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Scientific Productivity in Neonates' Health Field in Scopus

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Abstract

Background
The Neonatal period is one of the most dangerous and vulnerable stages of life. The importance of neonates' mortality has led to national and international efforts, notably as research and scientific studies. However, different aspects and patterns of the scientific productivity in the field have not yet been studied. The present study aimed to investigate the scientific production in the field of "Neonates' health" in Scopus.

Materials and Methods
Using a scientometric method, the present study tries to identify and analyze a sample of 2,842 neonates'-health-related items indexed by Scopus during 1914 to 2014. After some preparation and refinement, the data were analyzed by Excel 2010, using descriptive and analytical statistics including frequency, percentile, and regression models ($P < 0.01$).

Results
The Neonates' Health field showed to be growing on an exponential basis. Its authorship pattern adheres to Lotka's law in that the number of authors decreases as their publications increase on a power basis. The field is revealed to be globally distributed, within a wide language variation and a wide range of countries. USA is the most prolific country in Neonates' Health. "The Pediatrics" journal ranks first among the fields' core journals. Research articles are the dominant document type, implying the field's research-oriented nature.

Conclusion
The field's exponential growth model and its adherence to Lotka's law mark its similarity to established science systems implying it to be establishing and sustaining its research realm. The language and geographical diversity of the Neonates' Health signifies the world's concerns for research in the field, though at a very low and unbalanced level. Consequently, the Neonates' Health seems to get progressively developed throughout the world. This promises an improvement in neonatal health and well-being in a not-far future.

***Key Words*:** Bibliometrics, Health, Neonate.

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1-INTRODUCTION

The Neonatal period is one of the most dangerous and vulnerable stages of life. Neonates' mortality in the first 24 hours of birth makes up the highest number of deaths. Five million neonates die each year in the world, with 96% occurring in the non-developed countries. The neonates' mortality rate has been reduced to five per thousand among the developed nations, while being 53 per thousand in the less developed ones. Immunization and controlling respiratory infectious diseases has reduced neonates' mortality rate. However, neonates' mortality still covers 61% of child deaths (1).

The increasing global awareness about the importance of minimizing neonates' mortality has led to national and international efforts. For example, four of the national health indicators are dedicated to neonates' health issues. These include neonates' mortality rate, and the incidence of neonates born with low weight, neonatal hypothyroidism and neonatal tetanus (2). In a similar vein, since 2000 various intervention strategies have been adopted to improve neonatal health (3). Several studies in developed countries like the US, the UK, Italy and Norway have been devoted to various aspects of neonatal health care including outcomes of planned home births with certified professional midwives (4), the role of neonatal hearing screening in the detection of congenital hearing impairment (5), managed care and technology adoption and health care (6), epidemiology of Neonatal Acute Respiratory Disorders (7), Neonatal outcomes in offspring of women with anxiety and depression during pregnancy (8). Scientifically proficient countries such as South Africa, Croatia and the Czech Republic and some developing countries such as Turkey (9) have carried out studies on the burden of disease from neonatal mortality (10), the causes of death in neonates (11) and Infant health and mortality indicators (12). Overall, the review of the literature indicated that various aspects of neonates' health are in the focus of many studies. However, our widespread research conducted in a wide variety of sources ranging from journals to web resources indicated no scientometric research in this field carried out to clarify the quantity and quality of its scientific performance. The only exceptions worth mentioning are some efforts done to provide a list of papers submitted and projects carried out by researchers in Neonatal Research Centers in Los Angeles (13), School of Pediatrics and Child Health in Australia (14), Maternal and Child Health Research Center in the UK (15), Neonatal Health Research Center at Shahid Beheshti University of Medical Sciences (16) and Mashhad University of Medical Sciences (17).

In fact, like many medical fields, the topic has been generally ignored by scientometricians, despite their importance and relevance to human health and well-being. Among the rare exceptions, one may notice the article about scientific productivity in the field of "Patients' rights" revealing the field to be similar to other established science systems in terms of its exponential growth, worldwide concerns, and its research-oriented nature (18). Consequently, due to the lack information about scientific productivity in neonates' health, it is not clear if it is developing and emerging as a sustainable science system. Given the importance of research and development in the field of neonates' health, it is necessary to evaluate its scientific performance in order to monitor its formation and development towards a science system.

The main aim of the present study was to explore the scientific productivity patterns in neonates' health. The results may help reflect the knowledge progress and its patterns and highlight the weaknesses and strengths and thereby be useful in

managing and planning research & development in the field.

2- MATERIALS AND METHODS

The present study applies a scientometric method to investigate a sample consisted of all scientific items published on neonates' health and indexed in Scopus until 2014. It covers an era about a century (from 1914 to 2014). In order to identify the publications, an advanced search was conducted in Scopus in February 2015. In order to ensure that relevant records have been identified as comprehensively as possible, the following search formula was used:

Terms of (Neonat* Health*) OR (Newborn infant* Health*) OR (Newborn baby* Health*) OR (Newborn* Health*) which includes all probable forms and synonyms of "Neonates' health" concept in English. Finally, 2,842 records were identified and then analyzed by Excel. The data were analyzed using descriptive statistics (frequency and percentage) and analytical statistics (regression analyses).

To achieve the research aims, we attempt to assess the quantity and the growth of scientific items published on the topic. A research field with a sustainable pattern of scientific productivity was expected to exhibit an exponential growth model, no matter how big its initial size (19-21). Besides, its authorship pattern was expected to follow a power model, signifying that the contributing authors differ widely in their shares, according to Lotka's inverse square law (22-23). Furthermore, by examining the contributing countries and languages, efforts will be paid off to make clear worldwide contributions to the field. Most productive authors and journals, and document types will also be evaluated. Evaluating the document types such as research papers, letters, notes, reviews, news, meeting abstracts and so on may reflects the nature of scientific activities in this field – as being research oriented or theoretical and descriptive. In a scientific discipline, with a research concentration, it is obviously expected to observe the four first document types to be prevalent.

In brief, the important features of scientific productions including growth model, authorship pattern, language and geographical diversity, core journals, and document types are in the focus of the present study.

3- RESULTS

As mentioned above, the research results showed that 2,842 records on neonates' health have been indexed in Scopus from 1914 to 2014. The verification of the data show that research in the field starts in 1914 with just two articles and fluctuates in subsequent years, so that in several next years there is no research indexed in the database on the topic. The maximum number of papers in the field reaches 193 records (6.79%) in 2014. In spite of the scarce number of the papers in the field, they are revealed to exhibit a high annual growth rate based on the following formula:

[Growth Rate = $(N_j - N_i) / N_i \times 100 = 9550\%$].

Where $\mathbf{N_i}$ and $\mathbf{N_j}$ are the numbers of scientific productions in the first and last year, i.e. 1914 and 2014 respectively.

As of 1951, research on the topic seems to tend to get more consistent and sustained. The papers are still small in number in the period between 1951- 1996 (**Figure.1**).

One might attribute the scarcity in research on the topic to defects in Scopus coverage which is not comprehensive for the literature prior to 1996. Looking at the scatter plot of the data from 1950 to 2014, we find that scientific production in this field has been consistently increasing nonstop. Consequently, one may claim that scientific production in the field has started in early 50s and has been systematically

growing since then, although the sheer number of the publications is not reliable per se, due to the deficiencies in Scopus coverage till 1996.

2-1. Growth Model

Regression analysis is used, in order to study the significance and the model of the field's growth. Given the incompleteness of Scopus coverage for the years before 1996, the analysis is limited to the period from 1996 to 2014. The scatter plot of the data and the best fit model are illustrated in (**Figure.2**).

As seen, the exponential growth model best fits the data distribution. According to the determination coefficient yielded, almost 94% of the variance of the scientific productions can be predicted on the basis of the publication year (R^2=0.935).

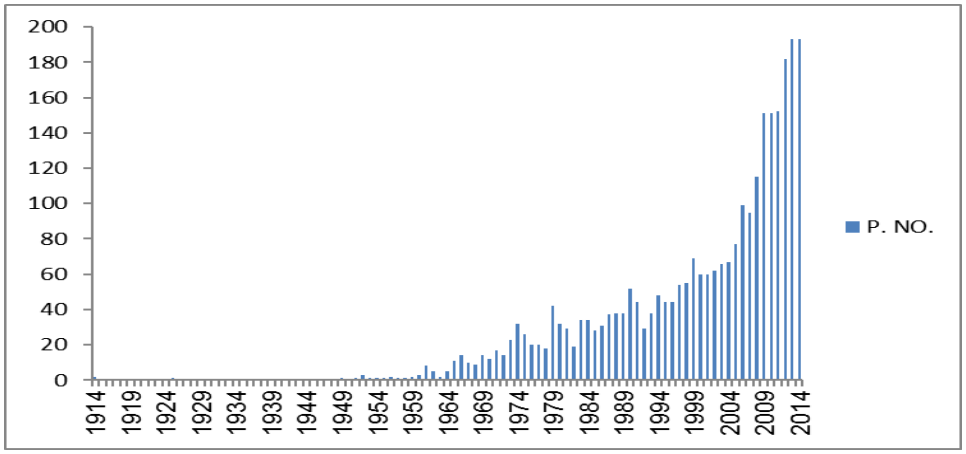

Fig 1: Neonates' Health Papers during 1914 to 2014 Years

The high determination coefficient (R^2=0.935) and the insignificant correlation between the predicted and residual values of the model (R^2=0.000, F=375.44, P-value =0.001) confirm the exponential model as the best fit for the growth trend in the field. Also, visual examination of the data distribution around the curve shows how fit the exponential model is. However, given the exponent of the model (n=0.084) being very small, it can be concluded that scientific products in the field of neonates' health has been increased slightly more than 100 percent every year,

$$\left(e^{0.084x} / e^{0.084(x-1)} \times 100 = 100.05\right).$$

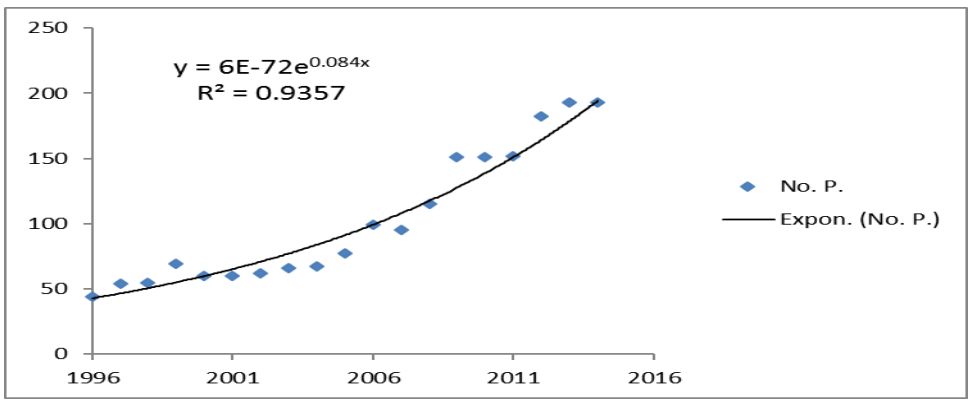

Fig.2: Exponential Growth of Neonates' Health Field

2-2. Authors and Authorship Model

Examination of authors indicates that 1,411 authors contribute in the publications as authors or co-authors. Given the high rate of co-authorship in the field, the number of contributions gets to 3,857 which exceed the absolute number of papers (2,842 unique titles) (**Table.1**).

Gary L. Darmstadt, with 30 (0.78%) articles, is the most prolific author in the field, followed by Zulfiqar A. Bhutta who ranked second with 25 contributions. Abdullah H. Baqui and Robert E. Black, with 20 articles each ranked third. Robert D. Christensen with 18 articles, ranked next (**Table.1**).

Table 1: The Most Prolific Neonates' Health Contributors

Rank	Authors	No. of contributions	Cumulative Percent
1	Darmstadt G.L.	30	0.78
2	Bhutta Z.A.	25	1.43
3	Baqui A.H.	20	1.94
4	Black R.E.	20	2.46
5	Christensen R.D.	18	2.93
6	Henry E.	17	3.37
7	Costello A.	14	3.73
8	Souza J.P.	14	4.10
9	Wright L.L.	13	4.43
10	Santosham M.	12	4.74
11	Lassi Z.S.	11	5.03
12	Menzel K.	11	5.32
13	Wiedmeier S.E.	11	5.60
14	Winberg J.	11	5.89
15	Paul V.K.	10	6.14
16	Prost A.	10	6.40
17	Vogel J.P.	10	6.66
Other 1,393 authors		3,600	93.34
Total		3,852	100

Table.2 summarizes the frequency of papers versus the number of their contributing authors. As seen, the numbers of contributions are diminishing as their authors increase in number. In other words a big portion of the publications in the field are created by a small number of authors. Consequently, it seems that the field productivity adheres to Lotka's Law.

Table 2: The Frequency of Papers and Contributing Authors

NO.	Paper NO.	Author NO.	NO.	Paper NO.	Author NO.
1	30	1	11	9	12
2	25	1	12	8	8
3	20	2	13	7	10
4	18	1	14	6	12
5	17	1	15	5	47
6	14	2	16	4	99
7	13	1	17	3	245
8	12	1	18	2	960
9	11	4	19	1	7875
10	10	3			

The Lotka's inverse square law states the number of authors publishing a certain number of articles is a fixed ratio to the number of authors publishing a single article, based on the formula:

$$X^nY = C \text{ or } Y = C/X^n$$

Where **Y** is the number of papers, **X** determines the number of authors and **n** and **C** are constants which vary depending on the related discipline. Also, **n** is found to approximate 2 in certain fields (22-23).

In order to test the adherence of the field's productivity pattern to Lotka's Law, a power model of regression is carried out. As seen in (**Figure.3**), the power law best fits the data distribution, with a high degree of predictability (R^2= 0.93). According to the model, the number of publications can be predicted based on the equation:

$$Y = 4303.3 \times X^{-2.861} = \frac{4303.3}{X^{2.861}}$$

As seen, the exponent yielded (n=2.86) is greater than 2, which is generally observed and reported in previous literature.

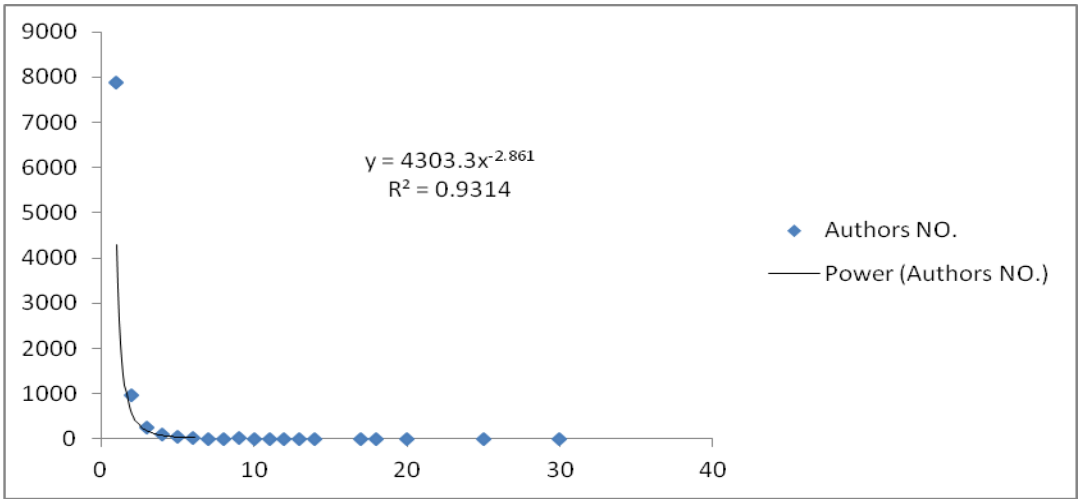

Fig 3: The Power Law Distribution of Authors No. vs. Papers No.

2-3. Contributing Countries

The verification of the authors' affiliations reveals that, in total, 108 countries contribute in scientific production in the field. This variety in the contributing countries indicates the worldwide spread, as well as global concerns and sensibilities toward the neonates' health. **Table.3** shows the ten top participating countries. As expected, the United States ranked first regarding its scientific contribution to the field. The United Kingdom, Germany, Italy and Canada ranked second to fifth, respectively. These five countries accounted for about half of the total scientific productions (43.28%). As seen, almost all the scientifically leading countries are among the developed countries. India and Brazil, being from the scientifically proficient block (9), are the only exceptions, ranking 6th and 7th, respectively. As expected from the meager size of the field, the countries' shares in their total publications are negligible. However, Brazil and Switzerland devoted higher portions of their papers to the field (0.014 and 0.01 percent respectively). All of the countries are found to have a per capita value less than one, signifying the low rate of productivity of the researchers being active in the field.

Table 3: The Most Prolific Countries in Neonates' Health in Scopus

Rank	Country	Percent		In the country's total publication	Per Capita
		No. of contributions	In the field		
1	USA	658	23.15	0.005	0.27
2	UK	201	7.07	0.006	0.34
3	Germany	153	5.38	0.005	0.28
4	Italy	115	4.05	0.007	0.22
5	Canada	103	3.62	0.006	0.22
6	India	97	3.41	0.008	0.30
7	Brazil	91	3.20	0.014	0.25
8	France	77	2.71	0.004	0.28
9	Australia	72	2.53	0.006	0.39
10	Switzerland	70	2.46	0.01	0.36

2-4. Core Journals

Scientific journals are among the most formal channels for information communication. It is important to identify the core journals publishing the highest portion of the publications in every field.

The verification of the journals publishing the Neonates' Health related papers shows that "the Pediatrics", with 82 articles ranks the first core journal, as it published the highest number of articles.

The "Voprosy Okhrany Materinstva i Detstva" and the "Journal of Perinatology" ranked second and third, respectively (with 42 and 41 articles, respectively).

Furthermore, the "Acta Paediatrica: International Journal of Pediatrics" and the "Pediatriya - Zhurnal im G.N. Speranskogo" ranked fourth (34 articles each). Expectedly, all the core journals were pediatrics-related journals. There are some journals specifically dedicated to neonates (**Table.4**).

2-5. Document Types

Given the importance of research, it is important to verify how research-oriented the nature of the knowledge is in the field. To do so, we evaluated the document types. The results indicated that the scientific products on Neonates' health were mostly issued in Article format (2,220 items accounting for 78.11 percent of the total publications). Reviews (with 203 acounting for 7.14% of the documents) and Letters (with 89 accounting for 3.13% of the total documents) were ranked second and third, respectively.

In sum, research articles, reviews, letters and research notes which are the research-intensive document types collectively encompass 2,572 titles (accounting for 90.50%) of all the papers on the topic, signifying that the nature of scientific activities in the field is more research-inclined.

2-6. Languages

Despite being small, the field varies in terms of the languages used, so that the documents are written in 27 languages. English, Russian, German and Spanish rank first to fourth, respectively (**Table.5**).

As expected, the number of publications in English is considerably larger than in other languages (77.48%), this is despite the fact that SCOPUS is relatively less inclined to use English compared to Thomson Reuters databases (**Table.5**).

Table 4: The Journals with Specific Titles on Neonates' Issues

Rank	Journal	Records
1	Biology of the Neonate	21
2	Newborn and Infant Nursing Reviews	9
3	Biology of the Neonate - Fetal and Neonatal Research	2
4	Infant Mental Health Journal	2
5	Journal of Sudden Infant Death Syndrome and Infant Mortality	2
6	Avery's Diseases of the Newborn (Ninth Edition)	1
7	Revista Brasileira de Saude Materno Infantil	1

Table 5: The Languages Mostly Used in Writing Scientific Productions on Neonates' Health

Rank	Language	Records	Percent	Rank	Language	Records	Percent
1	English	2,202	77.48	6	French	49	1.72
2	Russian	153	5.38	7	Polish	44	1.55
3	German	100	3.52	8	Portuguese	32	1.13
4	Spanish	89	3.13	9	Czech	15	0.53
5	Italian	54	1.90	10	Dutch	15	0.53

4- DISCUSSION

The present study reflects the overall picture of the state of the art of the scientific performance in neonates' health. The findings indicate that 2,842 records are published in the field till 2014. The maximum number of documents is issued during 2009 to 2014. The scientific productivity trend in Neonates' Health follows an exponential model. These findings reveal that the field's scientific performance pattern resembles that of the established science systems (20-21).

Given the small size of the field, the significant growth promises an improvement in neonatal health and well-being in a not-far future. In comparison to "patients' rights" field, which is relatively new and small in size, the growth model in this field follows a more steady and less fluctuating pattern (R^2=0.93 in comparison to R^2=0.79) (18). According to the equations, in both fields the papers are annually increasing at approximately the same rate (n=0.084 in comparison to n=0.071). Another similarity of the field to established science systems is its adherence to Lotka's law regarding its authorship patterns, as the number of authors diminishes on a power basis as their contributions increase. The documents are written in a variety of 27 languages. English is the dominant language in the field as observed in many disciplines (24-26), but not the only one as rarely noticed in some other ones (27). This is due to the fact that English is the dominant language in the science world and also in both the United States and Great Britain as the top nations contributing to the field. Although, 108 countries are found to (co)author the papers, the two nations as the most scientifically prolific countries (24-25, 28-29) gain the lion shares of the contributions on neonates' health, too. In spite of the language and geographical variety, the top ranked contributing countries are all from the scientifically developed and proficient blocks. This would mark unbalanced research situation and a widening gap in health and well-being inequalities throughout the world.

The articles are shown to be widely distributed among a large number of journals. The "Pediatrics" journal, with the highest portion, ranks first. Interestingly,

along with the core journals, there are some journals specifically dedicated to neonates' issues. The field is revealed to be mostly research-inclined as reflected by the document types and as expected by the high coverage of research journals in the database (24-25, 29). However, comparison of this field with patients' rights in terms of their document types shows that science production in this field is more research-oriented. Although both fields include research in most cases, research-intensive document types are more widely used in neonates' health field (90.50%) compared to the latter (77.99%).

5- CONCLUSION

According to the findings of the present study, the neonates' health seems to get progressively established and stabilized throughout the world, in that it exhibits many similarities to established scientific systems: the exponential growth of the papers, their language diversity, global distribution, and specially its research-intensive nature signify the development of the field as a research realm. In spite of the significant and consistent growth pattern, the field is still low as regards the quantity of its scientific papers. Further research is required to explore the quality of the papers as reflected in the citations received, the relations with other fields and collaboration patterns.

6- CONFLICT OF INTEREST: None.

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