COVID research across the social sciences in 2020: a bibliometric approach

Ryan Thomson[1] · Rebecca Mosier[2] · Michelle Worosz[1]

Abstract

Research on the COVID-19 pandemic has produced an incredible volume of social science research. To explore the initial areas of COVID-19 scholarship, the following study uses bibliometric co-citation network analysis on data from Clarivate's Web of Science database to analyze 3327 peer-reviewed studies published during the first year of the pandemic and their 107,396 shared references. Findings indicate nine distinct disciplinary research clusters centered around a single medical core of COVID-19 pandemic research. Topics ranging from tourism collapse, fear scales, financial contagion, health surveillance, shifts in crime rates, quarantine psychology, and collective trauma among others are found to have emerged in this initial phase of research as covid spread across the world. A corresponding infodemic highlights early communication challenges and a broader need to thwart misinformation. As this body of work continues to grow across the social sciences, key intersections, shared themes, and long-term implications of this historic event are brought into view.

Keywords COVID-19 · Coronavirus · Pandemic · Bibliometric · Citation analysis · Social sciences

Introduction to COVID-19 research

Millions of lives have been brought to an abrupt end during the COVID-19 pandemic. The impact of this immeasurable loss will continue to reverberate for decades to come. As one might expect, COVID-19 has also had a deep impact on social relationships and the study of those relationships. The COVID-19 pandemic has forever changed the social sciences, ushering in a wave of work ranging from topics of financial contagion to the psychology of isolation, to theories of cultural trauma, fear scales, and entirely new disease discourses.

Medical research boomed in response to the pandemic and the explosion of research quickly expanded across the social sciences (Torres-Salinas, 2020). In some instances, this meant reviving old concepts and in others introducing new ideas and hybrid areas of study.

✉ Ryan Thomson
rwt0012@auburn.edu

1 Department of Agricultural Economics and Rural Sociology, Auburn University, Auburn, USA

2 Department of Sociology, University of Oklahoma, Norman, OK, USA

Despite the prolific growth in recent months, there have been few empirical attempts to thematically evaluate this evolving body of social research. Accordingly, this study aims to assess and characterize this diverse body of work while also providing important insights into emerging subfields of study. Do disciplines overlap in their research interests? And if so, where does interdisciplinary research overlap and what ideas exist at these potential intersections? Considering this, the following study employs bibliometric citation analysis to analyze and describe the various disciplinary trajectories of COVID-19 research across the social sciences. Using the Girvan Newman algorithm, this study identifies the initial research clusters from a sample of 3327 covid studies published from January 1 to December 31, 2020, and their corresponding 107,396 cited references. In doing so, we provide a nuanced picture of the impact of the COVID-19 pandemic across the social sciences during the emergent period of the pandemic.

Bibliometric analysis is the "statistical analysis of written publications, such as books or articles" (OECD, 2002). The citation approach has become increasingly popular in recent years as a scholarly tool for summarizing vast amounts of research. It has proven particularly helpful for the eruption of COVID-19 research. Some noteworthy examples include medical studies (Chahrour et al., 2020; Yu et al., 2020), psychological impacts (Ho et al., 2021), geriatric medicine (Soytas, 2021), cross-national differences (Fan et al., 2020; Guleid et al., 2021), and biosecurity (Wang & Tian, 2021) to name a few. Aristovnik et al. (2020) and Zyoud and Al-Jabi's (2020) preliminary studies took a purely quantitative approach to classify early covid research. It was not until the seminal work of Liu et al. (2022) that the first in-depth examination of covid with a close emphasis on social science traditions. Similarly, we place special emphasis on the disciplinary differences between competing social science approaches as noted in the descriptions of each disciplinary cluster.

Methods

Bibliometric analysis and citation network data

Broadly considered, bibliometrics is an analytical approach used to quantitatively analyze academic literature as networks. This generates a refined understanding of how research is produced, and organized, as well as how they exert influence on later scholarship. These networks illustrate diverging disciplinary research areas as well as shared scholastic roots. Drawing on academic publications as data sources, bibliometrics uses citation and reference data to provide a rich understanding of who cites who. Bibliometrics has been employed as a quantitative technique to trace relationships across disciplines, assess scholastic groupings, identify gaps in research, and examine the influence of individual publications (De Bellis, 2009).

Citation analysis is a specialized application of social network analysis. The technique focuses on the examination of the frequency, patterns, and visualization of citation ties contained within a body of published literature. In citation analysis, journals or individual publications typically constitute network "nodes". Those nodes, in turn, contain keywords and references that can be used to identify network "edges" as links to other publications, scholars, and journals. Such an approach sheds light on the patterning of citations to reveal the network properties among a group of publications. This allows for the assessment of the underlying structure of a body of work, or to identify seminal works in the literature.

Co-citing occurs when a third publication cites two other publications and serves as a tool for expanded citation analysis. This measurement approach, as articulated by White and Griffith (1981), offers insights into the structure and influence of ideas in a network of publications over time with a historical emphasis. Similarly, bibliographic coupling identifies a link when two studies cite one or more shared references and is generally used to identify more current trends. The consensus among network analysts is the co-citation approach is the superior bibliometric statistical technique for big data (Van Eck & Waltman, 2014).

Citation data

The data for our study were obtained from Clarivate's (formerly Thomson Reuters' Institute for Scientific Information) Web of Science using the Core Collection citation indexes. We identified publications in the primary Social Science Citation Index and Emerging Sources Citation Index for 2020. This timeframe represents the respective topic from its formal origins to the present. Pertinent publications were identified by conducting independent title and keyword searches for each of the following terms, specifically "COVID", "coronavirus", "pandemic", and "quarantine". Each search also contained all known variations of these terms (e.g., the COVID search contained "covid19" or "sars-cov-2" or "coronavirus"). Works that did not contain some variations of these words have been omitted from the analysis.

The primary search yielded 3327 articles published (or available for pre-print) from the beginning of the current COVID-19 pandemic until February 11th, 2021, with a combined total of 107,396 references published between as early as 1927 and as recently as January 2021 pre-prints. The full records for these publications and their references were downloaded. Given the high number of references considered, all the references could not be cited here (available upon request).

Co-citation was employed to identify links among the publications, whether in terms of shared keywords or references cited. These links indicated relations between pairs of publications that share either one or more references or keywords, or directly cite one another. We used visualization techniques to observe the structure of the shared keywords and citations in the sample (i.e., bibliographic coupling method) and their shared citations (i.e., co-citation method). The bibliometric analyses were performed with VOSviewer, a software package developed for constructing and visualizing bibliometric networks at the University of Leiden, The Netherlands (Van Eck and Waltman, 2010, 2014). VOSviewer includes a "smart local moving algorithm" code to detect the presence of clusters and network centrality as specified by Van Eck and Waltman (2014).

Results

Keywords

The most popular keyword was "COVID-19" with 1933 uses. This significantly overlapped with the other variations such as coronavirus, sars, sars-cov-2, COVID pandemic, influenza, and epidemic. This was closely followed by health, impact, crisis, risk, social media, resilience, vulnerability, social distancing, quarantining, and telemedicine. Economic concerns were immediately apparent in the use of tourism, commodity-chain, trade, volatility

spillovers, economic effects, stock market, retail, financial crisis, recession, market, GDP, foreign direct investment, development, corporate responsibility, and remittances crosscut several subclusters (Fig. 1).

Mortality, morbidity, loneliness, PTSD, anxiety, isolation, burnout, and end of life were frequent keywords among the sample. These terms depict thousands of terrible experiences during 2020. These themes also overlap with several related keywords such as post-truth, fake news, Donald Trump, hoax, and lies. While a dark experience for many, there were other positive themes present among social science keywords in our sample. Words such as community capital, solidarity, empathy, wellbeing, degrowth, mutual-aid, and mindfulness illustrated a more positive tone, as did localism, agriculture, gardening, and rural revival.

Many popular works integrated their methods into their keywords, demonstrating the wide diversity of methodological approaches used in the COVID-19 wave of research. Among the most popular were autoethnography, ethnography, regression, GIS, models, time-series, content analysis, pedagogy, methods, cartogram, digital media, big data, factor analysis", and data visualization. The size of the node is weighted link strength to highlight the more important works which were gaining popularity in their respective fields. Many of these methods have served as strategic tools for understanding a wide-range of experiences and patterns associated with the COVID-19 pandemic.

COVID-19 research in the social sciences exhibits significant clustering largely by scholastic discipline. At the heart of the sample, we observed a clear medical core (displayed in purple) with nine surrounding subgroups that stretched out in various directions (Fig. 2) including the medical core, transmission mitigation, rationing, tourism, psychology, media, behavioral trends, criminology, sociology, macro-economic, financial contagion, historical-comparative, and infectious disease. In what follows, we summarize the literature within each of the ten research clusters.
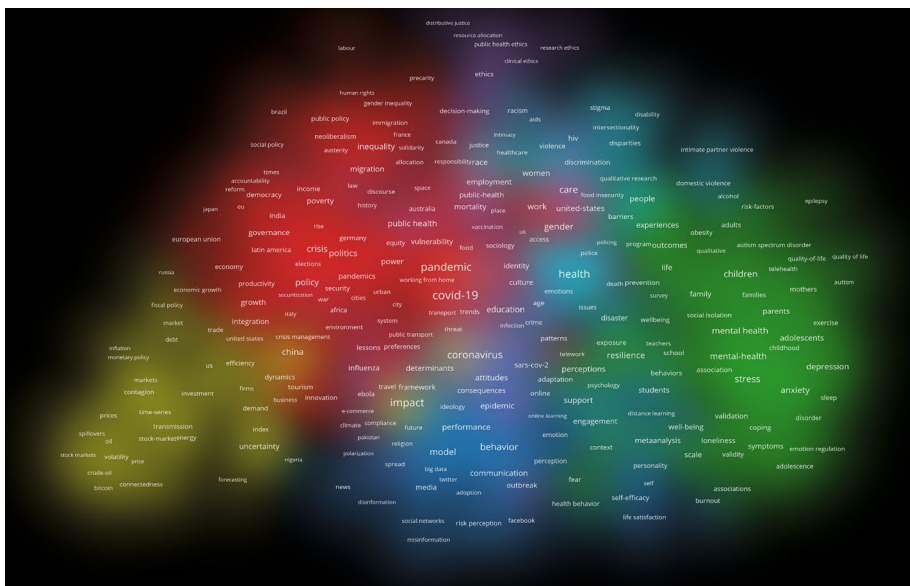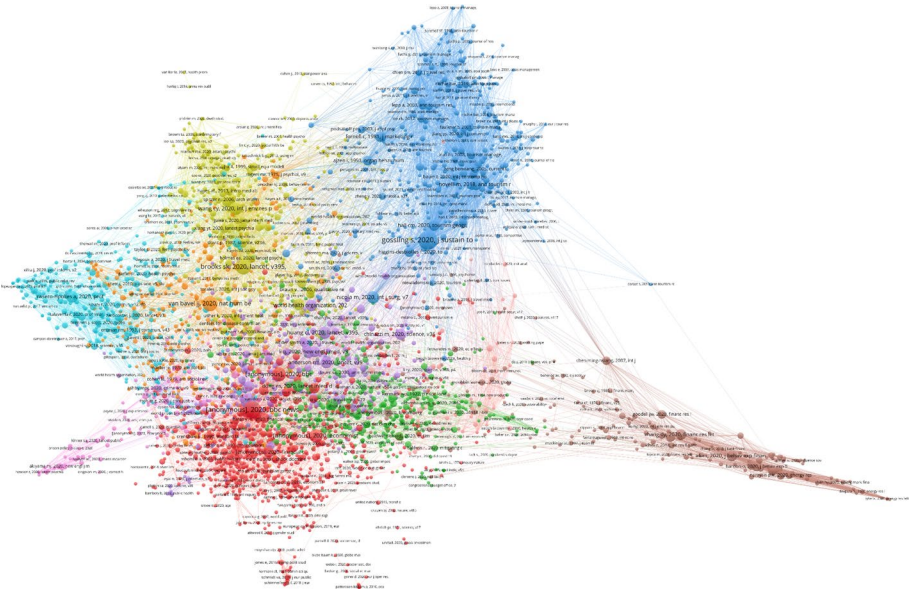

Fig. 1 COVID-19 keywords hot-spot map

Fig. 2 Co-citation network map of COVID-19 research between January 1 and December 31, 2020. (Color figure online)

Cluster 1: the medical core

Huang et al.'s (2020) piece in *The Lancet* in early February 2020 noted the lack of prior research on COVID-19 at the time of publication and in response served as the initial identification of the virus. The study explored an early cluster of 41 human patient cases exhibiting fatal or near-fatal instances of pneumonia. One-third of the patients required admission to intensive care units and six died, despite their relatively young median age of 49 years (Huang et al., 2020). After its publication, the piece prompted a larger wave of research on COVID-19. Following Huang et al. (2020) and Lauer et al. (2020) examined the incubation period of COVID-19, and placed incubation at around 5 days, with symptomology presenting between 11 and 14 days. Lauer et al. proposed a quarantine period of 14 days based on their epidemiological analysis. Li et al. (2020a, 2020b) continued examining 2019-nCoV for epidemiologic characteristics and incubation periods, finding that cases had an incubation period of 5.2 days, with the early stages determined to be doubling every 7.4 days (Li et al., 2020a, 2020b). At the time, the reproductive level of the virus was determined to be around 2.2, a high infection rate (over a reproductive rate of 1:1). Based on this information, Li et al. (2020a, 2020b) estimated the virus had likely been in existence since late 2019 (Fig. 3).

Guan et al. (2020) examined over 1000 patients throughout mainland China and found the average patient to be middle-aged, with men more likely to be impacted. Their study indicated 6.1% of patients met the composite endpoint, described as requiring intensive care, the use of mechanical ventilation, and death. Direct contact with residents from the originating sector of Wuhan was observed in 72.3% of cases (Guan et al., 2020). Guan et al. described a shorter median incubation period of 4 days.
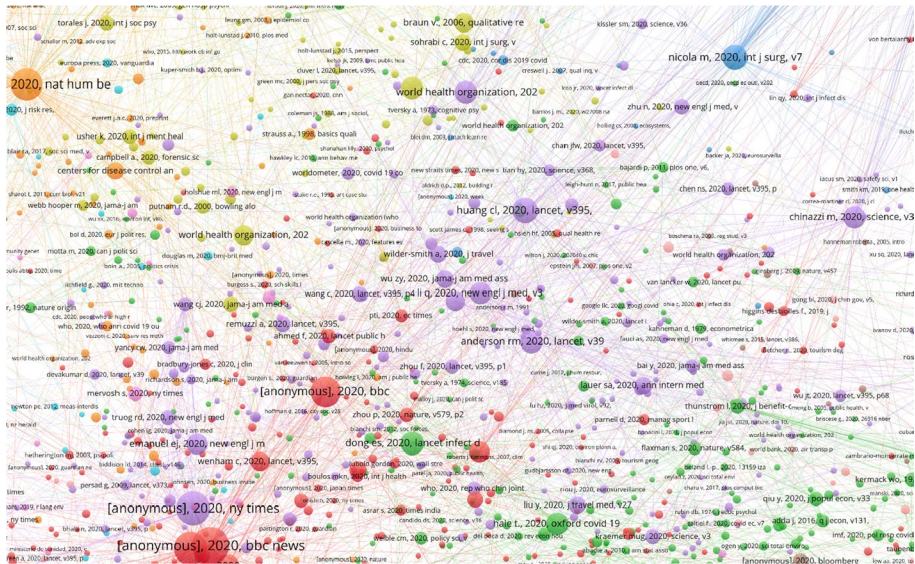
Fig. 3 Cluster 1 the medical core (Purple). (Color figure online)

This medical core contains a significant amount of research that examined symptoms and strategies for transmission mitigation. In an early response to the viral spread, China banned travel both from and to Wuhan in January 2020 (Tian et al., 2020). Tian et al. found that cities that implemented control measures early exhibited fewer cases than cities that delayed restrictions. Examples of the restrictions found to be effective included the suspension of public transportation and bans on large gatherings. These interventions were considered successful in limiting the spread of COVID-19, despite the high mobility of the virus. Real-time travel data and collections of case histories showed the effectiveness of the control measures in reducing virus transmissibility (Kraemer et al., 2020). The effectiveness of the control measures was considered crucial for reducing death and minimizing economic impact (Anderson et al., 2020). Small transmission chains were observed to spread quickly in countries such as Iran, Italy, and Japan.

Anderson et al. (2020) considered the spread in multiple other countries inevitable even with the implementation of control measures due to the reproductive rate, at the time of the article yet to be fully known but considered potentially as high as 2.5. Implementation of quarantine, isolation, and social distancing of both infected and potentially infected persons in China are described as having the potential for spread containment if utilized in other countries (Anderson et al., 2020). These containment measures had been utilized in the 2009 H1N1 influenza outbreak, but implementation had been haphazard (Bajardi et al., 2011). Bajardi et al. examined international air travel in and out of Mexico during the H1N1 epidemic and found travel reduced by around 40%. Bajardi et al. developed models to consider multiple alternative scenarios for the 2009 H1N1, which included an examination of more effective measures and what could occur if less effective measures had been implemented (2011).

Modeling and tracking software was developed by multiple countries and universities, considering real-time tracking and identifying potential future spread. The need for real-time surveillance software was identified as the viral outbreak of COVID-19 was observed

rapidly moving outward from China to 27 other countries and regions (Dong et al., 2020). Johns Hopkins University developed an interactive online COVID-19 tracking platform for real-time public data-sharing of the spread (Dong et al., 2020). Chinazzi et al. (2020) used a transmission model to anticipate the future global spread of COVID-19, and their findings considered the likelihood of containing international spread by travel limitations. Due to the rapid transmissibility of COVID-19 by the time of the travel ban to and from Wuhan, travel within China had already spread COVID-19 to most of the country. Travel restrictions may have delayed the disease progression by only 3–5 days within China but may have limited transmission associated with international travel (Chinazzi et al., 2020).

Another noteworthy sub-theme within this core medical cluster examines the economics and policy implications of rationing needs which boomed in the years to follow. As the virus spread, concern grew for the availability of necessary equipment, healthcare providers, patient triaging, and the subsequent economic fallout. The emerging pandemic created concern for shortages of medical equipment and services (Emanuel et al., 2020). In Italy, triaging patients needing treatment was implemented to conserve vital resources. International concerns over hospital bed availability and supplies such as N-95 masks and ventilator shortages were observed, with concerns over how the supply of such resources could be fairly allocated (Emanuel et al., 2020). Panic buying and hoarding behavior was found to be linked to both waves of scarcity as well as individual impulses often associated with fear of going without (Islam et al., 2021). Fears mounted over the economic implications of business and school closures, travel restrictions, and ensuring manufacturing, food production, and shipping sectors continued (Nicola et al., 2020). These micro-economic concerns share significant overlap with macro-economic trends and financial contagion.

Cluster 2: tourism

Travel and tourism created concerns focused on the implications of mobility and transmission, as well as corresponding economic concerns. The tourism and hospitality sectors experienced a harsh shift, despite anticipated growth from economic predictive models (Gössling, 2020). COVID-19 has limited progress toward the United Nations (UN) Sustainable Development Goals (SDG), and the tourism sector has impacted those already struggling financially. Global greenhouse emissions dropped as COVID-19 impacted travel, but an eventual return to pre-COVID-19 travel will spike these numbers once again above acceptable decarbonization levels. Contact tracing and hospitality technologies such as meal and grocery ordering advanced the ability to harvest data using Information and Communication Technologies (ICT), increasing surveillance opportunities (Gössling, 2020). This concern is directly echoed within the sociology sub-cluster but with a different discursive framing.

When traveling an inherent risk exists from the potential for additional exposures to the virus, and these exposures may result in a negative outcome (Ritchie & Jiang, 2019). While tourists may consider both real and perceived risks, tourist destinations are susceptible to external and uncontrollable factors. These concerns are varied by scale, economic impacts, predictability, and duration of impact for the tourism industry. Decision-making processes and follow-through are impacted not only by available information but other relevant factors (Ajzen, 1991). Elements of the theory of planned behavior involve a consumer's decision to plan for travel, including perceptions, motivation, control, time, and resources. The ability to travel is considered a right or entitlement among many privileged and affluent people (Baum & Hai, 2020). Freedom of movement has been declared a human right under

the UN Universal Declaration of Human Rights. Tourists who seek a novelty experience when traveling (Lepp & Gibson, 2003) are more likely to accept higher levels of perceived risks than those who prefer familiarity. Experienced travelers tend to worry less about infectious diseases.

The early movement of COVID-19 occurred predominantly among mobile, wealthy Europeans, Americans, and Asians (Baum & Hai, 2020). Travel restrictions limited mobility entitlements; rights that may be taken for granted within privileged groups. Tourism is vulnerable to crises because of the reliance on infrastructure, mobility, and tourists' safety concerns (Brown et al., 2017). Hotels should be cognizant that as tourism and travel are on the rise, the required infrastructure to support tourism and the community should rise in tandem. For destinations to be successful after a disaster, consideration should be given to the environment that attracts tourists, the physical structures of the destination, and the safety of staff and guests. The impacts of COVID-19 may transform tourism, and within that transformation, the opportunity exists to recenter tourism towards more responsible travel (Higgins-Desbiolles, 2020), meaning a shift away from exploitative practices that harm the local population and toward community well-being when creating a tourist destination. Globalization is likely to have contributed to the ability of infectious diseases to spread more rapidly with tourism directly contributing to the spread and increased exposure risk (Qiu et al., 2020). In response to crises occurring at tourism destinations, stakeholder groups should be inclusive of local businesses, community members, and others who will be impacted by the crisis, economically, as well as other potential areas of impact.

The impact of disasters on tourism has been found to have severe economic consequences even if those destinations are not directly impacted by a specific disaster (Novelli et al., 2018). For instance, media coverage may influence tourists' decisions about the safety of a destination, which can lead to negative consequences for developing nations that are dependent on tourism for their economies. Some nations, such as The Gambia, did not experience an Ebola outbreak, but spillover generalizations and lack of knowledge of African geography likely led to tourist cancellations. While some nations will transform tourism towards a more sustainable model in response to the impacts of COVID-19, others may continue short-sighted nationalistic policies that do not consider global impacts (Hall et al., 2020). A global approach, with a focus on community-based sustainability, is suggested as the means to sustain tourism (Fig. 4).

Cluster 3: psychological impacts

Quarantine, isolation, and infection resulted in numerous psychological impacts and stressors such as anger, confusion, boredom, fear, and post-traumatic stress (Brooks et al., 2020). When pandemic quarantine or isolation is needed, the period should not be longer than necessary, people should be well-informed, and supplies should be made available. Moreover, educating people that they are helping society through compliance may alleviate some psychological symptoms (Brooks et al., 2020). Galea et al. describe social distancing and behavioral response patterns as having both short- and long-term consequences (2020). A review of epidemics and natural disasters found depression, substance use disorder, domestic violence, and post-traumatic stress disorder (PTSD) rose after those incidents. These distress patterns were found to be both immediate and persistent over long periods (Galea et al., 2020). Concerns about isolation, mental health, and well-being ranked higher than the concern of becoming infected with COVID-19 (Holmes et al., 2020).
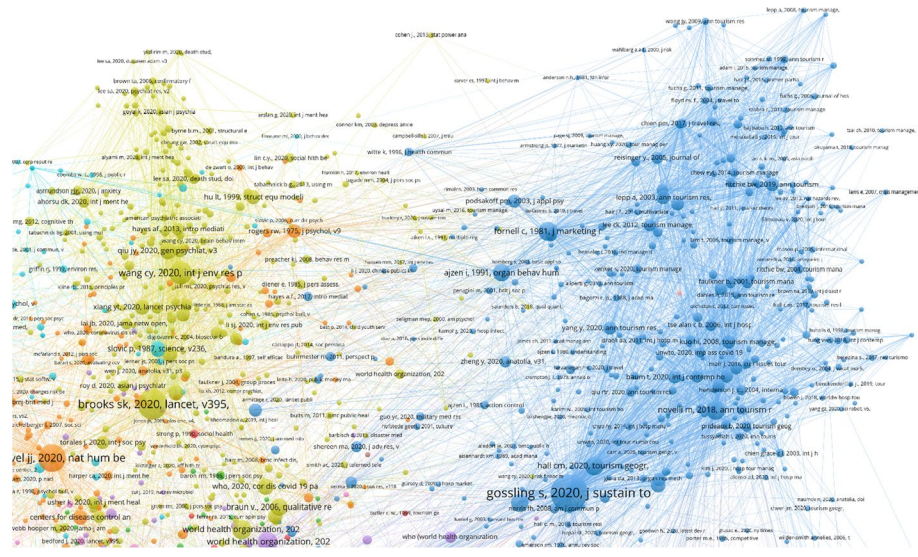
Fig. 4 Cluster 2 tourism (Blue) and Cluster 3 psychological impacts (Yellow). (Color figure online)

Current pandemic information and the use of precautionary measures such as hand washing, and masking reduced negative impacts such as anxiety and depression (Wang et al., 2020). Suggestions that China may have handled psychological impacts poorly in the early months were met with recommendations to look to the United States and the United Kingdom for crisis intervention techniques for emergencies (Duan & Zhu, 2020). Chinese college students were surveyed using the Generalized Anxiety Disorder Scale, or GAD-7 (Cao et al., 2020). About one-quarter of surveyed respondents were suffering from anxiety associated with the pandemic. Protective factors included residing in urban areas, living with parents, and economic stability (Cao et al., 2020). Having family members or friends living with COVID-19 was a risk factor for increased anxiety for college students. A survey of adults found that after 1 month of confinement, variables such as the ability to continue work, the severity of the outbreak in their community, and everyone's pre-existing health contributed to their mental health outcomes (Zhang et al., 2020a, 2020b). Moreover, those who had been physically active before the confinement tended to experience a higher risk for negative mental health outcomes from quarantine restrictions (Zhang et al., 2020a, 2020b).

A study conducted during the severe acute respiratory syndrome (SARS) outbreak considered perceptions of threat, vulnerability, and self-efficacy among three Asian and five European countries (De Zwart et al., 2009). 'Country of residence' was consistently shown to have a strong correlation to the level of perceived threat. Europeans had higher levels of perceived severity, and Asians had higher levels of perceived vulnerability; however, Asians also had higher levels of self-efficacy (De Zwart et al., 2009). An Iranian study developed a scale to understand the fear of COVID-19 (Ahorsu et al., 2020). The Fear of COVID-19 Scale (FCV-19S) considered fear as an exacerbated factor for hypochondriasis and anxiety, contributing to mortality and morbidity (Ahorsu et al., 2020). FCV-19 included the respondent's level of perceived germ aversion and disease susceptibility, finding similar results across gender and age (Ahorsu et al., 2020). Higher levels of fear of contracting COVID-19 corresponded with an increased risk of depression and anxiety.

Cluster 4: media

Language, framing, and metaphors may drive the public perception of disease spread and epidemics (Wallis & Nerlich, 2005). A critical disease discourse was not found within media portrayals of the severe acute respiratory syndrome (SARS). SARS was described as a singular killer in contrast to an army. While another pandemic was considered inevitable, the time, place, and symptoms are not known until the disease begins to spread. A lack of unified public health communication systems during the onset of COVID-19 led to public uncertainty about which source to turn to in search of critical information for key pandemic messaging (Balog-Way & McComas, 2020). The presentation or framing of an element, such as a media story, may influence how the receiver perceives the concept (Entman, 1993). When news is initially presented in a certain frame, conflicting news may be rejected as lacking credibility due to the pre-existing frame. Excessive media coverage can lead to stress responses that have the potential to cause adverse health impacts. These impacts can then lead to help-seeking behaviors that become an extra burden on already taxed medical providers (Garfin et al., 2020). Effective communication may alleviate some stressors on both people and secondary medical resources.

During the COVID-19 pandemic, the need for information led people to reconnect with 'legacy media' forms such as television news (Casero-Ripollés, 2020). The return to these media outlets gives them a heightened ability to influence the public while also reducing some of the inequalities in access to news. The news media is critical as the source of understanding a pandemic for the public, and "fake news" undermined important COVID-19 information. The expansion of newspaper media during the nineteenth century followed by radio and television in the twentieth century may have weakened the perceived legitimacy of its ability to act as a check on power (Allcott & Gentzkow, 2017). Concerns emerged that important debates would be reduced to sound bites and echo chambers of opinions driven by corporations. Additionally, in the twentieth century, concern grew of a lack of information about how fake news impacts individuals and society. New safeguards are needed against those who use fake news with malicious intent (Lazer et al., 2018). The spread of false news through social media may occur more rapidly through human sharing than by robot sharing (Vosoughi et al., 2018). Humans spread information they find novel such as stories that elicit disgust and surprise. Bots spread information regardless of emotional content or validity at equal rates.

During the 2009 H1N1 pandemic, also known as the 'swine flu' epidemic, a Twitter content analysis for keywords related to the outbreak was conducted (Chew & Eysenbach, 2010). These data showed an increase of almost 40% in posts using the World Health Organization (WHO) terminology of H1N1. News and media sources were shared more often than government or health agencies, whose tweets were shared only 1.5% of the time. Just two decades later, WHO director-General Tedro Adhanom Ghebreyesus suggested there are two simultaneous epidemics, the pandemic and the 'infodemic' (Zarocostas, 2020). Thus, an information platform was launched to relay information from the WHO Information Network for Epidemics (EPI-WIN) in the form of targeted messages to at-risk groups (Fig. 5).
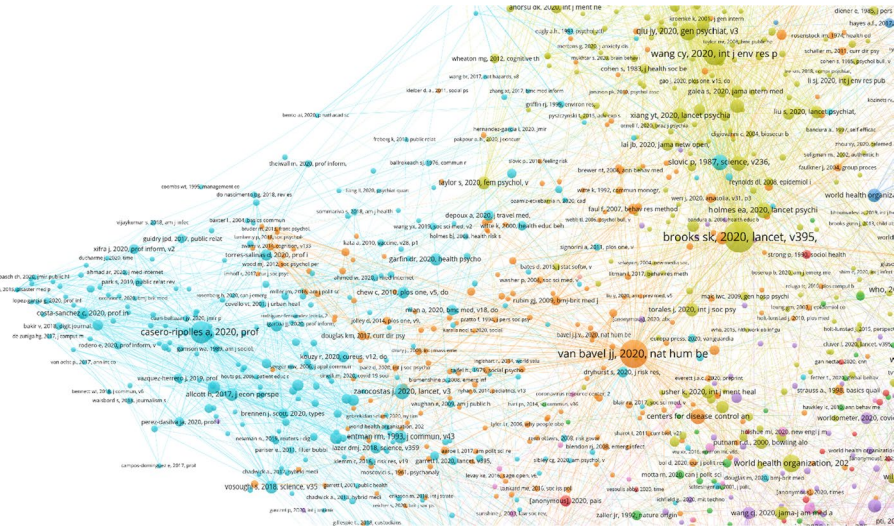
Fig. 5 Cluster 4 media (Light Blue) & Cluster 5 behavioral trends (Orange). (Color figure online)

Cluster 5: behavioral trends

Van Bavel et al. (2020) discuss the importance of bringing behavioral and social sciences into policy discussions that involve public health and medicine. In considering the public response to the pandemic, behaviors, reactions, and threats to compliance due to social and cultural influences should be anticipated (Van Bavel et al., 2020). Some elements of the media have focused on perceived connections between China and COVID-19, increasing discrimination against those of Chinese descent living outside of China (Wen et al., 2020). Wen et al. (2020) examine the impact of biased media coverage on the mental health of Chinese persons and those of Chinese heritage and the impact on tourism and tourist behaviors finding misleading media has likely stoked discrimination against Chinese persons.

Authors writing on COVID-19 behaviors and reactions turned to earlier researchers who had written on behavioral reactions to fear responses, such as wearing masks or hand washing during an epidemic. The concept of fear appeal, in which fear arousal is promoted to elicit a specific response, can be promoted as a behavior change method (Rogers, 1975). Persuasive communication techniques may include the event's severity, the probability of an event occurring, and protective action effectiveness (Rogers, 1975). The example provided by Rogers refers to the negative consequences of cigarette smoking and how fear appeal and smoking aversion techniques may inhibit the desire for cigarettes.

During the H1N1 Swine flu pandemic, Bish and Michie examined previous research on attitudinal determinants for protective behaviors (2010). The types of protective behaviors included avoidance, prevention, and illness management (Bish & Michie, 2010). Demographic differences were found in those who adopted protective behaviors. Characteristics of those who were more likely to utilize protective behaviors included people who are older, female, with higher levels of educational attainment, non-white, concerned about current health conditions and those who trusted authority figures. Another study conducted during the Swine flu outbreak considered behavioral changes as well. A phone survey

asked if survey participants had made changes in response to the swine flu (Rubin et al., 2009). Those who felt the swine flu threat severity had been exaggerated were the least likely to comply with avoidance behaviors such as handwashing. People most likely to adopt flu avoidance behaviors included those concerned about the severity of the outbreak, those who trusted authority figures, those that felt the adoption of control measures could reduce risks, and minorities (Rubin et al., 2009).

A survey designed to examine compliance with protective behaviors such as handwashing was conducted 48 h after the United Kingdom advised residents to cease non-essential travel and contact with others (Atchison et al., 2021). Most respondents indicated taking at least one recommended protective measure such as handwashing; about half avoided crowded places (Atchison et al., 2021). Older adults were found to be more compliant with social distancing measures. Those in low-income brackets were least likely to have the ability to work from home. The article recommended governments consider the impacts on those who would suffer the most economic impact when creating policies (Atchison et al., 2021).

Cluster 6: sociology

The sociology of COVID-19 offers a diverse blend of social topics. The cluster exhibits numerous references to top news articles suggesting a relative willingness to engage with recent current events. Many social scholars published work in public venues such as *The Guardian, The Economist, The New York Times,* and *Reuters* among others introducing sociological understandings into current public discourse. This cluster exhibits an unusually high emphasis on social theories ranging from individual coping strategies to suprastructural discussions of global politics.

Within this cluster, there exists several sub-pockets building on many canonical sociological works including numerous references to the works of Michel Foucault. Contemporary offshoots building on Foucault are prominent among this cluster including Mbembe's exploration of essential workers struggling with necropolitics or how politics dictate how some people may live and how others die (2008). A relatable offshoot includes Zuboff et al.'s discussion of surveillance capitalism (2019). In this same vein, *The Shock Doctrine* Klein (2007) and more recent *Screen New Deal* (2020) both by Naomi Klein, highlight the way the pandemic constitutes a significant economic shock enabling further incursion of surveillance technologies into personal spaces (Fig. 6).

The issue of racial inequality and the differential impacts of COVID-19 emerged from this cluster. Crenshaw's (1990) work on intersectionality as an analytical framework is widely cited by many COVID-19 studies. Drawing from racial geography, Massey and Denton's (1993) *American Apartheid* is frequently invoked to discuss the impacts of segregation on differential rates of spread and responses throughout the Black community. A relatively diverse Marxist camp was also found. From Harvey's (2020) analysis of the geographic spiraling of the virus, investment floods, and contradictions of a capitalist crash to Thomas Piketty's strict formulaic economic assessment of grossly exacerbated wealth accumulation (2013), these materialist works are mixed-in among the forefront of this cluster. Žižek's *Pandemic!* (2020) and *Pandemic 2!* (2021) are also prominently referenced. Both works touch on many of the topics but with a psychoanalytic emphasis and critique of capitalist ideology. Taken together, these popular references to Marx prioritize different materialist interpretations all centered around the concept of class.
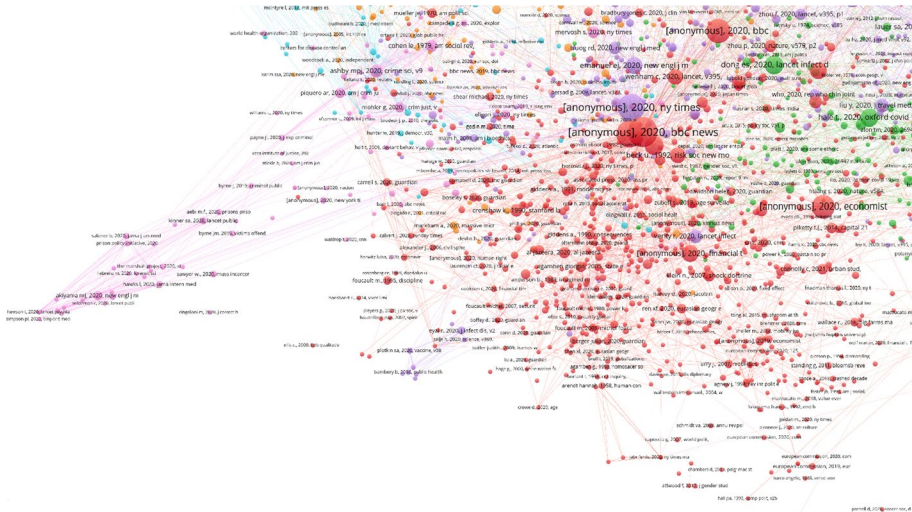
Fig. 6 Cluster 6 sociology (Red) and Cluster 7 criminology (Pink). (Color figure online)

Risk, and efforts to manage it, is a central topics commonly discussed within the sociology subcluster. Risk is the seventh most popular keyword in the sample. More specifically, Giddens's (1991) and Beck's (1986) and Beck et al. (1992) critiques of risk and reflexive modernity have been frequently invoked to describe the unfolding of the pandemic. Closing out this sub-group rooted in contemporary theory is Alexander et al. (2004) theory of cultural trauma as a basis for collective identity. Put differently for many groups throughout the world, COVID-19 constituted an event so horrendous that its memory could fundamentally alter group consciousness and underlying identity in the decades to come.

Cluster 7: criminology

Criminology exhibits a dense off-shoot closely tied to sociology, medical, and media studies. The impact of social distancing on crime exhibits several emerging directions of research. Violent crime is the arguable key focus spinning off several special issues in leading criminology journals examining the effects of the COVID-19 pandemic on crime (Ashby, 2020; Mohler et al., 2020; Payne et al., 2020). Quarantine domestic violence is also a widely researched and emerging hot topic with a diverse array of emergent findings (Piquero et al., 2020). Simultaneously, the issue of COVID-19 super-spreader events in prisons is an equally common focal area (Hawks et al., 2020, Kinner et al., 2020). Several pivotal studies including Akiyama et al. (2020) pushed a prison policy angle in a proactive direction seeking to flatten the curve in prisons via effective policy and decriminalization early on in the pandemic (Fig. 7).

Cluster 8: macro-economics

Early economic innovators applied mathematics to the epidemiological model of disease spread, considering how a disease is brought under control by "naturally" running its
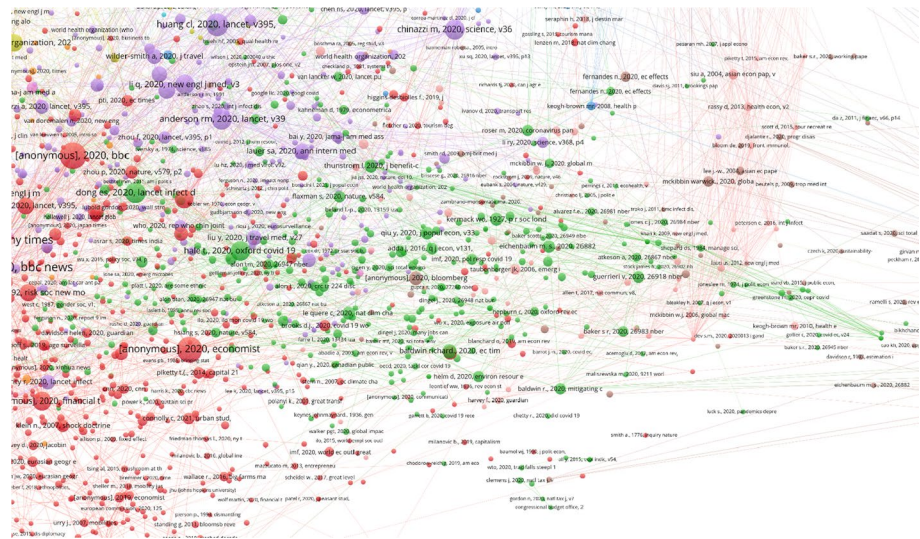
Fig. 7 Cluster 8 macro-economics (Green). (Color figure online)

course in an individual, across a community, and in terms of overall mortality (Kermack & Mckendrick, 1927). When making projections about the impacts of epidemics the literature suggests that economists should consider using the simple SIR disease model utilized in public health (Atkeson, 2020). As the COVID-19 epidemic has disrupted economies and spread across the globe, scenarios have been developed anticipating that even a well-constrained viral outbreak could have significant global impacts on economies (McKibbin & Fernando, 2020). Increased investment in public health has been recommended, with special concern for areas with low economic development and large population densities. A study in Europe found that lockdowns and school closures reduced the reproductive rate of SARS-CoV-2 below 1, which is considered a successful intervention to reduce disease transmission (Flaxman et al., 2020).

In response to the pandemic, consumers reduced their work and consumption patterns to avoid infection with COVID-19 (Eichenbaum et al., 2020). While the decision to stay at home likely saved lives, the severity of the resulting recession was impacted negatively by the labor shortages. A multi-sector economy experiencing an incomplete market may be vulnerable to Keynesian supply shocks, as jobs are lost, and capital does not exist to prevent shock changes (Guerrieri et al., 2020). Fiscal stimulus may not be enough to mute the changes if sectors are not open for spending.

Economic policies intended to control viruses may not be considered cost-effective; however, unchecked globalization and the corresponding economic practices contribute to the rates of viral transmissions (Adda, 2016). Disease diffusion studies correlating influenza or other outbreaks with French transportation strikes and school closures evaluate whether disease outbreak-related costs should be considered in public health responses depending on reproduction rates and the population impacted. Variations across global governmental policy responses and their degree of effectiveness were tracked, and composite indices were compiled to understand the evolution of responses over the course of disease transmission (Hale et al., 2020). The working paper intends to follow policies and interventions and update results to assist in understanding the pandemic's impacts.

Reductions in global CO^2 occurred due to the COVID-19 lockdown, with peak reductions as low as -26% for some countries, and an average daily decrease of -17% (Le Quéré et al., 2020). Conversely, a roll back green policies as a method of reducing the economic downturn quickly led CO^2 reductions to rebound beyond their pre-COVID-19 levels (Le Quéré et al., 2020). It is anticipated that COVID-19 will have short-term impacts on environmental policies whereas stimulus packages, investments in green policies, and globalization may have long-term impacts on climate (Helm, 2020). Potential impacts discussed include leaving debt and environmental concerns for future generations to solve.

Cluster 9: transnational studies

Early studies on economics and viral spreads were applied to COVID-19 to understand how the pandemic might impact the economy, tourism, and the viral spread Keogh-Brown et al. used an economics model to examine the impact of an influenza epidemic scenario (2010). Their United Kingdom model assumes the spending patterns of the uninfected would not be heavily impacted; GDP was anticipated to drop by an estimated 1.25% (Keogh-Brown et al., 2010). The model considers the economics of school closures and subsequent work absenteeism, as parents dealt with closures, as an unknown variable. An International Monetary Fund (IMF) estimate anticipated the economic impact of COVID-19 to be "moderate", but not debilitating (Fernandes, 2020). Nuno Fernandes' concern with the IMF findings is that comparisons with previous similar events lack (1) an understanding of the current state of supply and demand, (2) increased service sector job vulnerability as tourism shut down, (3) and comparisons with SARS do not consider China's powerful role in today's global economy.

The economic impacts to Mexico from the H1N1 swine flu pandemic were related not only to the loss of tourism but also to public concerns that the outbreak originated from a pork processing plant in Veracruz, Mexico (Rassy & Smith, 2013). While concerns about pork from Veracruz were not confirmed; Mexican tourism dropped from worry about the spread of swine flu, and multiple countries banned Mexican pork products. The article erringly suggested that tourism would be an unlikely vector for disease spread insisting it would create unnecessary and negative tourism industry impacts. However, the 2015 outbreak of Middle East Respiratory Syndrome (MERS) in the Republic of Korea resulted in significant losses to the service and transportation sectors from a decline in international tourism (Joo et al., 2019). The travel and activity patterns of people are impacted by the pandemic and social distancing (De Vos, 2020). There is less demand for public transport systems as people stay home. Well-being is impacted as people stay indoors more. Public policymakers need to keep these factors in mind as pandemic policies are implemented (De Vos, 2020). Browne et al. (2016) also found the role of transportation in the spread of respiratory virus found air travel, cruises, and ground transportation as likely transmission methods for influenza outbreaks. Air transmission was found to be a likely vector for respiratory illness.

A sub-theme within this cluster focused on infectious disease research and the professional dissemination of information to the public and corresponding challenges. Public health systems exist to control pandemics; however, implementation was lacking the best public health practice despite a wealth of existing knowledge for viral control. Using a metapopulation analysis, Li et al. (2020a, 2020b) determined 86% of COVID-19 infections were undocumented before the Wuhan travel shutdown, these undocumented cases were as contagious as the known cases, and they contributed to the spread of the disease

despite containment efforts. While the nature and interventions of viral transmissions are well understood, a constant battle occurs between how infectious diseases adapt and the interventions required to control these adaptations (Fauci & Morens, 2012). The means of protection against potential infections are well-known-handwashing, disinfection, and vaccination. Pandemic threats are rising due to increased population densities, zoonotic transmissions, climate change, and regional conflicts (Bloom & Cadarette, 2019). The authors go on to advocate for a self-governing Global Technical Council on Infectious Disease Threats to consider these threats and transnational mitigation techniques (Fig. 8).

Cluster 10: financial contagion

The initial effect of COVID-19 on Chinese financial markets diminished earnings by one quarter in just one month (Ali et al., 2020). While China stabilized, the pandemic and the resulting economic shocks spread to Europe and the United States; those markets were heavily impacted, and even commodities and supply chains previously considered stable were found to be fragile. The United States' decision to implement zero percent interest rates and quantitative easing during the pandemic may have exacerbated uneasy global markets (Zhang et al., 2020a, 2020b). As an example, the 2003 outbreak of severe acute respiratory syndrome (SARS) in Taiwan caused significant economic damage, especially to the tourism sector (Chen et al., 2007). Examination of hotel stock prices showed immediate impacts, which could be useful in predicting economic outcomes in future pandemics or disease outbreaks.

Another economic shock of COVID-19 was oil pricing (Narayan, 2020). As COVID-19 cases grew and oil prices dropped in tandem, the news reports on these events were a further blow to oil pricing. Research showed that any negative news is an important predictor of oil pricing, while positive news has a less significant effect. The onset of the most economically volatile periods for the oil market began in April 2020, when crude oil for the
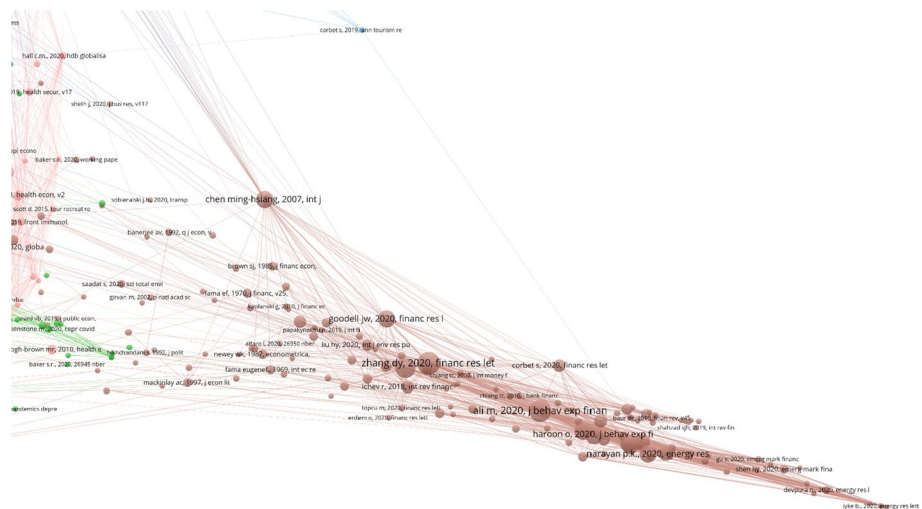

Fig. 8 Cluster 9 transnational studies (Salmon) and Cluster 10 financial contagion (Brown). (Color figure online)

first time recorded negative prices (Devpura & Narayan, 2020). Bans on travel and lock-downs decreased oil consumption, while pandemic fears had a negative influence on the economy more broadly. The two issues caused a downward economic spiral with oil prices continuing to fall in response to COVID-19 news of increasing cases and deaths.

Haroon and Rizvi (2020) considered several indices, combining the Dow Jones with fear surveys, and media measures concluding media sources may create a heightened panic level that corresponds with the volatility of financial markets. Markets crashed globally in response to COVID-19 news, which could be identified as a form of "financial conta-gion", meaning that negative markets 'infect' other markets (Akhtaruzzaman et al., 2021). This media-driven panic may be more strongly associated with market volatility than an outbreak in the location experiencing volatility. The usual political divisiveness observed in the United States may be mitigated slightly during times of stress including disasters (Apergis & Apergis, 2020). Apergis and Apergis (2020) argued that political leaders may become less focused on partisan gains during times of economic instability and epidemics. To further understand how large-scale shocks impact socioeconomics should be conducted based on previous similar historical events (Goodell, 2020).

Limitations

The primary limitation of our study is that we cannot entirely appreciate the breadth of work in the area. We find incredible variation among the 3327 articles published in 2020 (although several studies were technically released in 2021). This diversity was even more pronounced among the samples' 107,396 shared references dating back as early as 1927. This research is tasked with synthesizing a massive amount of research. An extensive vol-ume of books would likely be required to discuss each article in this rapidly emerging field. Instead, we elected to synthesize the pandemic sub-themes using several network graphics and a broad summary. A technical issue is the source of our second limitation. Specifi-cally, we chose to limit our search to exclude non-peer-reviewed sources from its search. To compensate for this issue, we include these works in the secondary co-citation analysis to better emphasize emergent and shared classical works from across the social sciences. This enlarged co-citation sample enabled us to look at pre-pandemic ideas and historical examples that were integrated into contemporary thinking. A third limitation is that stud-ies published earlier in the pandemic tended to receive more citations (especially those published in medical journals). This 'hot topic' effect introduced some bias into the rank-ing bibliometric rankings. With this temporal bias in mind, this study sought to reference across the 2020 sample window.

Discussion and conclusion

Each discipline engaged the core works on the topic of COVID-19 but each with their respective disciplinary traditions and corresponding trajectories. Within the citation net-work, we observe ten sub-clusters centered around a medical core containing numerous extensively referenced papers in high-impact publications such as *The Lancet* and *Sci-ence*. Considerable interdisciplinary overlap was found during the initial phase of pan-demic research. Many crucial keywords including mortality, epidemic, quarantine, and telemedicine became prominent thanks to the central medical core. The dense tourism and travel research cluster alternatively examined issues of decreased tourism, risk perception,

tracking surveillance, border closures, and transmission modeling. This cluster is loosely tied to a psychological impact cluster examining quarantine, isolation, confusion, boredom, fear, and PTSD. This overlapped directly with media studies examining disease discourse and infodemic challenges in communicating crucial information to high-risk groups. This cluster overlaps significantly with the central and interdisciplinary behavioral trends cluster which examines perceptions and determinants of protective behaviors. These issues segue into the diverse sociology cluster which generally analyzed how inequality exacerbated the effects of covid and cultural trauma. Branching off from these clusters, we observe criminology's early examination of differential shifts in criminal trends. Coming full circle, macro-economic research examines lockdowns, disease diffusion, and corresponding market impacts. We observe a historical transnational cluster pointing to different historical events which provided a range of predictive forecasts. Finally, we observe the isolated studies of financial contagion studies crossing national borders and corresponding shocks across different economic sectors.

This study examines the crucial period of 2020 and the ideas that characterized the nascent stages of social science research during the arrival of the pandemic. In doing so, we discover a central medical core with nine surrounding clusters each with a unique disciplinary character. Looking ahead, it is apparent that several pandemic-related topics emerged quite rapidly and shifted in the years that followed (e.g., vaccine disinformation). Topics such as geographic and racial impact disparities, demographics and migratory patterns, policy perceptions and misinformation spread, housing-related studies involving cohabitation, evictions, homelessness, and the housing boom. Additionally, the overlap between pandemic studies and other issues such as political discontent and collective behavior during this time demands further investigation. As the COVID-19 pandemic continues into another year with global cases and death toll climbing into the millions, analysis of early research publications grants insight into the social scientific frameworks and the ideas that represented the time. These frameworks continue to evolve bridging the identified gaps in knowledge and giving way to new areas of research. One such area will undoubtedly explore how future generations will be affected by these individual, local, structural, and cultural changes.

References

Adda, J. (2016). Economic activity and the spread of viral diseases: Evidence from high frequency data. *The Quarterly Journal of Economics, 131*(2), 891–941.

Ahorsu, D. K., Lin, C. Y., Imani, V., Saffari, M., Griffiths, M. D., & Pakpour, A. H. (2020). The fear of COVID-19 scale: development and initial validation. *International Journal of Mental Health and Addiction, 1*, 1–9.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179–211.

Akhtaruzzaman, M., Boubaker, S., & Sensoy, A. (2021). Financial contagion during COVID–19 crisis. *Finance Research Letters, 38*, 101604.

Akiyama, M. J., Spaulding, A. C., & Rich, J. D. (2020). Flattening the curve for incarcerated populations—COVID-19 in jails and prisons. *New England Journal of Medicine, 382*(22), 2075–2077.

Alexander, J. C., Eyerman, R., Giesen, B., Smelser, N. J., & Sztompka, P. (2004). *Cultural trauma and collective identity*. University of California Press.

Ali, M., Alam, N., & Rizvi, S. A. R. (2020). Coronavirus (COVID-19)—An epidemic or pandemic for financial markets. *Journal of Behavioral and Experimental Finance, 27*, 100341.

Allcott, H., & Gentzkow, M. (2017). Social media and fake news in the 2016 election. *Journal of Economic Perspectives, 31*(2), 211–236.

Anderson, R. M., Heesterbeek, H., Klinkenberg, D., & Hollingsworth, T. D. (2020). How will country-based mitigation measures influence the course of the COVID-19 epidemic? *The Lancet, 395*(10228), 931–934.

Apergis, N., & Apergis, E. (2020). Can the COVID-19 pandemic and oil prices drive the US partisan conflict index?.

Aristovnik, A., Ravšelj, D., & Umek, L. (2020). A bibliometric analysis of COVID-19 across science and social science research landscape. *Sustainability, 12*(21), 9132.

Ashby, M. P. (2020). Initial evidence on the relationship between the coronavirus pandemic and crime in the United States. *Crime Science, 9*, 1–16.

Atchison, C., Bowman, L. R., Vrinten, C., Redd, R., Pristerà, P., Eaton, J., & Ward, H. (2021). Early perceptions and behavioural responses during the COVID-19 pandemic: A cross-sectional survey of UK adults. *British Medical Journal Open, 11*(1), e043577.

Atkeson, A. (2020). *What will be the economic impact of COVID-19 in the US? Rough estimates of disease scenarios (No. w26867)*. National Bureau of Economic Research.

Bajardi, P., Poletto, C., Ramasco, J. J., Tizzoni, M., Colizza, V., & Vespignani, A. (2011). Human mobility networks, travel restrictions, and the global spread of 2009 H1N1 pandemic. *PLoS ONE, 6*(1), e16591.

Balog-Way, D. H., & McComas, K. A. (2020). COVID-19: Reflections on trust, tradeoffs, and preparedness. *Journal of Risk Research, 23*(7–8), 838–848.

Baum, T., & Hai, N. T. T. (2020). Hospitality, tourism, human rights and the impact of COVID-19. *International Journal of Contemporary Hospitality Management., 32*, 2397.

Beck, U. (1986). *Risikogesellschaft. Aufdem weg in eine andere moderne*. Suhrkamp.

Beck, U., Lash, S., & Wynne, B. (1992). *Risk society: Towards a new modernity* (Vol. 17). Sage.

Bish, A., & Michie, S. (2010). Demographic and attitudinal determinants of protective behaviours during a pandemic: A review. *British Journal of Health Psychology, 15*(4), 797–824.

Bloom, D. E., & Cadarette, D. (2019). Infectious disease threats in the twenty-first century: Strengthening the global response. *Frontiers in Immunology, 10*, 549.

Brooks, S. K., Webster, R. K., Smith, L. E., Woodland, L., Wessely, S., Greenberg, N., & Rubin, G. J. (2020). The psychological impact of quarantine and how to reduce it: Rapid review of the evidence. *The Lancet, 395*(10227), 912–920.

Brown, N. A., Rovins, J. E., Feldmann-Jensen, S., Orchiston, C., & Johnston, D. (2017). Exploring disaster resilience within the hotel sector: A systematic review of literature. *International Journal of Disaster Risk Reduction, 22*, 362–370.

Browne, A., St-Onge Ahmad, S., Beck, C. R., & Nguyen-Van-Tam, J. S. (2016). The roles of transportation and transportation hubs in the propagation of influenza and coronaviruses: a systematic review. *Journal of Travel Medicine, 23*(1), 002.

Cao, W., Fang, Z., Hou, G., Han, M., Xu, X., Dong, J., & Zheng, J. (2020). The psychological impact of the COVID-19 epidemic on college students in China. *Psychiatry Research, 287*, 112934.

Casero-Ripollés, A. (2020). Impact of COVID-19 on the media system. Communicative and democratic consequences of news consumption during the outbreak. *El profesional de la información, 29*(2), e290223.

Chahrour, M., Assi, S., Bejjani, M., Nasrallah, A. A., Salhab, H., Fares, M., & Khachfe, H. H. (2020). A bibliometric analysis of COVID-19 research activity: A call for increased output. *Cureus, 12*, 3.

Chen, M. H., Jang, S. S., & Kim, W. G. (2007). The impact of the SARS outbreak on Taiwanese hotel stock performance: An event-study approach. *International Journal of Hospitality Management, 26*(1), 200–212.

Chew, C., & Eysenbach, G. (2010). Pandemics in the age of Twitter: Content analysis of Tweets during the 2009 H1N1 outbreak. *PLoS ONE, 5*(11), e14118.

Chinazzi, M., Davis, J. T., Ajelli, M., Gioannini, C., Litvinova, M., Merler, S., Piontti, A. P., Mu, K., Rossi, L., Sun, K., & Viboud, C. (2020). The effect of travel restrictions on the spread of the 2019 novel coronavirus (COVID-19) outbreak. *Science, 368*(6489), 395–400.

Crenshaw, K. (1990). Mapping the margins: Intersectionality, identity politics, and violence against women of color. *Stanford Law Review, 43*, 1241.

De Bellis, N. (2009). *Bibliometrics and citation analysis from Science citation index to cybermetrics*. Scarecrow Press.

De Vos, J. (2020). The effect of COVID-19 and subsequent social distancing on travel behavior. *Transportation Research Interdisciplinary Perspectives, 5*, 100121.

De Zwart, O., Veldhuijzen, I. K., Elam, G., Aro, A. R., Abraham, T., Bishop, G. D., Voeten, H. A., Richardus, J. H., & Brug, J. (2009). Perceived threat, risk perception, and efficacy beliefs related to SARS and other (emerging) infectious diseases: Results of an international survey. *International Journal of Behavioral Medicine, 16*(1), 30–40.

Devpura, N., & Narayan, P. K. (2020). Hourly oil price volatility: The role of COVID-19. *Energy Research Letters, 1*(2), 13683.

Dong, E., Du, H., & Gardner, L. (2020). An interactive web-based dashboard to track COVID-19 in real time. *The Lancet Infectious Diseases, 20*(5), 533–534.

Duan, L., & Zhu, G. (2020). Psychological interventions for people affected by the COVID-19 epidemic. *The Lancet Psychiatry, 7*(4), 300–302.

Eichenbaum, M. S., Rebelo, S., & Trabandt, M. (2020). *The macroeconomics of epidemics (No. w26882)*. National Bureau of Economic Research.

Emanuel, E. J., Persad, G., Upshur, R., Thome, B., Parker, M., Glickman, A., Zhang, C., Boyle, C., Smith, M., & Phillips, J. P. (2020). Fair allocation of scarce medical resources in the time of Covid-19. *New England Journal of Medicine, 382*(21), 2049–2055.

Entman, R. M. (1993). Framing: Toward clarification of a fractured paradigm. *Journal of Communication, 43*(4), 51–58.

Fan, J., Gao, Y., Zhao, N., Dai, R., Zhang, H., Feng, X., Shi, G., Tian, J., Chen, C., Hambly, B. D., & Bao, S. (2020). Bibliometric analysis on COVID-19: A comparison of research between English and Chinese studies. *Frontiers in Public Health, 8*, 477.

Fauci, A. S., & Morens, D. M. (2012). The perpetual challenge of infectious diseases. *New England Journal of Medicine, 366*(5), 454–461.

Fernandes, N. (2020). Economic effects of coronavirus outbreak (COVID-19) on the world economy.

Flaxman, S., Mishra, S., Gandy, A., Unwin, H. J. T., Mellan, T. A., Coupland, H., Whittaker, C., Zhu, H., Berah, T., Eaton, J. W., & Monod, M. (2020). Estimating the effects of non-pharmaceutical interventions on COVID-19 in Europe. *Nature, 584*(7820), 257–261.

Galea, S., Merchant, R. M., & Lurie, N. (2020). The mental health consequences of COVID-19 and physical distancing: The need for prevention and early intervention. *JAMA Internal Medicine, 180*(6), 817–818.

Garfin, D. R., Silver, R. C., & Holman, E. A. (2020). The novel coronavirus (COVID-2019) outbreak: Amplification of public health consequences by media exposure. *Health Psychology., 39*, 355.

Giddens, A. (1991). *Modernity and self-identity: Self and society in the late modern age*. Stanford University Press.

Goodell, J. W. (2020). COVID-19 and finance: Agendas for future research. *Finance Research Letters, 35*, 101512.

Gössling, S. (2020). Technology, ICT and tourism: From big data to the big picture. *Journal of Sustainable Tourism, 29*, 1–10.

Guan, W. J., Ni, Z. Y., Hu, Y., Liang, W. H., Ou, C. Q., He, J. X., Liu, L., Shan, H., Lei, C. L., Hui, D. S., & Du, B. (2020). Clinical characteristics of coronavirus disease 2019 in China. *New England Journal of Medicine, 382*(18), 1708–1720.

Guerrieri, V., Lorenzoni, G., Straub, L., & Werning, I. (2020). *Macroeconomic implications of COVID-19: Can negative supply shocks cause demand shortages? (No. w26918)*. National Bureau of Economic Research.

Guleid, F. H., Oyando, R., Kabia, E., Mumbi, A., Akech, S., & Barasa, E. (2021). A bibliometric analysis of COVID-19 research in Africa. *BMJ Global Health, 6*(5), e005690.

Hale, T., Petherick, A., Phillips, T., & Webster, S. (2020). Variation in government responses to COVID-19. *Blavatnik School of Government Working Paper, 31*, 2020–2111.

Hall, C. M., Scott, D., & Gössling, S. (2020). Pandemics, transformations and tourism: Be careful what you wish for. *Tourism Geographies, 22*(3), 577–598.

Haroon, O., & Rizvi, S. A. R. (2020). COVID-19: Media coverage and financial markets behavior—A sectoral inquiry. *Journal of Behavioral and Experimental Finance, 27*, 100343.

Harvey, D. (2020). Anti-capitalist politics in the time of COVID-19. *Jacobin Magazine, 20*, 1.

Hawks, L., Woolhandler, S. & McCormick, D., (2020). COVID-19 in prisons and jails in the United States. *JAMA Internal Medicine*, *180*(8), 1041–1042.

Helm, D. (2020). The environmental impacts of the coronavirus. *Environmental and Resource Economics, 76*, 21–38.

Higgins-Desbiolles, F. (2020). Socialising tourism for social and ecological justice after COVID-19. *Tourism Geographies, 22*(3), 610–623.

Ho, Y. S., Fu, H. Z., & McKay, D. (2021). A bibliometric analysis of COVID-19 publications in the ten psychology-related Web of Science categories in the social science citation index. *Journal of Clinical Psychology, 77*(12), 2832–2848.

Holmes, E. A., O'Connor, R. C., Perry, V. H., Tracey, I., Wessely, S., Arseneault, L., Ballard, C., Christensen, H., Silver, R. C., Everall, I., & Ford, T. (2020). Multidisciplinary research priorities for the COVID-19 pandemic: A call for action for mental health science. *The Lancet Psychiatry, 7*, 547.

Huang, C., Wang, Y., Li, X., Ren, L., Zhao, J., Hu, Y., Zhang, L., Fan, G., Xu, J., Gu, X., & Cheng, Z. (2020). Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *The Lancet, 395*(10223), 497–506.

Islam, T., Pitafi, A. H., Arya, V., Wang, Y., Akhtar, N., Mubarik, S., & Xiaobei, L. (2021). Panic buying in the COVID-19 pandemic: A multi-country examination. *Journal of Retailing and Consumer Services, 59*, 102357.

Joo, H., Maskery, B. A., Berro, A. D., Rotz, L. D., Lee, Y. K., & Brown, C. M. (2019). Economic impact of the 2015 MERS outbreak on the Republic of Korea's tourism-related industries. *Health Security, 17*(2), 100–108.

Keogh-Brown, M. R., Wren-Lewis, S., Edmunds, W. J., Beutels, P., & Smith, R. D. (2010). The possible macroeconomic impact on the UK of an influenza pandemic. *Health Economics, 19*(11), 1345–1360.

Kermack, W. O., & Mckendrick, A. G. (1927). *Containing papers of a mathematical and physical character*, Vol. 115.

Kinner, S. A., Young, J. T., Snow, K., Southalan, L., Lopez-Acuña, D., Ferreira-Borges, C., & O'Moore, É. (2020). Prisons and custodial settings are part of a comprehensive response to COVID-19. *The Lancet Public Health, 5*(4), e188–e189.

Klein, N. (2007). *The shock doctrine: The rise of disaster capitalism*. Macmillan.

Kraemer, M. U., Yang, C. H., Gutierrez, B., Wu, C. H., Klein, B., Pigott, D. M., Du Plessis, L., Faria, N. R., Li, R., Hanage, W. P., & Brownstein, J. S. (2020). The effect of human mobility and control measures on the COVID-19 epidemic in China. *Science, 368*(6490), 493–497.

Lauer, S. A., Grantz, K. H., Bi, Q., Jones, F. K., Zheng, Q., Meredith, H. R., Azman, A. S., Reich, N. G., & Lessler, J. (2020). The incubation period of coronavirus disease 2019 (COVID-19) from publicly reported confirmed cases: Estimation and application. *Annals of Internal Medicine, 172*(9), 577–582.

Lazer, D. M., Baum, M. A., Benkler, Y., Berinsky, A. J., Greenhill, K. M., Menczer, F., Metzger, M. J., Nyhan, B., Pennycook, G., Rothschild, D., & Schudson, M. (2018). The science of fake news. *Science, 359*(6380), 1094–1096.

Le Quéré, C., Jackson, R. B., Jones, M. W., Smith, A. J., Abernethy, S., Andrew, R. M., De-Gol, A. J., Willis, D. R., Shan, Y., Canadell, J. G., & Friedlingstein, P. (2020). Temporary reduction in daily global CO2 emissions during the COVID-19 forced confinement. *Nature Climate Change, 10*(7), 647–653.

Lepp, A., & Gibson, H. (2003). Tourist roles, perceived risk and international tourism. *Annals of Tourism Research, 30*(3), 606–624.

Li, Q., Guan, X., Wu, P., Wang, X., Zhou, L., Tong, Y., Ren, R., Leung, K. S., Lau, E. H., Wong, J. Y., & Xing, X. (2020a). Early transmission dynamics in Wuhan, China, of novel coronavirus-infected pneumonia. *New England Journal of Medicine, 382*, 1199.

Li, R., Pei, S., Chen, B., Song, Y., Zhang, T., Yang, W., & Shaman, J. (2020b). Substantial undocumented infection facilitates the rapid dissemination of novel coronavirus (SARS-CoV-2). *Science, 368*(6490), 489–493.

Liu, Y. L., Yuan, W. J., & Zhu, S. H. (2022). The state of social science research on COVID-19. *Scientometrics, 1*, 1–15.

Massey, D., & Denton, N. A. (1993). *American apartheid: Segregation and the making of the underclass*. Harvard University Press.

Mbembe, A. (2008). Necropolitics. In A. Mbembe (Ed.), *Foucault in an age of terror* (pp. 152–182). Palgrave Macmillan.

McKibbin, W., & Fernando, R. (2020). The global macroeconomic impacts of COVID-19: Seven scenarios. *Asian Economic Papers, 30*, 1–55.

Mohler, G., Bertozzi, A. L., Carter, J., Short, M. B., Sledge, D., Tita, G. E., Uchida, C. D., & Brantingham, P. J. (2020). Impact of social distancing during COVID-19 pandemic on crime in Los Angeles and Indianapolis. *Journal of Criminal Justice, 68*, 101692.

Narayan, P. K. (2020). Oil price news and COVID-19—Is there any connection? *Energy Research Letters, 1*(1), 13176.

Nicola, M., Alsafi, Z., Sohrabi, C., Kerwan, A., Al-Jabir, A., Iosifidis, C., Agha, M., & Agha, R. (2020). The socio-economic implications of the coronavirus and COVID-19 pandemic: a review. *International Journal of Surgery, 78*, 185.

Novelli, M., Burgess, L. G., Jones, A., & Ritchie, B. W. (2018). 'No Ebola… still doomed'—The Ebola-induced tourism crisis. *Annals of Tourism Research, 70*, 76–87.

OECD. (2002). *Frascati manual; Oxford dictionary* (6th ed., p. 203). OECD.

Payne, J. L., Morgan, A., & Piquero, A. R. (2020). COVID-19 and social distancing measures in Queensland, Australia, are associated with short-term decreases in recorded violent crime. *Journal of Experimental Criminology, 1*, 1–25.

Piketty, T. (2013). *Capital in the 21st century*. Harvard College.

Piquero, A. R., Riddell, J. R., Bishopp, S. A., Narvey, C., Reid, J. A., & Piquero, N. L. (2020). Staying home, staying safe? A short-term analysis of COVID-19 on Dallas domestic violence. *American Journal of Criminal Justice, 45*(4), 601–635.

Qiu, R. T., Park, J., Li, S., & Song, H. (2020). Social costs of tourism during the COVID-19 pandemic. *Annals of Tourism Research, 84*, 102994.

Rassy, D., & Smith, R. D. (2013). The economic impact of H1N1 on Mexico's tourist and pork sectors. *Health Economics, 22*(7), 824–834.

Ritchie, B. W., & Jiang, Y. (2019). A review of research on tourism risk, crisis and disaster management: Launching the annals of tourism research curated collection on tourism risk, crisis and disaster management. *Annals of Tourism Research, 79*, 102812.

Rogers, R. W. (1975). A protection motivation theory of fear appeals and attitude change1. *The Journal of Psychology, 91*(1), 93–114.

Rubin, G. J., Amlôt, R., Page, L., & Wessely, S. (2009). Public perceptions, anxiety, and behaviour change in relation to the swine flu outbreak: Cross sectional telephone survey. *BMJ, 339*, 2651.

Soytas, R. B. (2021). A bibliometric analysis of publications on COVID-19 and older adults. *Annals of Geriatric Medicine and Research, 25*(3), 197.

Tian, H., Liu, Y., Li, Y., Wu, C. H., Chen, B., Kraemer, M. U., Li, B., Cai, J., Xu, B., Yang, Q., & Wang, B. (2020). An investigation of transmission control measures during the first 50 days of the COVID-19 epidemic in China. *Science, 368*(6491), 638–642.

Torres-Salinas, D. (2020). Daily growth rate of scientific production on COVID-19. Analysis in databases and open access repositories. Preprint at http://arxiv.org/2004.06721

Van Bavel, J. J., Baicker, K., Boggio, P. S., Capraro, V., Cichocka, A., Cikara, M., Crockett, M. J., Crum, A. J., Douglas, K. M., Druckman, J. N., & Drury, J. (2020). Using social and behavioural science to support COVID-19 pandemic response. *Nature Human Behaviour, 4*(5), 460–471.

Van Eck, N. & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics, 84*(2), 523–538.

Van Eck, N. J., & Waltman, L. (2014). Visualizing bibliometric networks. In Y. Ding, R. Rousseau, & D. Wolfram (Eds.), *Measuring scholarly impact: Methods and practice* (pp. 285–320). Springer.

Vosoughi, S., Roy, D., & Aral, S. (2018). The spread of true and false news online. *Science, 359*(6380), 1146–1151.

Wang, P. & Tian, D., (2021). Bibliometric analysis of global scientific research on COVID-19. *Journal of Biosafety and Biosecurity, 3*(1), 4–9.

Wallis, P., & Nerlich, B. (2005). Disease metaphors in new epidemics: The UK media framing of the 2003SARS epidemic. *Social Science & Medicine, 60*(11), 2629–2639.

Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., Ho, C. S., & Ho, R. C. (2020). Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China. *International Journal of Environmental Research and Public Health, 17*(5), 1729.

Wen, J., Aston, J., Liu, X., & Ying, T. (2020). Effects of misleading media coverage on public health crisis: A case of the 2019 novel coronavirus outbreak in China. *Anatolia, 31*(2), 331–336.

White, H. D., & Griffith, B. C. (1981). Author cocitation: A literature measure of intellectual structure. *Journal of the American Society for Information Science, 32*(3), 163–171. https://doi.org/10.1002/asi.4630320302

Yu, Y., Li, Y., Zhang, Z., Gu, Z., Zhong, H., Zha, Q., Yang, L., Zhu, C., & Chen, E. (2020). A bibliometric analysis using VOSviewer of publications on COVID-19. *Annals of Translational Medicine, 8*, 13.

Zarocostas, J. (2020). How to fight an infodemic. *The Lancet, 395*(10225), 676.

Zhang, D., Hu, M., & Ji, Q. (2020a). Financial markets under the global pandemic of COVID-19. *Finance Research Letters, 36*, 101528.

Zhang, S. X., Wang, Y., Rauch, A., & Wei, F. (2020b). Unprecedented disruption of lives and work: Health, distress and life satisfaction of working adults in China one month into the COVID-19 outbreak. *Psychiatry Research, 288*, 112958.

Žižek, S. (2020). *Pandemic!: COVID-19 shakes the world* (p. 2020). Wiley.

Žižek, S. (2021). *Pandemic! 2: Chronicles of a time lost* (p. 2021). Polity Press.

Zuboff, S., Möllers, N., Wood, D. M., & Lyon, D. (2019). Surveillance capitalism: An interview with shoshana zuboff. *Surveillance & Society, 17*(1/2), 257–266.

Zyoud, S. E. H., & Al-Jabi, S. W. (2020). Mapping the situation of research on coronavirus disease-19 (COVID-19): A preliminary bibliometric analysis during the early stage of the outbreak. *BMC Infectious Diseases, 20*(1), 1–8.