

Review

A Systematic Literature Review on Fake News in the COVID-19 Pandemic: Can AI Propose a Solution?

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Abstract: The COVID-19 pandemic has led to an incredible amount of fake news and conspiracy theories around the world. Calls for the integration of COVID-19 and fake news-related research have been advanced in various fields. This paper aims to unpack a structured overview of previous research topics and findings and identify gaps. Our goal in this systematic review is to (a) synthesize the selected earlier studies, (b) offer researchers a structural framework for future COVID-19 and fake news research, and (c) recommend relevant areas for future research. In this study, we focus on eighty conceptual and empirical studies on misinformation of COVID-19-related news on social media. We identify vital publications and methodological and theoretical approaches that exist in the COVID-19 literature. The articles were systematically analyzed, focusing on the research context and time frame, data collection/analysis procedures, and equivalence issues. While COVID-19 research has been advancing significantly over the past couple of months, numerous questions remain unexplained in the domain of the social media landscape. For example, our review suggests that researchers should begin to concentrate on a process framework blending Artificial Intelligence (AI) to curb the fake news problem. This can be achieved in all three phases, e.g., the study of individual decisions and experiences, the experiences of groups and organizations and the interactions between them, and finally, the interactions at the broadest level (micro, meso, and macro stages).

Keywords: COVID-19; fake news; artificial intelligence; social media



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1. Introduction

The World Health Organization (WHO) has called the current worldwide pandemic coronavirus disease-19 (COVID-19) [1]. Coronavirus Study Group (CSG) identified it as a species of severe acute respiratory syndrome coronaviruses (SARS-CoVs) [2]. The disease's quick spread and the abundance of fake news have drawn widespread international and national attention. WHO, along with other government and non-government organizations, is well aware of the consequences of fake news and offers ongoing information to governments and citizens through various media venues [3]. However, social media users consumed an immense volume of information and misinformation from various online sources, including COVID-19 hashtags in social media. These fake news and media headlines have inscribed fear and prejudice in society. The COVID-19 pandemic has also heavily impacted wellbeing and prosperity universally, and the pre-pandemic investigations propose a high commonness of essential health and business problems [4]. Sharing personal and private information during this pandemic crisis has become a big issue, particularly on online and social media platforms, which are neglected. Despite extensive interest from researchers, scholars, and practitioners, only a few studies provide a review of COVID-19 and fake news research. This includes an article [5] reviewing Online Social Networks (OSN), which have become valuable tools for disseminating misinformation. Study [6] unveils the

urgency of an infoveillance system for detecting and tracking COVID-19 misinformation or tweets. More recently, the research discusses that to understand Uses and Gratifications Theory (UGT) [2], focusing on how fake news can contribute to social cohesion, extending relationships, chatting, liking, and sharing new stories. Although these articles have provided valuable insights into the importance of the factors that lead to the propagation of fake news, they are limited in scope to systematically examine and document the gaps in the literature and provide guidance for future research. In order to overcome this hurdle, this study takes a different approach. We clarify what fake news is and then identify how it disseminates, tabulates, and provides information on theories and methods used, primary outlets, and critical publications. This helps us ask the central research question: what has been conceptually and empirically investigated on COVID-19 and fake news to date, and where should future research proceed? More specifically, research on conceptual and empirical works in this area will help identify COVID-19-related misinformation due during this crisis.

We also propose this is where artificial intelligence (AI) can help. AI is beginning to prove itself as a valuable tool in combating this problem by identifying fake news and misinformation, as well as tracking its spread and impact. In doing so, AI can help to stem the tide of false information, and keep people informed with accurate, up-to-date information about the pandemic. The rest of the paper is organized as follows: In Section 2, preliminaries and essential definitions around COVID-19 fake news are given, and Section 3 presents the methodology of this research. The findings and discussions are provided in Sections 4 and 5. Section 6 proposes the framework followed by the recommendations and future works in Section 7. Finally, Section 8 concludes the study.

2. Fake News and Research Domain

Fake news has received much national and global attention in recent years. Frequently it appears in a political context but is also discussed in health and business entities and their decisions toward stakeholders. False, deceptive, or incorrect material that resembles news media content in form but not in organizational procedure or aim can be defined as fake news [7]. Today, fake news has entered scholarly discourses and even everyday business conversations. A more formal definition through the construction of a typology can be found in [8] article, which classifies fake news according to its immediate intentions to deceive and the inadvertent sharing of false information. In fact, a study published by Egelhofer and Lecheler [9] identified three pillars of fake news: (1) low facticity (e.g., false connection, misleading content, fabricated content, false context, imposter content); (2) journalistic format (e.g., headline, text, body, picture); (3) intention to deceive (e.g., political/ideological, financial, to entertain/provoke). Li and Scott [10] asserted that fake news is classified into three categories: misinformation, disinformation, and malformation. Twitter and other public social media are great online resources for understanding public perception about a particular topic. Pulido et al. [11] did a study in this area on the circulation of false and accurate information during the pandemic. They investigated tweets posted in two days (6–7 February 2020) around COVID-19, with a total of 1000 tweets. It unpacks how people tend to retweet fact- and scientific-based information more than fake news; however, engagement around mere points is less than reality- and scientific-based tweets.

Manipulation involves the disruption and manipulation of real images or videos to create a false narrative [12] (p. 144). While news fabrication generally refers to text-based items, manipulation describes visual news. With the advent of photography and digital technologies that allow conducting operations over video and photo material, manipulation has become an efficient way of producing fake news. Misappropriation, which is giving non-manipulated images, pictures, and videos out of their original context to support a particular narrative, is currently part of photo manipulation. Tandoc Jr. et al. [12] discussed an example that involves a viral sharing via Twitter of a photo showing buses being gathered to transport anti-Trump protesters. A key point in manipulating news is that they

are produced mainly with concerns of delivering entertainment rather than a distortion of information [13]. Producers of news satire call themselves comedians or entertainers instead of journalists and newscasters.

As soon as the coronavirus started spreading in various developed and underdeveloped countries globally, we can see the spread of fake news on social media indicating that the virus had been developed in a laboratory in China [14]. Although there are many differences between the fake news spread on online platforms, some social media posts claim China created the virus in preparation for biological warfare [15]. In contrast, others say the primary purpose of making the virus is to harm other countries' economies [16]. The conspiracy theory has become even more widely believed because the city of Wuhan, China, is home to one of the largest virology centers in the world, the Wuhan Institute of Virology. Many great virologists of the world perform research here, and the quality of their work is highly improved. As a result, the story quickly became popular, saying that the virus was created at the Wuhan Institute under the direction of the Chinese government. Although there are many differences between these theories, the prime focus is an absence of a collective and comprehensive approach to seize the dissemination of unwanted news. Fake news is one of the main threats to modern society. When people receive more fake news, they are willing to accept this information as accurate. According to Vosoughi et al. [17], fake news is 70% more likely to be shared from micro to macro institutions. In addition, it can influence people to make bad decisions in the healthcare domain. The most popular misleading claims are unproven and unverifiable; alternative cures, such as alcohol use against diseases, are against their interest and society (i.e., myths surrounding vaccination and its link with autism) [18]. With this systematic review, we try to contribute to the existing literature in three different ways. First, our study differs from prior research in that we broadly examine theoretical approaches that have been used in COVID-19 research. Second, we attempt to fill a gap in fake news literature by reviewing fake news to highlight the critical contribution that has been made in terms of articles published recently. Our understanding is that a systematic review of these will help researchers focus on the other side of the problem: how fake news is disseminated on social media platforms. Third, most fake news studies have investigated the micro and institutional-level impacts on society. In this study, we use a comprehensive approach to combine the three stages of this problem (e.g., micro, meso, and macro-level analysis) and offer effective solutions by employing artificial intelligence (AI) to detect fake news.

3. Methods

Systematic literature review papers can be of several types, namely—a structured review focusing on widely used methods, a systematic review [19], bibliometric review [20], and a framework-based review [9]. We adopted a unique approach coupled with a systematic review and bibliometric citation analysis to conduct this study on a systematic literature review. A three-step process governs the criterion used for this review to identify articles.

First, we conducted an article search in November 2020. We repeated the investigation in February 2021 on COVID-19 and fake news to understand the concepts and phenomenon of problems and identify specific research gaps. While analyzing the literature, we also considered understanding the objectives of the study, considering the analytical tool, when the study was conducted, and the scope of the study (see Figure 1). A thorough examination of these articles indicated a paucity of literature reviews on COVID-19 and fake news.

A Systematic Review of the Literature on COVID-19: Methodological approach.

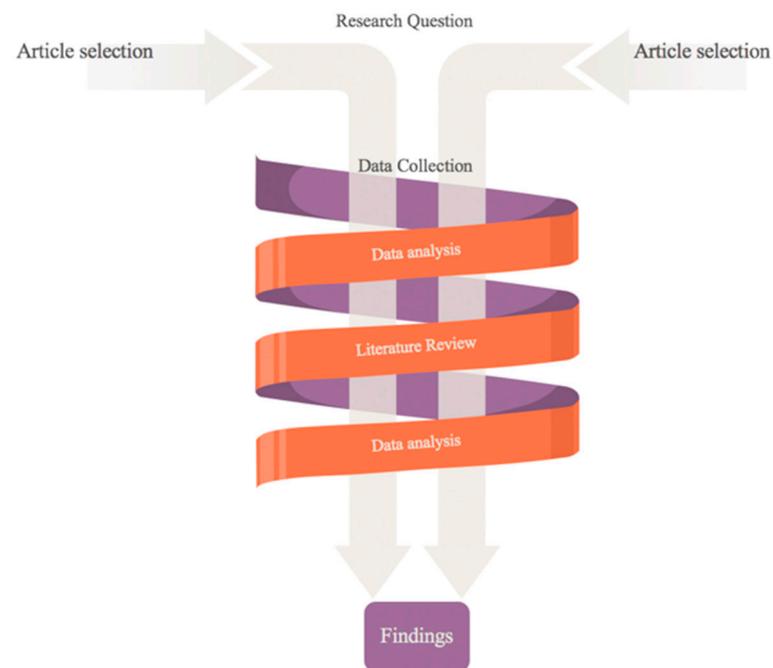


Figure 1. Systematic literature review process.

Google Scholar, Web of Science, and Scopus databases were used to find articles published during 2018–2021. The articles were obtained by using the advanced search option available in the Scopus database. The search terms used were COVID-19* OR Pandemic* AND SARS-CoV-2* OR conspiracy* AND Fake news* OR Misinformation*. AND (LIMIT-TO (OA, "all")) AND (LIMIT-TO (PUBYEAR, 2021) OR LIMIT-TO (PUBYEAR, 2020) OR LIMIT-TO (PUBYEAR, 2019) OR LIMIT-TO (PUBYEAR, 2018) OR LIMIT-TO (PUBYEAR, 2017)) AND (LIMIT-TO (LANGUAGE, "English")).

Figure 2 is provided to show the literature time frame. It is evident that as a recent issue, most of the publications on COVID-19 and fake news receive much attention and interest during 2020. We undertook a comprehensive review of this literature and unpacked how no research contributes to the existing knowledge or fake news dissemination on social media platforms. We also try to look into the current challenges indicated in the literature to cut down the problem. We have only considered peer-reviewed journal articles, conference papers, reports, reviews, and editorials (Figure 3) for this, and they went through a screening procedure to ensure quality. This procedure enables us to choose publications that fulfill a particular degree of conceptual and methodological rigor.

After filtering the articles, we selected the literature published only in the Social Sciences Citation Index (SSCI). The papers were further filtered and categorized depending on their keywords to exclude those that were irrelevant. Consequently, articles not focused on COVID-19 and fake news (as the primary study subject) were excluded. Three authors examined the abstracts of the papers in-depth at the same time to filter out irrelevant ones, and the impartial assessment of the authors of this study was used to support the removal of publications. Later, all authors reviewed the grounds for eliminating some papers and agreed on those that go to the next phase.

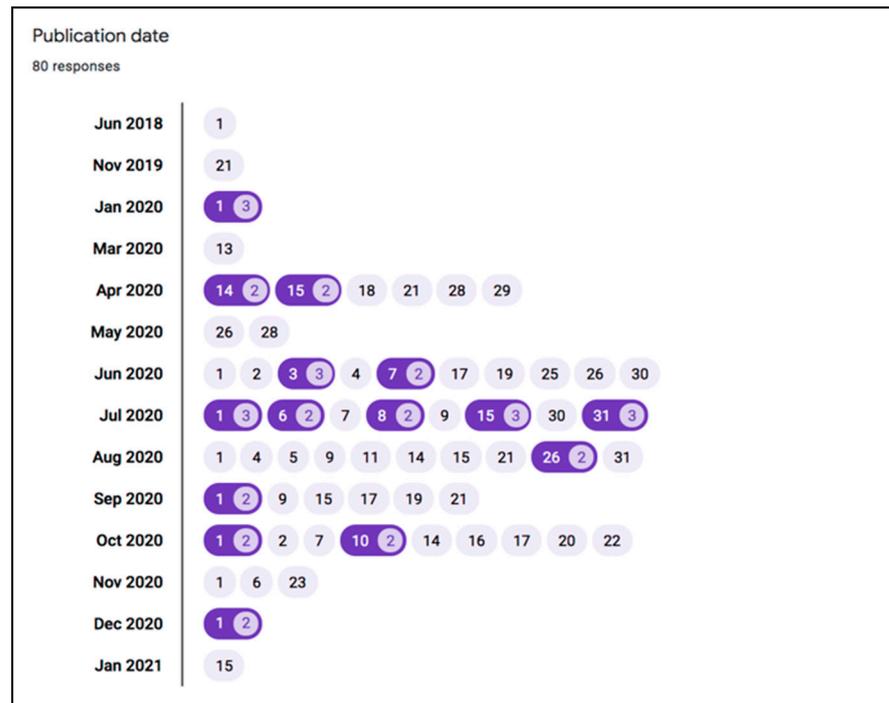


Figure 2. Literature time frame.

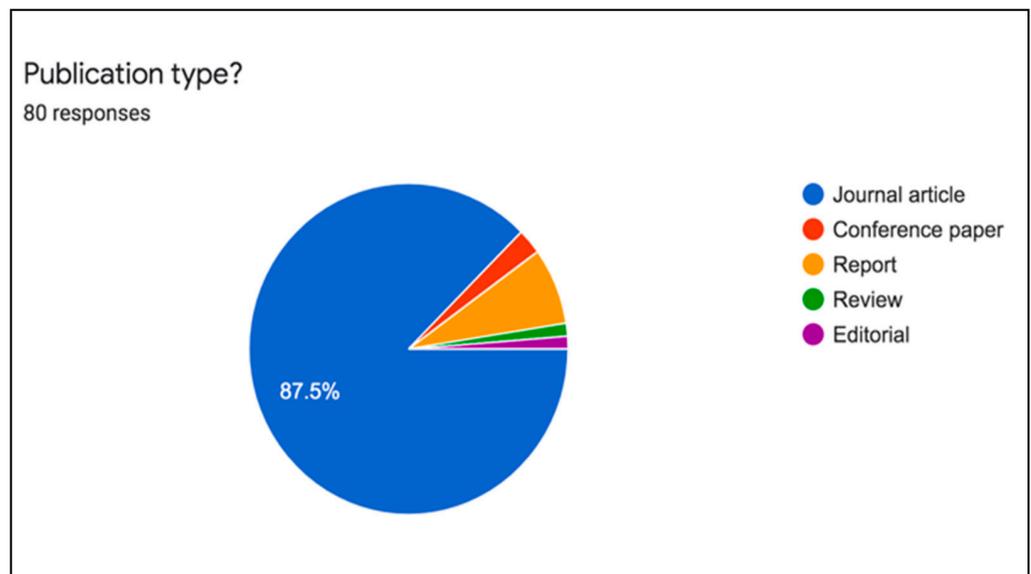


Figure 3. Type of publications reviewed.

Consequently, 80 articles were retained for additional screening to identify disciplines and knowledge domains (Figure 4). Even though the abstracts of all selected papers were examined closely, a complete content reading was performed. We did this to verify if the publications mainly focused on COVID-19 and fake news as their primary study subject. After that, each article was extensively examined to ensure that the aims, research issues, findings, and results were understood. Through this open coding procedure, 80 papers were classified into 32 study subjects or sub-sub-themes (open codes).

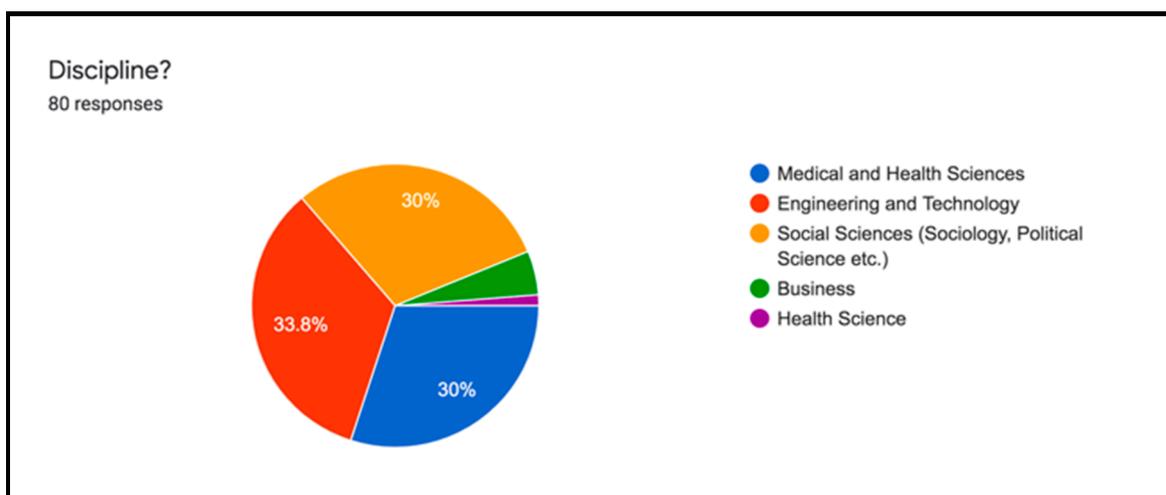


Figure 4. Disciplines of the paper reviews.

4. Findings

We reviewed the overall contributions of COVID-19 and fake news literature, looking at journals, authors, theories, and the methodological aspects of articles obtained in our search. Our systematic literature search and analysis assist us in providing essential knowledge of the study issues discussed here and the sorts of literature published on COVID-19 and false news. Our endeavor expands on widely researched subjects while highlighting research gaps. The findings section is divided into two subtopics. We begin by presenting research themes, sub-themes, and the total number of publications (Table 1). We then present theories and constructs used in all these 80 articles.

Table 1. Research themes, sub-themes, and the total number of publications related to them.

#	Theme	Sub Themes	Sub-Sub-Themes	Freq	%
1	COVID-19 and the pattern of fake news	Social context, Protest	Linguistic and syntactic features, followers, following, hashtags, trusted or fake	39	12
2	Fake news and motivation	User network, Creator, Spreader, Target, and Victim	Objectives, motivation, context, and mission	26	37
3	Prevalence and detrimental effects	Positive and negative sentiments	Misrepresentation of the facts, Playing to your emotions	22	08
4	Cyberchondria, fake news, and escalation of tension	News content, disharmony, and social unrest	Transfer, diversion	28	11
5	Conspiracy theory appeals	Morality, credibility, and reliability	Bias, propaganda, bandwagon, assertion	19	32

The following sub-sections include an overview of the research themes and the types of articles available on COVID-19 and fake news. It further reveals the popular research themes on COVID-19 and its relevance with a significant impact on the media system while presenting research gaps.

4.1. COVID-19, Research Stream, and the Pattern of Fake News

Researchers of COVID-19 [21,22] and of the fake news domain have studied the pattern of fake news, which includes the type of fake online posting or Tweets and objectives and missions perused by individuals or even groups. Many fake news or disinformation assertions have nothing to do with scientific data. Furthermore, the remainder comprises scientific material on viral dispersion, medical information, news from public personalities,

conspiracy theories, virus transmission, the genesis of the virus, and vaccine research. The news of getting rid of the coronavirus or its cure by accessing unorthodox measures (e.g., drinking cow urine or obtaining a coronavirus antidote in dreams) is being shared millions of times [21]. People from all walks of life, educated and uneducated, are being attacked by rumors and fake news. According to the space on various social and mainstream media, the presence of various misinformation patterns, such as avoiding ice cream and other cold foods can help prevent the spread of the virus. Research unpacks it as dangerous and wrong to misrepresent and misrepresent a trusted person or organization.

Casero-Ripolles's [23] research unpacks that individuals actively consume news at a rate that increases from 60% before the COVID-19 pandemic to 92% during the COVID-19 pandemic. According to this study, people's ability to recognize bogus fake news increased by 12% during the epidemic. Another intriguing discovery is that the more people consume media information, the more they can identify fake news. Anti-vaccine protests have been common in nations such as the United States and parts of Europe and Australia. Furthermore, protests against lockdowns and mandatory mask-wearing have occurred in several countries, including the United Kingdom, Canada, Germany, Poland, and the United States. Additionally, in certain nations, the repercussions of false news include pharmaceutical shortages such as hydroxychloroquine or medical face masks. The growing understanding is that COVID-19 conspiracies and widespread fake news can undermine the success of prevention strategies. Moreover, the prevalence of COVID-19-related fake news can radically affect people's perceptions of the virus's risk [24]. This is significant since risk perception has been connected to the implementation of COVID-19 preventive health practices [25].

4.2. Fake News and Motivation

Technology has been transformed into a tool for self-expression by social media users. They are also establishing a pseudo-truth, primarily through instant messaging apps. According to Dryhurst et al. [25], social media users use misleading information and are classified based on their published content. These are Conspiranoids, Proselytizing, Narcissists, Creators of Chaos, Satirists, and Paranoid Tyrants. The study displays the impact caused by social media users who spread fake news, turning content viral and generating engagement in other social media users. This engagement includes actions or indicators such as likes or comments. The prime intention of this creating untruthful content is to hide the facts. Individuals who receive fake news on social media platforms create opinions about the message's credibility based on the information source, storyline, and context. While the likelihood of spreading depends on the degree to which recipients suspect such disinformation.

Why are people sharing fake news? Due to heuristic beliefs, they sometimes consider information to be accurate. Heuristics are individuals' tendency to focus on superficial trends to minimize sound thinking investment. This is apparent in the dependence on previous views and opinions. If the evidence supports specific priors, it is more likely to be accepted and thus eventually transmitted (confirmation bias), e.g., [26]. Mueller and Skitka [27] asserted people feel it morally permissible to spread misinformation, primarily when fake news supports political agenda. In this context, fake articles are more likely to become viral. Furthermore, when people are exposed to a large amount of fake news, they usually judge and consider information sharing as less ethical, independent of their beliefs or accuracy, most of the time believing in fake news that they have seen before. Media platforms such as Instagram, Facebook, Snapchat, and Twitter have started to remove content that violates health guidelines, even when it was communicated by politicians, such as videos of Brazilian President Jair Bolsonaro [28]. The news about this social distancing by downplaying the epidemic and defending the use of chloroquine also received attention. A further instance is President of Venezuela Maduro's tweets about a so-called natural cure for COVID-19 that included lemongrass, ginger, and water [29].

4.3. Prevalence and Detrimental Effects

Baptista et al. [30] asserted that the presentation of information on social media (images, the format of the title, and language) can influence to become fake viral news. In addition, how factors such as impression, emotion, and shocking images can influence the success of fake news on social media. These authors evaluate differences and similarities between fake and real news to evaluate these characteristics and the influence in its dissemination, showing party and ideological identity as crucial factors. The approach used in this research was documentation from Google Scholar Database (2016–2020). Fake news is usually created using controversial headlines and emotional language, mainly content with solid feelings, making money the primary motivation. For instance, spreading false stories about the American election through Google AdSense [31]. It the importance to use significantly more words focusing on not the central argument but how the message is presented, and the tone's post is negative; bad topics such as crises, wars, and tragedies generate more attention and overall social engagement.

Nguyen et al. [32] discussed the risks and issues involved with COVID-19 misinformation in Vietnam. They discussed the impact of misinformation on social media, especially Facebook and YouTube, on disseminating fake news in the Vietnamese community. They discussed that there are Facebook pages in Vietnam where volunteers expose fake news, and many videos on YouTube disclose fake videos and information about the COVID-19 pandemic. According to other studies, individuals are more prone to experience emotional distress and sleeplessness due to the COVID-19 epidemic. Aside from creating applicable health regulations to prevent the spread of COVID-19 infection, healthcare practitioners should make relevant online campaigns to reduce people's ignorance of COVID-19 and reduce misunderstandings about COVID-19.

Anxiety, mistrust, and emotions of hopelessness are used to capture individual attention through fake news. Furthermore, negative attitudes to the administration have generated fear and uncertainty, which has resulted in news assumptions. However, research shows the prevalence is more extreme in some locations where they are deprived of education and knowledge [33]. The study unpacks the level of education that can influence the dissemination of fake news. It also highlights that kids and young people have problems differentiating between fake and real news. Intuitive individuals and women share more fake news overall. Although the spread of fake news has increased during the last few years, fake news has reached a small population compared to real news. Finally, simple, persuasive, and emotional language and modifying facts to become news more bizarre, surprising, and controversial increases the likelihood of sharing fake news on social media.

4.4. Cyberchondria, Fake News, and Escalation of Tension

Several researchers have focused on the "tension" element in the COVID-19 and fake news research domain. This theme broadly represents the multi-dimensional and complex global health and economic problem and how fake news can surge disharmony in society. Laato et al. [34] studied the causes of misinformation (unverified) information sharing and cyberchondria during the COVID-19 pandemic. It suggests how individuals' anxiety about their health is exacerbated by accessing, using, and sharing online medical information. They found that unverified information sharing is positively correlated with someone's trust in online content and perceived information overload. The study considers various interconnected constructs between cyberchondria, misinformation, and escalation of social tension (e.g., online information trust/overload, perceived severity/susceptibility, gender, age, etc.) Other studies [34] found that cyberchondria is influenced by severity/susceptibility factors, and unverified information sharing is correlated with trust in online content and perceived information overload. Hussain [35] discussed that social distancing and lockdowns, which governments have widely used, inherently increase the use of the internet and social media. This leads to people replying more to the news on social media, which is unfortunately heavily influenced by misinformation. They argued in their report that fake news leads to an escalation of tension between publishing and health

authorities, and it is essential that governments work with social media giants to stop the spread of misinformation.

Effron and Raj [36] discussed that repeated exposure to fake news could affect moral judgments. The study attempted to realize the potential moral condemnation due to liking and sharing fake news. Moreover, accuracy belief, rating headlines, and checking comprehension about the news (fake, true, some fake) are also correlated. This experiment displays that moral condemnation and accuracy measures were insignificant; this section has no illusionary-truth effect. Finally, more people posting fake news reduces or decreases moral condemnation and increases their inclination to share it on social media. The second experiment had 796 people (467 women, 326 men, and three non-binaries), 458 identified as or leaned toward being Democrat, and 223 identified as or leaned toward Republican. With continued growth in social media platforms during this pandemic, people eliminate moral condemnation if they find fake news shared at least once. A piece of information can make it less unethical to spread to consumers.

These studies have demonstrated how the number of fake news headlines and the dissemination of misinformation can affect the intention of retweeting them and create a societal imbalance. In addition to that, the metacognitive experience can affect moral judgments. The role of social media in this context is essential. For example, Facebook and other social media platforms have put measures to notify users about which news is real and which is fake; however, these attempts are ineffective since individuals feel it less moral to share the news that they have already encountered.

4.5. Conspiracy Theory Appeals

This sub-theme primarily comprises COVID-19 and fake news literature using multiple discussions based on assumptions or plots. Mainly the virus was engineered in a lab. The authors of [37] indicate conspiracy theories appeal due to the existential need to be safe during uncertain times. The research also explains how social media works like an “echo chamber” of conspiracy theories, mixing predisposition and stress, describing possible decision-making effects, including specific associations recalling ancient prophecies and previous events such as the Black Death. It includes earlier studies around the Spanish flu and Influenza to exemplify how people adopted medicine due to promising effects and efficacy to curb the new illness but with disappointing outcomes. Romer and Jamieson [38] investigated fears of vaccination associated with conspiracy beliefs, preventive behaviors, and willingness to receive vaccination against COVID-19 and evaluated previous vaccines’ misconceptions to children to know neurological consequences such as Autism. Different factors in adopting conspiracy beliefs mentioned in this research are socio-economic status, education, income, and racial and ethnic minorities who are more willing to accept conspiracy theories. Throughout surveys deployed in two waves in the U.S., people responded 59.6% (March) and 25.8% (July) that they were likely to be vaccinated in waves one and two. This cross-sectional study unpacks people who accepted scientifically proven narratives but not misinformed or conspiratorial narratives. The analysis was based on the structural equation program Mplus to model the predicted paths between conspiracy beliefs, preventive actions, and vaccination intention. This research strongly believed in conspiracy theories around COVID-19 respondents, mainly blaming the virus on the pharmaceutical industry and the Chinese government.

Di Domenico and Visentin [39] analyzed the impact caused by fake news in the marketing sector and how hoaxes and conspiracy theories can negatively affect consumers, companies, and democracy. In addition to that, how emotional appeal in fake news is consumed, identify the objective of the information, check out the relationship between source credibility and news credibility, and finally, how negative emotions can positively and negatively affect brand attitudes and reputation. For instance, 5G technology and COVID-19 presented in the United Kingdom caused vandalism in cell phone shops and attacks on telecom engineers affecting Huawei and Vodafone’s reputation. All in all, brands can be affected due to brand-dissociative behaviors identified in social media.

4.6. Theories and Constructs Used

According to Mueller and Skitka [27], people feel it morally permissible to spread misinformation, primarily when fake news supports the political agenda. In this context, fake articles are more likely to become viral. Furthermore, when people are exposed to a large amount of fake news, the judge sharing is less ethical independently of their beliefs or accuracy, most of the time believing in fake news they have seen before. Raj and Goswami [40] demonstrated that individuals consume and share the news that is “socially safe” to share in order to acquire social acceptability, which is essential for an individual’s self-esteem and identity. Using social identity theory [41] and the normative influence theory [42], they identified that quite frequently, individuals may share news without adequate fact-checking in order to demonstrate to society that “I am well-informed someone who knows everything”. van Mulukom et al. [16] proposed the inoculation theory, or psychological inoculation (or pre-bunking) hypothesis, as an effective means of giving large-scale psychological resistance to fake news. They did investigate how behavioral science insights may be used to manage an effective social reaction to stem the spread of fake news.

In van Der Linden et al.’s [43] work, by using the health belief model (HBM), it was indicated that males were more inclined to disseminate news without checking its veracity. In contrast, females were much more likely to suffer from cyberchondria. The findings imply that steps should be made to foster a healthy skepticism of medical news while also protecting against information overload. Islam et al. [44] conducted a fascinating study in Bangladesh to investigate the impact of personal attributes and motivational factors on sharing unverified news on social media during the COVID-19 pandemic. They collected data from 433 young adults and employed neural networks to analyze it. Based on in-depth analysis, they argued that there are two classes of people who are more likely to share unverified fake news: those who use social media for self-promotion and leisure and those who suffer from deficient self-regulation. The consequences of individuals being exposed to fake news can be political inefficacy, polarization of society, and alienation among individuals. The research proposes a new framework called SAFER (Socially Aware Fake nEws detection fRamework). It tries to provide new methods based on relational and hyperbolic GNNs to capture the distance between the node representations, comparing graph neural network models and graph encoders in two phases of training and testing. Moreover, it demonstrates the effectiveness of other methods when the framework is used on text-based representations and articles for fake news detection.

5. Discussions

Figure 5 extracts the most used words from the journal articles, reports, conference papers, reviews, and editorials that we reviewed during the evaluation process, propagation, and effects on fake news worldwide as a consequence of COVID-19 in social media. The analysis was conducted through Power BI (WordCloud 2.0), extracting the original documents’ main idea. It was focused on real, fake, statistics, and combined information, ranking keywords for each topic in engineering, social science, business, health, and politics. We obtained similar findings according to the research area studied. In the future, this visualization could allow researchers in exploratory textual analysis to identify frequencies, creating new relationships among variables. Finally, produce a more accurate repository of information recognizing capitalized and uncapitalized words from social media.

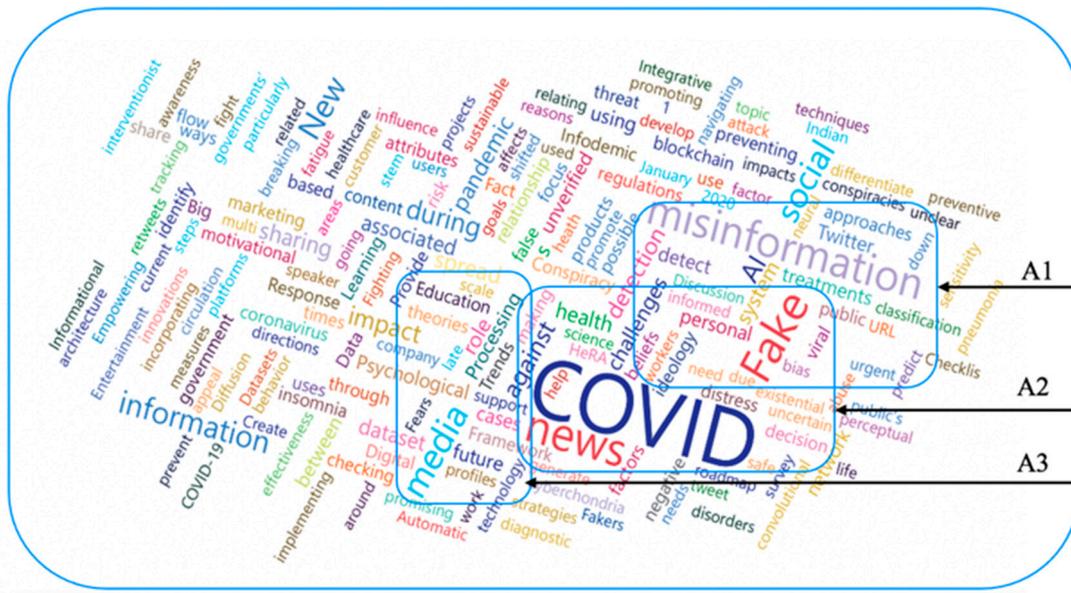


Figure 5. A word cloud of all papers we surveyed.

Undertaking a complete review of fake news allowed us to delineate a broader set of insights into information dissemination in online platforms (A1: misinformation, A2: COVID-19, and A3: media) that can inform industry managers and researchers. We discuss these insights: Macro: country level, Meso: organization level, and Micro: individual level (Figure 6). We have the means to counteract COVID-19-related fake news potency, but we must work sooner and faster or risk losing an ever-intensifying battle. Our understanding is that there is still much learning and coalition-building, development, and multi-domain communication between Macro, Meso, and Micro-level needs to be performed. Finally, we use these insights to offer managerial strategies and introduce novel theoretical propositions to guide future conceptual development and research.

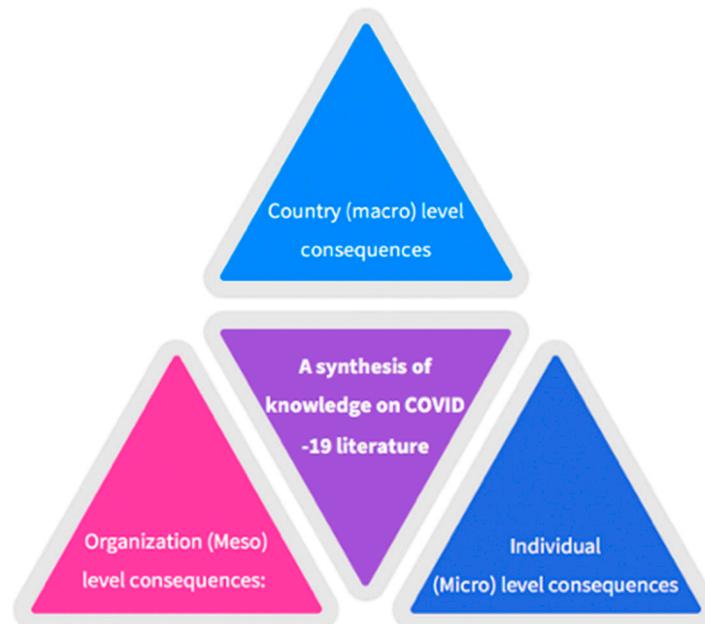


Figure 6. Macro (country level), meso (organization level), and micro (individual level).

5.1. Country (Macro) Level Recommendations

On a global scale, the COVID-19 crisis has exposed systemic weaknesses in governance and management. Science is showing an effort to combat the issue with research and innovation, i.e., CXR images to identify COVID-19 patients [45]. Pandemics involve policymakers accepting the input of scientists and ensuring that research is interpreted into community awareness, with relevant policy initiatives based on verifiable information. Misinformation and fake news, particularly content distributed through social media, compromise the effectiveness of evidence-based policy initiatives and damage the legitimacy of scientific experts with potentially longer-term implications. Research reveals that countries worldwide are facing two challenges in the current situation—the COVID-19 crisis and the deep economic crisis. This situation arises when the country is going through a critical chapter. Ortega and Orsini [46] indicated the COVID-19 crisis is also testing the effectiveness of government interventions, policies, and actions. Rini [47] unpacked that concentrating on individual epistemic virtue will not solve the problem of false news. Instead, we must regard false news as a macro crisis, and its resolution as a coordination challenge. This assertion refers to a size and issue—government measures—that are understudied in research on the failure to prevent the spread of fake news. Furthermore, Governments should act with the utmost haste to convey accurate information regarding COVID-19. Policymakers may launch a state-wide corona effort to combat the false news epidemic. What are the issues with COVID-19-related fake news? In 2018, the French Parliament enacted a new anti-fake news law. It has given French courts the authority to order the prompt removal of “false news” generated during election seasons [48]. The same legislation provides for the suspension of foreign television if it deliberately disseminates incorrect material intended to undermine the credibility of the elections. This suggests that governments have the authority to prosecute any new platform suspected of disseminating “fake news”.

Countries are combating COVID-19 without a coordinated reaction. Many nations are pursuing their strategy, despite the WHO’s solid recommendations. Countries that do not follow the WHO’s suggested social distancing standards endanger surrounding countries and jeopardize health security. Rumors and falsehoods have been widely disseminated across the community and the media. This study also reveals the cost of failing to detect and correct misinformed ideas initially. If there were misunderstandings that the vaccination may cause autism, it would not impact people’s willingness to take the COVID-19 vaccine. As a result, the public health community will need to boost its messaging in mainstream media, particularly conservative media sources. The government and policymakers should use cutting-edge scientific procedures to disprove conspiracy theories and vaccination concerns.

5.2. Organizations (Meso) Level Recommendations

The correct approach to detecting fake news is still challenging because of the dynamic nature of online social media complexity diversity of communication data. However, we can see the organizational level’s approach to overcoming this hurdle. Since COVID-19-related fake news detection has become a burning issue, giant online organizations are cultivating effective solutions to cut down this problem. With artificial intelligence, social media giant Facebook allows its online users to report and flag COVID-19-related news that is potentially anomalous and suspicious. Google has proposed an implemented “Google News Initiative” supported by AI to combat fake news (Google News Initiative). This will eventually help online news readers to spot any misleading news, reports, or information.

Research also identifies WHO is putting attention on social media that can hinder attempts to control the spread of COVID-19, for example, including fact-checking configuration, making it challenging to find fake news. Misconceptions about possible treatments against COVID-19 in Africa suggested, for instance, that the consumption of vitamin C and eating garlic could decrease counterpart contagiousness, increasing demand for products, similar to what happened in Europe. However, this report describes other factors that can produce severe caution about its uses, such as the mixture of sodium chloride with citric

acid, causing severe vomiting, life-threatening low blood pressure, and acute liver failure. Other similar statements were that COVID-19 was created as a biological weapon in China against the US. Possible actions proposed by the research are the demonetization of some sites to avoid misinformation, and implementing a partnership between health institutions and technological companies promoted by the government to build a centralized information system [49]. For instance, Facebook has implemented a system to guide consumers to local health authorities, and Google has redirected people to WHO's sites when the search contains the virus's keywords. Natural language processing or text mining, including charges such as public deceit, appears to be a complementary solution.

Fake news is a long-term issue that needs long-term, long-lasting solutions as well as short-term fixes. We have seen a lot of rapid technological improvements that improve social media platforms. Twitter, for example, has made changes to its algorithms or identified malicious content. Research shows that human-centered approaches teach people to think more critically about the media they expect to find online. Evidence-based educational programs, for example, have improved people's capacity to judge the credibility of information sources, separate facts from views, resist emotional manipulation, and be good digital citizens.

5.3. Individual (Micro) Level Recommendations

The abundance of material on social media, which is usually unchecked for authenticity and credibility, makes it extremely difficult to discern between facts and ideas, misinformation, or prejudices. There has been a significant increase in the number of infodemic on social media that look convincing at first but ultimately prove to be untrue or fake; nevertheless, by the time they are shown to be wrong, they harm many individuals. Fake news only achieves its ideological or financial aims if it is widely disseminated. The creator or distributor of fake news strives to investigate all elements that may encourage user consumption and spread. In order to recognize COVID-19-related fake news, information literacy and scientific literacy are required. The research examines how the potential harm of false news is amplified when new technologies are being utilized simultaneously. Deep fakes, immoral and unethical algorithms, and filter bubbles are just a few instances of how today's reality of IoT (Internet of Things) is being questioned, affecting elements of life beyond elections. Scientific literacy plays a role in establishing intellectual qualities, whereas information literacy is useful for stressing mindsets regarding information verification. Meanwhile, every citizen requires scientific literacy knowledge to think logically about science related to personal, social, economic, political, and other challenges experienced in people's lives [50]. We also acknowledge that scientific and digital literacy direct data and evidence in assessing the quality of information and arguments given by scientists or the media [51].

6. Proposed Framework

6.1. AI Technologies

Before we propose the list of recent, well-regarded AI techniques to curb and mitigate fake news-related challenges, it is essential to know that the AI methods that have become very popular in organizations can be divided into the following classes:

- **AI classification methods:** such methods predict categories in data.
- **AI regression methods:** such methods predict values in data.
- **AI clustering methods:** such methods find structures in data.
- **AI anomaly detection methods:** such methods find unusual data points.

Due to the nature of our proposed framework (see Figure 6), the focus of the AI techniques for data sets is in the area of data science. Other areas of AI, including image processing, natural language processing, logic, etc., can be considered pre-processing steps to break the news into sentences and verbs to find the logical relationships between them. Such methods are essential steps before using data science techniques to improve the accuracy of fake news detection systems.

The most popular, recent AI methods in each of these areas are summarized in Figure 7.



Figure 7. Most well-regarded AI methods for classification, regression, clustering, and anomaly detection.

In the following sub-sections, our recommendations as to where each of these classes of AI methods can be used are provided.

6.2. AI Classifiers

A classifier can be used to detect fake news with a certain level of accuracy. In the case of AI methods, the level of accuracy highly depends on how we train them. We usually have a training set with many fake and genuine news labeled correctly by humans. This dataset is fed into the classifier to learn the relation between the features and the authenticity of the news. After the training process is performed, then the AI classifier can be used for news that is not in the dataset.

The most recent AI methods classified here that can be used in the framework are as follows:

- Support vector machine [52].
- Artificial neural networks [53].
- Deep learning [54].
- Random forest [55].

6.3. AI Clustering

In classification, we know how many classes we have. For instance, if a piece of news is fake or not, so there are two classes here. In clustering, however, we know how the courses are in advance. In the context of fake news, clusters can be defined based on the reporter's demographics, sources, etc. An AI technique can find similarities in data to help identify

patterns that eventually lead to finding similar groups (clusters) in a given dataset [56]. The most recent AI methods in clustering here that can be used in the framework are as follows:

- K-means clustering [57].
- Mean-shift [58].
- Density-based spatial clustering of applications with noise [59].
- Expectation-maximization [60].
- Agglomerative hierarchical [61].

6.4. AI Prediction (Regression)

In this type of AI method, a learning method can learn to predict something that has not occurred. For instance, the AI method can be used to autocorrect a sentence. An example is auto-completed email sentences in Gmail. This can be used in fake news prediction too. To judge authenticity, a sentence can be predicted using an AI method and compared with the news.

- Linear regression [62].
- Logistic regression [63].
- Artificial neural networks regression [64].
- Deep learning [65].
- Bayesian linear regression [66].
- Decision forest regression [67].
- Ordinal regression [68].

6.5. AI Anomaly Detection

In this type of AI method, an abnormal behavior or pattern is identified in a dataset. A datum in a dataset is abnormal if it is significantly different from other data. For instance, your credit card can be suspended if it is used from a continent that you do not live on. A system alerts the bank of the first transaction of your card, in this case, since it is suspicious. In detecting fake news, the same concepts can be used. We can have a system to extract content from different resources automatically and detect news anomalies. In case of any contradiction or suspicious news, they are labeled as fake news.

- Bayesian support vector machine [69].
- One-class support vector machine [70].
- Principal component analysis [71].

7. Limitations and Future Research

We identified other potential ascribes of fake news dissemination, such as ignorance, obliviousness, peer pressure, and attention-seeking. However, in light of this study's results and the increasing health risk false information proliferation is causing during the COVID-19 pandemic, we feel there is a need for online media users to affirm the validity of the news they seem to be well as offered via web-based media. This can be accomplished by thinking about the authenticity of data, perusing past the features, checking the writers, in-depth investigation of a news article by checking the dates, looking at proof to affirm facts and figures, demonstrating fake pictures, looking through different sources, and asking experts when in doubt. The current study is inspired by the need for a comprehensive review and framework pertaining to the main factors of the online circulation of fake news linked to COVID-19. We draw on current work that has addressed the causes, the prevalence of the problem, and the steps taken against this malpractice by individuals and organizations. Although our work details the COVID-19-related fake news and spotlights categorizing these knowledge streams, it does not provide a comprehensive framework for influencing individual and group behavior change. Future work can concentrate on a more focused set of factors that unpacks this area.

Our study provides three broad research themes yielding an understanding of several theoretical aspects of COVID-19 and fake news. While existing literature offers further

insights into these topics, we believe the subject has not been thoroughly investigated, and there are several undiscovered study themes for future research. In this part of our paper, we propose possible future study questions: How is the impact of COVID-19 related to fake news on organizations, their brand equity, and their stakeholders in different locations? How can individuals adapt their attitudes and behaviors to the new online environment related to COVID-19 and fake news? How can organizations curb the acceleration and transformation of fake news and develop insightful initiatives using AI techniques? Although one of the goals of this exercise is to provide solutions to the problem, it is also essential to evaluate how our systematic literature review could be used by the stakeholders who identified and addressed this ongoing issue. This study identified some essential and valuable research on COVID-19 and fake news. We also provided a rich picture of some emerging trends in context, samples or participants, and methodological and theoretical approaches. We determined that the research publications on COVID-19 and fake news have drastically increased since January 2020. With this in mind, a significant integration of multidisciplinary theoretical perspectives could take place as scholarly interest in future research on this issue. We also found that some journals, such as *IEEE Access*, *Journal of Business Research*, *Journal of Communication*, *New Media and Society*, *Political Communication*, etc., are emerging as the primary source of interest for COVID-19 scholars.

Research on cooperation across disciplines can aid in understanding the best ways to work together in the face of difficulty while utilizing cutting-edge AI tools and mathematical modeling [72]. We can discover new approaches, such as artificial neural networks [73] and agent-based simulations [74] for problem-solving and task completion, by looking at how people from many fields can cooperate. The benefits of multi-disciplinary cooperation are especially evident in soft computing engineering. Soft computing engineering as a knowledge domain combines the insights of computer science with the knowledge of human cognitive processes. Additionally, research indicates that machine learning can be used to identify patterns of user behavior that may indicate the spreading of fake news. By identifying these patterns, machine learning can help social media platforms flag and remove fake news content. There is also an increasing need for machine learning and metaheuristic algorithms [75] to be used in soft computing engineering. This is due to the fact that these techniques can help solve complex problems more efficiently. However, it is essential to note that by combining the expertise of different disciplines [76], we can create algorithms that are more accurate and efficient than those developed by any one discipline alone.

8. Conclusions

COVID-19-related fake news transmitted on the Internet, particularly on social media platforms, is both a scientific conundrum and a practical difficulty. While research has been advancing significantly over the past couple of months, numerous questions remain unexplained, which we have indicated in this study. The research we have compiled in this study demonstrates that the widespread narrative that unpacks COVID-19-related fake or misleading news has been staggering. While research proposes various approaches for combatting fake news, our assertion is that artificial intelligence (AI) could be part of the solution. AI can help by identifying and flagging false or misleading content and helping to fact-check claims. This needs to be approached at the broadest level (Micro, Meso, and Macro stages). Our observation can be considered logical since the issue is gathering significant interest from researchers in various disciplinary fields.

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