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GEBELİK VE COVID-19 BAŞLIKLI YAYINLARIN BİLİM HARİTALAMA YÖNTEMİ İLE ANALİZİ

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Öz

Bu çalışma, geniş bir bilgi ve içgörü yelpazesini incelemek için Bibliometrix Programını kullanarak Covid-19 pandemisinin hamile kadınlar üzerindeki etkisinin kapsamlı bir analizini sunmayı amaçlamaktadır. Web of Science veri tabanında "SCI_EXPANDED (Science Citation Index Expanded) veya SSCI (Social Sciences Citation Index) veya ESCI (Emerging Sources Citation Index)" indekslerinde taranan İngilizce makalelere odaklanarak, bilim haritalama yöntemini kullanarak bibliyometrik analiz gerçekleştirdik. Bulgularımız, 2020'den 2022'ye kadar, çalışma alanımızdaki 594 dergide Covid-19 döneminde hamile kadınların prognozu ile ilgili toplam 1789 makale yayınlandığını ve yıllık büyüme oranının %44,01 olduğunu ortaya koymaktadır. %44,01'lik büyüme oranı, COVID-19'un hamilelik üzerindeki etkilerini anlama konusundaki artan küresel dikkat ve aciliyeti yansıtmaktadır. Analiz, bu konunun küresel öneminin ve karmaşıklığını anlamaya yönelik önemli araştırma çabalarının altını çizmektedir. Ayrıca bu çalışma, konuyla ilgili farklı bakış açıları kazanmak için Bibliometrix'in ötesinde çeşitli analiz programlarının kullanılmasının önemini vurgulamaktadır. Nihayetinde bulgularımız, Covid-19 ve hamileliğin kesişimini araştıran araştırmacılar için bilgi tabanını zenginleştirmeyi, mevcut araştırmaların manzarasına ilişkin değerli içgörüler sunmayı ve bu kritik çalışma alanının daha derinlemesine anlaşılmasını teşvik etmeyi amaçlamaktadır.

Anahtar Kelimeler: Covid-19, Gebelik, Bibliometrix programı, Koronavirüs, Fetüs

ANALYSIS OF PUBLICATIONS TITLED PREGNANCY AND COVID-19 WITH SCIENCE MAPPING METHOD

Abstract

This study aims to offer a comprehensive analysis of the impact of the Covid-19 pandemic on pregnant women, utilizing the Bibliometrix Program to examine a wide array of information and insights. By focusing on English-language articles indexed in "SCI_EXPANDED or SSCI or ESCI" within the Web of Science database, we conducted bibliometric analysis using the science mapping method. Our findings reveal that from 2020 to 2022, a total of 1789 articles pertaining to the prognosis of pregnant women during the Covid-19 period were published across 594 journals in our field of study, with an annual growth rate of 44.01%. The 44.01% growth rate reflects the heightened global attention and urgency to understand the implications of COVID-19 on pregnancy. The analysis underscores the global significance of this issue and the substantial research efforts dedicated to understanding its complexities. Additionally, this study emphasizes the importance of utilizing various analysis programs beyond Bibliometrix to gain diverse perspectives on the subject. Ultimately, our findings aim to enrich the knowledge base for researchers investigating the intersection of Covid-19 and pregnancy, offering valuable insights into the landscape of existing research and fostering a deeper understanding of this critical area of study.

Keywords: Covid-19, Pregnancy, Bibliometrix program, Coronavirus, Fetus

1. INTRODUCTION

Coronavirus disease (COVID-19) is an infectious disease caused by SARS-CoV-2. Elderly people, people with immunodeficiency, autoimmune and malignant diseases, as well as people with chronic diseases have a higher risk of developing more severe forms of the disease. Pregnant women and children can becomesick, although more often they are only the carriers of the virus. Recent studies have indicated that infants can also be infected by SARS-CoV-2 and develop a severe form of the disease with a fatal outcome. Acute Respiratory Distress Syndrome (ARDS) ina pregnant woman can affect the supply of oxygen to the fetus and initiate the mechanism of metabolic disorders of the fetus and newborn caused by asphyxia (1).

The risk of pregnancy distress in women who changed their mode of birth preferences due to the pandemic increased 5.4 times more than in those who preferred vaginal birth before and during the pandemic (OR: 5.4, $p<0.001$) (2). The normal physiologic changes of pregnancy are known to increase susceptibility to respiratory illness. Individuals who are pregnant are more likely to acquire a SARS-CoV-2 (the virus responsible for COVID-19) infection and develop COVID-19 than the general population; they are at increased risk for hospitalization; ventilator-assisted breathing; and other subsequent maternal, fetal, and neonatal health issues (3).

COVID-19 infection during pregnancy poses a dual threat, potentially leading to both respiratory complications for the mother and obstetric complications affecting both the mother and the fetus. However, despite the recognition of these risks, our understanding of the precise impact of COVID-19 on pregnancy remains limited, with emerging evidence still in its nascent stages. Efforts to mitigate the risks associated with COVID-19 in pregnancy, including vaccination, hold significant promise in reducing preventable complications stemming from this disease. As highlighted by Zayyan and Frise (4), vaccination efforts aimed at pregnant individuals have the potential to not only protect maternal health but also safeguard the well-being of the developing fetus. By reducing the incidence and severity of COVID-19 infections in pregnant individuals, vaccination can help mitigate the risk of adverse maternal outcomes such as severe respiratory illness and preterm birth, while also potentially lowering the likelihood of vertical transmission (transfer of infection from the mother to the fetus during pregnancy or childbirth) and its associated complications. Moreover, vaccination during pregnancy may confer passive immunity (the transfer of antibodies from the mother to the fetus) to newborns, providing them with added protection during the vulnerable early postnatal period. Overall, prioritizing vaccination efforts among pregnant individuals represents a crucial strategy in the broader public health response to the COVID-19 pandemic, offering the potential to minimize the burden of preventable complications and improve outcomes for both mothers and babies (5-7).

Emerging infections have many effects on the health of pregnant mothers and their fetuses. Given the importance of coronavirus disease (COVID-19) during pregnancy, this study aims to evaluate the pregnancy and fetal outcomes in pregnant women with COVID-19 by using previous studies. To conduct this study, all studies related to the subject under discussion during the years 2000-2021 were checked out by systematic search in internationally available databases, including Web of Science, Science Direct, Scopus, PubMed, and Google Scholar (8).

The COVID-19 pandemic and the associated restrictions and lockdown measures have profoundly impacted various aspects of society, including the delivery and accessibility of sexual and reproductive health services, particularly for vulnerable populations such as teenage girls. The closure of healthcare facilities, disruption of outreach programs, and redirection of resources to pandemic response efforts have all contributed to the compromised availability of essential reproductive health services. Furthermore, fear of contracting the virus, transportation challenges, and economic hardships have deterred individuals, including teenagers, from seeking reproductive health care, exacerbating pre-existing barriers to access. As a result, the ability of teenage girls to obtain

contraceptives, access prenatal care, and receive support for reproductive health issues has been significantly hampered. Despite these challenges, the precise impact of the pandemic on teenage pregnancy rates remains poorly documented and inadequately understood, highlighting the need for comprehensive research and data collection efforts to address this critical gap in knowledge. By better understanding the dynamics of teenage pregnancy during the COVID-19 pandemic, policymakers, healthcare providers, and stakeholders can develop targeted interventions and strategies to mitigate the adverse effects on adolescent reproductive health and rights (9).

2. METHOD

Nowadays, the number of academic publications is increasing rapidly and it is becoming more and more impossible to keep up to date with whatever is published. Literature reviews are used to effectively utilize the existing knowledge base and advance a line of research. It also plays an increasingly important role in synthesizing past research findings to provide evidence-based insight into the practice of applying and maintaining professional judgment and expertise.

Scientists use different quantitative and qualitative literature review approaches to make sense of and organize previous findings. Among them, bibliometrics offers a systematic, transparent and repeatable review process based on the statistical measurement of science, scientists or scientific activity.

Unlike other techniques, bibliometry provides more objective and reliable analyses. Bibliometry conducts a structured analysis of huge piles of information and new information, identifying trends over time, the themes being researched. It also provides the “big picture” of current research, making it easy to identify shifts in the boundaries of disciplines and identify conceptual developments, the most productive academics and institutions (10).

The concept of bibliometrics is used in the quantitative analysis of data from scientific articles published in the process with mathematical and statistical tools. It can be expressed as methods that provide some clues about the scientific discipline in question, the subject being studied, academic institutions, countries, authors, and cooperation between authors (11). The use of the Bibliometrix program is a comprehensive R-tool for performing bibliometric analysis, which allows users to analyze scientific literature quantitatively, providing insights into various aspects such as collaboration patterns, research trends, and influential works (12).

The flow chart of the Pregnancy & Covid-19 study topic is shown in Figure 1. The database used for our study is the Web of Science (WoS) database, which is one of the most complete and widely used databases for bibliometric analyzes or literature reviews (13).

The search was carried out on the WoS database on 08.12.2022. In the next step, the data obtained from the database was extracted and filtered. When the studies titled Pregnancy and Covid-19 ("covid 19" OR "covid-19" OR "cov 19" OR "cov-19" OR "corona" OR "coronavirüs" OR "corona virüs 2019" OR "coronavirüs" AND "Pregnancy" OR "gravidity" OR "pregnancies" OR "grossesse" OR "Pregnant”) were searched in the WoS database, and 2742 articles were found. To obtain the correct data, the articles between 2020-2023 were filtered and 2724 articles were found. “Article and Review Article” was selected and 1826 articles were reached. When “SCI_EXPANDED or SSCI or ESCI” was selected as the Web of Science index, the number of articles remained the same (1826). Finally, only “English” was chosen as the publication language and 1789 articles were reached. Science mapping was carried out with a total of 1789 articles obtained.

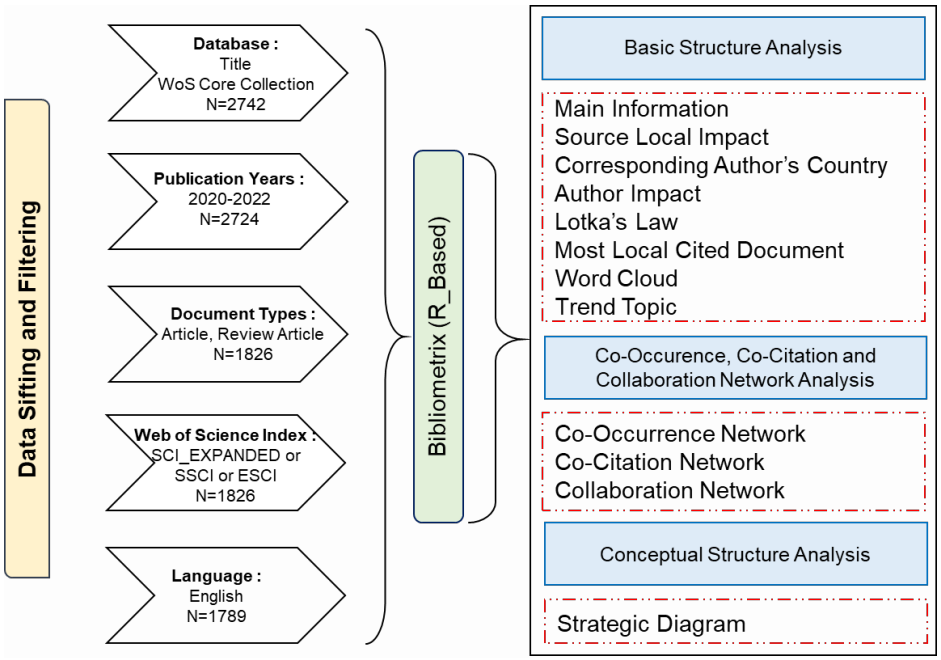


Figure 1. Workflow Of Science Mapping

To analyze the obtained data using bibliometrics, the Bibliometrix program was used in the final step. The bibliometrix program is one of the latest open-source software prepared on based on R to perform science mapping (10).

3. RESULTS

In our review, 1789 articles were analyzed in three parts. In the first part, the basic structure analysis of the articles in the field of Pregnancy & Covid-19 was performed. In the second part, co-occurrence, common citation and collaboration networks were analyzed. In the third part, conceptual structure analysis was performed.

In the keyword analysis, the words "covid-19, covid 19, cov 19, cov-19, corona, coronavirus, coronavirus, corona virüs 2019, sars-cov-2, coronavirus disease 2019, covid-19 pandemic, pandemic" were combined under the word "covid-19" and the words "pregnancy, gravidity, pregnancies, pregnant, grossese, pregnant women" were combined under the word "pregnancy".

Basic Structure Analysis

Main Information

A total of 1789 articles belonging to the Pregnancy and Covid-19 study area were published in 594 journals in the 3 years period between 2020-2022. The annual increase rate of articles is 44.01%. The average citation per article is 15.87. 33826 references were used in the articles. 10537 authors were included in the articles, and the number of authors with a single article is 51, and the number of articles belonging to a single author is 58. Each article had an average of 7.69 authors. Other statistical information is presented in Table 1.

Table 1. Main Information

Description	Results	Description	Results
Main Information About Data		Authors Collaboration	
Timespan	2020:2022	Single-authored docs	58
Sources (Journals, Books, etc)	594	Co-Authors per Doc	7.69
Documents	1789	International co-authorships %	19.23
Annual Growth Rate %	44.01	**Document Types**	

Document Average Age	0.784	article	1385
Average citations per doc	15.87	article; book chapter	1
References	33826	article; early access	85
Document Contents		article; proceedings paper	6
Keywords Plus (ID)	1294	review	294
Author's Keywords (DE)	2441	review; book chapter	3
Authors		review; early access	15
Authors	10537		
Authors of single-authored docs	51		

Source Local Impact

The top 20 journals are presented in Table 2 in order of the total number of publications (Source Local Impact). The total number of journals is 594. 31.80% (569/1789) of the total articles are published in these top 20 journals. BMC Pregnancy And Childbirth journal is the journals representing 3.24% of all articles (58/1789) and the International Journal Of Gynecology & Obstetrics is the journal representing 2.57% of all articles (46/1789). The most cited journal in the Pregnancy and Covid-19 study area is the American Journal of Obstetrics and Gynecology with 2921 citations.

Table 2. Source Local Impact

Source	NP	TC	TC/NP	h_index	PY_start
BMC Pregnancy And Childbirth	58	473	8,16	12	2020
International Journal of Gynecology & Obstetrics	46	1049	22,80	16	1963
International Journal of Environmental Research And Public Health	46	414	9,00	12	2020
Journal of Maternal-Fetal & Neonatal Medicine	44	711	16,16	12	1992
Obstetrics and Gynecology	39	1066	27,33	19	2020
American Journal of Obstetrics and Gynecology	32	2921	91,28	19	2020
Journal of Perinatal Medicine	30	366	12,20	7	1973
American Journal of Perinatology	27	732	27,11	10	2014
Journal of Clinical Medicine	26	91	3,50	6	2020
Cureus Journal of Medical Science	26	53	2,04	4	2020
Plos One	25	163	6,52	8	2020
BMJ Open	24	100	4,17	6	2020
Clinical Infectious Diseases	22	565	25,68	8	1979
Journal of Obstetrics and Gynaecology Research	22	115	5,23	5	2020
American Journal of Obstetrics & Gynecology	21	1362	64,86	12	2020
Vaccines	17	131	7,71	7	2020
ACTA Obstetricia Et Gynecologica Scandinavica	16	936	58,50	10	2020
European Journal Of Obstetrics & Gynecology and Reproductive Biology	16	252	15,75	8	2020
Journal of Medical Virology	16	341	21,31	8	1977
BMJ Case Reports	16	60	3,75	4	2020

NP = Number of publications, TC = Total citations, TC/NP = Citations per paper, PY_start = Publication year starting,

Among the top 20 journals with the highest number of articles published, the journals with the highest h index are Obstetrics And Gynecology, American Journal Of Obstetrics And Gynecology (19). These journals were followed by the International Journal of Gynecology & Obstetrics (16).

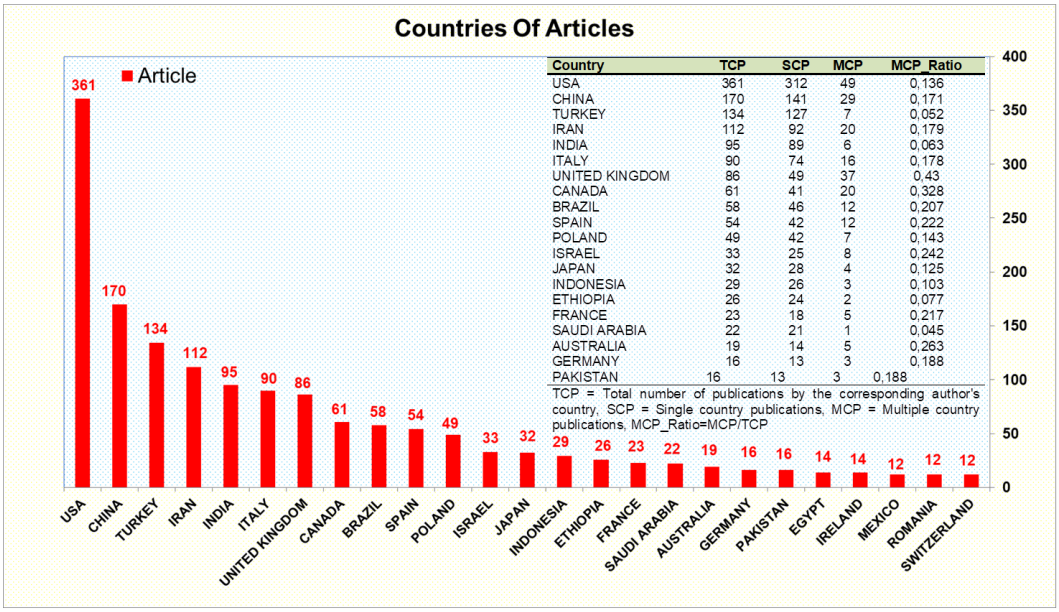
The number of citations per article represents the ratio between the number of citations and the number of documents for each journal. American Journal Of Obstetrics And Gynecology (91.28), American Journal Of Obstetrics & Gynecology MFM (64.86) have the highest average citation per publication. When the years in which journals started publishing articles are examined, many journals that entered the publishing life in 2020 have obtained very important statistics in a short time. BMC Pregnancy And Childbirth, International Journal Of Environmental Research And Public Health have obtained very high NP, TC, TC/NP and h-index statistics.

Corresponding Author's Country

To further examine the details of the Pregnancy & Covid-19 study area in terms of countries, the top 20 countries belonging to the author are shown in Figure 2. The figure was obtained sequentially from Bibliometrix. Figure 2 shows that the USA, China, Turkey, Iran and India are among the top five countries in terms of authors in the total number of articles in the Pregnancy & Covid-19 study area.

The top five countries in multi-country authors include the USA (49), England (37), China (29), Iran (20) and Canada (20). Single-country authors included the USA (312), China (141), Turkey (127), Iran (92), and India (89).

The MCP ratio is obtained from the ratio of the number of multi-country publications to the total number of country publications. The country with the best MCP value is England with 0.43. Canada followed the UK with a value of 0.328.



Country	TCP	SCP	MCP	MCP_Ratio
USA	361	312	49	0,136
CHINA	170	141	29	0,171
TURKEY	134	127	7	0,052
IRAN	112	92	20	0,179
INDIA	95	89	6	0,063
ITALY	90	74	16	0,178
UNITED KINGDOM	86	49	37	0,43
CANADA	61	41	20	0,328
BRAZIL	58	46	12	0,207
SPAIN	54	42	12	0,222
POLAND	49	42	7	0,143
ISRAEL	33	25	8	0,242
JAPAN	32	28	4	0,125
INDONESIA	29	26	3	0,103
ETHIOPIA	26	24	2	0,077
FRANCE	23	18	5	0,217
SAUDI ARABIA	22	21	1	0,045
AUSTRALIA	19	14	5	0,263
GERMANY	16	13	3	0,188
PAKISTAN	16	13	3	0,188

TCP = Total number of publications by the corresponding author's country, SCP = Single country publications, MCP = Multiple country publications, MCP_Ratio=MCP/TCP

Figure 2. Corresponding Author's Country

Author Impact

Statistics of the top 20 authors who made the most effective reviews in the Pregnancy & Covid-19 study area between 2020-2022 are shown in Table 3. This table was obtained according to the H-index value. The total number of publications (NP), total citations (TC), h-index and g-index were analyzed.

Table 3. Author Impact

Author	h_index	g_index	TC	NP
Sahin D	9	18	341	26
Tanacan A	9	17	307	21
Jamieson DJ	8	10	817	10
Keskin Hl	8	14	222	15
Anuk AT	7	13	197	13
Berghella V	7	7	960	7
Chen L	7	10	543	10
Erol Sa	7	13	193	14

Khalil A	7	10	1424	10
Picone O	7	7	196	7
Sun GQ	7	8	437	8
Tekin OM	7	15	230	20
Vivanti AJ	7	7	258	7
Yang J	7	8	249	8
Birol P	6	7	134	7
Deruelle P	6	6	603	6
Di Mascio D	6	6	757	6
Edlow AG	6	9	420	9
Gyamfi-Bannerman C	6	8	655	8
Liu J	6	9	246	9

The H-index was introduced to the literature by Jorge Hirsch. If the author of the article has X amount of publications cited at least X times by other authors, we can say that the h-index of this author is X (14) (15). The authors with the highest h-index value in our study are Şahin D (9), Tanacan A (9), Jamieson DJ (8) and Keskin HL (8).

According to the concept of G-index, which was introduced to the literature by Leo Egghe in 2006, it is a disadvantage that the citation scores of the articles in the scientific discipline are not taken into account in the h-index. The G-index gives more weight to highly cited articles (16). The authors with the highest G index values are Şahin D (18), Tanacan A (17), Tekin OM (15) and Keskin HL (14).

The author with the highest total number of citations is Khalil A (1424). This author was followed by Berghella V (960). According to the H index order, the authors with the highest number of publications are Şahin D (26), Tanacan A (21), Tekin OM (20) and Keskin HL (15).

Lotka's Law

The publications of authors working in the field of Pregnancy & Covid-19 according to Lotka Law are presented in Figure 3. According to Lotka Law, 60% of the authors contribute one article, 15% contribute 2 articles, and 7% contribute 3 articles to a field of study (17).

When the articles and authors are examined within the framework of Lotka law, the rate of authors who contributed only one article to the Pregnancy & Covid-19 study area is 82.4%. The rate of authors contributing with two articles is 11.1%, while the rate of authors contributing with three articles is 3.7%. Contributing authors with four articles are 1.3%, and authors contributing five articles are 0.7%. It is understood that the author distribution of the articles in the Pregnancy & Covid-19 study area does not comply with Lotka's law. However, authors with more than five publications can be considered to have deepened in the field of Pregnancy & Covid-19 and should be considered as core authors.

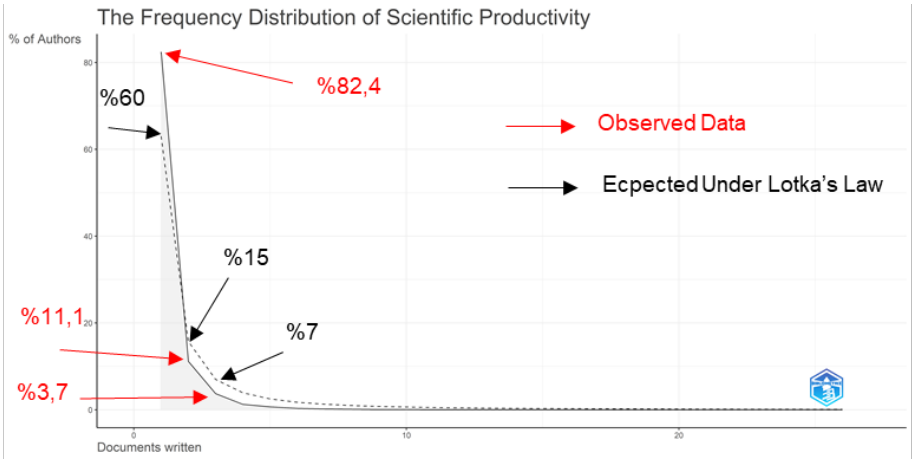


Figure 3. Lotka's Law

Most Local Cited Document

Citation analysis was conducted to identify the most cited articles in the Pregnancy and Covid-19 study area and the links between these articles. Citation analyzes are generally used to research the intellectual structure and development dynamics under the field of study. The 20 most cited publications in the Pregnancy and Covid-19 review area are presented in Table 4 in descending order of local citation (LC) numbers.

The local citation shows the number of citations of an article cited by publications in the data set (1789) taken from the WOS. The global citation, on the other hand, shows how many times a publication has been cited in the WoS database. Chen HJ's publication in 2020 has been the most influential in the field of Pregnancy & Covid-19 review, receiving 409 local citations and 2006 general citations. Allotey J's publication in 2020 reached 310 local citations and 775 general citations, making it the second most influential article in this field.

The top publications in the review time naturally have more time to receive citations. However, the publications involved in the process at the end of the period do not have time to receive sufficient citations. Annual Local Citations (LC/YYP) and Annual Global Citations (GC/YYP) definitions have been developed to eliminate the negative effects of the short period of time after the publication of the publications published in the last years of the process and to show the effect of the years in which the articles were published. The article with the highest LC/YYP (204,500) and GC/YYP (1003,000) is Chen HJ, 2020.

Table 4. Most Local Cited Document

Document	YP	LC	LC/YYP	GC	GC/YYP	LC/GC Ratio %
Chen HJ, 2020, Lancet	2020	409	204,500	2006	1003,000	20,39
Allotey J, 2020, Bmj-Brit Med J	2020	310	155,000	775	387,500	40,00
Di Mascio D, 2020, Am J Obst Gynec MFM	2020	194	97,000	490	245,000	39,59
Rasmussen SA, 2020, Am J Obstet Gynecol	2020	189	94,500	536	268,000	35,26
Dashraath P, 2020, Am J Obstet Gynecol	2020	188	94,000	521	260,500	36,08
Schwartz DA, 2020, Viruses-Basel	2020	187	93,500	503	251,500	37,18
Zaigham M, 2020, ACTA Obstet Gyn Scan	2020	165	82,500	376	188,000	43,88
Lebel C, 2020, J Affect Disorders	2020	141	70,500	344	172,000	40,99
Yu N, 2020, Lancet Infect Dis	2020	138	69,000	436	218,000	31,65
Yan J, 2020, Am J Obstet Gynecol	2020	136	68,000	325	162,500	41,85
Wu YT, 2020, Am J Obstet Gynecol	2020	128	64,000	293	146,500	43,69
Schwartz DA, 2020, Arch Pathol Lab Med	2020	122	61,000	462	231,000	26,41
Villar J, 2021, Jama Pediatr	2021	109	109,000	368	368,000	29,62
Mullins E, 2020, Ultrasound Obst Gyn	2020	104	52,000	250	125,000	41,60

Breslin N, 2020, Am J Obst Gynec MFM-A	2020	104	52,000	289	144,500	35,99
Alzamora MC, 2020, Am J Perinat	2020	97	48,500	355	177,500	27,32
Pierce-Williams Ram, 2020, Am J Obst Gynec MFM	2020	97	48,500	201	100,500	48,26
Liu H, 2020, J Reprod Immunol	2020	96	48,000	212	106,000	45,28
Liu DH, 2020, Am J Roentgenol	2020	89	44,500	223	111,500	39,91
Durankus F, 2022, J Matern-Fetal Neo M	2022	89	-	196	-	45,41

Year of Publication (YP), YYP= Year 2022-Year of Publication, Global Citations (GC), Local Citations (LC),

Another concept produced for the most cited authors is Local Citation Percentage. According to this concept, the most influential article belongs to Pierce-Williams RAM, 2020 with 48.26%. The 48.26% figure represents the ratio of Local Citations (1789) to Global Citations.

Word Cloud

Keywords are determined by the authors to describe the article. Considering that the keywords in question represent the article, it is considered remarkable to analyze with these words and to determine the current topics and themes of the study area (18).

The keyword frequency (repetition amount) of the Pregnancy and Covid-19 study area was obtained using Bibliometrix. The word cloud is a graphical demonstration of the latest concepts in the field of Pregnancy & Covid-19 review.

Through the word cloud, it becomes easier to identify areas that are intertwined with each other and analyze the words of these areas that have been on the agenda over the years (19).

Some words appear large in the word cloud. The larger the keywords appear, the more frequently they were used in the dataset. Figure 4 and Table 5 presents the top 20 most common keywords identified by the authors of the article. Since the words Pregnancy and Covid-19, which are our main keywords, suppress other words, other words are enlarged in the image. The most used keywords are Covid-19, Pregnancy, Anxiety, Depression, Vertical Transmission, Mental Health and Vaccination.

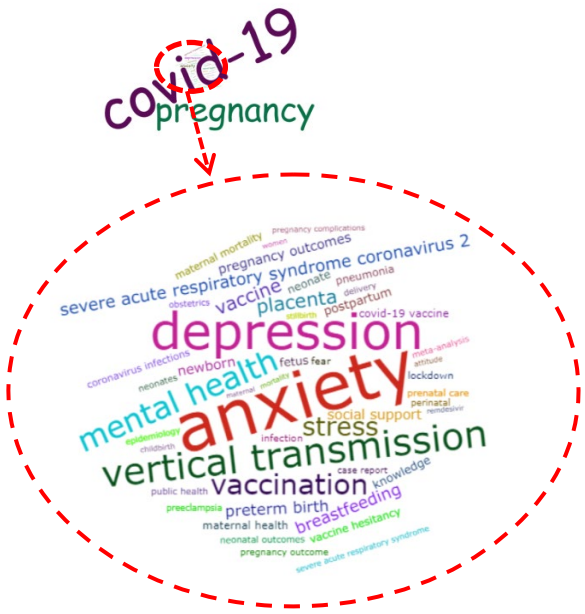


Figure 4.Word Cloud

Table 5. Word Cloud Frequency

Terms	Frequency
Covid-19	1877
Pregnancy	1133
Anxiety	144
Depression	108
Vertical transmission	80
Mental health	66
Vaccination	60
Stress	55
Placenta	41
Vaccine	40
Severe acute respiratory syndrome	
Coronavirus 2	36
Breastfeeding	35
Preterm birth	33
Newborn	29
Social support	29
Pregnancy outcomes	28
Postpartum	26
Fetus	25
Knowledge	25
Neonate	24

The graph in Figure 5 shows in which years and which of the keywords identified by the authors have become popular. Keywords that are used at least five times every year are visualized.

In 2020, the keywords "Infection", "Severe Acute Respiratory Syndrome", "Maternal Morbidity" and "Cesarean Section" were used more in the study of Pregnancy and Covid-19. In 2022, the keywords "Vaccination", "Vaccine", "Social Support", and "Pregnancy Outcomes" were used more. The keyword "Covid-19" was used the most in 2021, with 1877 and the keyword "Pregnancy" with 1133. Along with these words, the keywords "Anxiety" and "Depression" became trending topics.

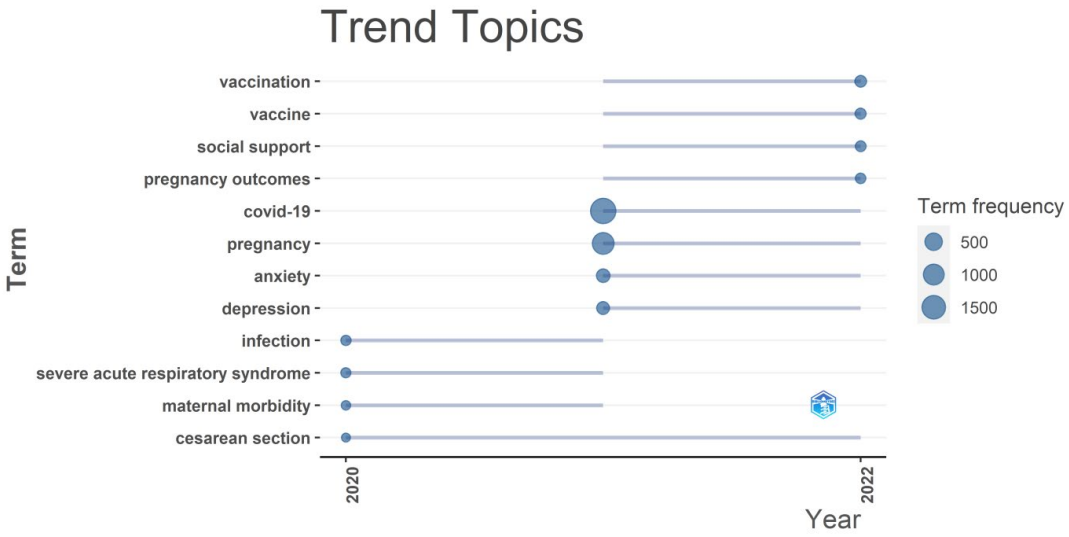


Figure 5. Trend Topics

Co-Occurrence, Co-Citation and Collaboration Network Analysis

Co-Occurrence Network

In Figure 6, the Co-occurrence Network is presented with the keywords created by the author representing the articles. The co-occurrence network of the top 20 keywords was examined.

Keywords are clustered in 3 clusters as red, blue and green clusters. The red cluster represented the keywords Pregnancy and Covid-19, which is our study topic. In addition, the words "Infection", "Vaccination", "Mortality" and "Pregnancy Outcomes", "StillBirth", "Pregnancy Complications", "Breastfeeding" formed the network of formations. The word "Anxiety" represented the blue cluster, and together with this word, the keywords "Depression", "Stress", "Fear" and "Social Support" formed the formation network. In the green cluster, the keywords "Epidemiology" and "Obstetrics" together with "Public Health" formed the formation network. The figural display size of the clusters indicates that the amount of usage of that keyword is higher.

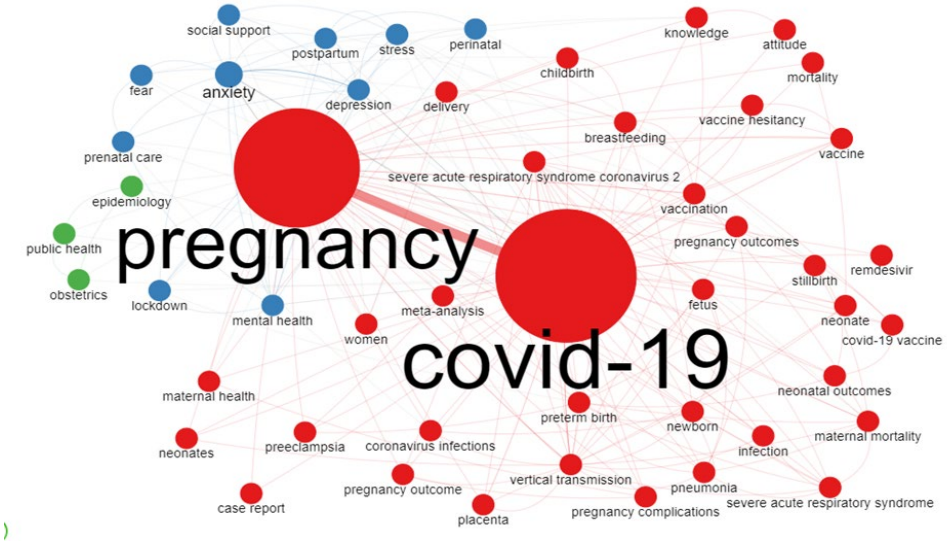


Figure 6. Co-occurrence Network

The strongest ties are between "Pregnancy" and "Covid-19". The thicker the line between two keywords, the more those two keywords were used together in the publication.

Co-Citation Network

The Paper Co-citation Network was examined by analyzing the common citations of the publications of the "Pregnancy" and "Covid-19" literature. As presented in Figure 7, the common citation network of 20 articles is divided into 4 node clusters indicated by circles. Each circle represents an article. The presence of the connecting line between the circles representing the article shows that there is a relationship between them. The thickness of the line between the circles represents the intensity of the relationship.

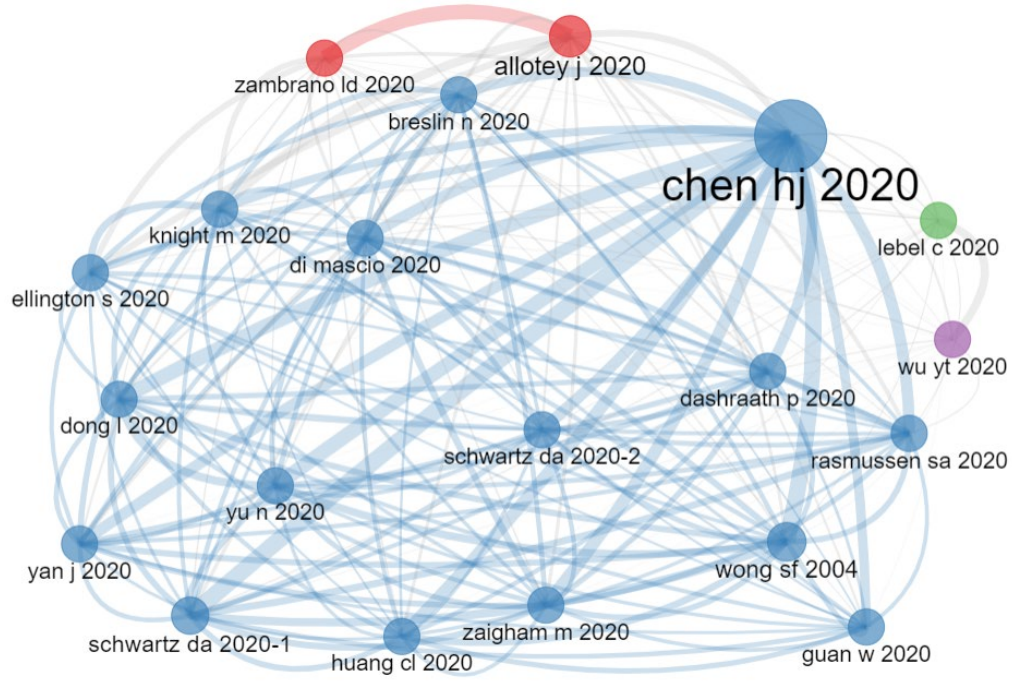


Figure 7. Papers' Co-Citation Network

Clusters are shown in blue, red, green and purple. The most cited article in the co-citation network and representing the blue cluster is Chen HJ's article in 2020. Chen HJ's article in 2020 received many more co-citations, along with articles Wong SF 2004, Schwartz DA 2020-1, Dong I 2020, Yu N 2020. The red cluster is represented by the Allotey J 2020 article. It has received a significant amount of co-citations with the Zambrano ID 2020 article. Lebel C 2020 articles represented the green cluster and Wu YT 2020 articles represented the purple cluster. There is a common citation between these two articles. The co-citation of the articles can be understood from the thickness of the line between them.

Collaboration Network

The results of the author's collaboration analysis (Authors Collaboration Network) are given in Figure 8. The analysis is based on 26 circles. Each circle in the figure represents an author.

It is seen that the top 26 authors working on "Pregnancy" and "Covid-19" are gathered in 5 clusters: Purple, Red, Green, Blue and Orange. It can be understood from the thickness of the line between Şahin D and Tekin OM, Tanacan A, Keskin HL that there is more co-citation relationship in this cluster. The red cluster consisted of 7 authors, the green cluster 4, the blue cluster 3, and the orange cluster 2 authors. The authors with a linear connection are cited together in another article.

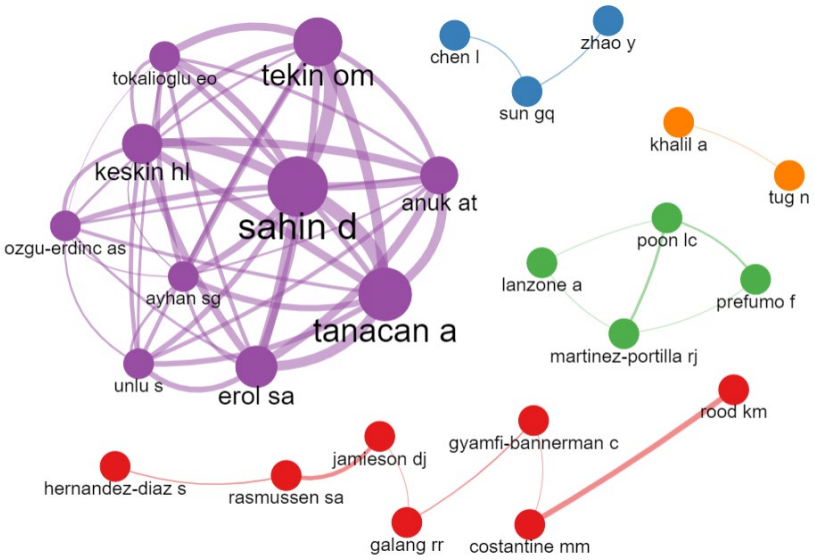


Figure 8. Authors' Collaboration Network

In Figure 9, it is seen that 28 institutions working on "Pregnancy" and "Covid-19" are clustered in 4 clusters. From the size of the circle, we can say that the institution that publishes the most articles in the citation and collaboration network is Huazhong Univ Sci And Technol in the blue cluster, Harvard Med Sch in the green cluster, Univ Hlth Sci in the red cluster. It is understood from the line thickness between them that Univ Hlth Sci and Ankara City Hosp institutions have received co-citation in more articles. There is also a strong co-citation link between Harvard Med Sch and Harvard th Chab Sch Publ Hlth in the green cluster. There is also a strong co-citation network between Huazhong Univ Sci And Technol and Wuhan Univ in the blue cluster. When the institutions are examined, the rate of co-citation of the geographically close institutions in the articles is quite high. The green cluster consisted of 13 institutions, the blue cluster 9, the purple cluster 4 and the red cluster 2 institutions.

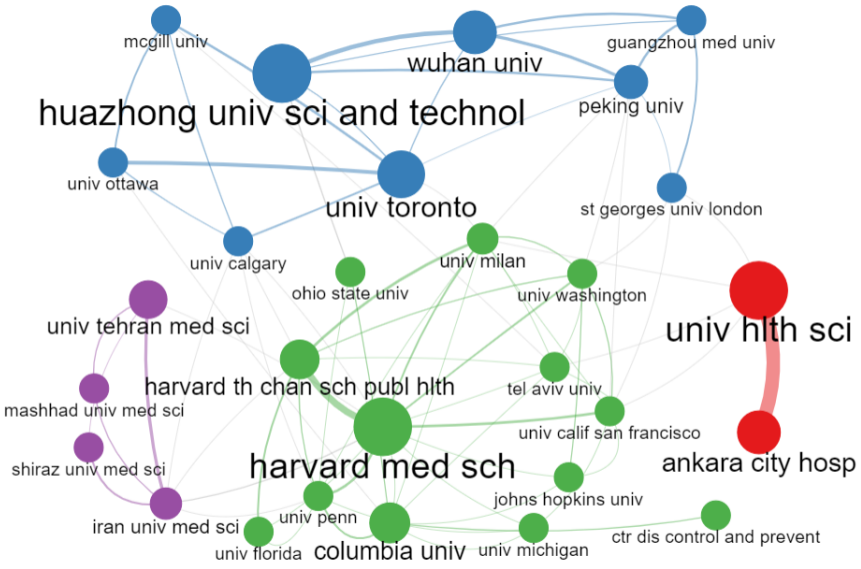


Figure 9. Institutions' Collaboration Network

The results of the Countries' Collaboration Network are visualized in Figure 10. 30 node points were taken as the basis for the analysis. The Louvain Algorithm was used and each circle represents a country.

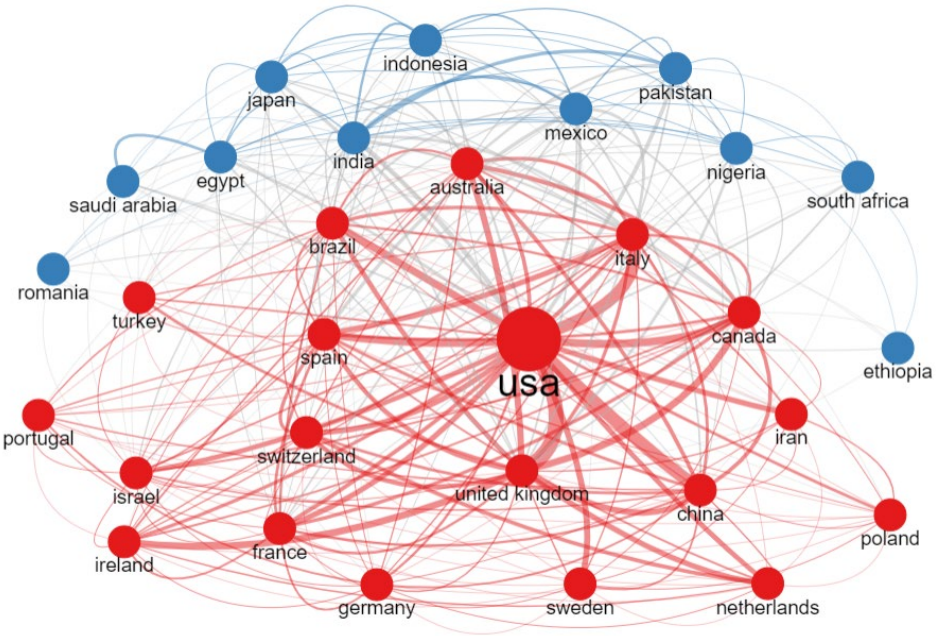


Figure 10. Countries' Collaboration Network

When the literature of the articles on "Pregnancy" and "Covid-19" is examined, it is seen that there are 2 clusters in terms of countries. The red cluster consists of 19 countries and the blue cluster consists of 11 countries. The USA dominated the red cluster. There is strong cooperation between the USA and the UK, China, Italy, Brazil and Canada. Turkey is in the red cluster and has established a collaboration network with the UK, USA and Italy. Although there is no dominant country in the blue cluster, there is a common citation relationship between India-Pakistan and India-Mexico. There

is also a common citation relationship between England Ireland, England Canada, Spain Italy in the red cluster.

Conceptual Structure Analysis

Strategic Diagram

Conventional research methods do not allow for detailed research of all aspects of a scientific discipline and analysis of the time-dependent dynamics of the subject of study. In the analyzes carried out through thematic mapping, research themes are visualized through networks that dissolve in multiple time periods and it is possible to detect their dynamics (20).

The strategic diagram reflects the interactions of factors over time on a defined study topic. This diagram is a static description of the network structure of a study area (21). There are four quadrants in the strategic diagram. These four quarters were first detailed by Callon in 1991. In the Cartesian coordinate system, the x-axis is used to represent centrality and the y-axis is used to represent density (22).

The thematic development of articles on "Pregnancy" and "Covid-19" between 2020-2022 was analyzed. Since the publication period is limited to 3 years, the publication year is divided into two. The years 2020 and 2021 were analyzed as one period and the year 2022 as the other period. Strategic diagrams of the "Pregnancy" and "Covid-19" study topics for each sub-period are presented in Figure 11. 250 author keywords that appeared at least eleven times in these diagrams were used for analysis. The most recurring keywords were grouped into theme clusters. 4 keywords are visualized in each cluster. The size of the circles is proportional to the keyword frequency.

The strategic diagram is divided into four slices expressing the themes. Each slice is interpreted in itself. For this purpose, two parameters including centrality and density were determined. The density parameter represents the y-axis, and the centrality parameter represents the x-axis of the thematic map. The more central the chosen theme is, the more important it is. The more intense it is, the more it has completed its development (23).

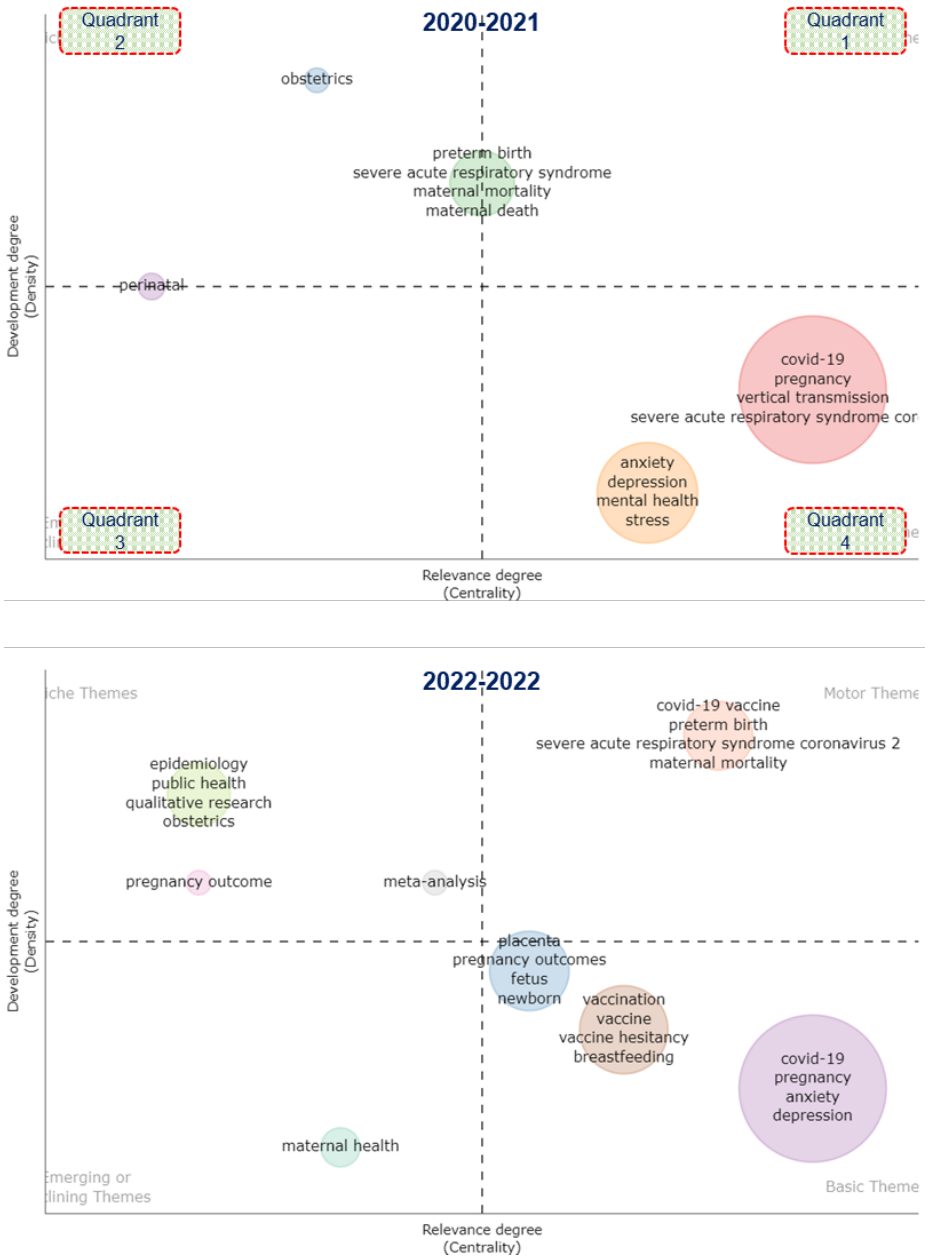


Figure 11. Strategic Diagram (1980–2021)

Motor Themes, which has been developed and expresses the high density and high centrality required for the studying area, is the first quadrant theme and is located in the upper right part. Highly Developed and Isolated Themes, which are highly developed but isolated expressing high density and lower centrality, are the second quarter theme and are located in the upper left part of the thematic map. Emerging or Declining Themes, which have newly emerged or decreased low centrality and low density values, are the third quarter theme and are located in the lower left part of the thematic map. Basic and Transversal Themes, which have been researched a lot and have well-developed internal connections, low density and high centrality, are the fourth quarter theme. It is located in the lower right part of the thematic map (24.).

When the themes of 2022 are examined;

The keywords Preterm Birth, Severe Acute Respiratory Syndrome Coronavirus 2, Maternal Mortality, represented by the Covid-19 Vaccine keyword, formed motor themes. The motor themes

that represent the focus and emphasis of the research area are the central and well-developed themes. These themes are dealt with systematically and for a long time by the researchers.

The keywords Public Health, Qualitative Research, Obstetrics, represented by the keyword epidemiology, formed the first theme. The Pregnancy Outcome and Meta-Analysis keywords were also well-developed and isolated themes as the second and third themes. These themes are peripheral and advanced, with well-developed internal ties and less-developed external ties, for which they are of only marginal importance.

The theme represented by the Maternal Health keyword formed the rising and falling theme. These themes are peripheral and undeveloped, have weak internal and external ties, and express emerging or disappearing issues.

The keywords Pregnancy, Anxiety, Depression, represented by the keyword Covid-19, constitute the first theme. The keywords Vaccine, Vaccine Hesitancy, Breastfeeding, represented by the keyword Vaccination, constitute the second theme. The keywords Pregnancy Outcomes, Fetus, Newborn represented by the keyword Plecentaon constitute the third theme. These themes can be active research topics and are maturing.

4. CONCLUSIONS

The analysis of the literature on Covid-19 and pregnancy is crucial, particularly in understanding the implications for maternal and fetal health. Our study contributes to this understanding by comprehensively analyzing articles indexed in reputable databases like Web of Science, focusing on those specifically in English to ensure accessibility to a broader audience. Through the utilization of the Bibliometrix Program, we were able to systematically gather and analyze a substantial volume of literature, providing insights into the trends, themes, and gaps in research concerning Covid-19 and pregnancy.

Our findings reveal a multitude of themes and research directions within this field. Firstly, we observed a significant increase in publications over time, indicating the growing interest and urgency surrounding this topic. This surge in research output underscores the recognition of Covid-19's impact on pregnancy as a pressing public health concern.

Furthermore, our analysis elucidates the diverse methodologies employed in studying Covid-19 and pregnancy, ranging from clinical trials and observational studies to meta-analyses and systematic reviews. This diversity in research approaches reflects the complexity of the interactions between Covid-19 and pregnancy and highlights the need for interdisciplinary collaboration to address this multifaceted issue comprehensively.

Moreover, our study identifies key topics of interest within the literature, such as the effects of Covid-19 on maternal outcomes, including complications during pregnancy, labor, and delivery, as well as the potential vertical transmission of the virus to the fetus. Additionally, the impact of Covid-19 on neonatal health and long-term developmental outcomes warrants further investigation, underscoring the need for longitudinal studies to assess the enduring effects of maternal Covid-19 infection on offspring health.

Importantly, our analysis also reveals notable gaps in the existing literature, such as disparities in research focus across geographic regions and populations. While a substantial body of literature originates from high-income countries, there is a paucity of research addressing the unique challenges faced by pregnant individuals in low- and middle-income countries, where access to healthcare resources may be limited. Bridging this gap is imperative for developing context-specific interventions and policies to mitigate the adverse effects of Covid-19 on maternal and neonatal health globally.

There is an urgent need for increased research in low- and middle-income countries to address the unique challenges faced by pregnant individuals in these regions. Additionally, specific policy measures must be developed to ensure equitable access to maternal and neonatal healthcare services worldwide.

In conclusion, our study offers a comprehensive overview of the current state of research on Covid-19 and pregnancy, highlighting trends, methodologies, key topics, and gaps within the literature. By synthesizing and analyzing a diverse range of publications, our findings provide valuable insights for researchers, policymakers, and healthcare practitioners involved in addressing the complex interplay between Covid-19 and pregnancy. Moving forward, we invite interdisciplinary researchers to collaborate in developing a standardized protocol to study the effects of COVID-19 on pregnancy outcomes. Concerted efforts are needed to prioritize research initiatives that address the identified gaps and promote equity in access to maternal and neonatal healthcare services in the face of the ongoing Covid-19 pandemic.

Investment Source

No financial support was received for this study.

Competing Interests

The authors have no conflict of interest to declare.

Author Contributions

Dr. Ayşe KONAC, contributing to the development of ideas or hypotheses for the research and/or article, planning the materials and methods to achieve results, taking responsibility for the experiments, taking responsibility for explaining and presenting the results, taking responsibility for creating the whole or the main part of the text.

Dr. Fatih ORHAN played an important role in creating the search strategy in the article and providing the science mapping analysis.

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