Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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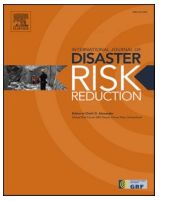

Infodemic and fake news – A comprehensive overview of its global magnitude during the COVID-19 pandemic in 2021: A scoping review

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ABSTRACT

The spread of fake news increased dramatically during the COVID-19 pandemic worldwide. This study aims to synthesize the extant literature to understand the magnitude of this phenomenon in the wake of the pandemic in 2021, focusing on the motives and sociodemographic profiles, Artificial Intelligence (AI)-based tools developed, and the top trending topics related to fake news. A scoping review was adopted targeting articles published in five academic databases (January 2021–November 2021), resulting in 97 papers. Most of the studies were empirical in nature (N = 69) targeting the general population (N = 26) and social media users (N = 13), followed by AI-based detection tools (N = 27). Top motives for fake news sharing include low awareness, knowledge, and health/media literacy, Entertainment/Pass Time/Socialization, Altruism, and low trust in government/news media, whilst the phenomenon was more prominent among those with low education, males and younger. Machine and deep learning emerged to be the widely explored techniques in detecting fake news, whereas top topics were related to vaccine, virus, cures/remedies, treatment, and prevention. Immediate intervention and prevention efforts are needed to curb this anti-social behavior considering the world is still struggling to contain the spread of the COVID-19 virus.

1. Introduction

The Coronavirus disease 2019 or later popularly known as COVID-19 was declared to be a global pandemic by the World Health Organization (WHO) in March 2020, in line with a growing number of COVID-19 positive cases worldwide [1]. Unfortunately, the pandemic also resulted in an excessive amount of information shared physically and digitally about the virus, disease, treatment, Standard Operating Procedures (SOP), lockdowns and vaccines, among others – a phenomenon known as infodemic. This information is typically unreliable, unverified, spreads rapidly, and thus making it difficult for the public to make informed decisions and solutions difficult to achieve [2]. Such unverified and inaccurate information is generally referred to as fake news, often encompassing misinformation (false information created without any harmful intention), disinformation (false information deliberately created to harm an entity), and malinformation (information based on reality, created to inflict harm on an entity) [3].

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Interestingly, the spread of fake news has spiked significantly during the COVID-19 pandemic [4,5], with a few examples including remedies involving the consumption of salty water, bleach or garlic, unverified news regarding lockdowns prompting panic buying and vaccine-related news causing fear among the citizens, and thus thwarting global solutions to treat the disease [1]. The spread became so worrisome that government agencies across the world introduced and applied several measures to mitigate the spread, such as urging the public to authenticate dubious news using fact-checking websites, promoting the deleterious effect of the behavior through online media, etc. [6,7].

The fake news phenomenon is not new, as the term was initially popularized during the US Presidential Campaign in 2016 [3]. A search of the pre-COVID-19 pandemic literature revealed a vast majority of related studies to be on automatically detecting fake news using Artificial Intelligence (AI) techniques [8–11]. Perspectives and empirical studies on the issue mostly discussed and explored the implications of fake news in business [12,13], elections [3,14], healthcare [15,16], and individuals cognitive ability [17,18], among others. A systematic review study targeting health-related fake news based on 57 studies (2012–2018) found the most extensively studied topics relate to vaccination, Ebola and Zika Virus, with the majority adopting theoretical frameworks from psychology and network science [19]. The authors recommended future studies to examine the susceptibility of different sociodemographic groups to fake news to better understand the phenomenon.

With the evidence of fake news spread in the current COVID-19 pandemic, the exact scale of the issue is still unknown but is nevertheless a cause of high concern. Therefore, it is not only pertinent to examine this phenomenon for a better insight, but timely as well. In view of this, this scoping review intends to examine and describe the extant literature on the magnitude of this phenomenon in 2021, specifically targeting the motives and sociodemographic profiles, automatic detection tools and strategies, and trending fake news topics. To the best of our knowledge, this is the first scoping review targeting fake news in the literature covering a span of almost a year (i.e., January 2021–November 2021). Existing reviews on fake news during the COVID-19 pandemic were mostly based on individuals' opinions [2], narratives and desk research method without employing a systematic guide [20–22], and surveys [23]. More recent reviews in 2022 include a review of 13 studies on COVID-19 (fake) news consumption and its effect on young people's mental health [24] and a general perspective based on literatures on COVID-19 vaccine hesitancy and communication methods applied in managing fake news dissemination [25].

2. Materials and method

The scoping review presented in this paper is part of a large study encompassing fake news related articles spanning from January 2020 to November 2021. Specifically, the large study involved scholarly articles searched using several keywords such as fake news, misinformation, risk communication and COVID-19 pandemic etc. Further details on this search strategy are provided in Section 2.2 below. A total of 840 articles were found, which were then screened accordingly, resulting in 325 articles. Details such as country of study, focus (e.g., motives, intervention, detection tools etc.), and methodology (e.g., surveys, machine learning, deep learning etc.) were extracted. Additional analyses were administered based on the methodologies, e.g., for machine learning studies details such as algorithms used, type of classification (i.e., binary versus multiclass) etc. were extracted as well. Of these 325 studies, relevant studies fitting the focus of this scoping review were then identified. The five-stage approach for scoping review as defined in the Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) Extension for Scoping Reviews [26,27] was adopted in this study. Each of the five stages is elaborated next:

2.1. Research questions

Four research questions (RQs) were formulated to support a knowledge synthesis of extant literature on fake news dissemination worldwide during the COVID-19 pandemic, as given below:

RQ1. – What is the magnitude of fake news proliferation related to the COVID-19 pandemic with regards to the number and type of studies, region, and cohort?

RQ2. – What are the main motives and sociodemographic profiles behind this phenomenon?

RQ3. – What are the AI strategies used to automatically detect fake news?

RQ4. – What are the trending topics related to fake news?

2.2. Search strategy

The main search strategy involved a literature search process targeting scholarly articles related to fake news and COVID-19 pandemic, spanning from January 2020 to November 2021. Articles were sought from five well-known academic databases, namely, PubMed, Web of Science (WoS), Google Scholar, Scopus, and Cochrane. Main keywords were manipulated using Boolean and wildcard operators to locate relevant papers. Specifically, these keywords are given below:

- *information (misinformation, disinformation, malinformation) and *Cov* (COVID19, COVID-19, SARS-COV-2)
- Fa* news (false news, fake news) and *Cov* (COVID19, COVID -19, SARS-COV)
- Risk * (risk communication, risk dialogues etc.) and *Cov* (COVID19, COVID-19, SARS-COV)

All the search queries above were also repeated by replacing *Cov* with pandemic.

2.3. Study selection

The main search strategy above resulted in a total of 840 scholarly articles, which were then filtered using inclusion and exclusion criteria. The inclusion criteria for this scoping review were: (i) articles published between January 2021 and November 2021, (ii) articles written in English, (iii) studies conducted using a valid research methodology/design in which proper methodologies were adopted in conducting the studies, regardless of the type (e.g., experiment, empirical etc.). For instance, a few studies were found to have reported results without a clear methodology (e.g., no details provided for the questionnaires used), hence these were excluded to ensure the quality of the articles included in this review. Conversely, the exclusion criteria were (i) review articles including personal opinions, narrations etc., (ii) other forms of publications such as book chapters, extended abstracts, and gray literature including pre-

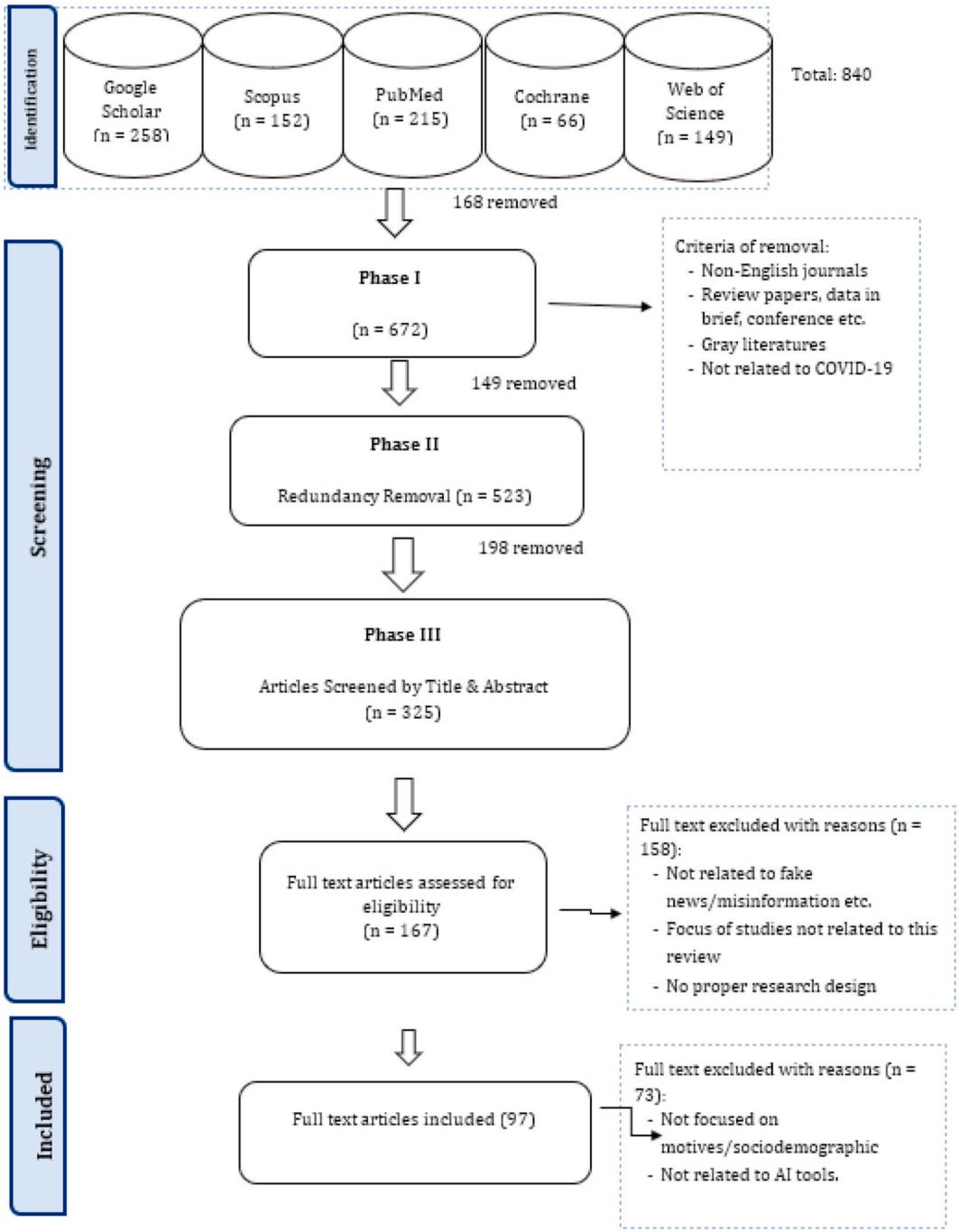

Fig. 1. PRISMA-ScR flowchart.

prints, (iii) studies specifically focusing on rumors, hoaxes, or conspiracy theories, etc. The exclusion criteria resulted in the removal of 168 articles (i.e., N = 672). This was further reduced to 523 upon redundancy checks. Three authors (VB, NWZ and TJL) then examined the titles and abstracts to ensure the appropriateness of the articles. The final number of articles deemed suitable for this review was set at 97, as shown in Fig. 1.

2.4. Charting the data

The fourth stage involved mapping the articles in terms of quantity, characteristics, and other attributes in accordance with the aim of this scoping review. This included data such as author, aim, focus of studies, cohort, and key results, among others. The task was accomplished by all the five authors. Upon the completion, a review session was conducted where three authors (VB, NWZ and TJL) collectively cross-checked the results to minimize errors. In cases involving ambiguity or disagreements, the first author made the final decision to include or exclude the said article.

2.5. Collating, summarizing, and reporting the results

In this final stage, the outcomes of the review are summarized and presented using tables and charts, as deemed fit. The outcomes of this stage are presented next.

3. Results and discussion

3.1. Magnitude of fake news in the wake of the pandemic

A descriptive analysis was performed to answer RQ1, which focuses on the magnitude of fake news proliferation related to the

Table 1
Descriptive statistics.

N	Characteristics	N (%)
Type of studies	Misinformation	45 (48.91)
N = 92	Disinformation	10 (10.87)
	Fake News	35 (38.04)
	Risk Communication	2 (2.17)
Sample Size	≤100	5 (11.63)
N = 43	101–1000	22 (51.16)
	1001–5000	14 (32.56)
	≥5000	2 (4.65)
Focus	Motives	56 (54.90)
N = 102	Sociodemographic	15 (14.71)
	Tool - Detection	27 (26.47)
	Tool - Intervention	1 (0.98)
	Dataset	3 (2.94)
Methodology	Experiment (Tools)	28 (28.87)
N = 97	Empirical (Survey)	43 (44.33)
	Empirical (Content analysis)	23 (23.71)
	Empirical - Interview	3 (3.09)
Continent	Europe	27 (23.68)
N = 114	North America	19 (16.67)
	South America	5 (4.39)
	Oceania	5 (4.39)
	Africa	18 (15.79)
	Asia	40 (35.09)
Cohort	Social Media Users	13 (29.55)
N = 44	General Population	26 (59.09)
	Healthcare Workers	2 (4.55)
	Students	2 (4.55)
	Experts	1 (2.26)
Topic	General	41 (61.19)
N = 67	Vaccine	10 (14.93)
	Remedies/Cure	6 (8.96)
	Virus	6 (8.96)
	Mask	4 (5.97)
Dataset Source	Social Media	29 (56.86)
N = 51	General Website	11 (21.57)
	Messaging Platform	3 (5.88)
	Blog	1 (1.96)
	News and Publication	7 (13.73)
Social Media & Messaging Platform	Twitter	20 (52.63)
N = 38	Facebook	4 (10.53)
	YouTube	4 (10.53)
	Others (Weibo, Reddit, TikTok, Pinterest, Instagram, Whatsapp, Telegram)	10 (26.32)

Note: CA- Content analysis; Numbers do not add up to 97 due to multiple/mixed use in some studies.

COVID-19 pandemic with regards to the number and type of studies, region, and cohort, etc. Table 1 shows the descriptive statistics of the studies reviewed. It can be observed that most of the fake news studies were based on an empirical approach, specifically surveys (N = 43; 44%); content analysis (N = 23, 23.71%) and interviews (N = 3, 3.09%), followed by AI-based tools (N = 28, 28%). Only three studies (3%) focused on developing COVID-19 fake news datasets [28–30]. Specifically [28,29], created datasets based on social media comments (i.e., Twitter and Sina Weibo, respectively), whereas Islam et al. [30] compiled comments from social media platforms, fact-checking websites, and Google for vaccine-related fake news.

Online surveys remained to be the most popular approach adopted for fake news studies in 2021; hence the results presented by the authors were based on the respondents' own perceptions. This is somewhat expected as the pandemic is still on-going, hence other approaches such as face-to-face interviews or focus groups were not feasible. Looking at the terms used, misinformation (N = 45, 48.91%) was widely used by researchers, followed by fake news (N = 35, 38.04%), and disinformation (N = 10, 10.87%). Most of the empirical studies were conducted in Asian countries (N = 40, 35%), followed almost equally in Europe (N = 27, 24%) and America (N = 24, 21%), with the majority focusing on fake news in general (N = 41, 61%). General population (N = 27, 59.09%) was the widely studied cohorts for the survey-based studies, followed by social media users (N = 13, 29.55%). Social media platforms emerged as the most popular source for studies (N = 29, 56.86%), with Twitter leading the list (N = 20, 52.63%). Similar patterns have been reflected in other reviews in which Twitter was specifically noted as the main platform for fake news dissemination [31].

Our analysis revealed an increase in empirical-based studies related to fake news during the COVID-19 pandemic, hence supporting existing literature and media reports highlighting a spike in this anti-social behavior worldwide. More than half the studies reviewed focused on social media platforms, however, those targeting mobile messaging applications (MMA) such as WhatsApp are lacking (N = 2; 5.26%). Future studies should explore other platforms, especially MMAs such as WhatsApp that is deemed as the most popular application used for daily communications in Southeast Asia [32–34]. For instance, Balakrishnan and peers found their respondents to cite MMAs as the topmost platform for fake news, as opposed to social media such as Facebook or Twitter [34].

3.2. Motives and sociodemographic profiles

This sub-section specifically presents the results for RQ2, focusing on the main motives and sociodemographic profiles behind fake news sharing behavior. A total of 43 studies were found to have focused on motives and sociodemographic profiles, with the majority using surveys (N = 40, 41.24%), with the remaining three using interviews [35,36,37], hence all the results reported were based on the respondents' own perceptions. For instance, most survey-based studies required their respondents to state or rate their fake news sharing behavior (e.g., "I have shared fake news before", "I have the tendency to forward news received", etc.) [34,38–40]. Tables 2 and 3 show the summary of the main motives and sociodemographic profiles related to fake news dissemination, respectively. It is to note that only significant results are reported in these tables. Further, only motives and sociodemographic profiles with at least three studies are included in the tables (i.e., the remaining variables reported as Others). The complete outcomes from the review can be found in Supplementary 1.

A low level of awareness, knowledge and media/health literacy emerged as the main motives for fake news dissemination (N = 7, 16.3%). A lack of awareness on the negative consequences of sharing fake news coupled with a lack of knowledge on the virus and disease can be detrimental when news is shared without prior authentication. This applies especially during the on-going pandemic whereby the Internet and social media are abuzz with false information, including eccentric ones suggesting people to consume more Vitamin C, bleach or take warm bath/shower to kill the virus. In fact, some individuals may also share such piece of news in the name of fun, as indicated by the emergence of Entertainment, Pass Time, and Socialization (N = 6, 14%).) as significant predictors for the dissemination of fake news. Although results are mixed, evidence show that people (especially the younger generations) share fake news (knowingly or unknowingly) as a form of entertainment and to pass their time [39,40,50,51]. This could be attributed to a low level of maturity among the respondents, or a low level of awareness of the deleterious consequences of the said behavior, as stated previously.

Altruism, which refers to the act of giving/doing something without expecting any rewards in return was identified as one of the main motives for fake news sharing [34,39,40,47]. This generally shows that individuals tend to share dubious news (without authenticating them) with no other expectation other than a benevolent intention to share the news (first) [42,56]. The COVID-19 pandemic is an unprecedented global crisis, and thus the virus, disease and its consequences are relatively new to everyone, hence a higher tendency to "help" each other out by rapidly and widely sharing news, albeit done with no regards to its veracity.

Other main motives include a low trust in government and news reported in their respective countries [43,45,48], and a high trust in social media news [43,48,65], the latter of which is deemed as a serious concern considering social media platforms are widely used

Table 2
Summary of extraction for motives.

Motives	Studies	Motives	Studies
Low level of awareness, knowledge, and media/health literacy/	[34,41–46];	Altruism	[34,39,40, 47]
Low trust in government/news	[43,45,48,49];	Status/self-promotion/ expression	[38,50,51];
Entertainment/Pass Time/Socialization	[34,38–40,50, 51];	Information seeking/sharing	[38–40,49]
Others: Low belief in science, eagerness to first share; ease of finding information; politics; commercial	[35,37,42,46,52–56,57,58];		

Table 3
Summary of extraction for sociodemographic profiles.

Sociodemographic	Studies	Sociodemographic	Studies
Age (Younger)	[59–64];	Education (Lower)	[4,43,52,65,59–62,64,66–68];
Gender (Male)	[4,65,59,61,63]	Lower Income or unemployed	[66,67,69];
Low fake news detection skill	[4,5,70]	High Internet or social media use	[41,65,71]
Others: low analytical skill/Socio-cognitive skill; age (higher); female			[5,54,58,60]

for this anti-social behavior [48,72,71]. Interestingly, we found one study on disinformation identifying the motives to be political and commercial benefits [35]. Unlike misinformation that has no malicious intent, disinformation refers to creating and spreading fake news deliberately to harm an entity, often for political or economic gain. Therefore, the identification of political and commercial benefits seems to tally with the definition for disinformation. The effect of disinformation could be deleterious for political parties (as witnessed during the US 2016 Presidential campaign) and businesses (e.g., bots used to spread negative reviews or spams on competitors, thus damaging business reputation), hence there is a need for effective and timely monitoring and detection systems to identify disinformation before it goes viral.

Looking at the sociodemographic profiles in Table 3, the top-most profiles for fake news sharing are lower levels of education (N = 12; 27.9%), followed by age (younger) (N = 6, 14%), and gender (male) (N = 5, 18.5%). A low level of education may indicate (although not necessarily) a low level of knowledge and awareness on the consequences of sharing dubious news without authentication as highlighted by others [4,43,52,66]. Interestingly, majority of the studies found the younger population to engage more in fake news sharing behavior [59,61]. This could be attributed to several factors - studies have mostly recruited younger population (students etc.), hence the cohort may be deemed to be immature, hence not only do they lack social responsibility, but it is also in their nature to act/react instantly, including sharing dubious news on social media compared to the older people [60,62].

Other main sociodemographic profiles include being unemployed/lower income (N = 3, 6.9%), low fake news detection skill (N = 3, 6.9%), and high Internet/social media use (N = 3, 6.9%). As a matter of fact, social media consumption has been reported to have increased during the COVID-19 pandemic as more people access the platform to seek information related to the virus and disease, hence it is somewhat expected for individuals who spend more time online to be more exposed to fake news, and thus have a higher tendency to share them [41,65,71]. As for individuals with low fake news detection skill, they were reportedly to be older in age (above 65) with an elementary occupation [5] whereas another study found participants who took a longer time to complete a study (i.e., reading eight short stories comprising both real and fake news) were able to detect fake news better [70]. The findings generally suggest that fake news detection skill is affected by other factors including demographic (e.g., age, education/income level) and behavior (e.g., reading time taken), among others.

3.3. Automatic detection and intervention tools

The results pertaining to RQ3 focusing on the AI strategies used to automatically detect fake news are presented in this sub-section. As for studies attempting to mitigate fake news using AI techniques (see Supplementary 2), the majority were found to have focused on detection mechanisms (N = 27, 27.8%), with only one targeting intervention [73]. Both machine learning (N = 15, 55.6%) and deep learning (N = 14, 51.8%) approaches emerged to be widely investigated, in line with the current trends in automatic detection studies. Looking at the machine learning studies, studies using the conventional supervised algorithms (i.e., those requiring labelled data points) such as Support Vector Machine (N = 6, 22.2%) Decision Tree (N = 7, 25.9%), and Random Forest (N = 7, 25.9%) were more popular, yielding accuracy ranging from 72.09% to 97.8% [74,75] and F-score between 81% and 95% [75,76]. A lower number of studies (N = 2, 7%) exploring unsupervised approach that performs clustering such as K-means and K-Nearest Neighbor (KNN) is probably due to the nature of the problem itself. As shown in our analysis (see Supplementary 3), fake news detection is deemed as a classification problem, often as a binary (N = 21; 77.8%) or multiclass (N = 6, 22.2%) classification, hence approaches without data labelling may not be very appropriate for fake news detection.

We found no studies merging both supervised and unsupervised techniques (i.e., semi-supervised), further supporting our notion that the issue requires dealing with labelled data for a better detection mechanism. However, deep learning algorithms can learn using very few or no labelled data, and thus, unlike the unsupervised approach, they emerge to be popular as well with algorithms such as

Table 4
Summary of top trending fake news topic (N = 23).

Topic	Studies	Topic	Studies
Prevention	[32,81–84]	Vaccine	[32,85–93]
Treatment	[32,81,83,84,90]	Virus	[84,86,89,94–96]
Medication	[35,84,97]	Politics	[32,33,86,90,98]
Government	[84,88,95,99,100]	Remedies/Cure	[35,82,86,89,95,100]
Science	[32,33,99]	Mask	[84,89,95,97]
Others: Technology; Pharma; Celebrity; Diagnosis; WHO, Unicef; Real-life stories; Warning; Public disorder; School reopening; Civil; Economic; Cases counts; Isolation; Pro-ecological; Fear-mongering; Animals; Food; Travel; Crime; Impact; Hospitals; Countries; Hygiene; Pandemic; Lockdown			[32,33,82,83,90,94,95,97,98,100]

Note: Only topics with a minimum of three mentions are highlighted.

Long Short-Term Memory (LSTM) (N = 8, 29.6%), Recurrent Neural Network (RNN) (N = 3, 11.1%) and Convolutional Neural Network (CNN) (N = 3, 11.1%) leading the pack. They were also found to yield good performance results with accuracy ranging from 46.36% to 99.68% [77,78] and F-score between 74.75% and 99.46% [79,80]. Finally, as anticipated, social media was found to be the most investigated platform with Twitter topping the list with 11 (40.7%) studies, followed by news articles (N = 2, 22.2%). This is in line with empirical studies that found fake news to be widely disseminated through social media platforms such as Twitter, Facebook and TikTok etc. [38,39,47,61]. The use of Twitter among AI-based studies can be attributed to the fact that automatically acquiring data from the public platform is easier compared to others such as Facebook (e.g., private profiles) or WhatsApp that are more stringent with their privacy rules and regulations.

3.4. Trending fake news topics

To answer RQ4 that is to identify the top trending topics related to fake news, we analyzed the data extracted through all the empirical studies that have adopted the content analysis approach (N = 23, 23.71%). Table 4 depicts the top topics related to fake news identified (the complete analysis is in Supplementary 3).

Our analysis revealed the top topics to include vaccine (N = 10; 43.5%), followed by virus (N = 6, 26%), and remedies/cures (N = 6, 26%), somewhat unsurprising considering the timeline of the studies reviewed (e.g., when vaccinations were rolled out) and the focus of the review, that is fake news dissemination during the COVID-19 pandemic. However, it is interesting to note that fake news related to remedies and cure remain to be popularly circulated in 2021, with most of them related to prevention [81–83], treatment [82,84,90] and medication [35,84]. False remedies could be fatal, especially those recommending the consumption of bleach or other form of disinfectants.

Other popular topics include those related to government (N = 5; 21.7%) and politics (N = 5; 21.7%), an interesting finding considering these were identified as motives in Section 3.2 as well. Our analysis show that most of the fake news related to these two topics are targeted at some of the strategies and measures imposed including lockdowns, school closure, public COVID-19 disinfectant spraying etc. [82,86,94,95,97,98].

4. Conclusion

The scoping review examined the magnitude of fake news dissemination during the COVID-19 pandemic in 2021 (N = 97), focusing on the motives and sociodemographic profiles, AI-based tools for detection and intervention, and top trending fake news topics. The salient findings are:

- In terms of the magnitude of fake news proliferation, results show an increase in fake news studies globally, in line with the spike in fake news dissemination witnessed during the COVID-19 pandemic. Most of the studies were empirical-based, and of these many administered online questionnaire surveys to solicit data. This is followed by experimental studies developing AI-based tools for automatic fake news detection.
- Top significant motives for fake news peddling reported by most of the studies include low level of awareness/knowledge/health literacy, altruism, low trust in government, status/self-promotion, entertainment, and information seeking.
- Unique sociodemographic profiles related to a higher fake news dissemination include being younger, males, high Internet/social media use, having low education, low income, and low fake news detection skill, hence showing a higher tendency among specific cohorts in engaging in this anti-social behavior.
- Majority of the AI-based studies focused on developing fake news detection models using machine and deep learning approaches, with very few or no studies using the unsupervised or hybrid approach.
- Finally, top fake news trending topics in 2021 were closely related to the pandemic such as vaccine, virus, remedies, and treatment.

5. Limitations and future works

This study has a few limitations – first, this study is based on a scoping review technique, which is more narrative in nature as it attempts to provide a general insight into the topic investigated. Therefore, other approaches including a systematic review and meta-analysis could be adopted by future studies to gain better or “richer” insights, especially on the focus points such as motives of spreading fake news.

Second, the scoping review focused on four main aspects, namely motives, sociodemographic profiles, AI-tools, and trending topics, with results focusing on significant findings/points reported by the relevant studies. Therefore, an in-depth analysis is required to further expand our analyses and findings for a better understanding of the phenomenon. For example, as most of the empirical studies found were based on questionnaire surveys, future studies could examine the instruments used, along with the scales and measurements as this would help in providing valuable insights into this anti-social behavior.

Finally, the review covered all the scholarly articles published in 2021 (Jan–Nov 2021), hence a temporal-based analysis was not possible. This could be addressed by future studies by including articles published in 2020 as well as 2022. This would be particularly useful in analyzing and comparing the top trending fake news topic based on the varying timelines (e.g., topics related to the virus and remedies may be highly trending in early 2020 whereas vaccine-related topics may be more popular in early 2021).

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to

influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijdrr.2022.103144.

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