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RESEARCH

Global bibliometric analysis of publications on COVID-19 in newborns

Yenidoğanlarda COVID-19 ile ilgili yayınların küresel bibliyometrik analizi

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Abstract

Purpose: Though there are gaps in the relationship between COVID-19 and newborns no bibliometric analysis was published until now. This study aims to perform a bibliometric overview of literature of the relationship between newborns and COVID-19 in order to guide future studies addressing the same problem.
Materials and Methods: Web of science was used to scan the published literature on newborns & COVID-19 by searching studies with and bibliometric networks were visualized by VOSviewer software. COVID-19, SARS-CoV-2, 2019-nCoV with perinatal, neonatal, newborn and infant were used as keywords.
Results: 912 keyword-coherent publications were found in the period 1970-2021, (491; 54.43% high quality studies) mostly about pediatrics and obstetrics gynecology with most frequent keywords; COVID-19, Sars-Cov-2, Pregnancy, Vertical Transmission and Newborn. United States, China, England and Italy have the highest number of studies as well as highest number of citations. COVID-19 on neonatal outcomes and pregnancy had highest citation.
Conclusion: Scientific network monitoring via bibliometric analysis is crucial and proved highly beneficial during COVID-19 crisis. Despite the articles on COVID-19 & newborn have a decent number of citations, it vastly lower compared to the other studies about adults or clinical features and should be increased while it is still early.

Keywords:. COVID-19, bibliometric analysis, newborn, neonates, infant

Öz

Amaç: COVID-19 ile yenidoğanlar arasındaki ilişkide eksik noktalar olmasına rağmen şu ana kadar hiçbir bibliyometrik analiz yayınlanmamıştır. Bu çalışma, aynı sorunu ele alan gelecekteki çalışmalara rehberlik etmek amacıyla yenidoğanlar ve COVID-19 arasındaki ilişkinin literatürüne bibliyometrik bir genel bakış yapmayı amaçlamaktadır.
Gereç ve Yöntem: Yenidoğanlar ve COVID-19 ile ilgili yayınlanmış literatürü taramak için Web of Science kullanıldı ve bibliyometrik ağlar VOSviewer yazılımı ile görselleştirildi. Anahtar kelime olarak COVID-19, SARS-CoV-2, 2019-nCoV ile perinatal, neonatal, yenidoğan ve infant kullanıldı.
Tartışma: 1970-2021 döneminde 912 anahtar kelime uyumlu yayın bulundu (491; %54.43 yüksek kaliteli çalışma), bunların çoğu pediatri ve obstetrik jinekoloji ile ilgili olup bu yayınlarda en sık kullanılan anahtar kelimeler; COVID-19, SARS-CoV-2, Gebelik, Dikey Bulaş ve Yenidoğan idi. Amerika Birleşik Devletleri, Çin, İngiltere ve İtalya en fazla çalışmaya ve en fazla atıf sayısına sahipti. Yenidoğan sonuçları ve gebelik üzerine COVID-19 en yüksek alıntıyı aldı.
Sonuç: Bibliyometrik analiz yoluyla bilimsel ağ izleme çok önemlidir ve COVID-19 krizi sırasında oldukça faydalı olduğu kanıtlanmıştır. COVID-19 ve yenidoğan ile ilgili makalelerde yeterli sayıda alıntı bulunmasına rağmen, yetişkinler veya klinik özelliklerle ilgili diğer çalışmalara kıyasla çok daha az sayıdadır ve erken dönemde artırılması gerekmektedir.

Anahtar kelimeler: COVID-19, bibliyometrik analiz, yenidoğan, neonatal, bebek

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INTRODUCTION

Despite the fact that newborns are less likely experience the severe complications of COVID-19 disease, they are also get ill from it. However, other strains of the virus such as the alpha, beta, gamma and delta variants, which have been underlined by the World Health Organization, may cause more severe complications even in younger patients[1]. The severity of the illness is not always directly proportional with the permanent long-term effects. It was reported that even asymptomatic patients struggle from the permanent organ damage and/or cardiovascular complications[2]. Thus, it is crucial to prevent COVID-19 from spreading through schools. It has been known that even after recovery from COVID-19, numerous long-term health problems such as myocardial inflammation, myocardial infarction, ventricular problems and other cardiovascular complications has been observed[3]. Moreover, neurological complications such as structural deformations in the cerebral cortex has also been underlined in another study[4].

The influence and effectiveness of scientific publications can be determined by bibliometric studies. With these studies, the most productive authors, countries or affiliations on certain topics can be identified. Bibliometric analysis can be used in many areas such as medicine[5,6]. In bibliometric studies, bibliometric databases, theses or any type of documents can be examined and the results are discussed in terms of study impact on future research and innovations[7]. Bibliometric analysis generally based on the citation numbers of the selected articles in order to perform a comparative analysis[8]. Web of science (WOS) is one of the most accepted database for bibliometric analysis. The WOS database launched in 1997 was the only database for bibliometric studies until the year 2004 when Scopus and Google Scholar were released[9]. The WOS database covers Emerging Sources Citation Index (ESCI), Science Citation Index (SCI) and Science Citation Index Expanded (SCI-E) studies and it is conventional to many official organizations thanks to its accuracy and reproducibility.

There are still several question marks about the relationship between COVID-19 and newborns. However, no publications regarding bibliometric analysis on Newborns &COVID-19 has been published till now. As the COVID-19 pandemic has not been fully under control and more knowledge should be obtained from these reference, bibliometric analysis of it is in critical need. Therefore, we sought to give a bibliometric overview of literature on "COVID-19" in the newborns as soon as possible to provide a broad understanding of the relationship between Newborns and COVID-19. Moreover, due to the fact that there is little knowledge about the subject, this study also aims to guide future studies addressing the relationship between newborns and COVID-19 pandemic.

MATERIALS AND METHODS

The study was conducted in accordance with the ethical principles stated in the Declaration of Helsinki and approved by Cukurova University Non-Interventional Clinical Research Ethics Committee (Date of Approval: 13/10/2023; Decision No: 12).

A bibliometric method was conducted to analyze the publications on newborns &COVID-19. The global published literature on newborns &COVID-19 was scanned in the WOS core collection database[10]. The keywords for the search in the title bar were "COVID-19" or "SARS-CoV-2" or "2019-nCoV" and "perinatal" or 'neonatal" or 'Newborn' or 'Infant' 'Neonate' which was used as the keyword in the title. The search language was English. For each publication, the total number of citations as well as the average number of citations per item were calculated (citation rate). The publishing date, place of origin, and institution of the items were also investigated. The bibliometric data from the findings was kept in a separate database and visualized using table sheets. Preprint articles translated versions of articles reviews, comments, letters and editorials and duplicated literature were excluded from the analysis as these studies lack methodology and scientific quality to include in the analysis.

The information for the documents that meet the requirements contained year of publication, language, journal, title, author, themes, affiliation, keywords, document type, abstract and counts of citation which were exported into CSV format. The date of the retrieval was 15th June 2022. VOSviewer (version 1.6.18)[11] was used to analyze the Citation, Co-authorship, Co-occurrence and Co-citation. Moreover, there have been identified collaborations between countries and institutions. A partnership was defined as an effort involving at least two authors from two distinct countries or institutions. We used

linking lines to highlight our findings and show the collaborations between countries or institutions.

Statistical and mapping analysis

The Wos database's Results Analysis and Citation Report were used to analyze the number of publications in various viewpoints, such as years, journals, and authors. To visualize country collaboration networks and keywords, the VOSviewer 1.6.18 for Microsoft Windows systems program was used. We created co-occurrence networks from the obtained publications' bibliographic metadata (e.g., affiliations, citations and keywords).

RESULTS

General features

The search included the publications in the period between 1970 and 2022. Unpublished articles were excluded from the study. Firstly, by using the keywords 1057 publications were founded from search query. 601 (56.86%) of them articles and we only analyzed the articles as their scientific quality is higher than other publications. The first article named "Using ICT to research maternal, newborn and child health during the COVID-19 pandemic in Nigeria" and it was published in the year 2020. 51.75% of the articles were published in the year 2021. Most of the articles were published in SCI-E (n= 446, 74.21%) and Social Sciences Citation Index (SSCI) (n=154, 25.62%) indexed journals.

Table 1. The mostly preferred keywords.

Keyword	Occurrences	Total link strength
COVID-19	330	1363
Sars-Cov-2	112	565
Pregnancy	94	451
Newborn	52	215
Pandemic	41	223
Vertical transmission	40	183
Neonate	37	147
Coronavirus	34	157
Breastfeeding	33	155
Perinatal	19	114

Research areas

The majority of the retrieved articles were from research areas of Pediatrics (n=196; 39.91%), followed by Obstetrics Gynecology (n=93; 18.94%), General Internal Medicine (n=68; 13.84%), Infectious Diseases (n=40; 8.14%), Public Environmental Occupational Health (n=39; 7.94%) and the rest was various areas.

Keywords

The mostly preferred keywords used in the selected articles were COVID-19, Sars-Cov-2, pregnancy, pandemic, newborn and vertical transmission. The visualization map of the keywords of the articles was given in Figure 1a and Table 1.

Published countries

The articles were from 103 different countries. The leading country on journal number is the United States of America (USA) (n=180; 29.950%), followed by England (n=55; 9.151%), The People's Republic of China (PRC) (n=53; 8.819%), India (n=50; 8.319%) and Italy (n=43; 7.155%) (Table 2).

Published affiliations

The League of European Research Universities (LERU) (n=47, 7.820%) was the most productive affiliation on COVID 19 & newborn research. Harvard University, University of London, Huazhong University of Science Technology and Harvard Medical School also in top 5 affiliations on COVID 19 & newborn research (Table 2). The papers co-authored by authors from more than one country were classified as "international collaborations". International collaboration network map visualized in (Figure 1b) International collaboration analysis for active countries which has to have at least 1 document, using the VOSviewer technique showed that there were clusters of international collaboration. (Figure 1b).

Funding agencies

The most of the main funding agencies were from the USA and Europian countries (Table 3).

Publishing journals

The most of the articles were published in International Journal of Environmental Research and Public Health (n=16, 2.662%), Frontiers in Pediatrics (n=15, 2.496%) and The Journal of Maternal-Fetal &Neonatal Medicine (n=15, 2.496%) journals (Table 3).

Table 2. The countries and affiliations having more than 10 published articles on COVID-19 & newborn

Countries/Regions*	**Frequency**	**% of 601**
USA	180	29.950
England	55	9.151
Peoples R China	53	8.819
India	50	8.319
Italy	43	7.155
Canada	35	5.824
Turkey	35	5.824
Australia	32	5.324
Iran	32	5.324
Spain	28	4.659
France	23	3.827
Israel	21	3.494
Brazil	18	2.995
Germany	16	2.662
Netherlands	15	2.496
Nigeria	15	2.496
South Africa	13	2.163
Japan	12	1.997
Switzerland	12	1.997
Belgium	11	1.830
Ireland	11	1.830
Austria	10	1.664
Norway	10	1.664
Pakistan	10	1.664
Peru	10	1.664
Affiliations**	**Record Count**	**% of 601**
League of European Research Universities Leru	47	7.820
Harvard University	27	4.493
University of London	24	3.993
Huazhong University of Science Technology	22	3.661
Harvard Medical School	18	2.995
University of California System	18	2.995
University College London	14	2.329
University of Pennsylvania	14	2.329
University of Toronto	14	2.329
Childrens Hospital of Philadelphia	12	1.997
Columbia University	12	1.997
Johns Hopkins University	12	1.997
Stanford University	12	1.997
Udice French Research Universities	12	1.997
University of Colorado System	12	1.997
University of North Carolina	12	1.997
Sackler Faculty of Medicine	11	1.830
Tel Aviv University	11	1.830
University of North Carolina Chapel Hill	11	1.830
University of Texas System	11	1.830
University of Washington	11	1.830
University of Washington Seattle	11	1.830
Assistance Publique Hopitaux Paris Aphp	10	1.664
Boston Children S Hospital	10	1.664
Northwestern University	10	1.664

*Showing 25 out of 103 entries, 5 record(s) (0.832%) do not contain data in the field being analyzed.
**Showing 25 out of 1.690 entries, 5 record(s) (0.832%) do not contain data in the field being analyzed

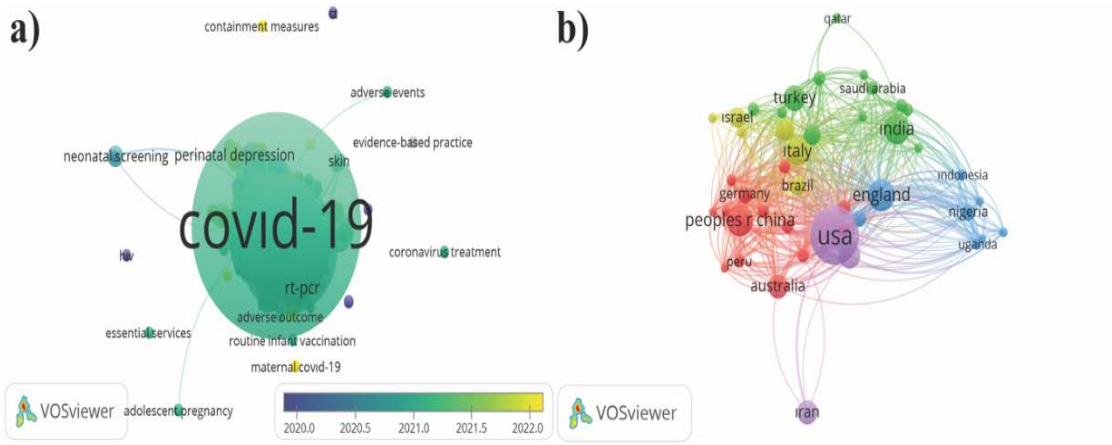

Figure 1. Network visualization map of the keywords of articles and co-authorship among countries with a minimum of one publication. a) Map of the keywords of articles. Lines connecting are indicative of occurrence relations in articles. Keywords represented with larger circle size or font size had relatively more occurrence in the articles. b) Co-authorship among countries. Lines connecting countries are indicative of collaboration. Thicker lines indicate stronger collaborations. Countries represented with larger circle size or font size had relatively more international collaboration.

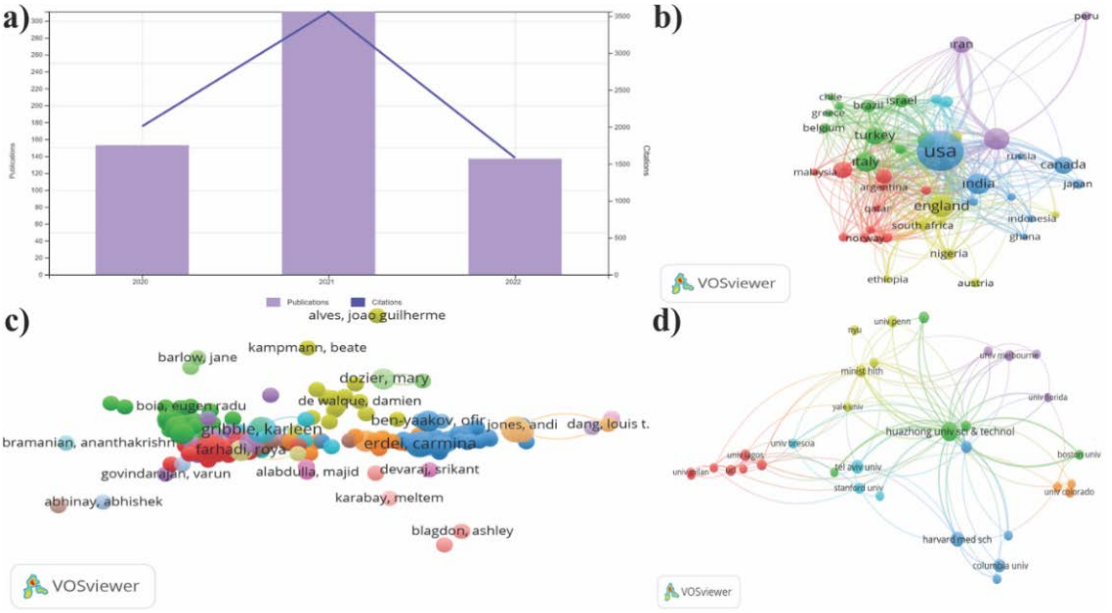

Figure 2. The number of publications and citing visualization maps. a) publications and citing status over the years. First six months of 2022. Line express the cite number. b) Network visualization of citation map among countries with a minimum of five publications. Lines connecting countries are indicative of collaboration. Thicker lines indicate stronger collaborations. Countries represented with larger circle size or font size had relatively more international collaboration. c) Citation visualization map among authors. Lines connecting countries are indicative of citation. Authors represented with larger circle size or font size had relatively more citation. d) Citation visualization map among affiliations. Line express the cite number.

Table 3. Main funding agencies and the list of mostly publishing journals on COVID & newborn

Funding Agencies*	**Record Count**	**% of 601**
United States Department of Health Human Services	35	5.824
National Institutes of Health USA	33	5.491
European Commission	11	1.830
Nih Eunice Kennedy Shriver National Institute of Child Health Human Development	11	1.830
Medical Research Council UK	9	1.498
UK Research Innovation	9	1.498
National Natural Science Foundation of China	8	1.331
Bill Melinda Gates Foundation	6	0.998
Cgiar	5	0.832
National Health And Medical Research Council Nhmrc of Australia	4	0.666
Publishing journals**	Record Count	% of 601
International Journal of Environmental Research And Public Health	16	2.662
Frontiers In Pediatrics	15	2.496
Journal of Maternal Fetal Neonatal Medicine	15	2.496
Bmc Pregnancy and Childbirth	13	2.163
Pediatric Infectious Disease Journal	13	2.163
Journal of Perinatal Medicine	11	1.830
Cureus Journal of Medical Science	10	1.664
European Journal of Pediatrics	10	1.664
Bmj Open	9	1.498
Infant Mental Health Journal	9	1.498
Journal of Clinical Medicine	9	1.498
Journal of Perinatology	9	1.498
Acta Paediatrica	8	1.331
American Journal of Perinatology	8	1.331
Journal of Tropical Pediatrics	8	1.331
Plos One	7	1.165
BMJ Global Health	6	0.998
Children Basel	6	0.998
Cureus	6	0.998
BMJ Case Reports	5	0.832
Indian Pediatrics	5	0.832
International Journal of Gynecology Obstetrics	5	0.832
Clinical Pediatrics	4	0.666
Iranian Journal of Neonatology	4	0.666
JAMA Pediatrics	4	0.666

*Showing 10 out of 322 entries,405 record(s) (67.388%) do not contain data in the field being analyzed
**Showing 25 out of 308 entries

Citing analysis

A total of 601 articles had an average of 11.9 and total of 7151 citations. The number of publications and citing status of the articles over the years, among countries with a minimum of five publications, among authors and among affiliations were given in Figure 2a, 2b, 2c and 2d, respectively. The mean of Hirsch (H) index was found as 35 (Table 4). The first article (Using ICT to research maternal, newborn and child health during the COVID-19 pandemic in Nigeria) did not have any citation. Huaping Zhu from China was the most cited author with 484 citations. The list of the most cited articles were given in Table 4.

Table 4. The comparison of number of publications, number of citations, H-indexes, Number of average citation per items of the top 5 publishing countries and the summary of most cited articles

Country	**Number of publications**	**Number of citation**	**H index**	**Average citation**
Total	601	7151	35	11.90
The USA	180	3016	22	16.76
England	55	825	13	15.00
The People's Republic of China	53	2384	16	44.98
India	50	433	9	9.66
Italy	43	540	11	12.56
First author, year	**Article name**	**Journal**	**Average cite per year***	**Total**
Zhu et al. ,2020	Clinical analysis of 10 neonates born to mothers with 2019-nCoV pneumonia	Translational Pediatrics	161.33	484
Schwartz and Graham , 2020	Potential Maternal and Infant Outcomes from Coronavirus 2019-nCoV (SARS-CoV-2) Infecting Pregnant Women: Lessons from SARS, MERS, and Other Human Coronavirus Infections	Viruses-Basel	152.67	458
Schwartz, 2020	An Analysis of 38 Pregnant Women With COVID-19, Their Newborn Infants, and Maternal-Fetal Transmission of SARS-CoV-2	Archives Of Pathology & Laboratory Medicine	142.67	428
Yu et al. ,2020	Clinical features and obstetric and neonatal outcomes of pregnant patients with COVID-19 in Wuhan, China: a retrospective, single-centre, descriptive study	Lancet Infectious Diseases	135.67	407
Villar et al. ,2021	Maternal and Neonatal Morbidity and Mortality Among Pregnant Women With and Without COVID-19 Infection The INTERCOVID Multinational Cohort Study	JAMA Pediatrics	103.5	207
Edelson et al. ,2020	Interim Guidance for Basic and Advanced Life Support in Adults, Children, and Neonates With Suspected or Confirmed COVID-19 From the Emergency Cardiovascular Care Committee and Get With The Guidelines-Resuscitation Adult and Pediatric Task Forces of the American Heart Association	Circulation	68.33	205
Liu et al. ,2020	Pregnancy and Perinatal Outcomes of Women With Coronavirus Disease (COVID-19) Pneumonia: A Preliminary Analysis	American Journal of Roentgenology	67.33	202
Chen et al. ,2020	Infants Born to Mothers With a New Coronavirus (COVID-19)	Frontiers In Pediatrics	65.67	197
Hong et al. ,2020	Clinical characteristics of novel coronavirus disease 2019 (COVID-19) in newborns, infants and children	Pediatrics and Neonatology	50.67	152
Zimmermann and Curtis, 2020	COVID-19 in Children, Pregnancy and Neonates: A Review of Epidemiologic and Clinical Features	Pediatrics Infectious Diseases Journal	50.33	151

*, Citation number of all databases

DISCUSSION

The importance of the bibliometric analysis on the collection of scattered data about COVID-19 is underlined by several studies[12-16]. As a result, many hot-topic trends such as COVID-19 in newborns needs to be overcome were easily presented to many researchers in order to perform landmark studies or to monitor activity. Similarly, current study primarily underlines the lack of studies about newborns and COVID-19 while gathering the scattered high quality information of the published studies about newborns and COVID-19 to present the subject-specific trends to researchers and non-researchers.

According to our results, the citation analysis and bibliometric network visualization with VOSviewer reveals that publications "COVID-19" or "SARS-CoV-2" or "2019-nCoV" and "perinatal" or 'neonatal" or 'Newborn' or 'Infant' 'Neonate' have been increasing and growing rapidly since the beginning of COVID-19 indicating a global cooperation. The very first study about COVID-19 were published from China while the citation rate is also high due to the first emergence of COVID-19 in China, which causes the initial case studies to appear and cited as a baseline. After the collection of real-life data about COVID-19, other research and meta-analysis studies started to publish from various countries[17]. However despite zero citation, the very first study about the relationship between newborns & COVID-19 were published from Nigeria.

LitCovid is COVID-19-based database act as a global teamwork in order to reach up-to-date scientific literature with several fields[18,19]. The global panic created by the pandemic since December 2019 has caused the number of publications about COVID-19 to reach an incredible number. Bibliographic studies concerning the relationship between older adults and COVID-19 are much frequent compared to the relationship between newborns and COVID-19 due to the fact that COVID-19 is more dangerous in older adults[20]. The issue of Newborn COVID-19 is also one of the interesting topics as we found 1621 publications in our search with the same keywords we utilized in our study in LitCovid. But the articles cannot be further separated from LitCovid database according to their subtypes. The number in our study is less than half of LitCovid, which may be due to the WOS database indexing higher quality journals and the fact that we only included research articles with higher scientific content.

Our bibliometric analysis focuses on COVID-19 in pediatrics and obstetrics gynecology topics more than the general distribution of the research areas revealed by several studies[5-7,21]. However, areas of general internal medicine, infectious diseases and public environmental occupational health were retrieved the most in this study as well as other bibliometric analysis based on the general distribution of COVID-19 research topics.[7] Other bibliometric studies lack pediatric studies in the most frequent research topics of COVID-19, which underlines the requirement of more studies about pediatric and obstetric studies about COVID-19.

As expected, Covıd-19 and Sars-Cov-2 were the most occurring keywords (330 and 112, respectively). Moreover, while neonate is comparatively lower with 37 occurrences. Moreover, infant, perinatal and children were one of the least occurring keywords (33, 16 and 11, respectively). This underlines the lack of studies about the relationship between newborns and COVID-19. Global corporation towards the relationship between newborns and COVID-19 is not only underlines the negative impact of health but also social and psychological results on infants[21].

Furthermore, the majority of the studies underlining COVID-19 & newborns are from USA which is one of the most developed country with many high quality institutions and immense scientific funding opportunities[22]. Moreover, similar to other bibliometric studies United States (US) had the most published articles, followed by China, Italy and the United Kingdom (UK)[7,23]. However other bibliometric studies reported higher number of studies and citation numbers for China as it is the country with the highest contribution to COVID-19 research[24-26]. This is due to the fact that our study only includes studies related with newborns and COVID-19, which US may have preceded Chine in terms of pediatric impact of COVID-19.

Similarly, to the highest amount of published studies about COVID-19 pandemic, highest number of citations were belongs to China followed by USA, England and Italy.

Among the researched studies; obstetrics and COVID-19, neonatal outcomes, effects of COVID-19 on pregnancy, perinatal outcomes, and COVID-19 characteristics in newborns, guidance for life-support during the pandemic, epidemiological meta-analysis and review studies have the most citation according to our research. "Clinical analysis of 10

neonates born to mothers with 2019-nCoV pneumonia", "Potential Maternal and Infant Outcomes from Coronavirus 2019-nCoV (SARS-CoV-2) Infecting Pregnant Women: Lessons from SARS, MERS, and Other Human Coronavirus Infections" and "An Analysis of 38 Pregnant Women with COVID-19, Their Newborn Infants, and Maternal-Fetal Transmission of SARS-CoV-2" were the studies with highest score of average citation per year (161.33, 152.67 and 142,67, respectively). These findings underline the impact of these studies on the literature and requirement more studies covering every aspect related with COVID-19 and newborns as soon as possible to position newborns safely during this pandemic. Another bibliography also reported that the subject neonates were the second most frequently published studies after clinical features of COVID-19 (27.5% and 39.9%, respectively)[27,28]. Clinical characteristics of COVID-19 and mortality in adults were the most cited topics in another study. Despite numerous citations of studies about COVID-19 and newborns &, citation number of the studies about mortality of COVID-19 in adults and clinical characteristics of COVID-19 have been cited approximately 20 times more[29-31]. This underlines the requirement of more high quality studies to increase the overall knowledge about the effects on COVID-19 on newborns.

This is the first bibliometric analysis to focus on COVID-19 and newborns publication trends. This bibliometric analysis study, however, has several limitations. Other electronic databases, such as PubMed, Embase, Scopus, and the Cochrane Library, were not searched or reviewed because the electronic data was limited to the WOS database.

Moreover, unpublished articles as well a as low quality studies were excluded from the study. This may affect the overall number of studies and citation numbers hosted by a specific country. However, we have decided that this bibliography should reflect the amount of impact on literature about this subject. Thus, we exclude low-quality studies to strengthen our report.

It may be necessary to follow and direct the scientific flow in COVID-19 with bibliometric analyzes. Articles on COVID-19 & newborn, which have a very high number of citations, should be increased while the unknowns of the disease are still not clarified.

From 912 publications between 1970 and 2021, 491 (54.43%) were chosen as high quality studies. The use of bibliometric analysis to monitor scientific networks has proven indispensable, especially during the COVID-19 crisis. Bibliometric analyses show that there are no pediatric studies on the predominant research topics of COVID-19. This underlines the urgent need for additional research on pediatric and obstetric aspects of COVID-19. Although articles dealing with COVID-19 and newborns have received a considerable number of citations, the number of citations is significantly lower compared to studies dealing with adults or clinical characteristics. It is imperative to improve the visibility and impact of research on COVID-19 and newborns at this early stage. More bibliometric studies are required to fully compensate the need of subjects lagging behind other study areas and keywords.

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