

# Scientific Evolution of Research Trends on Psychological Distress, Anxiety, and Burnout Among Women Healthcare Workers During the COVID-19 Pandemic

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## Systematic Review

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# **SCIENTIFIC EVOLUTION OF RESEARCH TRENDS ON PSYCHOLOGICAL DISTRESS, ANXIETY, AND BURNOUT AMONG WOMEN HEALTHCARE WORKERS DURING THE COVID-19 PANDEMIC**

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## **Abstract**

This study aimed to examine global research trends, thematic evolution, and collaboration patterns in the literature on psychological distress, anxiety and burn out among women healthcare workers during the COVID-19 pandemic. A bibliometric analysis was conducted on 1,210 publications published between 2020 and 2025, retrieved from Scopus, PubMed, and OpenAlex databases. Biblioshiny was employed to analyze publication trends, influential journals, authors, institutions, country-level collaborations, and thematic structures. A substantial increase in publications was observed between 2021 and 2022, reflecting heightened research attention during the peak of the pandemic. The United States and the United Kingdom emerged as leading contributors and central hubs of international collaboration. The literature primarily focused on workplace challenges and mental health outcomes, particularly anxiety and depression, with specific attention to vulnerable groups such as women and pregnant healthcare workers. Keyword co-occurrence analysis identified three major thematic clusters: pandemic impact, clinical research, and psychological outcomes. Thematic evolution analysis revealed a transition from general COVID-19-related studies to more specialized research emphasizing mental health outcomes, vulnerable population, and methodological advancements. This study provides a comprehensive overview of the evolving research landscape on psychological outcomes among women healthcare workers during the COVID-19 pandemic. It highlights key research trends, collaboration patterns, and thematic shifts, while identifying critical gaps that indicates the need for targeted, gender-sensitive mental health interventions. The findings offer valuable insights for guiding future research, policy formulation, and intervention strategies in occupational mental health.

## **Keywords**

COVID-19; coronavirus; women healthcare workers; bibliometrics; research trends

## 1. Introduction

Healthcare workers (HCWs) around the world faced previously uncommon psychosocial pressure as a result of the COVID-19 pandemic. A recurring trend has surfaced across several geographic and healthcare contexts. Compared to their male and non-frontline counterparts, female healthcare workers, especially nurses and frontline staff, report higher levels of psychological distress, anxiety, and associated mental health issues (Spoorthy et al., 2020). The current synthesis highlights consistencies, contextual subtleties, and research gaps while integrating findings from cross-sectional and cohort studies to shed light on the extent, causes, and consequences of psychological distress among female healthcare workers during COVID-19 (Lai et al., 2020).

Psychological distress is generally conceptualized as a non-specific state of emotional suffering characterized by symptoms such as anxiety, depression, mood disturbance, somatic complaints, demoralization, and loss of perceived control. Rather than representing a discrete DSM diagnostic category, it is understood as a dimensional and subjective experience that may impair functioning and well-being (Carrozzino et al., 2023). This broad conceptualization allows researchers to capture the complex and overlapping emotional responses observed during large-scale crises such as the COVID-19 pandemic.

Anxiety refers to a sustained state of worry, fear, and hyperarousal that can affect cognition, mood, and functioning. In HCWs during COVID-19, anxiety has been operationalized using validated screening instruments (e.g., GAD-7, HAM-A, HADS-A) and is often reported as both symptom severity and clinically meaningful anxiety in cross-sectional and longitudinal studies (Buselli et al., 2020; Morgan et al., 2022).

Burnout is a syndrome of emotional exhaustion, depersonalization, and reduced personal accomplishment that arises from chronic workplace stress. The pandemic has amplified burnout risk among HCWs, and in many studies, burnout is assessed with instruments like the Maslach Burnout Inventory (MBI) or related scales (MBI-GS, MBI-22) to quantify EE, DP, and PA dimensions; some studies also report proxies such as professional quality of life or compassion fatigue (Swed et al., 2022; Fukushima et al., 2023).

In parallel, the medical and public health literature has emphasized the importance of definitional clarity during the pandemic. Debates regarding COVID-19 case definitions such as distinguishing infection confirmation from hospitalization criteria or defining severe disease based on clinical indicators like hypoxia demonstrate how definitional choices influence surveillance data and interpretation (Vu et al., 2022). Similarly, provisional definitions of COVID-19 associated neurological conditions highlight the broader challenge of establishing temporal and causal relationships between SARS-CoV-2 infection and subsequent health outcomes (Li et al., 2020). These definitional discussions underscore the importance of conceptual precision when examining psychological distress in pandemic contexts.

For the purpose of this synthesis, a woman healthcare professional refers to an individual who works within the healthcare system in a professional capacity, identifies as a woman (including cisgender and transgender women), and performs a credentialed or regulated health-related role such as physician, nurse, nurse practitioner, physician assistant, midwife, or allied health professional across primary, secondary, or tertiary care settings (Karakcheyeva et al., 2024; Gagliardi et al., 2023).

Although numerous bibliometric and systematic studies have examined the mental health consequences of COVID-19 among healthcare workers highlighting distress, anxiety, depression, burnout, and post-traumatic stress (Luo et al., 2020; Pappa et al., 2020; Serrano-Ripoll et al., 2020) most analyses have adopted a broad HCW perspective without

explicitly focusing on gender-specific dimensions. Emerging evidence suggests that women healthcare professionals may have experienced disproportionate psychological burdens due to dual caregiving responsibilities, heightened frontline exposure, workplace inequities, and intensified emotional labour demands.

Despite these literature evaluations, there is still a significant lack of targeted bibliometric studies that methodically chart the development of studies that particularly address psychological distress among female healthcare professionals during COVID-19 (Liu et al., 2024). Bibliometric analysis allows researchers to identify influential articles, prominent authors, and adaptive trends in publication practices over time, which is crucial for understanding the evolution of a subject area (Kalsoom and Zámečník, 2023). In this gender-focused field, prominent research clusters, collaborative networks, citation structures, and emerging topic trajectories are not fully identified by few literatures (Zhang et al., 2022; Yang et al., 2024). As a result, the current study performs a thorough bibliometric review of international studies on psychological distress, anxiety and burnout among female healthcare workers during the COVID-19 epidemic.

This gap limits the ability to understand the intellectual structure and global research patterns of the field, thereby restricting evidence-based policymaking, targeted mental health interventions, and future research prioritization for female healthcare professionals. Addressing this gap is important because women healthcare workers constituted a major proportion of the frontline workforce during the pandemic and were disproportionately exposed to psychological burdens arising from occupational stress, caregiving responsibilities, and workplace inequalities (Nishi and Sasaki, 2022).

Therefore, the major aim of the present study is to conduct a comprehensive bibliometric analysis of global research on psychological distress, anxiety, and burnout among female healthcare workers during the COVID-19 pandemic.

## **2. Materials and Methods**

This study used a bibliometric research design to quantitatively analyse the pattern of the field. Bibliometric analysis enables the mapping of a field's intellectual structure, research collaboration networks, and conceptual trends through statistical and network-based techniques (Adarsh and Sulthana, 2025). Across the candidate references, the core methods cluster around citation-based analyses, co-citation, bibliographic coupling, co-authorship networks, text mining, visualization, and multi-method triangulation. Some studies compare variants of disruption indices to identify landmark papers within a domain (e.g., Scientometrics) (Bornmann et al., 2020). Science mapping uses visualization tools to create intuitive representations (e.g., landscapes, networks, maps) of citation and co-citation relationships over time (Chen et al., 2005). Given the complexity of science dynamics, combining multiple Scientometric techniques (e.g., co-citation, bibliographic coupling, overlay visualizations) yields more robust inferences and a fuller understanding of a field's evolution (Chandra, 2018).

### **2.1 Study Design**

This approach serves as a framework for conducting systematic reviews and meta-analyses of pre-existing research, rather than functioning as a data-gathering technique (Page et al. 2021). It offers a methodical and thorough strategy for locating, choosing, and combining pertinent studies. PRISMA seeks to enhance the clarity and excellence of these evaluations by establishing guidelines for documenting essential components such as search methodologies, criteria for inclusion, and data extraction (Samala et al. 2024b) (Fig.1). The design integrates bibliometric performance analysis and science mapping techniques to examine publication trends, citation structures, collaborative networks, and thematic

evolution over time. Scopus was selected as the primary database due to its extensive coverage of peer-reviewed journals, interdisciplinary indexing, reliable citation tracking system, and comprehensive export functionalities.

## 2.2 Data Collection

The search strategy incorporated keywords related to COVID-19, psychological distress, mental health outcomes (e.g., anxiety, depression, burnout, stress, post-traumatic stress), healthcare professionals (e.g., nurses, physicians, frontline workers), and gender-specific terms (e.g., women, female healthcare workers). Boolean operators (AND, OR) were used to refine the search string and ensure comprehensive retrieval of relevant publications. After data extraction, duplicate records were identified and removed using the Biblioshiny plugin, and non-relevant records were excluded. The final dataset was subjected to bibliometric performance analysis, including annual publication output, most productive countries, institutions, authors, and journals, as well as citation metrics such as total citations and h-index.

## 2.3 Inclusion and Exclusion criteria

The study followed predefined inclusion and exclusion criteria to ensure the selection of relevant literature for bibliometric analysis. Peer-reviewed publications, including journal articles, review papers, book chapters, and conference proceedings focusing on psychological distress, anxiety, burnout, and mental health among women healthcare workers during the COVID-19 pandemic were included. Studies addressing gender-related psychosocial and occupational challenges were also considered. Only publications published between 2020 and 2025 were included in the study. Articles unrelated to women healthcare workers or COVID-19 mental health issues, studies without psychological or psychosocial focus, non-scholarly sources such as editorials and news reports, and duplicate records were excluded.

## 2.4 Screening and merging process

The initial search retrieved 1145, 103, and 136 records retrieved from Scopus, PubMed and Open Alex. All records were merged and screened using R programming and the *Bibliometrix* function `mergeDbSources()`. After removing 67 duplicate records, 1210 unique documents were retained for the final bibliometric analysis on the scientific evolution of research trends related to psychological distress, anxiety, and burnout among women healthcare workers during the COVID-19 pandemic (Fig.1).

## 2.5 Search Strategy

A structured search strategy was developed using keywords related to psychological distress, female healthcare workers, and the COVID-19 pandemic to capture relevant literature within the study scope. The search was designed as a multi-concept query combining terms associated with mental health outcomes, healthcare professionals, gender-specific population, and pandemic-related contexts. The data collection stage involved retrieving publications from Scopus, Open Alex, and PubMed using well-defined search queries.

*("psychological distress" OR "mental distress" OR anxiety OR depression OR burnout OR "mental health") AND ("healthcare worker\*" OR "health care worker\*" OR "health professional\*" OR nurse\* OR physician\* OR doctor\*) AND (women OR woman OR female OR "female healthcare worker\*" OR "female health professional\*" OR "female nurse\*" OR "female physician\*") AND ("COVID-19" OR covid19 OR "SARS-CoV-2" OR coronavirus)) AND NOT (men OR man OR male OR "male healthcare worker\*" OR "male physician\*" OR "male nurse\*").*

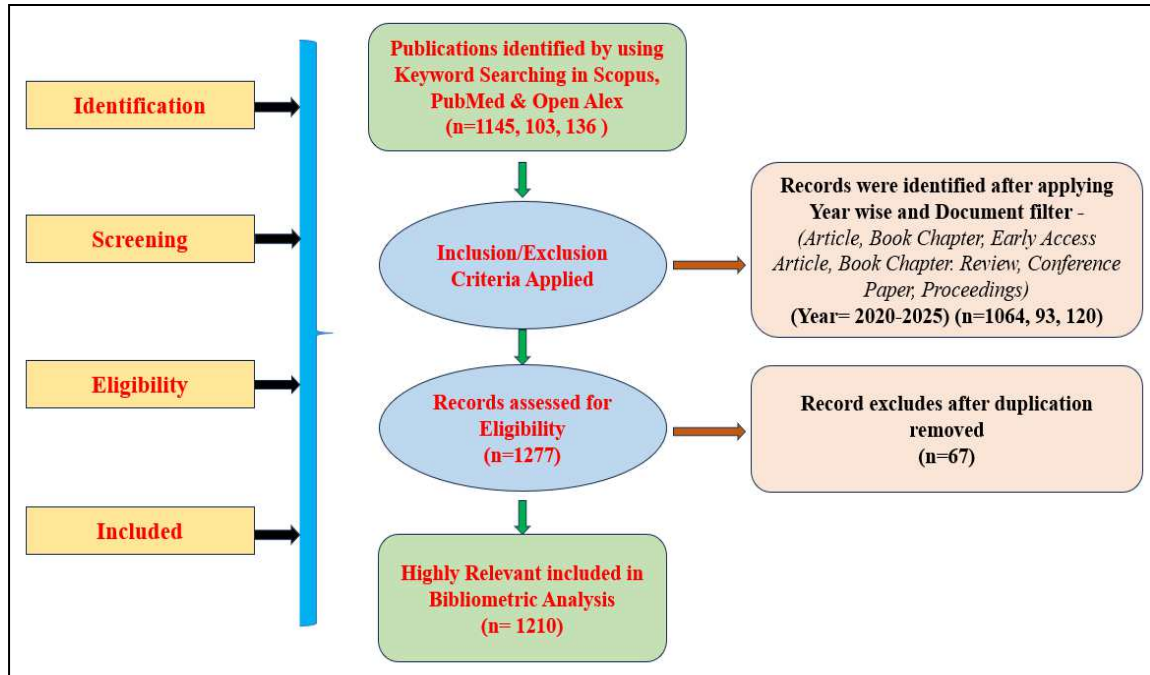


**Fig.1** Methodology Flow Chart

## 2.6 Data Analysis

The study utilized Biblioshiny, a web-based bibliometric analysis interface developed from the bibliometrix R package (Aria & Cuccurullo, 2017), to perform a comprehensive analysis of the selected body of literature. Various analytical methods were employed to explore the structural, thematic, and collaborative characteristics of the research domain. The methods applied include:

1. Descriptive Analysis: Conducted to evaluate publication trends, prominent journals, productive authors, contributing institutions, and citation indicators.
2. Co-occurrence Analysis: Used to analyse relationships among author keywords and to reveal the conceptual structure of the research field.
3. Thematic Mapping: Performed to categorize research themes according to their centrality and density, grouping them into Motor Themes, Basic Themes, Niche Themes, and Emerging or Declining Themes.
4. Thematic Evolution Analysis: Applied to investigate the temporal development of research themes and track changes in scholarly focus over specific time periods.
5. Factorial Analysis: Used to identify and interpret multidimensional thematic clusters through dimensionality reduction techniques.
6. Collaboration Network Analysis: Conducted to examine international co-authorship patterns, identify key country-level research hubs, and visualize the global structure of scientific collaboration.

## 3. Results

### 3.1 Descriptive Analysis of the Bibliographic Dataset

The final bibliographic dataset consists of 1,210 publications retrieved from multiple databases, including *Scopus*, *OpenAlex*, and *PubMed*, covering the period 2020–2025. This relatively short timeframe highlights the recent and rapidly evolving nature of research in this field, largely driven by the global impact of the COVID-19 pandemic and its

associated psychological and social implications. The publications are distributed across 725 different sources, including journals, books, book chapters, conference papers, dissertations, and preprints (Fig.2).

### **3.2 Growth and Productivity Trends**

The bibliometric dataset demonstrates sustained research activity during the study period, with an annual growth rate of 2.07%. Although relatively modest, this rate reflects a steady increase in scholarly output over time. The average document age of 3.65 years further confirms that the dataset primarily consists of recent research contributions.

### **3.3 Impact and Citation Patterns**

The dataset demonstrates notable scholarly influence, with an average of 22.15 citations per document. Considering the relatively recent publication period of the dataset, this citation level indicates that the studies have already gained substantial academic attention and recognition. The citation performance suggests that research in this field is actively contributing to ongoing scientific discussions related to mental health, healthcare systems, and the broader societal impacts of the COVID-19 pandemic.

### **3.4 Keyword Distribution and Thematic Diversity**

The bibliographic dataset contains 3,991 Keywords Plus and 2,333 Author Keywords, indicating a broad conceptual and thematic diversity within the research field. The large number of keywords reflects the multidimensional nature of the topic, covering areas such as mental health outcomes, healthcare workforce experiences, pandemic-related stress, and clinical or epidemiological aspects of COVID-19. Keywords Plus, which are generated from database indexing systems, complement author-provided keywords by capturing additional conceptual relationships.

### **3.5 Authorship Patterns and Collaboration**

The examination of collaboration networks highlights the structure and strength of scholarly interactions, demonstrating how co-authorship contributes to knowledge production and the dissemination of scientific research (Newman, 2001). A total of 6,687 authors contributed to 1,210 publications, reflecting strong scholarly participation. Only 74 documents were single-authored, while most studies were collaborative, with an average of 6.16 authors per document. This indicates the interdisciplinary nature of the field. International collaboration was notably high at 99.17%, emphasizing the global relevance and extensive cross-country cooperation in this research area (Wagner et al., 2015).

### **3.6 Document Types and Publication Characteristics**

In terms of document types, research articles represent the majority of the publications (967 documents), followed by review articles (149 documents). Other document types including books, book chapters, conference papers, dissertations, and preprints appear in smaller numbers. The dominance of research articles suggests a strong emphasis on empirical and analytical investigations, while the substantial presence of review papers reflects an increasing effort to synthesize existing knowledge and consolidate research findings in this rapidly growing field.

### **3.7 Data Limitations**

Despite the comprehensiveness of the dataset, certain metadata elements were unavailable. In particular, cited references and science category classifications were missing due to differences in metadata structures across the merged databases (*Scopus*, *OpenAlex*, and *PubMed*). Similarly, the lack of science category data restricts a precise assessment

of disciplinary classifications and the degree of interdisciplinarity within the dataset. These limitations should therefore be considered when interpreting the results of the bibliometric analysis.

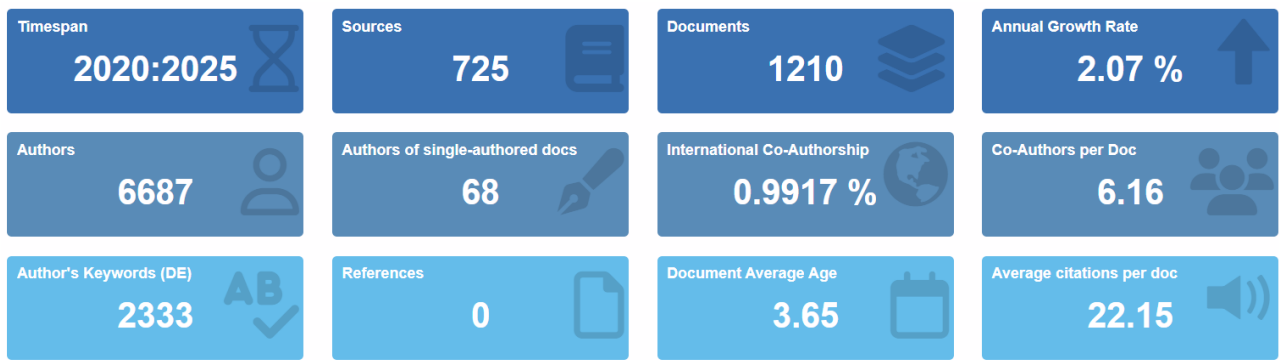


Fig.2 Main Information

### 3.8 Publication Trends Over the Years

The analysis of the retrieved literature reveals a significant variation in the number of publications related to *psychological distress among female healthcare workers during the COVID-19 pandemic* over the study period (Lucas et al., 2022). The results indicate that research output increased rapidly during the initial years of the pandemic and gradually declined in the later years. In 2020, a total of 102 articles were published, marking the beginning of scholarly attention to the psychological impact of the pandemic on healthcare workers ((Fig.3). The number of publications increased substantially in 2021, reaching 273 articles, reflecting growing academic interest in understanding the mental health challenges faced by healthcare professionals.

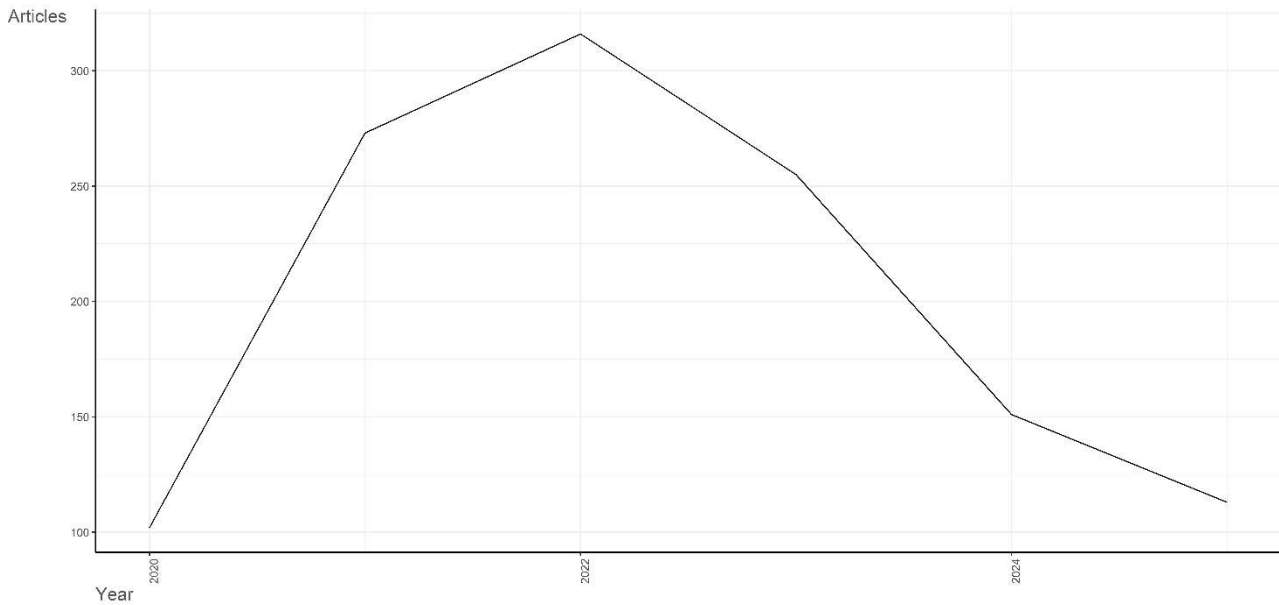


Fig.3 Annual scientific production (all figures in this paper, except Fig.7, Fig.8 has been prepared using Biblioshiny (Aria and Cuccurullo, 2017))

The research output continued to rise and reached its peak in 2022, with 316 articles, indicating heightened global research engagement on this topic. However, a gradual decline in publication volume was observed in subsequent years. In 2023, the number of articles decreased to 255, followed by 151 articles in 2024 and 113 articles in 2025. This trend suggests that scholarly attention intensified during the peak phases of the pandemic and gradually decreased as the

immediate global health crisis subsided (Umbetkulova et al., 2023). Nevertheless, the sustained publication output in later years indicates continued academic interest in examining the *long-term psychological impacts of COVID-19 on female healthcare workers*. (De Sousa et al., 2020; Vindegaard & Benros, 2020).

### 3.9 Life Cycle of Scientific Production

Depending on the logistic growth model, the bibliometric life cycle analysis proves a rapid increase in the production of scientific works within the frame of the study period of 2025 (Aria et al., 2020). The compilation of Scopus, OpenAlex, and PubMed has a compressed research life cycle with an initial growth period followed by an era of rapid expansion followed by a levelling off (Bettencourt et al., 2009). Such a life cycle of scientific production outlines the temporal development and maturity of scientific output, which usually represents stages of emergence, growth, maturity and possible decay of a given discipline (Price, 1963).

The cumulative curve of publication follows a canonical S-shaped logistic path, with small initial growth in 2020 and the early years of 2021, when the active research sphere first reacted to the emerging global health crisis. After that, there was a sharp rise in publication in 2021-2022, which is an indicator of a surge in scholarly interest in the topic worldwide (Fig. 4).

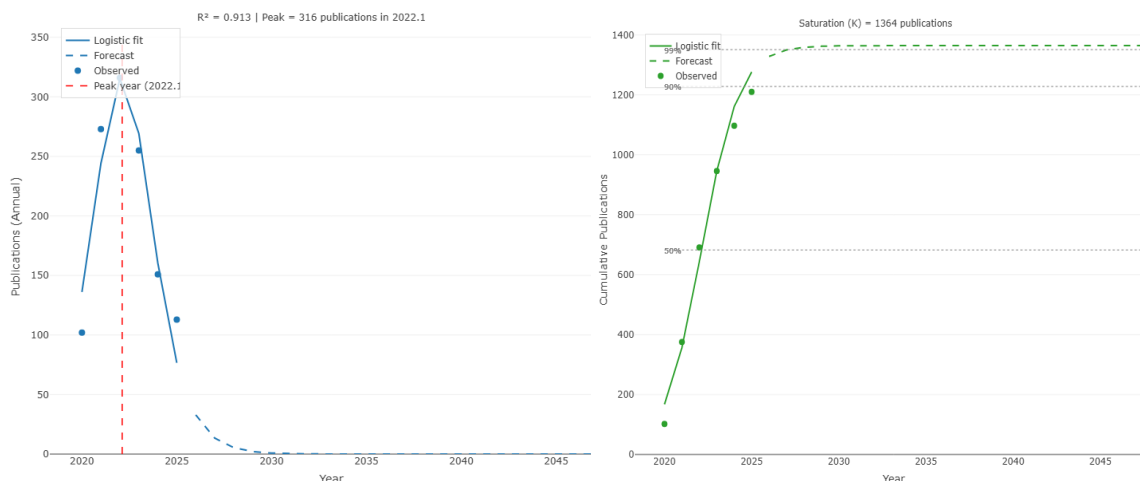


**Fig.4** Life Cycle of Scientific Production

The logistic growth model shows a strong statistical fitting with the recorded publication data. The fact that the logistic growth model is aligned satisfactorily with the trends in publications suggests that the field follows a traditional pattern of scientific development, where it grows, develops faster and, ultimately, stabilizes (Pautasso, 2012). The coefficient of determination ( $R^2 = 0.913$ ) indicates that the model can explain over 91% of the variance in the data, which means the logistic model can accurately explain the growth trend of the research domain over the period of study (Rogers, 2003). The Root Mean Square Error ( $RMSE = 24.53$ ) represents a relatively small difference between the actual and forecasted values, which once again prove the soundness of the model (Small and Upham, 2009). The carrying capacity ( $K = 1364.48$ ) shows that the total number of publications in this field is set to stabilize at such a scale whereas the inflection point ( $t_0 = 2022$ ) marks the point at which the rate of growth of publications was the highest (Wang, 2018).

According to these trends, the publication path in 2020-2025 could be subdivided into three epochs, namely emergence, expansion, and maturity. The emergence phase (2020-2021) is the first research development stage and is characterized by a slow increase in the number of publications. The expansion period (2021-2022) relates to the period of the highest

activity of the research since the number of publications each year increased dramatically as researchers adapted to the demands of the COVID-19 pandemic. After 2022, it entered the maturity or stabilization phase, as the growth in new publications slowed down and research output started a slight downward trend. Such a fast-tracked and shorter life cycle reflects the crisis-fueled nature of the study area, in which the worldwide sense of urgency during the pandemic instilled a remarkable volume of academic work within an already comparatively short timeframe (Else, 2020).

### 3.10 Core Sources Based on Bradford's Law

In the identification of the key journals used to carry out research on psychological distress among women healthcare workers during the COVID-19 pandemic, Bradford Law was used. In this regard, analysis of the law shows that few journals have a high proportion of publications in this field (Bradford, 1934; Egghe, 1986).

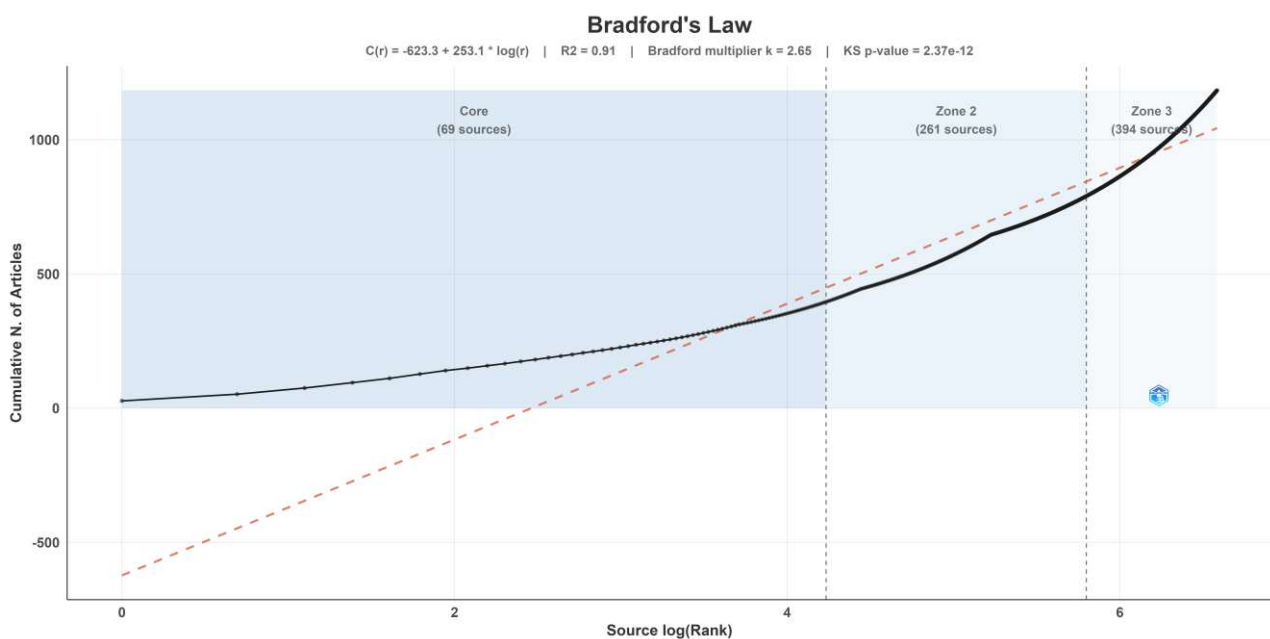


**Fig.5** Core Sources Identified by Bradford's Law for Publications. The shaded region highlights the “core zone” of journals contributing the majority of publications in the dataset

The most fruitful *core journals* are the ones in the list of *Frontiers in Psychology*, *Frontiers in Public Health*, and the *International Journal of Environmental Research and Public Health* (Fig. 5). The other important sources include *Frontiers in Psychiatry*, *Healthcare (Switzerland)*, *PLOS ONE*, and *BMJ Open*. The rest of publications are spread among numerous different journals and include fewer contributions which is the typical *Bradford distribution* and it illustrates the *interdisciplinary character* of the research in this field (Brookes, 1969).

### 3.11 Author Productivity Based on Lotka's Law

The author productivity analysis based on the Law of Lotka can give information about how the scholarly contribution to the research field is distributed (Pao, 1985). Lotka Law states that most authors will publish only one paper but a relatively small percentage of researchers will publish more than one (Lotka, 1926). The results of the current paper follow the trend of this *bibliometric rule* according to which a considerable number of researchers published only one publication, and the rate of decline that the number of publications authored by a researcher has been rather high. This trend suggests a very *skewed productivity distribution*, which is the norm in *scientific research community* (Fig. 6).

The observed result is compared to the *theoretic Lotka distribution* whose behaviour is similar with declining tendencies, thus showing that there is an overall consistency of the *productivity pattern* within the dataset in accordance with the expected *bibliometric behaviour* (Aria and Cuccurullo, 2026). The number of *prolific writers* who raise a large number of publications is small, and most of them raise low amounts (Nicholls, 1986). This is a common occurrence in *fast evolving research fields*, where most researchers are dented with *intermittent research*, but few *core researchers* who are continuously involved in the development of the field.

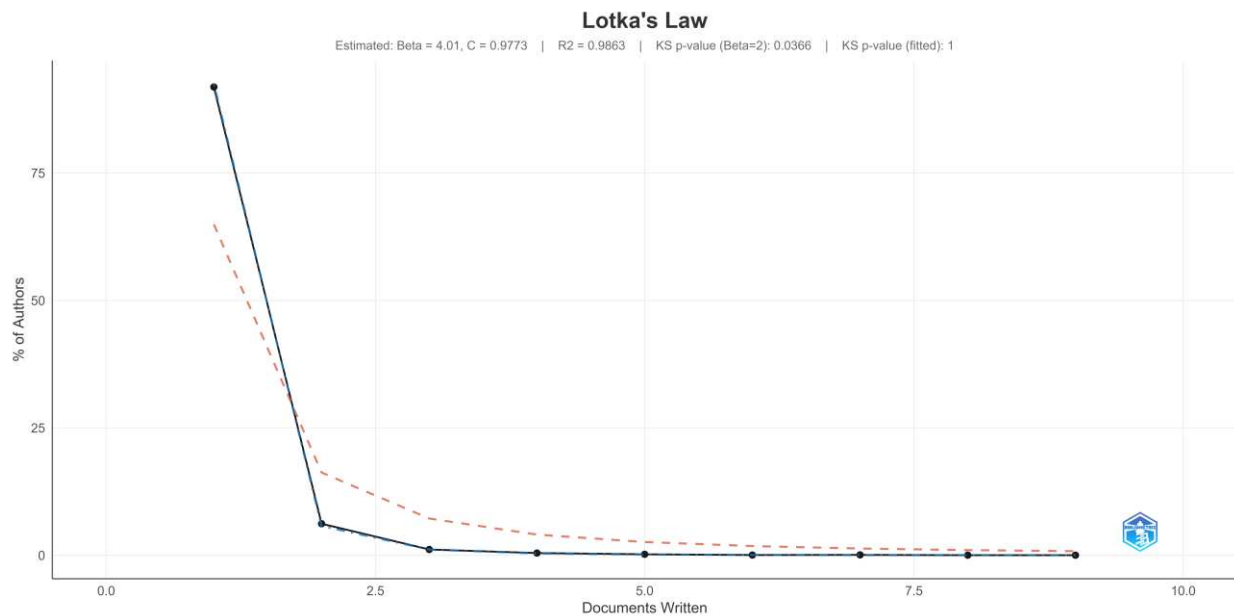


**Fig.6** Author Productivity Distribution Following Lotka’s Law

### 3.12 Most Productive Institutional Affiliations

The analysis of institutional affiliations shows that research on psychological distress among female healthcare workers during the COVID-19 pandemic is concentrated in several leading universities and medical research institutions (Krystal et al., 2021). The University of Toronto is the most productive institution with 35 publications, followed by the Icahn School of Medicine at Mount Sinai (33 articles), the University of British Columbia (32 articles), and Tehran University of Medical Sciences (27 articles).

Other notable contributors include the University of California, Deakin University, University of New South Wales, University of Washington, King Saud University, and King’s College London. The presence of institutions from multiple regions highlights the global and interdisciplinary nature of research on healthcare workers’ mental health during the COVID-19 pandemic (Fry et al., 2020).

### 3.13 Countries’ Scientific Production

The review of the scientific output on the topic by country reveals that the study of female medical workers in psychological distress during the COVID-19 pandemic is widely distributed across the world, but with a small number of highly-developed countries. Among the analysed set of countries, the *United States* is the country of the largest number of publications, which testifies to its *leading role in the world of scientific activity and health sciences* (Al-Jabi, 2017). This leading contribution may be attributed to the *vast research system* in the United States, the scope of the *network of universities and medical institutions*, and *intensive investment in healthcare research*, which is depicted in

Fig. 7. Past *bibliometric studies* of the COVID-19-related mental health research have also found the United States as the most fruitful nation in this region (Hossain, 2020).

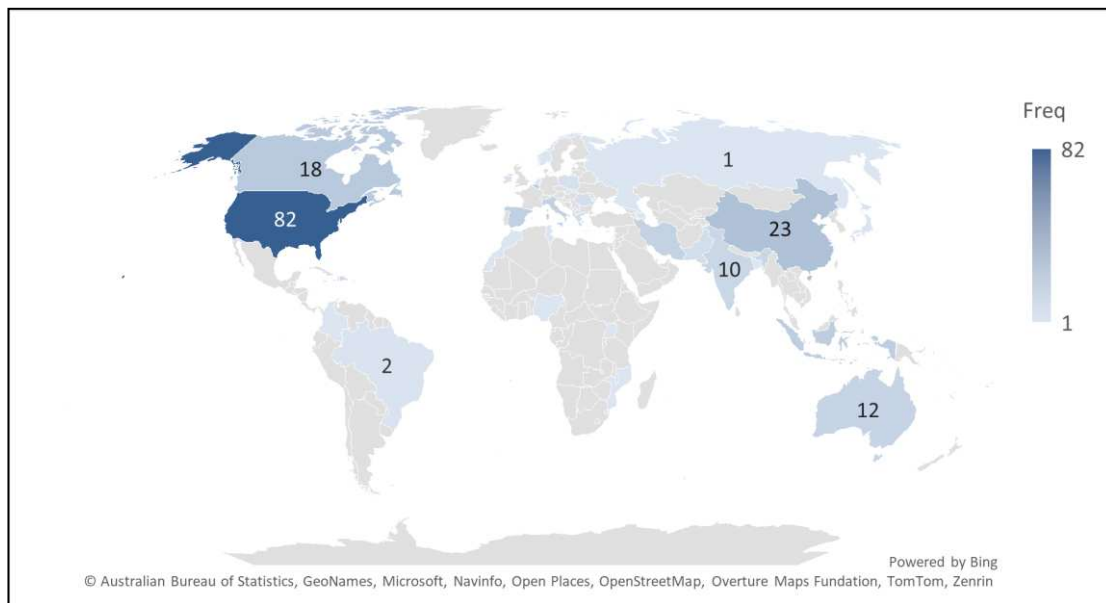


**Fig.7** Countries' Scientific Production

*China* follows the United States with 23 publications, which demonstrates that the country is deeply engaged in the COVID-19-related research especially in the initial pandemic stages. *Canada* (18 publications), *Belgium* (16 publications), and *Indonesia* (15 publications) are other significant contributors that highlight the contribution of both the developed and emerging research communities. Other European nations, in particular, *Spain* (14 publications) and *Italy* (13 publications) also show a significant level of scholarly activity, which can probably be explained by the serious pandemic in these countries during the initial stages.

It is further seen that *Iran* (13 publications), *Australia* (12 publications), and *India* (10 publications) contribute to the same. The fact that the countries that belong to different continents have been present suggests that the study of mental health of healthcare professionals in the state of a pandemic gained the character of a globally topical and interdisciplinary study subject (Beltrán-Ruiz, 2022).

### 3.14 Most Cited Countries

The most mentioned countries have been identified, which shows the coverage of the most significant research by geography thus indicating how some countries have formed a disproportionate contribution to the international scientific impact of the field (Donthu et al., 2021). The country-level citation analysis helps to make a sense of the trends of international research prevalence and cooperation, as well as to identify those regions where the high-impact scholarly performance occurs as the central nodes (Aria and Cuccurullo, 2017).

The citation analysis shows that a number of countries have contributed remarkably to the study of psychological distress among healthcare workers who are females during the COVID-19 pandemic. The first place is held by *India* (168 total citations) and the next place by the *United States* (162 citations) which is a reflection of the strong scholarly presence in the field (Fig. 8). The other salient contributors are *Spain* (94 citations) and *Belgium* (49 citations), though they have not had as many publications in general.



strategies. The *keyword analysis* shows that the literature mainly focuses on the *pandemic situation, mental health outcomes, medical personnel, and research methodologies based on the survey* (Simone et al.,2024; Froessl and Abdeen, 2021).

### 3.16 Trend topic

The trend in keywords 2020–2025 analysis indicates that the research priorities were changed significantly during the COVID-19 pandemic. During the initial stage (2020), the research was mainly focused on the knowledge about the virus, with keywords like *coronavirus infection* and *coronavirus infections*, as attempts were made to discover and research the emerging disease (Hossain, 2020).

In 2021–2022, the emphasis shifted to wider aspects of human and social effects of the pandemic. The keywords that gained more popularity included *COVID-19*, *human*, *female*, *women*, *coping behavior*, and *quality of life*, which suggests a higher level of interest in the psychological and occupational implications on healthcare workers and women (Spoorthy et al., 2020). Later (2023–2025) the focus of the research changed to the long-term outcomes and disease management. Such terms as *long COVID*, *therapy*, and *SARS-CoV-2* became significant, as there has been an increase in attention to the chronic effects of health and the methods of treatment (Davis et al., 2021).

### 3.17 Collaboration Network of Keywords

Co-occurrence network is the keyword that describes the conceptual framework of the research about psychological distress in female healthcare workers during the COVID-19 pandemic (Cobo et al., 2011). Thematically connected relationships between most commonly used keywords result in three main areas of thematics (Fig. 10).

It is rooted in the idea that terms appearing together in scientific documents are semantically related. When two keywords frequently co-occur across multiple publications, they are likely associated with the same research theme or concept. This principle has been widely used in scient metrics since the pioneering work of Callon et al. (1983) on co-word analysis.

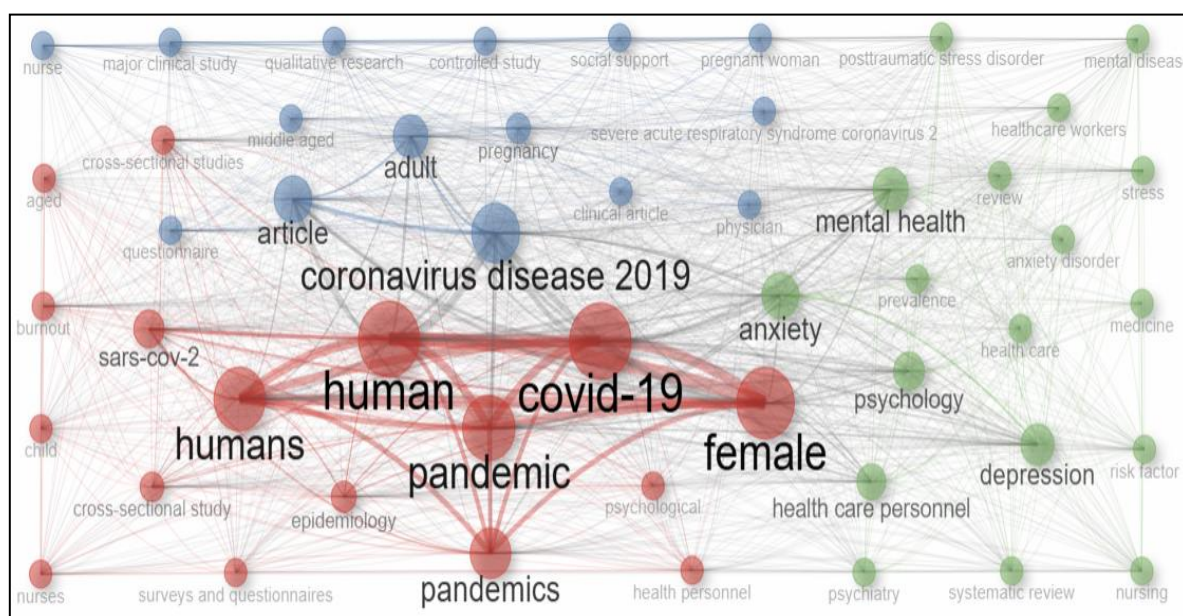


**Fig. 10** Co-Occurrence network of Keywords

The resulting network provides a map of the knowledge structure of a field highlighting themes and central concepts (Van Eck and Waltman, 2010). The first cluster (*red*) is focused on the effect of the pandemic on human population and healthcare systems including such keywords as *COVID-19*, *human*, *pandemic*, *SARS-CoV-2*, *female*, and *healthcare personnel*. It also includes the use of words like *burnout*, *nurses*, and *cross-sectional study*, thus indicating the research related to occupational stress in the healthcare personnel.

The second cluster (*blue*) represents clinical and methodological research, including the following keywords *coronavirus disease 2019*, *clinical article*, *controlled study*, *qualitative research*, and *adult*. This cluster reflects the literature on the investigation of the clinical aspects of the COVID-19 pandemic and the support measures.

The third cluster (*green*) prefigures psychological outcomes, and includes such terms as *mental health*, *anxiety*, *depression*, *stress*, and *post-traumatic stress disorder*. In all, the network shows that research of the area is largely structured around *pandemic effect*, *clinical research*, and *psychological consequences among medical workers* (Georgieva et al., 2021).

### 3.18 Strategic Thematic Map Analysis

The thematic map strategic map explains the conceptual structure applied in the research area by analysing the centrality of keyword clusters (relevance) and density of the clusters (development) (Aria et al., 2025). These two dimensions can be used to categorize the themes into four categories namely, *motor themes*, *niche themes*, *basic themes*, and *emerging or declining themes* (Fig. 11) (Callon et al., 1991). In the current analysis, the cluster with the *coronavirus disease 2019* at the centre of focus is located in the *motor theme quadrant*, indicating that it is both highly developed and also in close relation to the overall field of research. This observation suggests that the research related to *COVID-19*, especially that based on the adult population and in general academic publications, is a developed and powerful field that grounds the intellectual framework of the field (Rong et al., 2020).

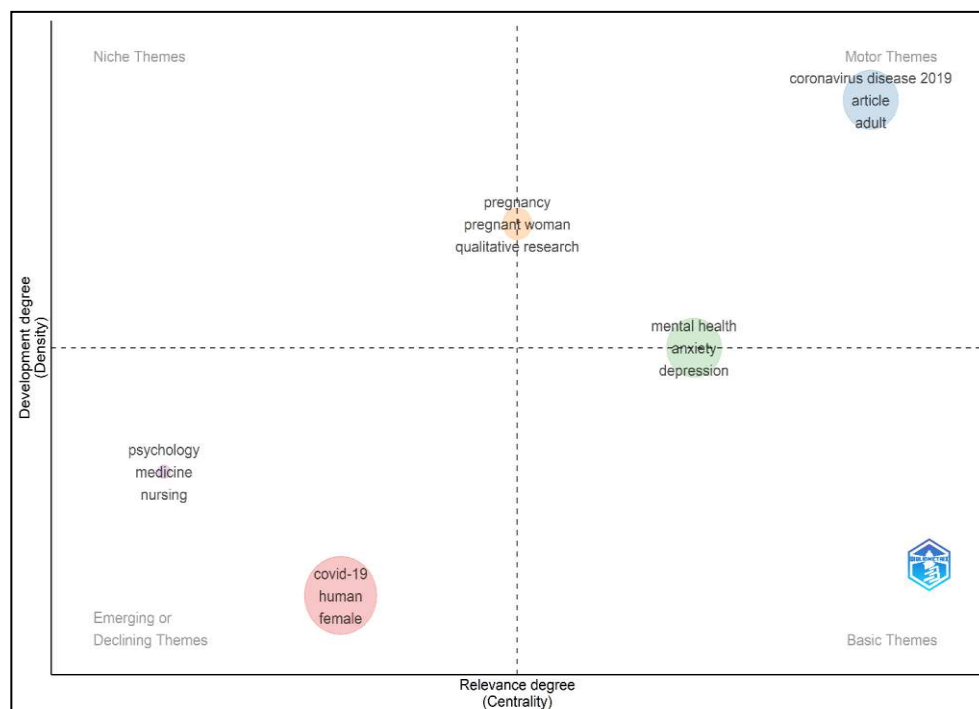


**Fig.11** Strategic visualisation of the intellectual structure of research by plotting the main themes based on two key metrics: centrality and density

The cluster related to *mental health* which includes the keywords like *anxiety* and *depression* falls within *basic theme quadrant*. Its position shows that mental health is a very relevant and central theme in the research environment, despite a more diffused internal development in the divergent sub-topics (Georgieva et al., 2021). Such a centrality of this cluster highlights the great amount of academic research paid to the field (Cobo et al., 2012) of psychological implications of the pandemic. The *pregnancy cluster*, which includes such keywords as *pregnant woman* and *qualitative research*, falls within the *niche theme quadrant*, which means that it is a strong but tightly specialized research area that is concerned with maternal health and experience of pregnant women during the pandemic (Sun et al., 2021).

Other clusters, like those on *COVID-19*, *human*, and *female*, and overarching terms of discipline, such as *psychology*, *medicine*, and *nursing*, fall within the *emerging quadrant* (Sun et al., 2021; Georgieva et al., 2021). All these themes have lower centrality and density, which implies that they represent either emerging or relatively less integrated spheres in the field of research. The *strategic map* represents a research environment in which *COVID-19-related studies* and *mental-health research* are central and specialized topics, like *pregnancy*, represent specific research niches, and more general disciplinary areas are continuously developing as new areas of interest.

### 3.19 Thematic Evolution and Strategic Mapping of Research Topics

Thematic evolution and strategy mapping offer a broad model of explaining how the studying topics have evolved over time, distinguishing the central, emergent, and decadent ones and evaluating their importance and maturity in the scientific field (Morris and Van der Veer Martens, 2008). This approach extends static thematic mapping into a longitudinal framework. It was originally formalised by Cobo et al. (2011), who introduced overlap-based similarity measures to identify continuities, splits, and mergers between themes across consecutive periods. Aria et al. (2025) further developed the methodology by addressing a key structural asymmetry in existing approaches: while cross-sectional theme detection is explicitly relational (based on weighted co-occurrence networks), lineage construction was traditionally reduced to set-theoretic comparisons of term lists, discarding the relational structure that defines a theme's semantic core (Callon et al., 1991).

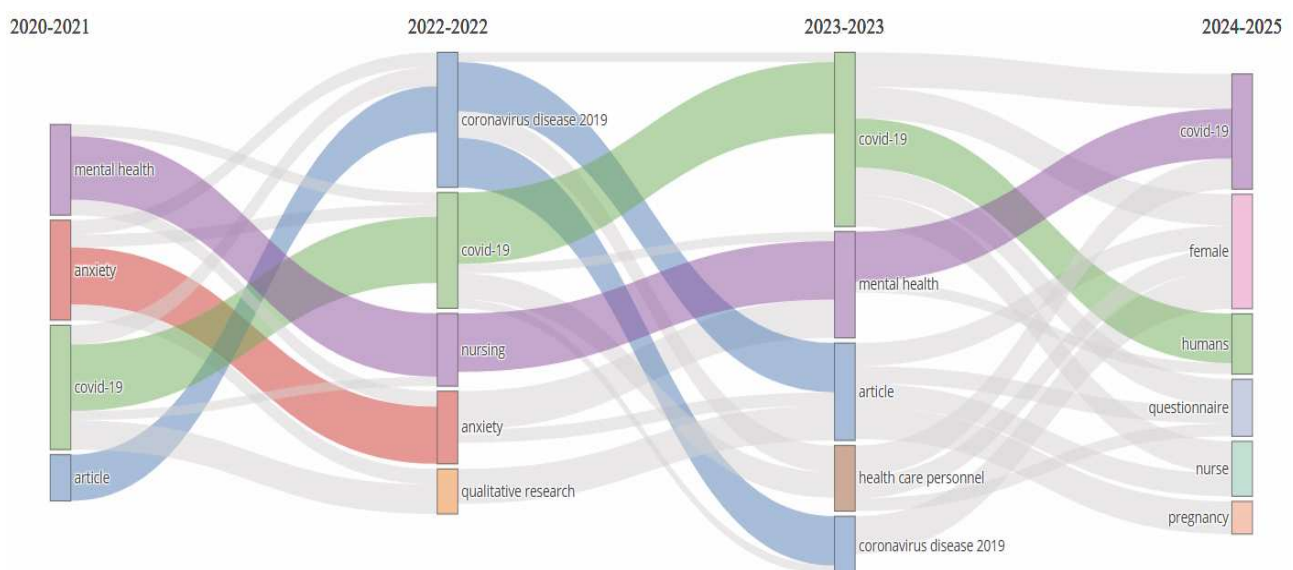


**Fig.12** The thematic evolution analysis provides a longitudinal view of research themes in have evolved over time

The *thematic evolution analysis* shows the development of research priorities about psychological distress in female healthcare workers during the COVID-19 pandemic, which changed between 2020 and 2025. According to the Sankey diagram, the themes associated with *COVID-19* were prevalent during the entire period, so such keywords as *COVID-19* and *coronavirus disease 2019* were repeatedly identified in consecutive time intervals. The problem of *mental health* and *anxiety* also did not disappear during the early pandemic and continued to exist in the later periods, which is the manifestation of long-standing academic interest in the psychological effects of the crisis (Fig. 12).

In the first wave (2020–2021), the research was skewed to general pandemic-related themes *COVID-19*, *human*, and *pandemic* which reflected the new scientific reaction to the new health crisis. By 2022, the research area is mature and such themes as *coronavirus disease 2019*, *adult*, and *research outputs* became mainstream, whereas the special ones like *qualitative research*, *social support*, and *healthcare delivery* started emerging.

Later (2023–2025) the attention was paid to selected groups of people and methodologies. Thematic focus like *pregnancy*, *pregnant woman*, and *female* were more pronounced and methodological terminologies like *questionnaire* and *cross-sectional study* were more apparent. On the whole, the shift implies the replacement of wide pandemic studies by more specific studies with a focus on *mental health outcomes*, *vulnerable groups*, and a high level of *empirical research*.

### 3.20 Factorial Analysis

The factorial map as obtained by Multiple Correspondence Analysis (MCA) provides a graphic representation of the conceptual framework of the research inherent in the set of data (Greenacre, 2007). Analysis was performed with merged keys and a minimum degree of 59 and only the most recurring and most interesting terms were included. The map is grouped on two main dimensions; *Dimension 1* (77.05%), and *Dimension 2* (8.38%) which show a cumulative over 85% of the total variance in co-occurrence of keywords (Benzecri, 1973). Such a large cumulative variance shows that the *factorial map* is a good synthesis of the conceptual interrelations between keywords, and it serves well to draw the lines between the major thematic areas in the research sphere (Cuccurullo et al., 2016).

The location of words in the factorial map form's various theme groupings which relate to important areas of research (Aria and Cuccurullo, 2017). One of the clusters is focused on methodological and epidemiological approaches, including such terms as *surveys*, *questionnaires*, *cross sectional study*, *epidemiology*, *adult*, and *aged*, thus representing the vast use of questionnaire-based observational designs (Fig. 13). Another cluster highlights clinical and pandemic-related research, and the key terms that can be identified include *coronavirus disease 2019*, *major clinical study*, *controlled study*, *pregnant woman*, *health-care personnel*, and *prevalence*, which all reflect clinical studies on COVID-19 and its effects on certain groups (Nalbandian et al., 2021).

Another cluster focuses on mental health outcomes, including *depression*, *anxiety disorder*, *post-traumatic stress disorder*, *mental disease*, and *risk factor* alongside evidence synthesis terminologies like *systematic review* and *review* (Sun et al., 2021). Another cluster is associated with *COVID-19*, *mental health*, *anxiety*, *nurses*, and *healthcare workers*, highlighting the research on the psychological well-being of frontline health-care workers (Pietrzak and Hanke, 2024).

The factorial map therefore illustrates a research environment where the research on *mental-health*, *clinical and epidemiological research questions related to COVID-19* and the studies focusing on the *psychological impact of the pandemic on health-care workers* are predominant.

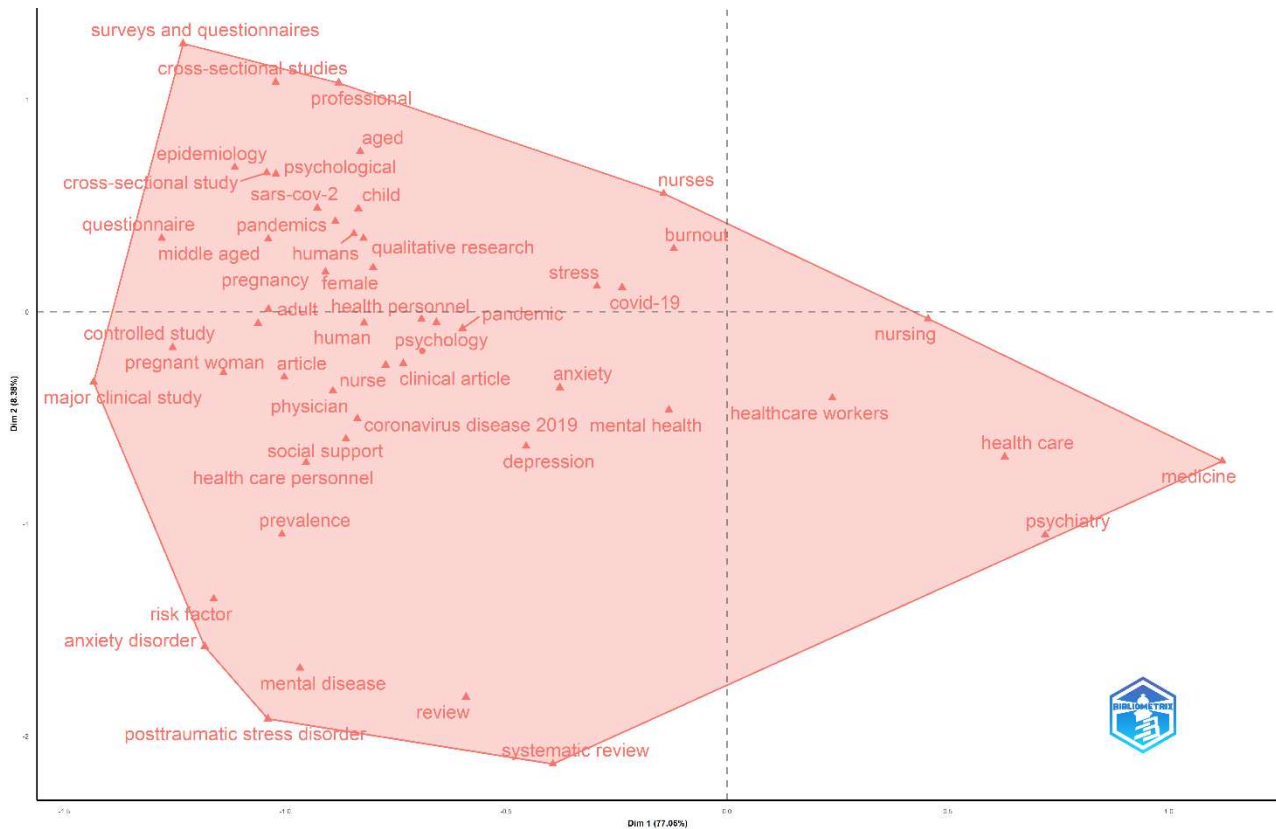


**Fig.13** The factorial analysis, performed using Multiple Correspondence Analysis (MCA)

### 3.21 Country Collaboration Network Analysis

The country collaboration network illustrates the global pattern of research partnerships in studies (Aria and Cuccurullo, 2026) on psychological distress among female healthcare workers during the COVID-19 pandemic. The network shows a hub-and-spoke structure dominated by a few highly connected countries, particularly the United States and the United Kingdom. Their large node sizes and numerous links indicate strong international collaboration, with a particularly strong partnership observed between these two countries (Cuccurullo et al., 2016).

The analysis also reveals several collaborative clusters. One cluster centers around the United States, connecting with countries such as China, Pakistan, Albania, and Romania. Another cluster is led by the United Kingdom, with collaborations involving Italy, Ireland, Canada, Malta, Taiwan, Spain, Norway, Colombia, and Australia. A third group includes countries such as Japan, the Netherlands, Slovakia, Belgium, Morocco, Mozambique, Lebanon, and Tanzania, which maintain links with both major hubs. A smaller cluster involving India, Bangladesh, and the Russian Federation reflects more regional collaboration. The network highlights the dominant role of the United States and the United Kingdom in facilitating global research collaboration in this field.

## 4. Discussion

The present bibliometric analysis highlights several major research directions that have shaped the scholarly landscape between 2020 and 2025. First, a dominant research stream focuses on the COVID-19 pandemic and its impact on healthcare systems and human population, particularly frontline healthcare workers. The high frequency of keywords such as *COVID-19*, *pandemic*, *SARS-CoV-2*, and *healthcare personnel* indicates that the pandemic served as the central context driving research in this field (Shanafelt et al., 2020; Lai et al., 2020). Within this broader context, substantial

attention has been directed toward female healthcare workers, reflecting the increasing recognition of gender-specific experiences and vulnerabilities during global health emergencies (Alahdal et al., 2020).

A second major finding involves the psychological and mental health consequences of the pandemic. The prominence of keywords such as *mental health*, *anxiety*, *depression*, *stress*, and *burnout* suggests that the literature has strongly focused on understanding psychological distress among healthcare professionals (Lai et al., 2020; Pappa et al., 2020). Bibliometric analyses such as keyword co-occurrence networks and thematic mapping further reveal that mental health constitutes a core conceptual pillar connecting multiple research streams, including occupational stress, healthcare workforce well-being, and public health outcomes (Donthu et al., 2021). This indicates that mental health research has evolved from an emerging concern into a foundational research area within the broader COVID-19 literature.

A third major indication relates to specific vulnerable populations and healthcare contexts, particularly women and pregnant healthcare workers. The emergence of keywords such as *female*, *pregnancy*, and *pregnant woman* suggests an increasing emphasis on gender-focused and population-specific studies (Alahdal et al., 2020). Methodological trends show a strong reliance on cross-sectional studies, surveys, and questionnaire-based research, reflecting the need for rapid data collection during the pandemic (Vindrola-Padros et al., 2020). Together, these directions demonstrate that the research field has progressed from broad pandemic-related investigations toward more specialized, population-focused, and methodologically structured studies.

## **5. Theoretical and Practical Implications**

The country collaboration network highlights the dominant role of global research hubs, particularly the United States and the United Kingdom, in shaping the knowledge structure of research on psychological distress among female healthcare workers during the COVID-19 pandemic. Previous studies suggest that international collaboration networks significantly influence the development of scientific knowledge and theoretical advancement within research fields (Glänzel and Schubert, 2005; Wagner and Leydesdorff, 2005). The dominance of high-income countries in collaborative networks may also shape research priorities and theoretical perspectives, often reflecting the healthcare systems and socio-economic contexts of these regions (Wagner et al., 2019). Therefore, increasing participation from developing countries could enrich theoretical understanding by incorporating diverse cultural and healthcare contexts.

From a practical perspective, international research collaboration facilitates knowledge exchange, resource sharing, and the development of evidence-based strategies to address global health challenges. Strong collaborative networks can accelerate scientific innovation and improve the translation of research findings into healthcare policies and interventions (Wagner et al., 2019). Strengthening collaboration among underrepresented regions, particularly in low- and middle-income countries, can enhance research capacity and contribute to more inclusive mental health policies aimed at protecting healthcare workers during public health emergencies.

## **6. Limitations and Future Directions**

This study has several limitations that should be acknowledged. The dataset was compiled by merging records from Scopus, Open Alex, and PubMed, which may have excluded relevant publications indexed in other databases or available in grey literature. Differences in indexing standards and metadata structures across these databases may also have resulted in incomplete or inconsistent information during the data merging process. And also, the analysis relies on bibliographic metadata, including author keywords and database-generated keywords, which may not fully capture the conceptual depth or methodological nuances of individual studies. Variations in keyword selection, indexing practices,

and citation behaviour may therefore influence the interpretation of thematic structures, collaboration networks, and research trends. As a quantitative bibliometric analysis, the study focuses on publication patterns and citation metrics rather than evaluating the theoretical quality, methodological rigor, or empirical validity of the included publications.

## **7. Conclusion**

This study provides a comprehensive bibliometric overview of research on psychological distress among female healthcare workers during the COVID-19 pandemic between 2020 and 2025. The findings reveal a rapidly evolving research field characterized by intense scholarly activity during the early years of the pandemic. The life-cycle analysis shows a rapid expansion phase around 2021–2022 followed by gradual stabilization, indicating that the field experienced accelerated development driven by the urgent global health crisis.

The analysis also demonstrates that research output is widely distributed across multiple journals, institutions, and countries, highlighting the global and interdisciplinary nature of this research area. The results further show that scientific production and collaboration are strongly influenced by leading research nations, particularly the United States and the United Kingdom, which function as major hubs in international collaboration networks. At the same time, contributions from countries across Asia, Europe, and Oceania illustrate the widespread global engagement in studying the psychological impact of the pandemic on healthcare workers.

The study demonstrates that research on mental health and psychological distress among female healthcare workers has become an important and rapidly developing area within the broader COVID-19 research landscape. While the intensity of publication growth has begun to stabilize in recent years, the thematic analyses suggest that future research may increasingly focus on long-term mental health outcomes, gender-specific experiences, and targeted interventions to support healthcare professionals. These findings provide valuable insights into the development of the field and offer a foundation for guiding future research and policy initiatives aimed at improving the well-being of healthcare workers.

## **Declaration of Generative AI Use**

During the preparation of this manuscript, the authors used generative AI-assisted tools, including ChatGPT (OpenAI), to support language editing, grammar checking, improve clarity and readability, and assist in the design and visual representation of the major findings diagram based on the authors' analyses. These tools were used solely as supportive resources and did not replace the authors' intellectual contribution or responsibility for the research methodology, data collection, analysis, interpretation, and conclusions. All AI-assisted outputs were critically reviewed, revised where necessary, and verified by the authors. The authors retain full responsibility for the accuracy, originality, integrity, and final content of the manuscript, including all text, analyses, interpretations, and visual materials.

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## **Conflict of Interest**

The authors declare that there are no conflicts of interest associated with this study.

## Informed Consent

Not applicable. This study is based exclusively on secondary data derived from published literature and publicly available bibliographic databases and does not involve human participants.

## Authors' Contributions

**Haneena Sulthana K. P.:** Conceptualization, Methodology, Data curation, Formal analysis, Investigation, Writing – original draft.

**Sandhya Aravind C. A.:** Conceptualization, Supervision, Validation, Writing – review & editing.

**Adarsh T.:** Methodology, Data curation, Formal analysis, Visualization, Investigation, Writing – review & editing.

**All authors:** Review and approval of the final manuscript and agreement to be accountable for all aspects of the work.

## Data Availability Statement

This study is based on bibliometric data retrieved from the Scopus and Web of Science databases. Due to licensing restrictions of the databases, the full datasets cannot be shared publicly; however, processed data and analytical outputs used in the study are available from the corresponding author upon reasonable request.

## References

1. Adarsh T., and Sulthana K.P. (2025). Trends and insights in Nature-Based Solutions: bibliometric study. *International Journal of Disaster Studies and Climate Resilience* 1(1):22–34. <https://doi.org/10.64866/j.ijdsr.2025.10003>
2. Alahdal, H., Basingab, F., & Alotaibi, R. (2020). An analytical study on the awareness, attitude and practice during the COVID-19 pandemic in Riyadh, Saudi Arabia. *Journal of Infect Public Health*, 13(10), 1446–1452. <https://doi.org/10.1016/j.jiph.2020.06.015>
3. Al-Jabi, S. W. (2017). Global Trends in Aspirin Resistance-Related Research from 1990 to 2015: A Bibliometric Analysis. *Basic & Clinical Pharmacology & Toxicology*, 121(6), 512–519. <https://doi.org/10.1111/bcpt.12840>
4. Aria, M. & Cuccurullo, C. (2017). bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of Informetrics*, 11(4), 959–975. <https://doi.org/10.1016/j.joi.2017.08.007>
5. Aria, M., & Cuccurullo, C. (2026). *Science Mapping Analysis: A Primer with Biblioshiny*. McGraw-Hill, New York, NY, USA. ISBN: 978-88-386-2297-7.
6. Aria, M., D'Aniello, L., Misuraca, M., & Spano, M. (2025). Rethinking Thematic Evolution in Science Mapping: An Integrated Framework for Longitudinal Analysis. Working Paper.
7. Aria, M., Misuraca, M., & Spano, M. (2020). Mapping the evolution of social research and data science on 30 years of Social Indicators Research. *Social Indicators Research*, 149, 803–831. <https://doi.org/10.1007/s11205-020-02281-3>
8. Beltrán-Ruiz, A. C., Jiménez-Peña, L. M., & Palencia-Mojica, C. L. (2022). Efectos de la pandemia por COVID-19 en la salud mental de los trabajadores de la salud. Revisión de la literatura. *Revista Investigación En Salud Universidad De Boyacá*, 9(2). <https://doi.org/10.24267/23897325.666>

9. Benzecri, J.-P. (1973). *L'Analyse des Donnees. Volume II: L'Analyse des Correspondances*. Paris: Dunod.
10. Bettencourt, L. M., Kaiser, D. I., & Kaur, J. (2009). Scientific discovery and topological transitions in collaboration networks. *Journal of Informetrics*, 3(3), 210–221. <https://doi.org/10.1016/j.joi.2009.03.001>
11. Bornmann, L., Devarakonda, S., Tekles, A., & Chacko, G. (2020). Disruptive papers published in Scientometrics: meaningful results by using an improved variant of the disruption index originally proposed by Wu, Wang, and Evans (2019). *Scientometrics*, 123(2), 1149–1155. <https://doi.org/10.1007/s11192-020-03406-8>
12. Bradford, S. C. (1934). Sources of information on specific subjects. *Engineering: An Illustrated Weekly Journal*, 137, 85–86.
13. Brookes, B. C. (1969). Bradford's law and the bibliography of science. *Nature*, 224(5223), 953–956. <https://doi.org/10.1038/224953a0>
14. Buselli, R., Corsi, M., Baldanzi, S., Chiumiento, M., Lupo, E., Dell'Oste, V., ... & Carmassi, C. (2020). Professional Quality of Life and Mental Health Outcomes among Health Care Workers Exposed to Sars-Cov-2 (Covid-19). *International Journal of Environmental Research and Public Health*, 17(17), 6180. <https://doi.org/10.3390/ijerph17176180>
15. Callon, M., Courtial, J.-P., & Laville, F. (1991). Co-word analysis as a tool for describing the network of interactions between basic and technological research: The case of polymer chemistry. *Scientometrics*, 22(1), 155–205. <https://doi.org/10.1007/BF02019280>
16. Callon, M., Courtial, J.-P., Turner, W. A., & Bauin, S. (1983). From translations to problematic networks: An introduction to co-word analysis. *Social Science Information*, 22(2), 191–235. <https://doi.org/10.1177/053901883022002003>
17. Carrozzino, D., Patierno, C., Pignolo, C., & Christensen, K. (2023). The concept of psychological distress and its assessment: A clinimetric analysis of the SCL-90-R. *International Journal of Stress Management*, 30(3), 235–248. <https://doi.org/10.1037/str0000280>
18. Chandra, Y. (2018). Mapping the evolution of entrepreneurship as a field of research (1990–2013): A scientometric analysis. *Plos One*, 13(1). <https://doi.org/10.1371/journal.pone.0190228>
19. Chen, C., McCain, K., White, H., & Lin, X. (2005). Mapping Scientometrics (1981–2001). *Proceedings of the American Society for Information Science and Technology*, 39(1), 25–34. <https://doi.org/10.1002/meet.1450390103>
20. Cobo, M. J., Lopez-Herrera, A. G., Herrera-Viedma, E., & Herrera, F. (2011). An approach for detecting, quantifying, and visualizing the evolution of a research field. *Journal of Informetrics*, 5(1), 146–166. <https://doi.org/10.1016/j.joi.2010.10.002>
21. Cobo, M. J., Lopez-Herrera, A. G., Herrera-Viedma, E., & Herrera, F. (2012). SciMAT: A new science mapping analysis software tool. *Journal of the American Society for Information Science and Technology*, 63(8), 1609–1630. <https://doi.org/10.1002/asi.22688>
22. Cobo, M. J., López-Herrera, A. G., Herrera-Viedma, E., & Herrera, F. (2011). Science mapping software tools: Review, analysis, and cooperative study among tools. *Journal of the American Society for Information Science and Technology*, 62(7), 1382–1402. <https://doi.org/10.1002/asi.21525>

23. Cuccurullo, C., Aria, M., & Sarto, F. (2016). Foundations and trends in performance management. A twenty-five years bibliometric analysis in business and public administration domains. *Scientometrics*, 108(2), 595-611. <https://doi.org/10.1007/s11192-016-1948-8>
24. Davis, H. E., Assaf, G. S., McCorkell, L., Wei, H., Low, R. J., Re'em, Y., Redfield, S., Austin, J. P., & Akrami, A. (2021). Characterizing long COVID in an international cohort: 7 months of symptoms and their impact. *EClinicalMedicine*, 38, 101019. <https://doi.org/10.1016/j.eclinm.2021.101019>
25. De Sousa, A., Mohandas, E., & Javed, A. (2020). Psychological interventions during COVID-19: Challenges for low- and middle-income countries. *Asian Journal of Psychiatry*, 51, 102128. <https://doi.org/10.1016/j.ajp.2020.102128>
26. Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research*, 133, 285–296. <https://doi.org/10.1016/j.jbusres.2021.04.070>
27. Egghe, L. (1986). The dual of Bradford's law. *Journal of the American Society for Information Science*, 37(4), 246–255. [https://doi.org/10.1002/\(SICI\)1097-4571\(198607\)37:4<246::AID-AS110>3.0.CO;2-F](https://doi.org/10.1002/(SICI)1097-4571(198607)37:4<246::AID-AS110>3.0.CO;2-F)
28. Else, H. (2020). How a torrent of COVID science changed research publishing—in seven charts. *Nature*, 588(7839), 553. <https://doi.org/10.1038/d41586-020-03564-y>
29. Froessler, L., & Abdeen, Y. (2021). The Silent Pandemic: The Psychological Burden on Frontline Healthcare Workers during COVID-19. *Psychiatry Journal*, 2021, 1–11. <https://doi.org/10.1155/2021/2906785>
30. Fry, C. V., Cai, X., Zhang, Y., & Wagner, C. S. (2020). Consolidation in a crisis: Patterns of international collaboration in early COVID-19 research. *PLOS ONE*, 15(7), e0236307. <https://doi.org/10.1371/journal.pone.0236307>
31. Fukushima, H., Imai, H., Miyakoshi, C., Naito, A., Otani, K., & Matsuishi, K. (2023). The sustained psychological impact of coronavirus disease 2019 pandemic on hospital workers 2 years after the outbreak: a repeated cross-sectional study in Kobe. *BMC Psychiatry*, 23(1). <https://doi.org/10.1186/s12888-023-04788-8>
32. Gagliardi, A., Abbaticchio, A., Theodorlis, M., Marshall, D., MacKay, C., Borkhoff, C., ... & Ahluwalia, V. (2023). Multi-level strategies to improve equitable timely person-centred osteoarthritis care for diverse women: qualitative interviews with women and healthcare professionals. *International Journal for Equity in Health*, 22(1). <https://doi.org/10.1186/s12939-023-02026-x>
33. Georgieva, I., Lepping, P., Бозев, B., Lickiewicz, J., Pekara, J., Wikman, S., Loseviča, M., Raveesh, B. N., Mihai, A., & Lantta, T. (2021). Prevalence, New Incidence, Course, and Risk Factors of PTSD, Depression, Anxiety, and Panic Disorder during the Covid-19 Pandemic in 11 Countries. *Healthcare*, 9(6), 664. <https://doi.org/10.3390/healthcare9060664>
34. Glänzel, W., & Schubert, A. (2005). Analysing scientific networks through co-authorship, *Handbook of quantitative science and technology research* (257–276). [https://doi.org/10.1007/1-4020-2755-9\\_12](https://doi.org/10.1007/1-4020-2755-9_12)
35. Greenacre, M. J. (2007). *Correspondence Analysis in Practice* (2nd ed.). London: Chapman and Hall/CRC. <https://doi.org/10.1201/9781420011234>

36. Hossain, M. M. (2020). Current status of global research on novel coronavirus disease (COVID-19): A bibliometric analysis and knowledge mapping. *F1000Research*, 9, 374. <https://doi.org/10.12688/f1000research.23690.1>
37. Kalsoom, G. and Zámečník, R. (2023). Servant leadership knowledge structures: a bibliometric review. *ECMLG*, 19(1), 471-479. <https://doi.org/10.34190/ecmlg.19.1.1674>
38. Karakcheyeva, V., Willis-Johnson, H., Corr, P., & Frame, L. (2024). The Well-Being of Women in Healthcare Professions: A Comprehensive Review. *Global Advances in Integrative Medicine and Health*, 13. <https://doi.org/10.1177/27536130241232929>
39. Krystal, J. H., Alvarado, J., Ball, S. A., Fortunati, F., Hu, M., Ivy, M. E., Kapo, J., Olson, K., Rohrbaugh, R. M., Sinha, R., Tebes, J. K., Vender, R. J., Yonkers, K. A., & Mayes, L. C. (2021). Mobilizing an institutional supportive response for healthcare workers and other staff in the context of COVID-19: The Yale experience. *General Hospital Psychiatry*, 68, 12–18. <https://doi.org/10.1016/j.genhosppsych.2020.11.005>
40. Lai, J., Ma, S., Wang, Y., Cai, Z., Hu, J., Wei, N., Wu, J., Du, H., Chen, T., Li, R., Tan, H., Kang, L., Yao, L., Huang, M., Wang, H., Wang, G., Liu, Z., & Hu, S. (2020). Factors associated with mental health outcomes among healthcare workers exposed to coronavirus disease 2019. *JAMA Network Open*, 3(3). <https://doi.org/10.1001/jamanetworkopen.2020.3976>
41. Li, H., Hao, H., & Chen, X. (2020). Provisional case definitions for COVID-19-associated neurological disease. *The Lancet Neurology*, 19(11), 890-891. [https://doi.org/10.1016/s1474-4422\(20\)30373-2](https://doi.org/10.1016/s1474-4422(20)30373-2)
42. Liu, N., Yi, J., Yuan, F., & Su, P. (2024). Knowledge graph analysis of research on nurses' psychological resilience. *Medicine*, 103(32), e39249. <https://doi.org/10.1097/md.00000000000039249>
43. Lotka, A. J. (1926). The frequency distribution of scientific productivity. *Journal of the Washington Academy of Sciences*, 16(12), 317–323.
44. Lucas, D., Brient, S., Grand, T. L., Dewitte, J.-D., Loddé, B., Pougnet, R., & Eveillard, B. M. (2022). Evolution of Global Health and Psychosocial Factors among Hospital Workers during First Year of SARS-CoV-2 Pandemic: A Longitudinal Study. *International Journal of Environmental Research and Public Health*, 19(22), 15260. <https://doi.org/10.3390/ijerph192215260>
45. Luo, M., Guo, L., Yu, M., Jiang, W., & Wang, H. (2020). The psychological and mental impact of coronavirus disease 2019 (COVID-19) on medical staff and general public – A systematic review and meta-analysis. *Psychiatry Research*, 291. <https://doi.org/10.1016/j.psychres.2020.113190>
46. Morgan, R., Tan, H., Oveisi, N., Memmott, C., Korzuchowski, A., Hawkins, K., ... & Smith, J. (2022). Women healthcare workers' experiences during COVID-19 and other crises: A scoping review. *International Journal of Nursing Studies Advances*, 4. <https://doi.org/10.1016/j.ijnsa.2022.100066>
47. Morris, S. A., & Van der Veer Martens, B. (2008). The cognitive structure of scientific revolutions. *Scientometrics*, 75(3), 423-442. <https://doi.org/10.1007/s11192-007-1804-x>
48. Nalbandian, A., Sehgal, K., Gupta, A., et al. (2021). Post-acute COVID-19 syndrome. *Nature Medicine*, 27(4), 601–615. <https://doi.org/10.1038/s41591-021-01283-z>
49. Newman, M. E. J. (2001). The structure of scientific collaboration networks. *Proceedings of the National Academy of Sciences*, 98(2), 404–409. <https://doi.org/10.1073/pnas.98.2.404>

50. Nicholls, P. T. (1986). Empirical validation of Lotka's law. *Information Processing & Management*, 22(5), 417–419. [https://doi.org/10.1016/0306-4573\(86\)90007-0](https://doi.org/10.1016/0306-4573(86)90007-0)
51. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, Shamseer L, Tetzlaff JM, Akl EA, Brennan SE, Chou R, Glanville J, Grimshaw JM, Hróbjartsson A, Lalu MM, Li T, Loder EW, Mayo-Wilson E, McDonald S, McGuinness LA (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 372. <https://doi.org/10.1136/bmj.n71>
52. Pao, M. L. (1985). Lotka's law: A testing procedure. *Information Processing & Management*, 21(4), 305–320. [https://doi.org/10.1016/0306-4573\(85\)90055-X](https://doi.org/10.1016/0306-4573(85)90055-X)
53. Pappa, S., Ntella, V., Giannakas, T., Giannakoulis, V., Papoutsis, E., & Katsaounou, P. (2020). Prevalence of depression, anxiety, and insomnia among healthcare workers during the COVID-19 pandemic: A systematic review and meta-analysis. *Brain, Behavior, and Immunity*, 88, 901–907. <https://doi.org/10.1016/j.bbi.2020.05.026>
54. Pautasso, M. (2012). Publication growth in biological sub-fields: Patterns, predictability, and sustainability. *Scientometrics*, 90(3), 851–865. <https://doi.org/10.3390/su4123234>
55. Pietrzak, P., & Hanke, W. (2024). The long COVID and its mental health manifestations – the review of literature. *International Journal of Occupational Medicine and Environmental Health*, 37(3), 360–380. <https://doi.org/10.13075/ijomeh.1896.02373>
56. Price, D. J. de S. (1963). *Little science, big science*. Columbia University Press.
57. Rogers, E. M. (2003). *Diffusion of Innovations* (5th ed.). New York: Free Press.
58. Rong, L., Jiang, P., Wang, Y., Ye, M., & Ou, R. (2020). Instant response to the novel virus: A bibliometric analysis of the incipient publications on COVID-19. *Malaysian Journal of Library & Information Science*, 25(3), 91–101. <https://doi.org/10.22452/mjlis.vol25no3.6>
59. Samala AD, Rawas S, Criollo-C S et al (2024b). Emerging Technologies for Global Education: a comprehensive exploration of trends, innovations, challenges and future horizons. *SN COMPUT SCI*, 5, 1175. <https://doi.org/10.1007/s42979-024-03538-1>
60. Serrano-Ripoll, M. J., Meneses-Echavez, J. F., Ricci-Cabello, I., et al. (2020). Impact of viral epidemic outbreaks on mental health of healthcare workers: a rapid systematic review and meta-analysis. *Journal of Affective Disorders*, 277, 347–357. <https://doi.org/10.1016/j.jad.2020.08.034>
61. Shakil, A., Sohail, M., & Mohammed, A.-M. I. (2017). SCImago, Eigenfactor Score and H5 Index Journal Rank Indicator : alternatives to the Journal Impact Factor for water resources journals. *Library and Information Science Research E-Journal*, 27(2). <https://doi.org/10.32655/libres.2017.2.4>
62. Shanafelt, T., Ripp, J., & Trockel, M. (2020). Understanding and addressing sources of anxiety among healthcare professionals during the COVID-19 pandemic. *JAMA*, 323(21), 2133–2134. <https://doi.org/10.1001/jama.2020.5893>
63. Simone, S. D., Franco, M., Servillo, G., & Vargas, M. (2024). A Gender Analysis of Hospital Workers during the COVID-19 Pandemic Using the Distress Questionnaire-5: A Cross-Sectional Study. *Psych*, 6(1), 135–142. <https://doi.org/10.3390/psych6010008>

64. Small, H., & Upham, S. P. (2009). Citation structure of an emerging research area on the verge of application. *Scientometrics*, 79(2), 365–375. <https://doi.org/10.1007/s11192-009-0424-0>
65. Spoorthy, M. S., Pratapa, S. K., & Mahant, S. (2020). Mental health problems faced by healthcare workers due to the COVID-19 pandemic—A review. *Asian Journal of Psychiatry*, 51. <https://doi.org/10.1016/j.ajp.2020.102119>
66. Sun, P., Wang, M., Song, T., Wu, Y., Luo, J., Chen, L., & Yan, L. (2021). The Psychological Impact of COVID-19 Pandemic on Health Care Workers: A Systematic Review and Meta-Analysis. *Frontiers in Psychology*, 12. <https://doi.org/10.3389/fpsyg.2021.626547>
67. Swed, S., Bohsas, H., Ibrahim, I., Hafez, W., shoib, S., Sawaf, B., ... & Rakab, A. (2022). Health-care provider burnout in Syria during COVID-19 pandemic's Omicron wave. *Medicine*, 101(50). <https://doi.org/10.1097/md.00000000000032308>
68. Umbetkulova, S., Kanderzhanova, A., Foster, F., Stolyarova, V., & Cobb-Zygadlo, D. (2023). Mental Health Changes in Healthcare Workers During COVID-19 Pandemic: A Systematic Review of Longitudinal Studies. *Evaluation & the Health Professions*, 47(1), 11–20. <https://doi.org/10.1177/01632787231165076>
69. Van Eck, N. J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, 84(2), 523–538. <https://doi.org/10.1007/s11192-009-0146-3>
70. Vindegaard, N., & Benros, M. E. (2020). COVID-19 pandemic and mental health consequences: Systematic review of the current evidence. *Brain, Behavior, and Immunity*, 89, 531–542. <https://doi.org/10.1016/j.bbi.2020.05.048>
71. Vindrola-Padros, C., Andrews, L., Dowrick, A., Djellouli, N., Fillmore, H., Gonzalez, E. B., Javadi, D., Lewis-Jackson, S., Manby, L., Mitchinson, L., Symmons, S. M., & Martin, S. (2020). Perceptions and experiences of healthcare workers during the COVID-19 pandemic in the UK. *BMJ Open*, 10(11). <https://doi.org/10.1136/bmjopen-2020-040503>
72. Vu, C., Kawaguchi, E., Torres, C., Lee, A., Stafylis, C., Klausner, J., ... & Khan, S. (2022). A More Accurate Measurement of COVID-19 Hospitalizations. *MedRxiv* <https://doi.org/10.1101/2022.06.03.22275891>
73. Wagner, C. S., & Leydesdorff, L. (2005). Network structure, self-organization, and the growth of international collaboration in science. *Research Policy*, 34(10), 1608–1618. <https://doi.org/10.1016/j.respol.2005.08.002>
74. Wagner, C. S., Park, H. W., & Leydesdorff, L. (2015). The Continuing Growth of Global Cooperation Networks in Research: A Conundrum for National Governments. *Plos One*, 10(7), e0131816. <https://doi.org/10.1371/journal.pone.0131816>
75. Wagner, C. S., Whetsell, T. A., & Mukherjee, S. (2019). International research collaboration: Novelty, conventionality, and atypicality in knowledge recombination. *Research Policy*, 48(5), 1260–1270. <https://doi.org/10.1016/j.respol.2019.01.002>
76. Wang, Q. (2018). A bibliometric model for identifying emerging research topics. *Journal of the Association for Information Science and Technology*, 69(2), 290–304. <https://doi.org/10.1002/asi.23930>
77. Yang, L., Wang, Y., Mu, X., & Liao, Y. (2024). A visualized and bibliometric analysis of nursing research during the COVID-19 pandemic. *Medicine*, 103(32), e39245. <https://doi.org/10.1097/md.00000000000039245>

78. Zhang, Q., Li, S., Liu, J., & Chen, J. (2022). Global Trends in Nursing-Related Research on COVID-19: A Bibliometric Analysis. *Frontiers in Public Health*, 10. <https://doi.org/10.3389/fpubh.2022.933555>