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Biomedical Publications as a Reflection of Research Capacity: Analysis of Last Two Decades (1998-2019) of Research Productivity in Kosova

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ABSTRACT

Background and Objective: Developing countries are facing serious challenges in creating sustainable advanced biomedical research institutions due to the lack of investment in research infrastructure and human capacities. This phenomenon is further exaggerated in countries that often have medical systems affected by wars/conflicts or neglect. We aimed to review and analyze the research productivity as a reflection of research capacities of Kosova.

Methods: A literature search of all biomedical research publications from Kosova between January 1, 1998 and July 15, 2019 were identified and analyzed. Subsequently, the results were divided into two groups; those featuring a Kosovar as the first author and those not featuring a Kosovar first author. The authorship, institution, and quality of studies were compared between the two groups through the study design and impact factor. Chi-square test, t-test and ANOVA were used for analyses.

Results: In the past 20 years, 1334 published biomedical papers on PubMed were identified. This research productivity was lowest among all Western Balkans Countries. Out of the 1334 journals, 39% of all journals that published Kosovar articles had no impact factor, 45% had impact factor <1, and 7% had impact factor >5. Median impact factor of the journals was 1.16. The first author in 46% of published papers was Kosovar and in 46% was non- Kosovar. In 8%, no Kosovar author was listed among the authors (but Kosova-related publications). Their corresponding journals' mean impact factors were 1.02, 3.14 and 6.87, respectively, which differ significantly (p=0.0001). Kosovar first author's meta-analysis, systematic review, experimental studies and cohort studies altogether covered 2.9% of all papers. More than 52% of all papers were published through collaboration with authors from other countries. The lower the quality of study, the higher the chance of having the Kosovar as the first author. In all study types, except case-series and case-reports, the impact factors of journals that published Kosovar first author articles were significantly lower than those in non-Kosovar first author articles.

Conclusion: Biomedical research capacities and infrastructure are almost non-existent in Kosova and ranks in the bottom 10 countries in the world. The main factors are lack of funding, infrastructure and human capacities, as well as absence of a clear strategic framework and inefficient delivery mechanism to support research programs. This represents a major opportunity for research investment, prioritizing multi-disciplinary research, capacity building research strategy and international collaborations in Kosova.

Keywords: Kosova, Research, Challenges, Capacity Building, Western Balkan Region.

INTRODUCTION

The Western Balkan Countries (WBCs) region covers six member states which include Albania, Bosnia and Herzegovina, Kosova, Montenegro, the Republic of North Macedonia, and Serbia.[1] Despite major wars and continuous conflicts, the people from WBCs continue to rebuild their lives. This has been done through the improvement of national systems of education, scientific research, technology and innovation.[2] Since the mid-1980s, there has been an on-going research collaboration between the European Union (EU) and the Western Balkan countries that has resulted in a number of positive improvements in the area of innovation-driven research. In total, the region is represented in 254 EU-funded projects; the EUs research and innovation program has received €75 million[3], including €2.28 million for 9 EU-funded projects dedicated to build an e-infrastructure in the WBCs in 2020.[3] The WBC INCO-NET project supported the development of a sci-

entific relationship between these countries and the EU. The project started in 2008 and ended in 2013. It assisted in the Steering Platform on Research for the WBCs in facilitating the interaction between the EU, the WBCs and the states associated to the Framework Program for research, technological development and demonstration (RTD) and the European Commission.[4] In 2013, the WBCs ministers of science approved the Regional research and development (R&D) Strategy for Innovation. It was prepared under the World Bank Technical Assistance Project funded by the EU Commission. The key priorities were R&D essentials to augment innovation and growth in these countries.[5] In addition, R&D would boost the cooperation and the stability among WBCs which is needed for smoother integration into the EU.[6]

However, dissemination of such support for research among these countries varies greatly and has not supported research capacities. In some cases, such as Kosova and Albania, the research capacities were in a better state before the war of 1998/1999. These capacities were systematically destroyed during the decade that culminated in the war of 1998/1999 war in Kosova or neglected (in the case of Albania) starting 1990 and early 2000 with significant negative consequences. Moreover, while there have been several EU projects, a number of WBCs are still not members of EU (Albania, Kosova, Montenegro and the Republic of North Macedonia; Bosnia-Herzegovina and Serbia are pending EU candidacy) and thus have no direct benefits from geographically being part of Europe in this aspect. Lack of these projects and further funding has caused deterioration of research capacities in the biomedical field.

As a consequence of this inequality in research funding dissemination and the turbulent political situation over last 30-years in Kosova and other WBCs to date, the research systems in the region remained weak with negative consequences not only for research and innovation, but also for the quality of higher education. The health status of research in Kosova is most critical due to being a low and middle-income country,[7] with an unclear health financing system,[8,9] severely underfunded public healthcare institutions,[8–10] and a growing but unregulated private sector.[8,11] To add more to the demise of science and healthcare in Kosova, in most recent years there is a growing concern of massive and severe brain drain of healthcare capacities (doctors and nurses) who are being hired aggressively by recruiting agencies imbedded in the country to a number of European countries, particularly to Germany. Since 2011, healthcare reform efforts have focused around health financing reform and the re-organization of the healthcare system.[8] The Balkans Policy Research Group findings show that scientific research in Kosova is mainly financed by the Government of Kosova.[2] Although the Law on Scientific-Research Activities (Law No. 04/L-135) foresees the associated spending to reach at least 0.7%, the total government spending on scientific research is only 0.1%. The University of Pristina has a surplus of students, nonexistent or very poor infrastructure, and inaccessibility to scientific journals and other resources.[12] Moreover, there is not a single medical scientific journal being published in Kosova.

This study aimed to analyze the research productivity from Kosova over the past 20 years as a reflection of research capacities and to discuss the challenges and recommendations for improving research outcomes in Kosova with special consideration on building research capacity.

Methods

We reviewed the literature between January 1, 1998 and July 15, 2019 to identify all published biomedical research articles associated with each country in the Western Balkan region. We searched research publications by country name, as we intended to include most articles published from WBCs. We utilized the PubMed search engine by using medical subject headings "[MeSH Terms] OR [All Fields] as "Albania," "Bosnia-Herzegovina," "Kosova," "Croatia," "Macedonia," "Montenegro," and "Serbia." The electronic database search with the keyword "Kosovo" resulted in a total of 1334 publications, which were selected for further review and analysis. We manually reviewed all 1334 abstracts to look for the language of the article, the nationality of authors, and the institutional and department affiliations. In addition, we analyzed the importance of the publications by evaluating the study design and the impact factor of the journals that published these articles.

Statistical Analysis

The trend of frequency distributions of biomedical publications by year from WBCs was plotted for every country. Articles related to Kosova were analyzed more extensively. The frequency distributions of the nationality of the first authors, the language of published articles, the department and affiliations, the design of study and the impact factor of the associated journals were extracted. The trend of mean impact factor of the journals that published Kosovar articles between January 1, 1998 and July 15, 2019 was plotted. Furthermore, the articles were divided into two groups: Kosovar first author articles vs. non-Kosovar first author articles. The qualities of studies were compared between the two groups based on study design and impact factor. Frequency distributions of various study designs were compared using Chi-square test. Mean impact factors were compared using Student t-test. Articles about Kosova without including Kosovar author composed the third group. One-way ANOVA was used to compare the mean impact factor among the three groups. Statistical significance was set at p-value <0.05. All statistical analysis was carried out using IBM SPSS Statistics for Windows, version 26 (IBM Corp., Armonk, N.Y., USA).

Results

The total number of biomedical publications from Western Balkan region is shown in **Figure** 1. Over the past 20-years, the majority of biomedical publications originated from Croatia and Serbia, followed by Bosnia, Montenegro, Macedonia (now Northern Macedonia), and Albania. Notably, Kosova had the least number of publications. **Table** 1 demonstrates the frequency distribution of biomedical publications by year among Western Balkan countries. The majority of articles were published between January 2009 and December 2018, thus there was a steep rise that started from the year 2009 onwards. Moreover, from 1998 onwards, an increasing trend for the frequency of publications has been observed among all the Western Balkan countries, but the publication trend was highest among Croatia and Serbia (**Figure** 2). Interestingly, an increasing trend for the frequency of publications was observed in Kosova (**Figure** 2), but overall there was an underperformance of research outcome in this country.

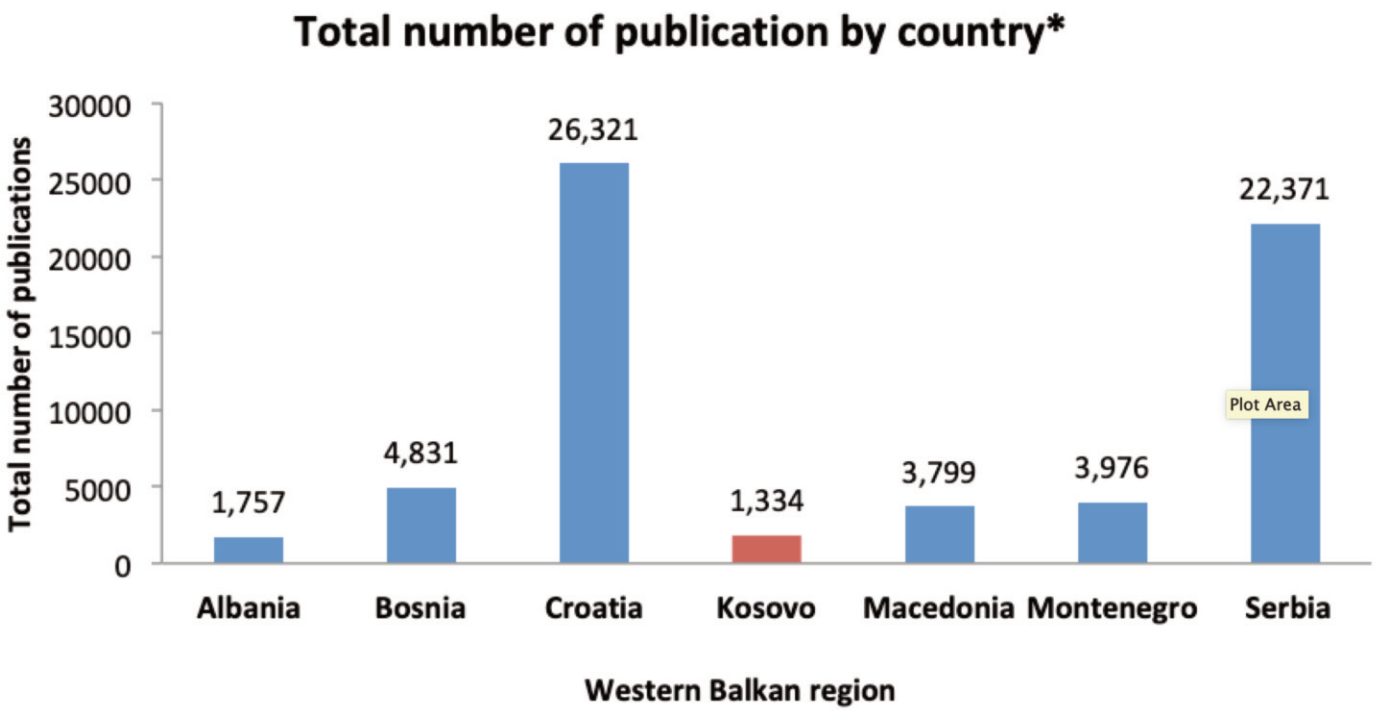


*Figure 1. Total frequency distribution of biomedical publications from Western Balkan region (*publications from January 1, 1998 till July 15, 2019)*

Table 1. Frequency of biomedical publication by year from Western Balkan Countries

Year	Albania (n=1,757)	Bosnia (n=4,831)	Croatia (n=26,321)	Kosovo (n=1,334)	Macedonia (n=3,799)	Montenegro (n=3,976)	Serbia (n=22,371)
2019*	120	243	1387	80	227	174	1563
2018	182	460	2249	137	446	250	2227
2017	151	443	1951	138	378	220	2058
2016	173	414	1855	107	363	193	2110
2015	162	364	1657	115	342	197	1913
2014	129	321	1609	103	295	226	1830
2013	78	290	1470	69	222	165	1728
2012	73	273	1522	50	183	134	1507
2011	64	250	1492	57	192	136	1248
2010	55	247	1374	61	151	113	1097
2009	42	207	1228	59	118	117	1018
2008	41	175	1109	38	133	134	832
2007	26	207	1028	34	115	197	701
2006	29	171	938	25	109	476	607
2005	26	145	896	31	93	514	596
2004	30	157	765	34	74	352	414
2003	35	132	723	27	46	131	212
2002	26	100	648	48	64	52	130
2001	30	98	651	33	79	49	84
2000	20	71	563	36	45	44	87
1999	30	107	485	47	37	37	81
1998	29	95	449	3	26	48	91

* Included publications until July 15, 2019

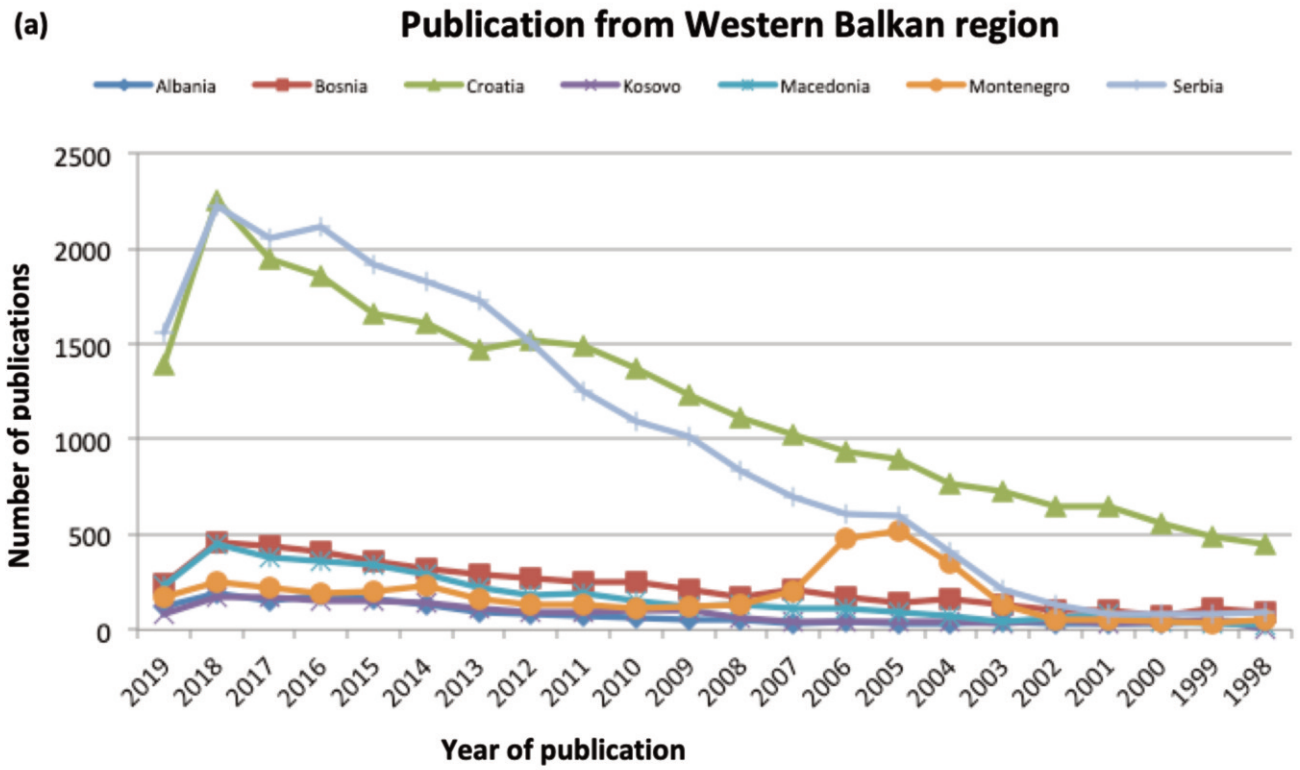


*Figure 2. Total number of publications by year from Western Balkan region (*January 1998 till July 15, 2019).*

In the past 20 years, 1334 biomedical research articles associated with Kosova have been published in PubMed. After 2008, the publication rate started to grow linearly to reach the maximum rate of 170 articles/year in 2017. On the other hand, the impact factor of the associated journals was the highest between 1998 and 2000. Most of the latter group were short articles concentrated on the local war, refugees and human rights (**Figure** 4) and were published by non-Kosovars.

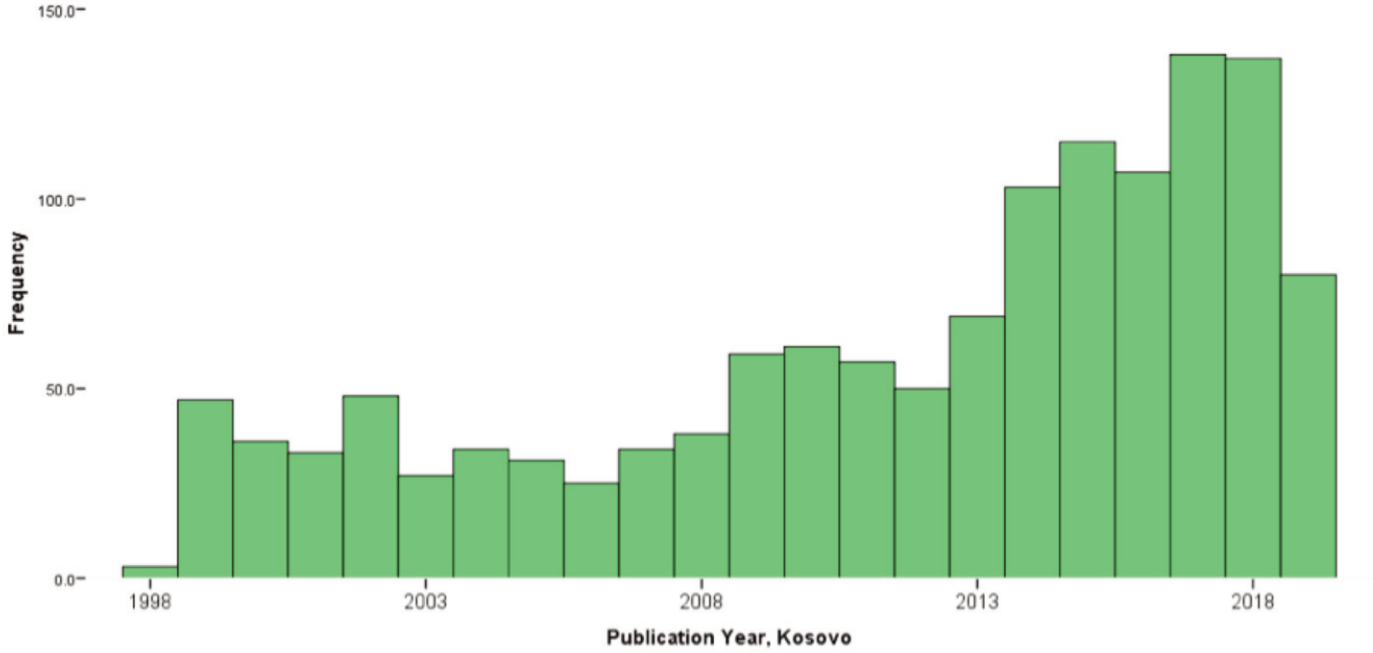


Figure 3. The rate of publication of Kosovar papers in the past 20 years.

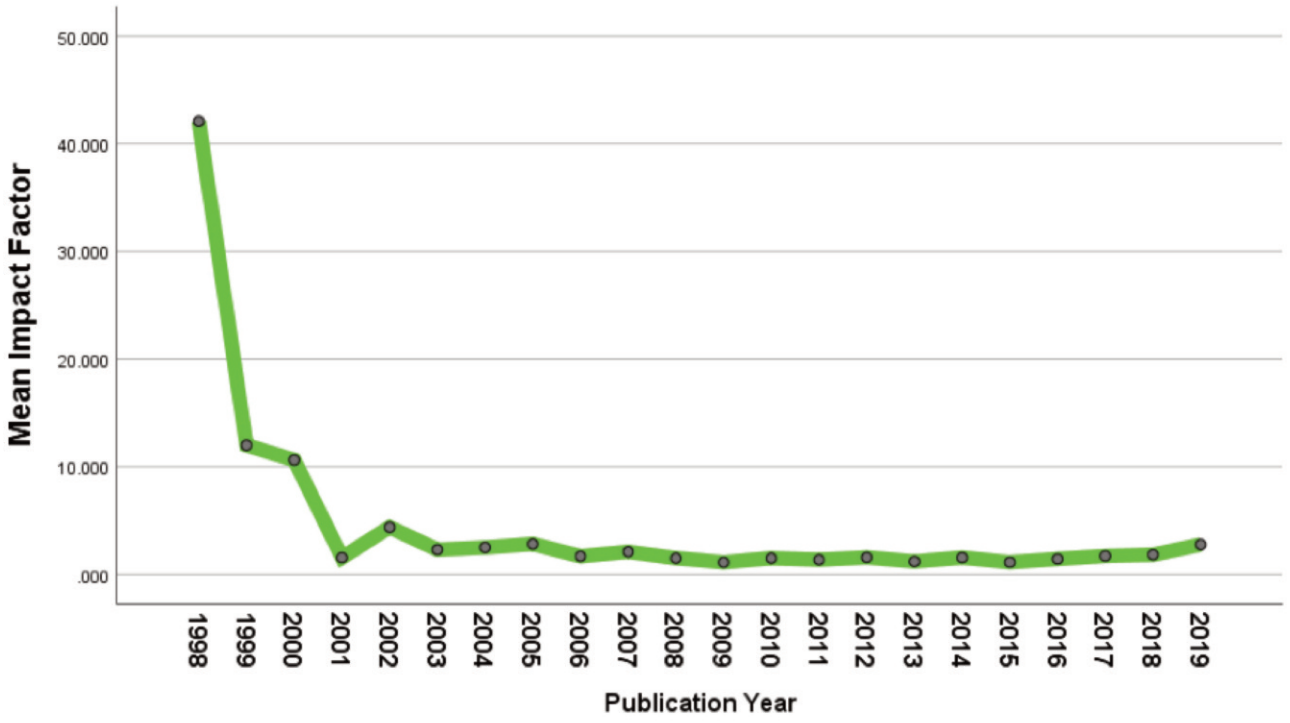
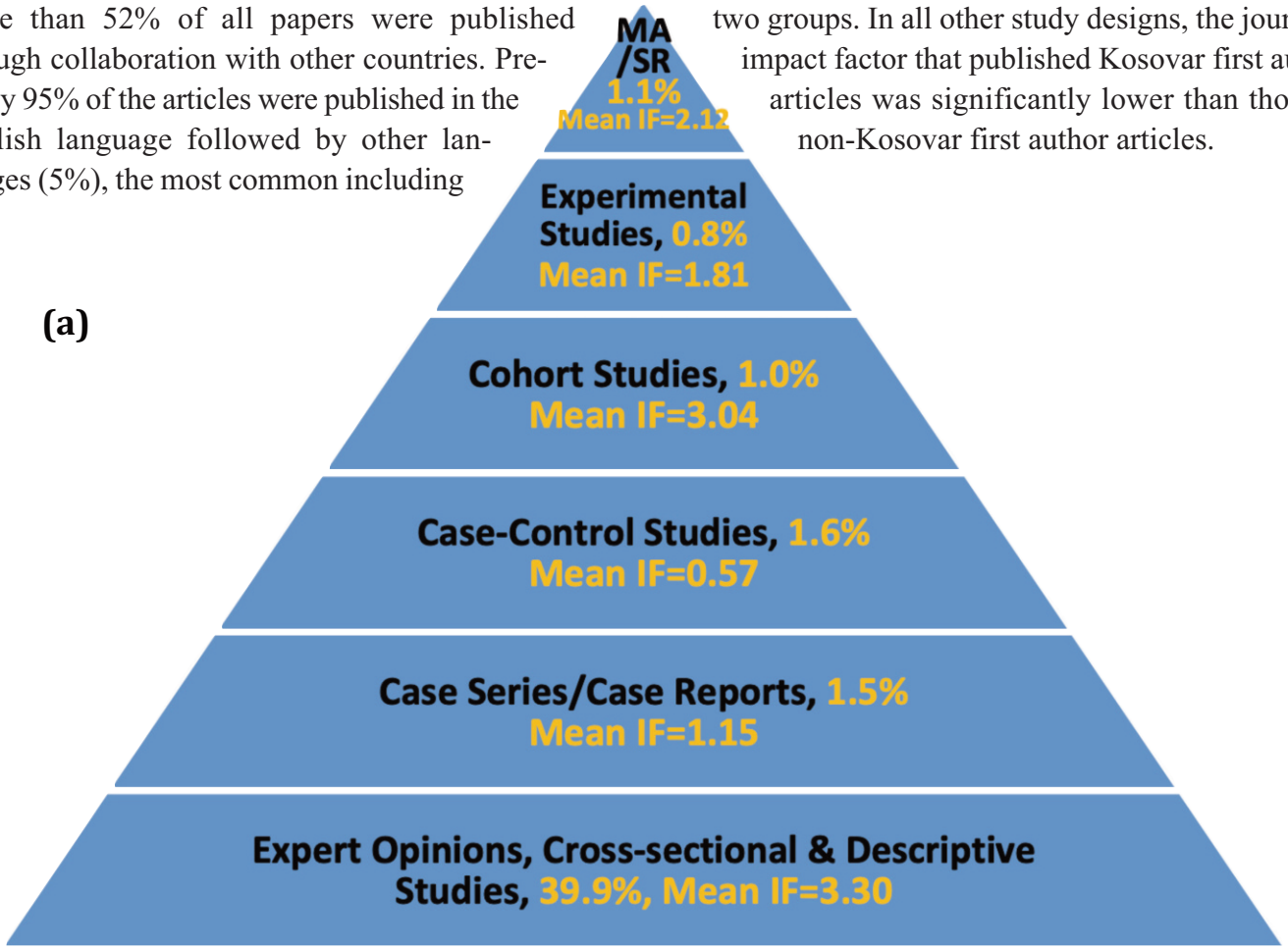


Figure 4. Mean impact factor of the journals published Kosovar papers in the past 20 years.

Each of the following 9 journals published ≥1% of Kosovar papers: Medical Archives, Open Access Macedonian Journal of Medical Sciences, Materia Socio-Medica, Acta Informatica Medica, Cases Journal, Journal of Medical Case Reports, Military Medicine, Bosnian Journal of Basic Medical Sciences, and, European Journal of Public Health, of which only the last three had an established impact factor. About 39% of all articles published in journals had no impact factor, 45% had an impact factor <1 and 7% had an impact factor >5. Median impact factor of the journals was 1.16. The first author in 46% of published papers was Kosovar, and in 46% was non- Kosovar. In 8%, no Kosovar author was listed among the authors. Their corresponding impact factors were 1.02, 3.14 and 6.87, respectively, which differ significantly (p=0.0001). Out of those 46% papers with a Kosovar first author, 22% were related to internal medicine, 13% to surgery, 11% to basic science, 9% to dental science, 6.5% to pediatrics, 4.5% to physical therapy, 3% to gynecology and obstetrics, 2% to anesthesiology, 2% to dermatology, and 27% to epidemiology/public health studies and other fields. More than 52% of all papers were published through collaboration with other countries. Precisely 95% of the articles were published in the English language followed by other languages (5%), the most common including German, French, Serbian, and Italian.

Figure 5 shows the quality of scientific evidence produced by the study design. As we move from the bottom of pyramid towards the top, the quality of study design will improve and consequently, the validity, the reliability, and the accuracy of associated evidence will improve. The frequency distributions of study designs of Kosovar papers are also demonstrated accordingly. Meta-analysis, systematic review, experimental studies (not just randomized clinical trials) and cohort studies altogether covered 5.8% of all published articles within the past 20 years. Kosovar first author's meta-analysis, systematic review, experimental studies and cohort studies altogether covered 2.9% of all articles. The distribution of having a Kosovar first author was significantly different among various study designs; the lower the quality of study, the higher the chance of having a Kosovar first author (**Figure** 5). When comparing the journals' impact factor of different study designs of Kosovar first author articles with those of non-Kosovar first author articles, we noticed that only case-reports and case-series had similar impact factors between the two groups. In all other study designs, the journals' impact factor that published Kosovar first author articles was significantly lower than those in non-Kosovar first author articles.

(a)



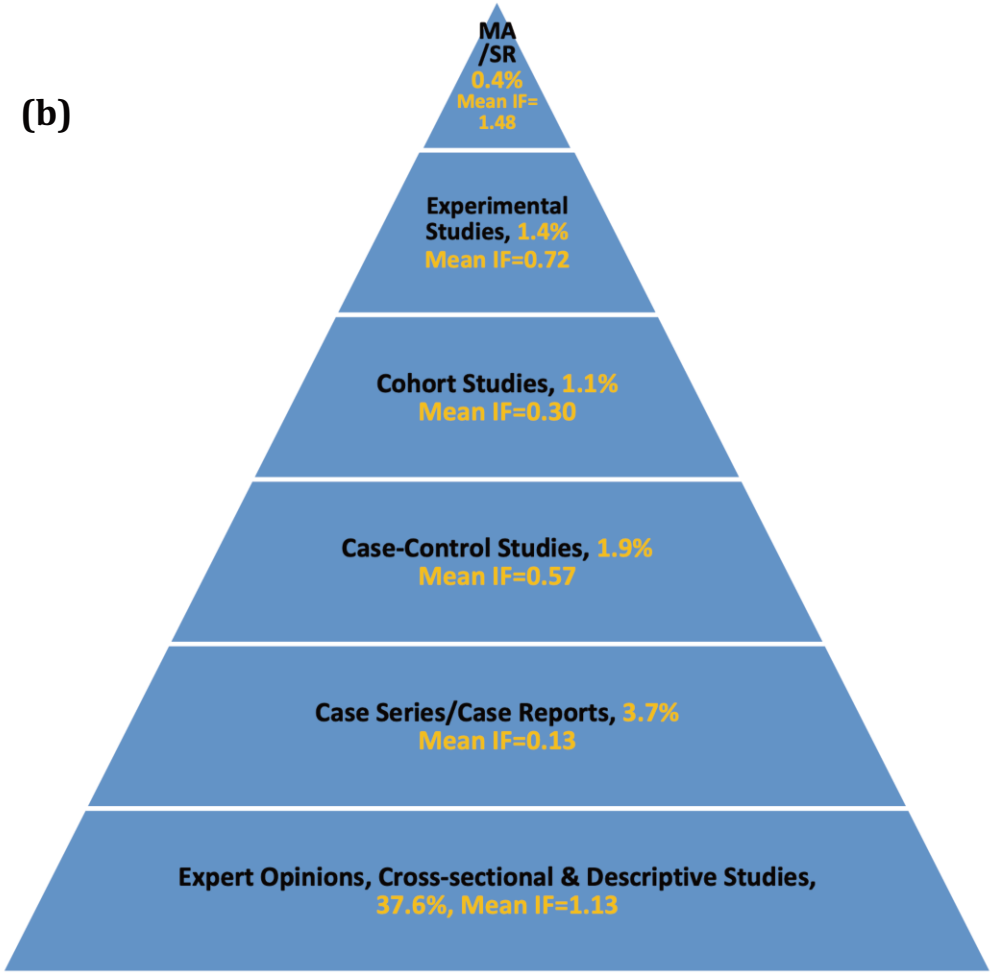


Figure 5. Pyramid of study designs, frequency distributions and the associated journals' impact factor. ***(a)*** *Non-Kosovar first author articles* ***(b)*** *Kosovar first author articles. [MA/SR=Meta-Analysis/Systematic Reviews; IF = Impact Factor].*

Discussion

The current study aimed to demonstrate the bioresearch productivity (publications found in PubMed between January 1998 and July 15, 2019) as an indicator of the research capacities of Kosova. It was revealed that less than 6% of country's publications involved high quality studies such as meta-analysis, systematic reviews, experimental studies and cohort studies. In addition, less than 3% of these high-quality publications had Kosovar researchers as the first author of the articles. Furthermore, the mean journals' impact factor of these high-quality Kosovar first author articles was significantly lower than the journals' impact factor of non-Kosovar first author articles. Our findings are in agreement with the country's scientific ranking by Nature Index, which assessed growth in the scientific contribution of all countries around the world. According to natureindex.com, the bottom 10 countries of the world in terms of science productivity are San Marino, Kosova, Samoa, Palestine, Montenegro, Chad, Liberia, Micronesia, Tonga, and Cape Verde.[13]

There are a number of factors responsible for the lack of scientific development and research productivity in the Western Balkan countries. Lower economic status (GDP), which leads to lack of infrastructure and human capacities; brain drain; and inadequate and poorly structured policies to support research are the main reasons.[14–17]

Economic Status in the Western Balkan countries

The overview of socioeconomic status and research capacity in the Western Balkan region for the year 2016 is shown in **Table** 2.[16] In that year, Serbia and Croatia had the highest estimates of gross domestic products (GDP). Additionally, they had the highest per capita in-

come and the highest GDP expenditure on healthcare and social work. Both of these countries had better research performance in terms of published research articles. In contrast, Kosova had the lowest per capita income, less expenditure of the GDP on health care and social work, and had the least research output.

Balkans Countries	Population (million)*	GDP, Estimate 2016 (billion $)	Per capita ($)	Public Health Expenditure (% of GDP)
Albania	2,9	11.880	12,582	5.9
Bosnia	3,8	41.127	11,647	6.8
Croatia	4,2	97.026	23,171	6.4
Kosovo	1,9	18.840	10,134	4.01
Macedonia	2,1	30.377	14,631	4.1
Montenegro	0,6	10.436	16,654	3.7
Serbia	8,9	112.888	15,828	6.4

Table 2. Overview of socioeconomic status and research capacity in Western Balkan region.

Research Capacity in the Western Balkan Countries

A functioning research system relies upon many factors, as such, it requires a strong education system, sufficient resources (both human and financial), and adequate mechanisms for implementation and monitoring.[12] Across the WBCs these components are frequently inexistent or not fully in place, or do not function efficiently.[2] The research system also requires a confluence of strategy, structure and policies that are focused, coherent, transparent and accountable.[17] Therefore, a significant increase in national research funding would be a necessary pre-condition for a successful and sustainable research capacity building.[14] Notably, the national investment in research and development is low due to overall weaker economies. For instance, Serbia invests 0.89% of GDP (2016), the other five systems invest 0.5% or less.[2] This is well below the 2% or more of EU average.[15]

As a result of the high competition and a lack of capacity and resources, the EU's research funding programs for WBCs tend to be beyond the reach of all except for the strongest institutions.[15] In some countries, such as Albania, the government's intention was to move most of the research to universities.[18] This has triggered some tension and dissatisfaction between the different institutions.[2,18] Contrarily, in Serbia, the Serbian Academy of Sciences and Arts is still very active, one of its main activities consisting of international cooperation with good research output.[19,20] Among the WBCs, we have also observed the highest biomedical publication frequency from Croatia and Serbia.[2,21–24] Kosova Academy of Science and Arts has 22 regular members, of which only three members have a total of 11 scientific publications in international academic journals. This alone shows the degree of disconnect between the academy and international scientific standards.[25]

Research Challenges in the Western Balkan Region

Overall in the Western Balkan countries, major research challenges include the development of infrastructure and maintaining research equipment and regular supplies of research consumables[14]; funding mecha-

nisms and decentralized governance[12,14]; institutional research support and sufficiently qualified and experienced administrative staff[12]; and having no private sector investment in R&D activities. These factors are profoundly pronounced in Kosova, where there is a lack of funding for R&D.

Moreover, funding allocation to the different parts of the institution is handled differently in each Western Balkan system. According to the survey for institutional leaders, 89% of Albanian institutions reported that allocation is carried out by the Senate, while 50% of higher education institutions from Bosnia and Herzegovina, and 58% from Serbia reported that the ministry is responsible.[12] Other factors that impact negatively are the uncertainty and lack of transparency in the funding processes and the delay on the release of funds. The core of the funding that universities receive is allocated for teaching and mainly linked to student numbers, making it difficult to achieve an adequate balance between research and teaching. The study shows that 90% of researchers across the region have teaching responsibilities, and salaries are commonly perceived as being only for teaching activity.[1,2]

Major challenges and potential scope of research in Kosova

Kosova is one of the poorest countries in Europe with a population of less than 1.8 million and the GDP of 3.1 billion euros in 2014. According to the World Bank,[26] the poverty rate is about 80%, while according to the Kosova Agency of Statistics, 29.7% of 1.8 million citizens are considered poor.[27] In such a social context, higher education and research is seen as a way to improve career and life opportunities.[28] Therefore, in order to strengthen the research capacity, effective research strategies and resource allocation, it is important to explore the potential of scientific research in Kosova, which remains unclear to date (**Table** 1).

Notably, the EU-Kosovo Stabilization and Association Agreement (SAA) was the first contractual relationship between the EU and Kosova signed on 1 April 2016.[29] It has a comprehensive framework for closer political dialogue and economic relationship. According to the 2016 EU Commission's Report on recent developments regarding research and innovation cooperation, in 2015 public spending on research and innovation amounted to only 0.05 % of GDP, out of which only one-fifth was allocated to scientific research grants.[30] During the 2016-2017 reporting period, there was some progress in the area of research. Based on the report, the European Commission has suggested that Kosova should, again and in particular, improve innovation capacity through reforms in higher education system and boosting research investment.

According to the 2016 Communication on EU Enlargement Policy, Kosova has taken limited action to develop its research and innovation capacity. The quality of post-graduate programs is very limited. The budget for research remains insufficient and is still below 0.2% of GDP.[12] The 2004 Law on Scientific Research Activities which stipulates that domestic gross expenditure on research and development should stand at 0.7% of GDP is not being properly implemented simply due to a lack of funding. Kosova also needs to strengthen its administrative capacity for research and innovation.

In Kosova, the notable institution involved in the governance of scientific research system is the Ministry of Education, Science and Technology, and the responsible body is the National Research Council. Notably, research is predominantly performed at universities in Kosova, the top performer being the University of Pristina, the Academy of Sciences and Arts, and a limited number of other institutes, respectively. Of note, the majority are teaching institutions which has sub-standard research infrastructure and low productivity (Figure 1).[2,6,9]

Lack of research funding, and the absence of a clear strategic framework and delivery mechanism to support research are perceived to be the main problems hindering the advancement of research in Kosova. Academic career development in Kosova tends to focus more on the teaching career, which provides long-term financial security. However, there is a strong need for reforms, as presently institutions are not in a position to adequately support research and development programs due to inefficient research system in the universities.

Apart from University of Pristina, the productivity of other universities in Kosova is negligible. The total annual research budget for all research programs in Kosova is 4.8 million euros and 0.1% of GDP, which

is the lowest in the region.[12] Even this very low budget is usually not fully dispersed due to the lower number of research grant applications received by the ministry.

In addition to limited funding, the mechanism of funding poses extra limitations. Both research infrastructure and research capacity are severely limited in Kosova. There is little or no access to journals and databases, and there is no institutional support for research. Similar to other economies in the region, one of the largest barriers to research excellence is the lack of capacity in the research community to secure and manage research projects, such as preparing EU grant proposals and managing EU-funded projects. Therefore, lack of qualified researchers is a major obstruction that hinders improving the quality of research. Presently, there is no clear national framework for assessment of research activities. Qualified researchers from abroad are also unable to conduct quality research due to the lack of infrastructure and facilities.[2,6,7]

International research collaboration

Fortunately, over the years the situation for international collaboration has improved in Kosova. Due to financial and political constraints, Kosova institutions cannot be the lead partner in H2020 projects, but they can participate as partners.[31] There is effective cooperation with Albania, but unfortunately, political turbulence is responsible for limited collaboration with other countries in the region. Consequently, finding project partners is challenging and researchers have to rely on personal networks to find potential partners.[32] In addition, engagement in technology transfer and knowledge exchange activities are very low.[31] Some institutions are trying to improve the situation with a focus on securing more research funding. For example, the University of Pristina has recently established an office for sponsored research, following a US model. The new office will focus mainly on securing EU grants, as the economy is not sufficiently stable to sustain public-private partnerships.[33]

Key recommendations for research advancement in Kosova

As the public investment in research in Kosova has fallen below the levels required by national legislation, it should be taken seriously, and more funds should be allocated for research. It is crucial that the national authorities and policy makers should improve long-term support for research infrastructure and human capacities by increasing the national research budget. Also, it is necessary to provide incentives to young academic faculties to strive for research excellence. The country has a significant proportion of young people who require education, and this justifies the need to open new educational institutions. Some of these institutions, particularly those with a new generation of young researchers, have the potential to develop into strong research performers. Research funding should be granted to support a selective, performance-based development of researchers. Moreover, the brain drain of young doctors and nurses should be stopped with the creation of better opportunities and work-life balance.

For a long time, due to restricted resources, higher education institutions in Kosova have extremely limited access to contemporary literature and scientific journals. Furthermore, higher education institutions should develop mechanisms for moderating the teaching load of academic staff and promoting research output. There is also a need to improve the criteria for academic career promotions based on research performance that facilitates better financial security and job satisfaction.

In **conclusion,** biomedical research capacities and infrastructure are almost non-existent in Kosova and ranks in the bottom ten countries in the world. The main factors are lack of funding, infrastructure and human capacities, as well as absence of a clear strategic framework and inefficient delivery mechanism to support research programs. This represents a major opportunity for research investment, prioritizing multi-disciplinary research, capacity building research strategy and international collaborations in Kosova. The impact of the quantity and quality of scientific publications on the quality and delivery of patients' healthcare need further evaluation in this region.

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