

Short Communication

The Trend of Scientific Publications of the Top 20 Productive Countries in the Field of Public, Environmental and Occupational Health

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- Environmental health
- Growth mixture model
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Abstract

Objective: This study was devoted to clustering the growth of research outputs among the top-ranking 20 countries in the field of public, environmental and occupational health.

Method: This is a longitudinal bibliometric study that uses SCImago Journal & Country Rank information about scientific published documents in the field of public, environmental and occupational health from 2000 to 2018. To identify the main patterns, the growth mixture model was implemented and the optimum number of patterns was obtained based on the likelihood ratio test (LRT) in Mplus 7.4 software.

Results: The overall trend in the number of published scientific documents was raising with an annual growth of 7.65%. The United States (US) and the United Kingdom (UK) had a higher level of contribution to published documents. The model with three patterns was introduced as the model with the best fit using LRT. The first pattern of published documents, including Germany, Australia, Canada, Japan, France, Italy, Sweden, Netherlands, Brazil, Spain, India, Russian Federation, Switzerland, Denmark, China, South Africa, South Korea and Iran, had a slow growth with the mean annual increase of 74 documents. The US with an annual growth of 598 documents had a very sharp rising trend and, as the third identified pattern, the UK experienced a moderate growth with an annual increase of 156 documents.

Conclusions: The proposed model confirmed that annual growths of the published documents in the field of public, environmental and occupational health in the US and UK are significantly higher than in other countries in this field.

INTRODUCTION

Public, environmental and occupational health is one of the most important fields in medical science. According to the World Health Organization, about a quarter of all deaths in the world are associated with the environment which explains the growing importance of this branch of science. It should be noted that public health research is used to assess and identify health and safety factors and related risks [1-3]. Studying public health is important for several reasons; this field of science can affect the epidemiology of diseases and care criteria; it also helps politicians and health planners become more aware of future challenges [4]. Moreover, occupational health refers to well-being in the workplace beyond physical and mental health and the lack of any disease.

A regular and objective study of the scientific efficiency of countries and comparing them with each other can play a decisive role in making fundamental decisions and formulating research policies. It also highlights the importance of cooperation between

research institutes and the government and national programs [5]. As a leader in public health research, Canada, European countries and especially the United States [6], were more active in epidemiological research, public health, and medicine. In general, Europe plays a key role in public health research, however, there are significant differences between various countries in the continent [7]. Having attracted a great deal of attention in recent years, bibliometrics (bibliography) was first introduced in 1969 by Alan Pritchard [8]. It consists of a combination of the words "biblio" and "metrics", which refers to the application of mathematics to this type of study [9]. In bibliographic studies, researchers use available information to examine and identify research problems, strengthen future studies and predict the course of the study [10]. In general, bibliographic indicators determine the number of articles published on a particular topic and facilitate the study and comparison of the activity of countries and continents in this field. It also expresses the extent of their progress and effectiveness [11]. As a result, areas of the world that have been more active and specialized in a particular

field of science have been identified. On the other hand, countries with research weaknesses can be observed [12,13]. In general, bibliographic analysis is often used to evaluate the characteristics of institutions, countries, articles and citations, as well as international and other collaborations [14].

Best to the our knowledge, the trend changes of research outputs in the fields of occupational health, environmental health and public health didn't investigated in the literature. So, the current study was devoted to clustering the research outputs growth among the top-ranking 20 countries in the field of public, environmental and occupational health from 2000 to 2018.

METHODOLOGY

This is a longitudinal bibliographic study which uses SCImago Journal & Country Rank information about scientific documents published on public, environmental and occupational health from 2000 to 2018. Related information for the top-ranking 20 countries in 2018 were extracted as an Excel file for each year. The inclusion criteria was production of at least 1% of documents in 2018 based on the SCImago report.

For taking into account both the within and between variability of the published documents among the under-study countries, the growth mixture model (GMM) was implemented. GMM tries to cluster observed various longitudinal trends into a number of latent patterns which comes from different sub-populations. For data collection, we used MS Excel 2007 software. SPSS 19.0 software was employed for descriptive statistics and GMM was fitted in Mplus 7.4 software. Entropy index was reported to show the quality of clusters membership and optimum number of patterns was obtained based on the likelihood ratio test (LRT). Due to low sample size of the study, none of the P-values were significant. Thus, the lower ones were taken into consideration as the best.

RESULTS

The total number of published scientific documents in the field of public, environmental and occupational health was 19499 in 2000, reaching 73455 in 2018 and indicating the annual growth of 7.65%. In 2000, the United States (US) had the higher level of contribution (35.48%) followed by United Kingdom (UK) and Germany with 10.77% and 4.52%, respectively. However, the US (with 24.25%), the UK (with 6.90%) and China (with 5.30%) gained the most contribution in 2018 year (Figure 1).

In order to better understand each country's growth, the annual change in the number of documents was reported in two periods, i.e. 2000 to 2009 and 2009 to 2018. As it is shown in Table 1, China, India, South Korea and Iran were the only countries which gained a better rank in both the aforementioned periods. Likewise, the rank of the US, UK and Australia did not show any change at all. Moreover, the Russian Federation was the only country that showed falling trend in the number of documents from 2000 to 2009 with the annual change of -7.1% [Table 1].

The estimated P-value of LRT and other fit indices are summarized in Table 2. The model with three patterns is introduced as a model with best fit. Moreover, the entropy of 1.00 indicates the excellent quality of clusters membership.

The growth mixture model showed that the identified patterns for the US and UK are different with the other countries. Both the observed and estimated linear trend of three obtained patterns are displayed in Figure 2. The corresponding intercept and slope for each linear pattern are reported in Table 3. Amounts of intercept shows the number of documents in 2000 in each pattern. The amount of linear slope indicated the annual growth in number of documents.

The first pattern of the published documents including Germany, Australia, Canada, Japan, France, Italy, Sweden, Netherlands, Brazil, Spain, India, the Russian Federation, Switzerland, Denmark, China, South Africa, South Korea and Iran had a slow growth with the mean annual increase of 74 documents. With the annual growth of 598 documents, the US had a very sharp rising trend and as the third identified pattern, the UK experienced a moderate growth with the annual increase of 156 documents in the field of public, environmental and occupational health from 2000 to 2018.

DISCUSSION

Clustering growth of research outputs among the top-ranking 20 countries in the field of public, environmental and occupational health via growth mixture curves showed three main patterns including: the USA with a tremendous rising trend, the UK with a moderate growth during the last decades and the other 18 countries comprised the other cluster with a slow annual increase in scientific outputs in the aforementioned fields.

In line with our findings, bibliometrics analysis in Europe over a ten-year period found that 6329 health-related articles were available on the PubMed database alone. Among the most popular topics, which account for about 73% of the above figure, we can mention the issue of work environment and health (2339), then the environment (1314) and environmental diseases (952) [2]. According to our findings, public health in the United States has not only been very strong and dominant, but the number of published articles has shown that it has grown significantly in recent years. The reason for this may be the increase in research budgets in this field, which has led to an increase in the quality and quantity of articles [15,16,6]. In the UK, the public health research system is very complex. However, the increase in the number of articles in recent years indicates an increase in cooperation between health research budgets and the four countries of the union [15,17].

The monitored raising trend in countries such as Canada, China, Germany and Brazil could be due to the increase in the budget of this field and economic growth [15,18,5]. Another study conducted in India shows a 42% increase in research in this field during the years 2000-2010. About 7893 articles have been published in this field [19]. The observed growth may be

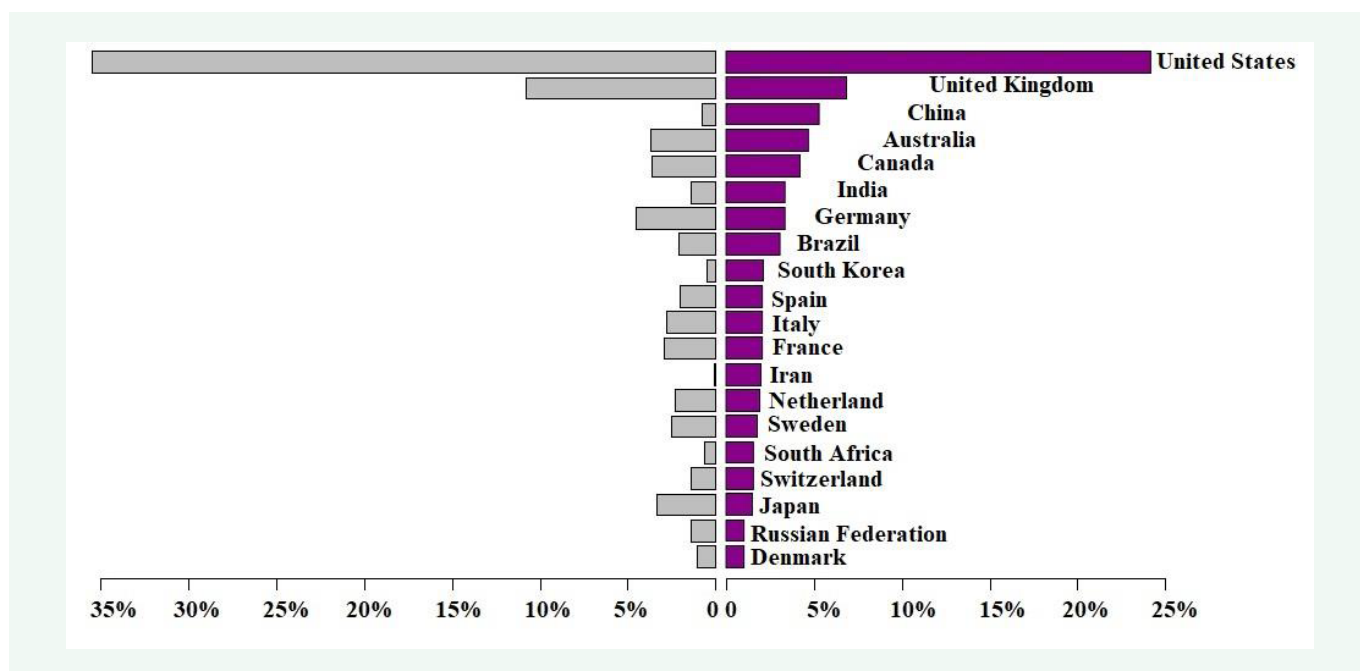


Figure 1 The percent of collaboration in the field of public, environmental and occupational health among the top-ranking 20 countries in 2000 (left) and 2018 (right).

Table 1. The annual change in the number of documents in the field of Public, environmental and occupational health

Country	Rank in 2000	Country	Rank in 2009	annual change	Country	Rank in 2018	annual change
United States	1	United States	1	+5.8%	United States	1	+5.0%
United Kingdom	2	United Kingdom	2	+5.6%	United Kingdom	2	+4.4%
Germany	3	Canada	3	+11.8%	China	3	+16.6%
Australia	4	Australia	4	+9.7%	Australia	4	+8.5%
Canada	5	Germany	5	+6.8%	Canada	5	+5.5%
Japan	6	Brazil	6	+15.2%	India	6	+11.9%
France	7	Italy	7	+8.7%	Germany	7	+4.9%
Italy	8	France	8	+7.5%	Brazil	8	+5.2%
Sweden	9	Spain	9	+11.6%	South Korea	9	+19.0%
Netherlands	10	China	10	+23.1%	Spain	10	+4.2%
Brazil	11	India	11	+14.2%	Italy	11	+3.2%
Spain	12	Netherlands	12	+8.1%	France	12	+3.7%
India	13	Japan	13	+3.6%	Iran	13	+15.4%
Russian Federation	14	Sweden	14	+6.3%	Netherlands	14	+5.6%
Switzerland	15	Switzerland	15	+8.1%	Sweden	15	+5.1%
Denmark	18	South Africa	16	+17.0%	South Africa	16	+10.4%
China	22	Denmark	19	+9.0%	Switzerland	17	+8.9%
South Africa	26	Iran	20	+47.6%	Japan	18	+2.6%
South Korea	30	South Korea	26	+15.8%	Russian Federation	19	+21.0%
Iran	73	Russian Federation	43	-7.1%	Denmark	20	+6.0%

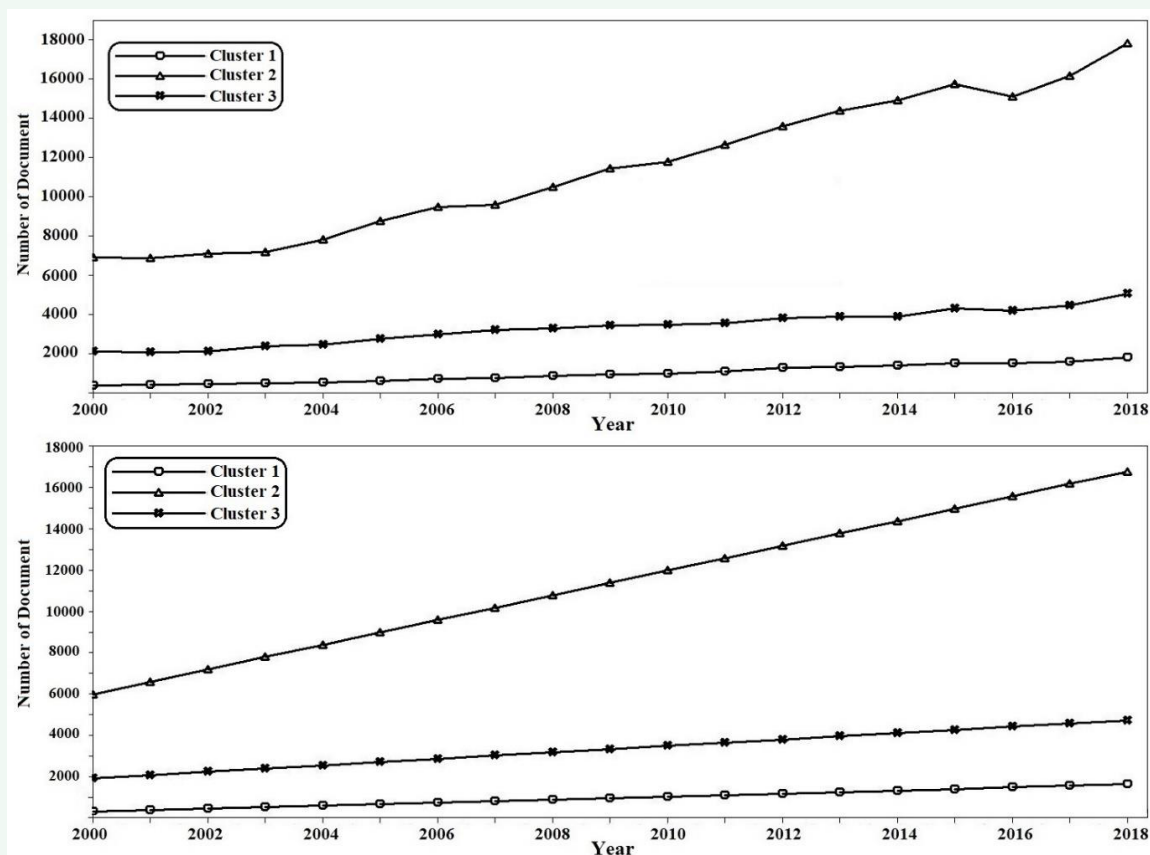


Figure 2 The actual observed (top) and estimated linear trend (bottom) of the patterns.

Table 2. Fit indices for different number of clusters

Fit indices	Number of cluster						
	1	2	3	4	5	6	7
AIC	1744	866	589	326	148	115	109
BIC	1765	890	616	356	181	151	147
SSBIC	1700	816	533	263	79	40	27
LRT P-value	---	0.18	0.10	0.32	0.65	0.59	0.73

Table 3. The intercept and slope of the estimated linear trend for each pattern

Pattern	Number of countries	Intercept		Slope	
		Estimate	SE	Estimate	SE
1	18	305	68	74	10
2	1	5990	93	598	12
3	1	1933	19	156	2

due to the increasing need for community health or as a results of efforts to enhance the different aspects of general health [20]. In Sweden, Switzerland, South Africa and Spain, the coordination and cooperation between research teams in this field has led to a significant increase in the publication of articles in various health journals in the last two decades [15,7,2,5].

A related study which observed the global activity in public health research from 1996 to 2010, indicates that the number of published articles in the field of public health increased

significantly over a three-year period from 63,571 (1996-2000) to 89,992 (2001-2005) and 158,938 (2006-2010). In the first period, Europe with the highest number of articles, i.e. 27688, has depicted a high level of activity in public health. Meanwhile, the United States shows a figure close to Europe, i.e. 25951. This pattern continues in the next two periods, with the number of articles published in Europe and the United States during 2006-2010 being 68,260 and 66,933, respectively. The lowest number of publications in the Eastern Mediterranean region in 2006-2007 were 820 [15]. The results of another bibliometrics study about South African environmental health articles showed a strong positive and significant correlation ($r^2=0.83$, $p<0.001$) between time and number of published articles during 1998 to 2015 [21].

The current study is the first one in term of comparing a bibliometric index in different countries via a professional statistical modeling. To obtain a better insight about the impact of each country in public, environmental and occupational health field, more investigation in another informative index such as citable documents, the number of articles in the top journals and number of citations using modern statistical analysis are highly suggested. Although the proportion of the US and UK's contribution in the production of documents shows

a considerable decrease, the proposed model confirms the fact that annual growths of the published documents in the field of public, environmental and occupational health in the US and UK are significantly higher than other countries in the field.

DATA AVAILABILITY STATEMENT

Dataset is freely available in the SCImago Journal & Country Rank website (www.scimagojr.com).

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