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Rotavirus – Global research density equalizing mapping and gender analysis

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ABSTRACT

Background: Rotaviruses are the leading reason for dehydration and severe diarrheal disease and in infants and young children worldwide. An increasing number of related publications cause a crucial challenge to determine the relevant scientific output. Therefore, scientometric analyses are helpful to evaluate quantity as well as quality of the worldwide research activities on Rotavirus.

Up to now, no in-depth global scientometric analysis relating to Rotavirus publications has been carried out. This study used scientometric tools and the method of density equalizing mapping to visualize the differences of the worldwide research effort referring to Rotavirus. The aim of the study was to compare scientific output geographically and over time by using an in-depth data analysis and New quality and quantity indices in science (NewQIS) tools. Furthermore, a gender analysis was part of the data interpretation.

Methods: We retrieved all Rotavirus-related articles, which were published on "Rotavirus" during the time period from 1900 to 2013, from the Web of Science by a defined search term. These items were analyzed regarding quantitative and qualitative aspects, and visualized with the help of bibliometric methods and the technique of density equalizing mapping to show the differences of the worldwide research efforts. This work aimed to extend the current NewQIS platform.

Results: The 5906 Rotavirus associated articles were published in 138 countries from 1900 to 2013. The USA authored 2037 articles that equaled 34.5% of all published items followed by Japan with 576 articles and the United Kingdom – as the most productive representative of the European countries – with 495 articles. Furthermore, the USA established the most cooperations with other countries and was found to be in the center of an international collaborative network. We performed a gender analysis of authors per country (threshold was set at a publishing output of more than 100 articles by more than 50 authors whose names could be identified in more than 50% of cases) showed a domination of female scientists in Brazil, while in all other countries, male scientists predominate. Relating the number of publications to the population of a country (Q1) and compared to the GPD (Q2), we found that European and African countries as well as Australia and New Zealand – not the USA – were among the top ranked nations.

Conclusion: Regarding rotavirus-related scientific output, the USA was the overall leading nation when qualitative and qualitative aspects were taken into account. In contrast to these classical scientometric variables, indices such as Q1 and Q2 enable comparability between countries with unequal conditions and scientific infrastructures helping to differentiate publishing quality and quantity in a more relevant way. Also, it was deduced that counties with a high rotavirus-associated child mortality, like the Democratic Republic of Congo, should be integrated into the collaborative efforts more intensively.

Abbreviations: DEMP, density equalizing map projections; GDP, gross domestic product; h-Index, Hirsch-Index; IF, impact factor; NewQIS, New Quality and Quantity Indices in Science; NIH, National Institutes of Health; OWSD, Organization for Women in Science for the Developing; UK, United Kingdom; USA, United States of America; WHO, World Health Organization; Wisat, Women in Global Science & Technology; WoS, Web of Science.

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1. Background

Worldwide, the family of Rotaviruses is the most common cause of severe digestive tract infections presenting in infants and young children with symptoms such as diarrhea, vomiting, fever, abdominal pain, loss of appetite and dehydration [1]. While most episodes are observed in young patients between three months and two years, older children and adults can also be affected [1,2]. Particularly in low-income countries, Rotavirus infections are associated with a high mortality of children less than five years old; in 2008, the condition was responsible for 453,000 deaths worldwide [1,3]. While more than 50% of the Rotavirus-associated child mortality can be observed in five countries (India, Pakistan, the Democratic Republic of Congo, Ethiopia and Nigeria), Rotavirus infections are rarely lethal in Europe, North America or Australia [1,3].

With an efficacy of up to 98%, the Rotavirus vaccination provides a safe way to protect children from severe infections [4]. Before vaccines were available in the United States of America (USA), the percentage of infected children younger than five years was almost 100% leading to approximately 70,000 hospitalizations per year. Nowadays, the frequent vaccine use prevents an estimated 40,000–50,000 annual hospitalizations [5].

Considering the existing high prevalence and morbidity of Rotavirus infections around the globe, we deduce the need to conduct further research in this field. To guide individual scholarship and to provide background information for all of those who are working on performance assessment in the field, evaluation of the vast global scientific activity becomes crucial but extremely challenging. In this context, scientometric analyses provide reliable tools, which allow the standardized, in-depth investigation of the worldwide research output. Up to now, no global scientometric analysis on "Rotavirus" exists. Hence, the objective of the study was to assess the worldwide scientific output regarding quantitative and qualitative aspects and to compare geographical and chronological developments. As part of the global NewQIS project, this study utilizes the NewQIS platform [9], which was established in 2009 [9] and validated in other studies (i.e. for yellow fever and influenza [10,11]). Here, scientometric methods and advanced visualizing procedures such as density equalizing mapping were combined to map the global Rotavirus research architecture [6–8]. Furthermore, we conducted a gender analysis of authors working in the field.

2. Methods

2.1. Data collection

For data collection, the Web of Science (WoS) Core Collection database of Thomson Reuters was employed. The search term "(rotavirus* OR "rota virus*" OR "rota infection*" OR (rota AND diarrhea*))" was inserted in the title.

The Boolean operators "AND" as well as "OR" were combined for limiting the search to publications of relevance and to minimize misidentifications. An asterisk was used as wild card for an undefined string of characters. To cover only original research on "Rotavirus", the document type filter "article" was applied and other document types such as letters or meeting abstracts were excluded from the search. The search was restricted for the time period of January, 1st 1900 to December 31st 2013, which ensures that only years completed by the time of the search were included in the analysis.

2.2. Data analysis

All identified publications were examined regarding quantity and quality of the research output; the number of publications was used as an indicator for the research quantity and the Hirsch-Index (h-Index), as described below, was used as an indicator for the quality [12,13]. Publications were further analyzed by calculating the total number of citations as well as the average citations per item (citation rate). Further, items were analyzed with respect to the publication date, country of origin or institution. The bibliometric information of the findings was listed in a separate database and depicted in diagrams using table sheets.

2.3. Analyses and parameters

2.3.1. Q-indices

To evaluate the scientific output of a specific country in relation to the number of citizens (Q1) and to the gross domestic product (GDP) of this country (Q2), two quotients were calculated based upon data published by The World Bank [14].

Definition of the indices:

Q1 Articles/population-index: number of articles/population in millions.
Q2 Articles/GDP-index: number of articles/GDP in millions.

2.3.2. Modified h-Index

The American physicist Hirsch developed the h-Index in 2005, which is a bibliometric tool for measuring an author's research productivity and particular impact on the scientific world [12,13]. An author with an index of *h* has published *h* papers, each of which has been cited at least *h* times [12,13]. In this study, we investigated a modified h-Index by applying the concept of the h-Index to the scientific output of specific countries in order to assess their quality of research on a global scale.

2.3.3. Gender analysis

In this study, the distribution of male and female authors who were participating in the publications referring to "Rotavirus" was analyzed. Online name databases were utilized to identify the gender of the authors [15,16]. Furthermore, a manual search (websites, corresponding addresses, social networks) was initialized to minimize the percentage of names that were hard to classify e.g. some first names were only quoted as initials or not gender specific (i.e. many Chinese names)

2.3.4. Cooperation analysis

The collaborations between countries and institutions were ascertained. A collaboration of at least two authors coming from two countries or institutions was defined as a cooperation. We created spider charts to illustrate our results and employed connecting vectors to visualize the collaborations between countries or institutions.

2.3.5. Journal analysis

The journals were analyzed quantitatively based on the amount of Rotavirus-related articles they published in the past, as well as qualitatively, based on the average citation rate those articles gained.

2.4. Subject areas

We also analyzed bibliographic details of identified articles regarding subject categories. Journals listed in the WoS are attributed to a standard category based on their area of expertise. These categories are assigned to every journal and its publications by the Journal Citation Reports. More than 200 subject categories exist, subdivided into different groups such as Life Sciences & Biomedicine, Physical Sciences, Technology, Arts & Humanities,

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