is used as a ranking criterion instead of H-index or other verified indexes for the quality of scientific impact. It would be more effective and objective to use verified scientific indexes for stimulation of researchers in all universities in R. Macedonia.

Several problems arise when author impact analysis search is used: i) some authors have used different names in different periods of time; ii) some authors transliterate their names in several different ways; iii) some authors add or do not add "v"; iv) some authors use only one of their two surnames; v) there are some identical names and surnames for different researchers in the world [29]. All of these variables are recognized as author ambiguity. There are several ambiguous researchers in the top 20 authors from R. Macedonia, but unfortunately PubMed do not have a tool for ambiguity resolution and because of this the precise results of the top 20 authors should be treated very carefully. One of the effective solutions for ambiguity resolution is registration of researchers in the ResearchersID (<http://www.researcherid.com/>) [30] and in the ORCID (<http://orcid.org/>) [31].

Publication ethics established by the Editorial Boards of Macedonian medical journals are in the very early stage, with very rare use of tools for checking similarities between submitted manuscripts and published papers. There are ten papers with very great similarities deposited in Deja vu database from the medical scientists of R. Macedonia [32]. Only two retractions have been recorded in the Scopus database from R. Macedonia: one was a Master of Science thesis from a Macedonian author [33] and another on clinical science from a Serbian author [34]. At the moment only two Macedonian biomedical journals are members of the Committee on Publication Ethics (COPE) (*Macedonian Journal of Medical Sciences* and *Macedonian Veterinary Review*). Obviously, more efforts are needed from the Editors-in-Chief of

Macedonian biomedical journals to implement international ethical standards in the publication process [35].

In conclusion, the rank of subject area Medicine for R. Macedonia according the SCImago Journal & Country Rank (SJR) is 110th in the world and 17th in Eastern Europe. Of 20 universities in R. Macedonia, only Ss Cyril and Methodius University, Skopje, and St Clement of Ohrid University, Bitola, are listed in SCImago Institutions Rankings (SIR) for 2013. A very small number of Macedonian scholarly journals is included in Web of Science (2), PubMed (1), PubMed Central (1), SCOPUS (6), SCImago (6), and Google Scholar metrics (6). The rank of Hirsh index (h-index) was different from the rank of number of abstracts indexed in PubMed for the top 20 authors from R. Macedonia. The current biomedical scientific impact (2013) of institutions, academic journals and researchers in R. Macedonia is very low. There is an urgent need to organize measures to improve the quality and output of institutions, scholarly journals, and researchers in Macedonia in order to achieve higher international standards.

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СЕГАШНО БИМЕДИЦИНСКО НАУЧНО ВЛИЈАНИЕ (2013) НА ИНСТИТУЦИИТЕ, АКАДЕМСКИТЕ СПИСАНИЈА И ИСТРАЖУВАЧИТЕ ОД РЕПУБЛИКА МАКЕДОНИЈА

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