SYSTEMATIC REVIEW

Analysing Public Health Impact of Misinformation During COVID-19 Pandemic using the Socio-Ecological Model: A Systematic Review

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ABSTRACT

Introduction: Social media and Internet use during disasters have been proven to be useful tools in helping public health agencies to respond to pandemics. However, this tool can also be the culprit in the spread of misinformation to the public. This study aims to identify the public health impact of misinformation during the COVID-19 pandemic using the socio-ecological model. **Methods:** A systematic review guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines was initially undertaken by searching relevant articles published from January to November 2020 in several electronic databases including Medline, PubMed, and Springer link. All publications produced in English regarding the impact of misinformation during the COVID-19 outbreak were included except review articles. **Results:** Eleven articles were identified from these databases. The public health impact of misinformation from these articles was analysed and discussed according to the domains of the socio-ecological model. It was found that various elements of misinformation on the COVID-19 pandemic caused a significant impact on the individual, interpersonal, organisational, community, and policy levels across various nations. **Conclusion:** This study concludes that addressing misinformation during a pandemic such as the COVID-19 phenomenon is an important measure to improve public health response in mitigating the spread of pandemics.
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Keywords: Conspiracy, COVID-19, Fake news, Misinformation, Socio-ecological model

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INTRODUCTION

The pandemic of the coronavirus illness in 2019 presented a new challenge for mankind at the beginning of 2020. COVID-19 was discovered in Wuhan City in December 2019, and the illness quickly spread throughout Hubei Province and other regions of China. After causing substantial morbidity and death in China, COVID-19 has spread to a number of other nations by February 2020 including the United States of America, Italy, Spain, Germany, France, and Iran (1–3). It has caused significant mortality and morbidity worldwide and has created panic about how many more lives may be lost worldwide without travel restrictions and other checks in place. The spread of the disease has already been difficult to contain, and the spread of conspiracy theories, fake news, and misinformation have worsened the current situation.

The phrase "fake news" is frequently connected with politics and the propagation of misinformation for political benefit, but it is also a concern in emergency and disaster management. During a crisis, the spread of misinformation or "fake news" can mislead and endanger public safety (4). Misinformation is false or inaccurate information that is communicated regardless of the intention to deceive (5). Other words that denote misinformation are 'hoax', 'lies', 'rumour', and 'gossip' that can mislead the real situation.

According to experts, responsible circulation of information is crucial to avoid misconceptions in the community understanding (6). Fake news has been

identified as a major threat globally and has influenced presidential elections (7), disease outbreaks (8), hate crime (9), and racism (10). In the time of social media and the Internet, the effect of fabricated lies propagated by mimicking news content to achieve nefarious ends has increased exponentially (11).

The advancement of information technology, particularly social media, provides a new channel for the transmission of critical information during catastrophes to those in need such as survivors, emergency responders, volunteers, and the general public (12). However, extensive use of social media during disasters raises the essential issue of the spread of misinformation. Prevention, preparedness, response, and recovery are the four crucial stages of a disaster, and proper communication during a crisis reduces the impact of the disaster (13). Misinformation not only causes a delay in reaction and effort for emergency management rescue, but it also has an impact on the general population (14). Four factors that can lead a person to spread misinformation include 1) the eagerness to share claimed relevant and up-to-date information since they believed it came from a credible source and it is essential to them or their followers. 2) a person wishes for others to be aware of information deemed 'vital.' Their view is based on their own assessment of how critical it is (15). An article also indicated that people's decisions to propagate rumours and unconfirmed information are influenced by their impression of accuracy (16). 3) A person's attention is piqued by knowledge, and they are eager to tell others about the uncommon circumstance that happens during a tragedy. 4) Intention to solicit feedback and inform others in order to elicit response and input from their target audience (15). This component shows prosocial behaviour in times of crisis, which leads to solidarity and altruistic deeds even among strangers (17). Sometimes people share unverified information with others with the intention of having it verified or denied as a rumour. Empowering individuals to detect fake news on the Internet, as well as preventing the spread of fake news using robust statistical methods and artificial intelligence are necessary to counteract the trend of spread of misinformation (18,19).

In the context of COVID-19, curbing the spread of misinformation may help prevent individuals and communities from engaging in non-recommended high-risk practices thus this will aid in the prevention of transmission (20). Misinformation could also lead to undermining the adoption of important preventive measures (21–23), which could exacerbate the spread of the pandemic.

The impact of misinformation on various levels of the system must be identified in order to plan effective communication and public health actions during a pandemic. This study aims to provide empirical evidence on the impact of misinformation during the COVID-19 pandemic using the social-ecological model. The model was used to understand the dynamic interrelations among various personal and environmental factors for misinformation during the COVID-19 pandemic. The socio-ecological model (SEM) has proposed five hierarchical levels namely individual, interpersonal, community, organisational, and policy (22) in which all of these levels are interrelated. The theory explains that an event that occurs at one level may affect another event and that a new event does not occur in a vacuum (24). However, with respect to changing circumstances, this system is dynamic and paradoxically retains integrity while adapting to the inevitable changes that occur around the issues.

METHODS

The empirical data for this investigation was gathered using a systematic review that was based on the Cochrane Collaboration technique (25) and followed the PRISMA standards (26). The PRISMA diagram is shown in Fig. 1.

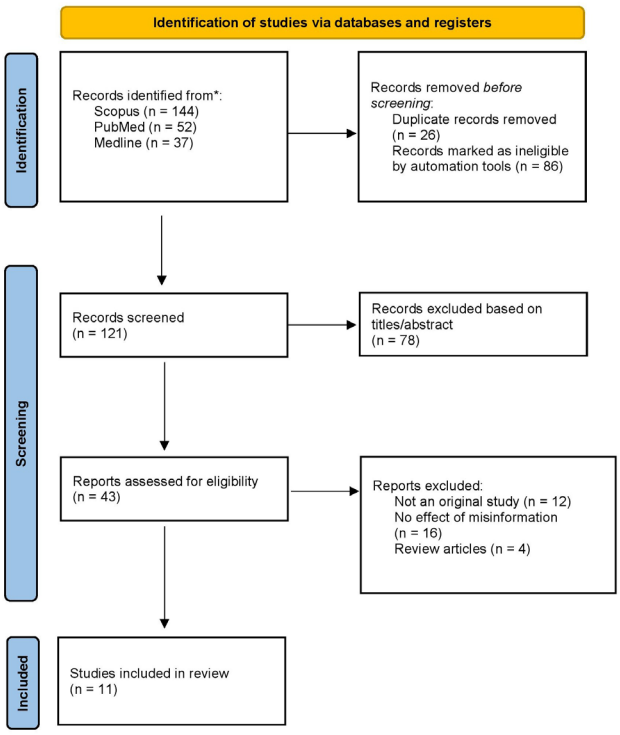

Figure 1: PRISMA flowchart for the selection of studies. Outcomes of the literature's systematic review by record identification, screening, and analysis in the PRISMA statement flow diagram

Inclusion and Exclusion Criteria

The inclusion criteria were 1) the articles are related to the public health impact of miscommunication during COVID-19, 2) the article is a peer-reviewed article, 3) it is published in English language, and 4) it is published from January 2020 to November 2020. However, the articles were excluded if the study was not an original article (a review or a commentary).

Data Source and Search Strategy

A systematic search was performed using three electronic databases namely PubMed, Medline, and Springer link. The search strategy was built using a combination of keywords of 1) COVID-19 OR coronavirus OR 2019-nCoV OR pandemic AND 2) Misinformation OR misleading OR fake OR rumours OR hoaxes OR gossip AND 3) impact OR effect OR consequence.

Study Selection

The titles and abstracts were evaluated separately by all authors. Articles that met the inclusion criteria were chosen, and complete articles were obtained for additional review. Any disagreements in the evaluation were handled by discussing among the authors, which resulted in a consensus, with a third party acting as an arbitrator if required.

Data extraction

A form for data collection and data extraction was designed, which includes information such as the study's title, study setting, sample size, study design, study objective, study duration, and the social-ecological model domains (individual, interpersonal, organisational, community, and public policy). The data were extracted separately by all authors, and any differences were addressed by discussion. The features of the included studies are summarised in Table I.

Decision Criteria

Articles were analysed for content on the public health impact of misinformation on the COVID-19 pandemic at the individual, interpersonal, organisational, community, and policy levels. Relevant information was extracted and categorised based on these domains. The individual

Table I: Characteristics and impact of misinformation during COVID-19 pandemic (According to SEM)

						Impact of Misinformation based on the social ecological model				
Study	**Setting**	**Sample size**	**Study Design**	**Study Objective**	**Study Duration**	**Individual**	**Interpersonal**	**Organisational**	**Community**	**Public Policy**
Kim et al. (2020) (27)	US, Singapore, and South Korea	2,942	Cross-sectional	To examine the implications of exposure to misinformation about COVID-19 in the United States, South Korea, and Singapore in the early stages of the global pandemic	Two months	Prevent individual from getting correct information			Prone to believe incorrect information as being true	Difficulty in implementing the policy
Barua et al. (2020) (28)	Bangladesh	483	Cross-sectional	To determine the individual responses toward COVID-19 as the effects of misinformation on social media in Bangladesh	-	Different interpretation of information	Poor interpersonal support		Influence community perceptions and acceptance	Inefficient implementation of standard operating procedure policy
Ahmad and Murad (2020) (29)	Iraq	516	Cross-sectional	To determine how social media affects self-reported mental health and the spread of panic about COVID-19 in the Kurdistan Region of Iraq	-	Negative influence on people's mental health and psychological well-being				
Moscadelli et al. (2020) (30)	Italy	2102	Cross-sectional	To measure how much fake news and corresponding verified news has circulated and to estimate the quality of informal and formal communication in Italy	Four months	Individual suspected with COVID-19 become more stressed and depressed		Damage diplomatic relations between countries	Fuels social conflict and friction in the population	
Jolley and Paterson (2020) (31)	United Kingdom	601	Cross-sectional	To investigate the association between beliefs in 5G COVID-19 conspiracy theories and the justification and willingness to use violence in the UK	-	Anger and violence	Harm towards telecommunication workers	Destruction of telecommunication infrastructure		
Ezeibe et al. (2020) (32)	Four states and the capital city of Nigeria	120	Cross-sectional	To explore the impact of political distrust on the spread of the COVID-19 pandemic in Nigeria	Six months	Disobeyed to SOP	Families opted for alternative medicine	-	Increase the spread of COVID-19 in the community	

(continue.....)

Table I: Characteristics and impact of misinformation during COVID-19 pandemic (According to SEM) (continued)

Study	Setting	Sample size	Study Design	Study Objective	Study Duration	Impact of Misinformation based on the social ecological model				
						Individual	Interpersonal	Organisational	Community	Public Policy
Jovančević and Milićević (2020) (33)	Serbian and Latin American	412	Cross-sectional	To examine the role of optimism-pessimism, general trust, and belief in conspiracy theories in COVID-19 related fears, preventive and hoarding behaviours in Serbia and Latin America	One week	Negatively linked to curfew observance				
Liu and Huang (2020) (34)	China	511	Cross-sectional	To investigate the impact of COVID-19 digital fake news exposure on individuals' perceived susceptibility of influence on themselves, their close others, and their distant others in China	One month	Associated with self- other perceptual discrepancy	Negative emotional outcomes		Undermines health and risk communication	
Bowles et al. (2020) (35)	Zimbabwe	864	Randomized controlled trials	To examine how information from trusted social media sources can shape knowledge and behaviour when misinformation and mistrust are widespread in Zimbabwe.	Two weeks period of intervention	Not obey the lockdown guidelines				Distrust of COVID-19 informations from government
Greene and Murphy (2020) (36)	Ireland	3746	Cross-sectional	To investigate the effect of exposure to fabricated news stories about COVID-19 on related behavioural intentions in Ireland	14 days	Individuals' health behaviours were altered			The vaccines being produced are viewed with skepticism by the public	
Islam et al. (2020) (37)	87 countries	2,311	Cross-sectional	To examine COVID-19–related rumours, stigma, and conspiracy theories circulating on online platforms, including fact-checking agency websites, Facebook, Twitter, and online newspapers, as well as their impacts on public health	Four months	Stigmatization towards COVID-19 patients and healthcare workers		Decrease trust in governments and international health agencies	Decrease efforts to combat COVID-19	

level explains how an individual behaves and increases the possibility of misinformation. The interpersonal level is how the spread of misinformation from individual to family, friends, intimate partners, leaders, and peers influenced their behaviour to receive misinformation. Organisational level refers to the level of reaching more people in different community sectors such as schools, neighbourhoods or workplaces that influence them to perceive information. On the other hand, community level refers to the culmination of various organisations in an area. These include local or national governmental levels, local and international health agencies or companies, and how these communities will be affected by the spread of miscommunication. The final level is public policy, which is the governing body in charge of preventing misinformation.

Study Risk of Bias

For the cross-sectional study, the study quality was assessed using the appraisal tool for cross-sectional studies (AXIS) tool (37). Twenty questions were asked and each item was classified as 'Yes', 'No' and 'Do Not Know/Comment'.

The quality of each included randomised controlled trial study was assessed using the COCHRANE guideline for systematic review assessment (25). The studies were evaluated based on eight criteria that include random sequence generation, allocation concealment, reporting bias, performance bias, detection bias, attrition bias, and other biases. The risk of bias was categorised as 'low risk', 'high risk' or 'unclear risk' for each item, with the final category suggesting either a lack of information or confusion about the potential for bias—the findings were given in a 'Risk of bias' sum.

RESULTS

Search results

A total of eleven articles that fulfilled the inclusion criteria were selected from our electronic database search. Nine articles were single-country studies while two articles

included multiple countries in their studies. Nearly half of the studies were conducted in developing countries (n=7) while the rest were in developed countries. The study duration of the included articles was in the range of two weeks to six months. Most of the articles were conducted in a cross-sectional study design (n=10) while one study was conducted in a randomised controlled trial design.

The results of the review are outlined in Table I. In this review, we found evidence regarding the impact of misinformation on each level based on the socio-ecological model that includes individual, interpersonal, organisational, community, and public policy. For the individual level, misinformation during the COVID-19 pandemic would influence compliance with new norms such as curfew, physical distancing, and wearing face masks that altered the health behaviours. However, it also negatively influences people's mental health including anger, anxiety, depression, and stigmatisation. Interpersonal impact due to misinformation during the COVID-19 pandemic also created poor interpersonal support such as from the family members, bad influence from misinformed religious faith leaders, and negative emotional outcomes.

Besides that, misinformation can impact various organisations including damaging diplomatic relations between countries and decreasing trust in governments and international health agencies. On the other hand, community impact due to misinformation involves low community perceptions and acceptance of the efforts to combat COVID-19 hence increasing the transmission of COVID-19 in the community and fueling social conflict and friction in the society. Lastly, misinformation was proven to create difficulty in implementing public policy and standard operating procedures (SOP) to fight COVID-19.

Risk of bias assessment

Randomised controlled trial study

We assessed the risk of probable bias in the included studies using the eight criteria listed in the Cochrane's technique for assessing bias risk. A randomised controlled trial design was employed in only one study (25). Random sequence generation was found to have a high risk of bias, whereas the allocation concealment of the included study was found to have a low risk of bias. The reporting bias domain has been reported to have a low risk of bias. Performance bias was assessed as a low risk of bias. Furthermore, detection bias was also reported to have a low risk of bias. The attrition bias domain was assessed as having an unclear risk of bias.

Cross-sectional studies

Twenty items were used to assess the risk of bias in cross-sectional studies. The AXIS tool was used to critically appraise the chosen articles. The results are summarised in Table II.

DISCUSSION

The discussion is based on the socio-ecological model. The idea of adapting this theory is that everything is connected and every occurrence can affect everything else. It is impossible to understand the whole without recognising how the domains interact, affect, and change each other. As the domains interact, they create the character and function of the whole. The social, institutional, and cultural settings of people-environment connections are explicitly addressed in social ecology. This viewpoint emphasises numerous aspects (such as physical environment, social and cultural environment, and personal characteristics), multiple levels (such as people, groups, and organisations), and the complexities of human situations (such as the cumulative impact of events over time).

Individual impact

Individual knowledge is addressed at the individual level. Knowledge of a disease allows a person to get a better understanding of susceptibility to the disease, the severity of the sickness, and the overall hazard. Most of the time, knowledge is insufficient to change attitudes, but it may assist a lot by influencing crucial attitudes and decisions that people make. The personal impact of misinformation is well established. This was mentioned in all of the reviewed articles.

Exposure to misinformation prevents individuals from obtaining real information regarding COVID-19 (18). Those participants who were exposed to general information about COVID-19 will be more motivated to attain more information. Information insufficiency is the reason why participants who received false information avoided themselves obtaining real information (27).

People are also unable to tell which information on social media is true and which is false, which adds to the confusion and spreads rumours about the true nature of the epidemic. Moreover, viewers' or readers' evaluation of the credibility of any information they receive will influence their responses to COVID-19 (28). Each individual is likely to interpret the information they received in different ways. The credibility of the information influences the interpretation of the information, either correctly or incorrectly. The worst-case scenario is when the information is incorrect and the individual is unconcerned about obtaining the truth from credible sources of information, which can lead to confusion and panic and jeopardise their mental health, and psychological well-being (29).

It has been revealed that there is the stigmatisation of individuals involved in managing patients as well as the patients themselves that came from Asia (28). Due to misinformation, numerous reports of physical

Table II: Cross-sectional Critical Appraisal and Risk Assessment using AXIS tool

Appraisal question	Author, year (Yes, No, Do Not Know/Comment)									
	Kim et al (2020)	Barua et al (2020)	Ahmad and Murad (2020)	Moscadelli et al (2020)	Islam et al (2020)	Jolley and Paterson (2020)	Jovančevič and Miličevič (2020)	Ezeibe et al (2020)	Liu and Huang (2020)	Green and Murphy (2020)
Were the aims/objectives of the study clear?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Was the study design appropriate for the stated aim(s)?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Was the sample size justified?	Yes	Yes	Yes	Do not know	Do not know	Yes	No	No	Yes	Yes
Was the target/reference population clearly defined? (Is it clear who the research was about?)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Was the sample frame taken from an appropriate population base so that it closely represented the target/reference population under investigation?	Yes	Yes	Yes	Yes	Yes	Do not know	Do not know	Yes	Yes	Yes
Was the selection process likely to select subjects/participants that were representative of the target/reference population under investigation?	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes
Were measures undertaken to address and categorise non-responders?	Do not know	Do not know	Yes	Yes	Yes	No	No	No	No	Yes
Were the risk factor and outcome variables measured appropriate to the aims of the study?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Were the risk factor and outcome variables measured correctly using instruments/measurements that had been trialled, piloted or published previously?	Yes	Yes	No	Only descriptive statistic involved	Only descriptive statistic involved	Yes	Yes	Yes	Yes	Yes
Is it clear what was used to determined statistical significance and/or precision estimates? (e.g. p values, CIs)	Yes	Yes	No	Only descriptive statistic involved	Only descriptive statistic involved	Yes	Yes	No	Yes	Yes
Were the methods (including statistical methods) sufficiently described to enable them to be repeated?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Were the basic data adequately described?	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes
Does the response rate raise concerns about non-response bias?	No	No	No	No	No	Do not know	Do not know	Do not know	No	No
If appropriate, was information about non-responders described?	No	No	No	No	No	No	No	No	No	Yes
Were the results internally consistent?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Do not know	Yes	Yes
Were the results for the analyses described in the methods, presented?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Were the authors' discussions and conclusions justified by the results?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Were the limitations of the study discussed?	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Were there any funding sources or conflicts of interest that may affect the authors' interpretation of the results?	No	No	No	No	No	No	Do not know	No	No	No
Was ethical approval or consent of participants attained?	Yes	Yes	Do not know	No	No	Yes	Do not know	Yes	Yes	Yes

harassment and violent attacks on healthcare staff, persons of Asian ancestry, those who were quarantined or people evacuated from Wuhan have been received (37). It may even cause loss of lives due to people not receiving proper treatment after receiving incorrect information about COVID-19 (38). Misinformation during the COVID-19 pandemic has evoked anger and violence (31). There is a group of people who believed in a conspiracy theory that claimed the COVID-19 virus spread through 5G mobile communication and suggested that radiation from 5G lowers the immune system thus making an individual more susceptible to the virus (39). This will eventually evoke anger in individuals with a strong conspiracy mentality. Individuals with anger and heightened paranoia would be involved in violence once they believe the wrong information.

In Nigeria, some assumed that COVID-19 is a big scam (30). The misinformation that had been spread led them to neglect the SOP that was outlined to control the pandemic. This further led to the spread of the virus. A study reported that patients that were put in isolation claimed that their human rights were violated since they believe that COVID-19 is a scam due to misinformation (32). The same study showed that messages spread via social media such as WhatsApp potentially lead to harmful behaviour that causes the individual to not abide by the lockdown guidelines (32). These groups of people tend to break the rules and guidelines that have been implemented during a lockdown and resisted practising new social norms.

Those who believe in conspiracy theories have a negative relationship with curfew observance. Pessimists, on the other hand, are more fearful (38). Worry was associated with all information sources, implying that more knowledge leads to more fear owing to the misinformation about COVID-19. The study also found that information sources are associated to fear in a positive way, implying that being more educated, regardless of the type of information, leads to increased levels of dread in an individual (40). Furthermore, the findings suggest that those who are optimistic, trust other people, and do not believe in conspiracy theories about COVID-19 participate in preventative behaviours (33).

It was shown that bogus news from social media is positively connected with a self-other perception gap. Fake news exposure through social media live streaming was connected with perceptions of misinformation consequences such as anxiety, fear, and worry regarding COVID-19 (31). This conclusion is also corroborated in another study that exposed social media has a substantial impact on disseminating fear and panic connected to the COVID-19 epidemic, possibly having a negative impact on people's mental health and psychological well-being (41). They discovered a statistically significant positive association between self-reported social media use and the spread of fear linked to COVID-19. However, individuals who engage in more active fact-checking are less susceptible to misinformation because they obtain information in a more critical manner (31). Meanwhile, they assist in the correction of misinformation among family and friends, therefore, minimising the consequences of misinformation on others.

Misinformation also changed individuals' behaviour toward their health, whereby the individual believed that certain foods might help protect against COVID-19 (33). The dissemination of misinformation through poor health owing to COVID-19 and poor digital literacy has been shown to make a person with suspected COVID-19 symptoms feel more anxious and depressed (27). On the other hand, individuals with higher degrees of health literacy will comprehend and accept their illness better (35). Better literacy aids in combating the pandemic's fear and stress.

The individual level shows a significant result in the impact of misinformation. Misinformation changed individual behaviour and perceptions, and creates fear in an individual. Misinformation prevented an individual from getting the truth about COVID-19. They believe that it is a scam. It also led to stigma toward patients, healthcare professionals, and Asian people.

Interpersonal Impact

The findings of this systematic review indicate that misinformation undermines interpersonal responses to the COVID-19 pandemic. COVID-19 poses a risk to physical health and a psychosocial and economic sphere, requiring the affected persons to have interpersonal support such as family, friends, neighbours, peers, colleagues at the workplace, and religious leaders. However, this support is violated or not present in the event of the spread of misinformation to the public (28,31,32,34).

Highly vulnerable populations such as children, pregnant women, the elderly, and those who suffer from chronic diseases require interpersonal support such as from their families to cope with the COVID-19 pandemic, especially in receiving prompt treatment. However, the spread of misinformation dampens interpersonal coping strategies. It was reported that misinformation from the government amid the COVID-19 pandemic led families to hinder their loved ones from receiving proper treatment and resorted to alternative medicine (32).

Interpersonal trust in religious faith leaders is high among religious groups, which can be productive or counterproductive in measures taken to reduce the spread of COVID-19 (28). They can negatively influence their followers' behaviours through religious misinformation. Therefore, it is important for public health practitioners to include religious faith leaders in their risk communication strategies and provide accurate information as they can also play a role in spreading

accurate information (28).

Belief in conspiracy theories such as the spread of the COVID-19 virus by 5G telecommunication towers also poses negative harm to the workers or engineers responsible for building those infrastructures. This was demonstrated in a study that reported violence toward workers and infrastructure that is mediated by anger (31). The participatory process with the conspiracy theories' believers through engagements such as online dialogue, debate or negotiation should be explored in future research to correct the misinformation thereby reducing violence (31).

In another study, it was demonstrated that misinformation is highly associated with negative emotional outcomes among the respondents' families and friends (34). Negative emotional outcomes such as anxiety, fear, and worry can be transmitted via interpersonal communication or false information. With these findings, practitioners must limit exposure to false information and educate the public via fact-checking or credibility (34).

In brief, the interpersonal impact of misinformation during the COVID-19 pandemic is significant and warrants a concerted effort among various stakeholders to address the misinformation issue. Such interpersonal impact, as described previously, includes preventing family members from receiving proper treatment, ignoring good self-hygiene behaviours through the influence of religious faith leaders, violence toward co-workers, and transmitting negative emotional outcomes via interpersonal communication.

Organisational impact

It is vital to manage information appropriately as it becomes the primary factor of an organisation's intelligence and advantage. Information management will help the organisation to its mission and strategy, affirming its operational area (42). In recent years, there has been considerable concern that misinformation on social media has harmed society and democratic systems. As a result, social media networks have announced measures to curb the dissemination of fake material (43). A BuzzSumo research in Italy collects data from social media sites such as Facebook, Pinterest, Reddit, and Twitter to create a list of links with the most online interaction such as 'likes', 'comments', and 'shares' on social media. The author discovered that links containing incorrect material were shared 2.3 million times, accounting for about 23.1 percent of the total shares of all the articles analysed in the study (28). Fake news harmed other countries and exacerbated complex diplomatic ties during COVID-19. The pandemic complicated the political connections between the United States and China, the world's two largest economies, to the point where some labelled it a new Cold War (28).

One study in this review investigated the influence of Covid-19-related rumours on worldwide internet platforms and found 2,311 reports of rumours, stigma, and conspiracy theories from 87 nations (37). Rumours, stigma, and conspiracy theories can erode public trust in governments and international health organisations (37). In Australia, for example, medical health personnel of Chinese origin endure stigma in the hospital (37). Furthermore, panic buying and price increases in goods such as face masks, hand sanitisers, and toilet paper may have helped to COVID-19 transmission in many nations throughout the world due to shortage of goods. As a result, misinformation stymied health officials' efforts to communicate with the public on epidemic management and control measures (37).

In reaction to a purported relationship between 5G mobile technology and COVID-19, research in the UK found that conspiracy theories were positively connected with state displeasure, which was associated with a more substantial justification of violence. Anger finally destroyed the United Kingdom's 5G telecommunications infrastructure (31).

Thus, it is clear that misinformation has negatively impacted various organisations including at the government or national level, local and international health agencies, telecommunication organisations, and companies. Advances in technology and social networking can substantially impact organisations in addressing the COVID-19 pandemic. However, this effort has been disrupted by misinformation and disinformation.

Community Impact

In the articles reviewed in this paper, seven articles mentioned community impact due to the dissemination of fake news or misinformation regarding COVID-19.
In line with the community's fixed false belief, conspiracy theory, which may influence community perceptions and acceptance of the COVID-19 pandemic worldwide was mentioned in one study (28). Conspiracy beliefs play a negative role in influencing the public's responses. In addition, the community views the vaccines being developed with a sense of mistrust (36). This misinformation might have terrible consequences, especially for health behaviours that are frequently shared in trusted networks. Furthermore, community cultural beliefs affect their behaviour for information seeking in which they were more prone to believe incorrect information as being true (27).

COVID-19 misinformation has the potential to erode the community's faith in government and international health agency efforts to address COVID-19 (37). Cooperation, coordination, and social order need trust, which lessens the need for coercive governmental imposition. During a pandemic, individuals must rely on professionals to

assist them to comprehend and respond to the crisis, as well as governments to coordinate policy instruments and make decisions concerning coercion and citizens' degrees of cooperation in order to reduce infection. The pandemic response revealed the absence of clear lines in responsibilities. Without public trust, such things fall apart. When the government fails, citizens do not know whom to hold accountable or whom to credit (37).

The influence of misinformation on COVID-19 was adequately illustrated in the examined publications on exploitation and social disputes. For example, the scapegoating phenomenon exploits existing social differences such as religion, race, ethnicity, class or gender identity and fosters social conflict and friction among the general population of the government (30). Similarly, fake news was connected with favourable judgements of the misinformation effect on distant people. The propagation of misleading information is ultimately a very disruptive and harmful phenomenon that may seriously impact health and risk communication, especially during emergencies or crises (34). The dissemination of misinformation regarding the pandemic may also increase the spread of COVID-19 more rapidly in densely populated areas (32). This misinformation impairs community compliance with government protocols, limiting the outcomes of government facilitation as well as COVID-19 responses. As a result, strengthening government accountability in public sector management is important for encouraging individuals to follow COVID-19 safety measures and preventing pandemics from spreading (30).

In summary, the dissemination of COVID-19 misinformation is faster than the spread of the virus itself and can have significant adverse effects on the health of the population. The community's fixed false belief or stigma, distrust of the authority efforts, and exploitation or social conflicts were identified as the impacts of misinformation on the community during the COVID-19 pandemic. The respective authorities of countries should initiate proper safety measures for this disastrous misinformation. Elevating public health authorities' voices as much as possible through effective communication is crucial as it may alleviate panic, keep the public safe, and protect the public health system from being exploited.

Policy Impact

The spread of misinformation may disrupt the policy to be implemented on COVID-19. As the lay public trusts the false information fed to them, they are less likely to follow the prevention SOP as well as treatment. In the articles reviewed in this paper, three articles mentioned the policy impact due to misinformation.

One of the studies mentioned how the conspiracy theory might affect the COVID-19 policy. Individual beliefs such as believing the virus is a biological weapon and that this is China propaganda may make it difficult for the government to persuade the public to follow SOP (28).

Misinformation causes several countries including the United States, South Korea, and Singapore to struggle with implementing the SOP because individuals are less likely to find the right information and, in some cases, reject government policy due to greater faith in false information acquired earlier (27). Furthermore, there is distrust of messages received from government sources compared to international organisations such as WHO and CDC, and this distrust may lead the government to threaten the possibility of implementing a lockdown in the country (35).

This review shows how misinformation can disrupt the strategy and plans constructed by the government. No matter how good the strategy is, if the laypeople do not trust the government, most policies will fail. It is of utmost importance for the government to find an effective way to reduce the public's misinformation before implementing any policy to combat COVID-19.

Strengths and Limitations

The strength of this review is that multiple reliable electronic databases sources were searched by using the combinations of specific terms in each database. Secondly, there is an equal number of developed and developing countries in our studies. Hence, the findings can be generalised to a different population. However, the outcome was also influenced by demographic considerations. It also implies various cultural and legal contexts and significant differences in how COVID-19 information is accepted. The selected papers in this review are restricted to only the English language. Therefore, it is possible that not all articles on the misinformation were included, which may have introduced bias, and there is little evidence from other regions.

Furthermore, the variety of outcome assessments using different statistical analyses may have generated inconsistencies and reduced comparability of outcomes. The majority of the research was cross-sectional. It contains flaws such as the inability to make causal inferences. The findings could be difficult to understand because they do not look at the temporal relationship between outcomes and COVID-19 misinformation.

Recommendations

Based on the reviewed articles, individuals were the most affected component according to the SEM. Strategies should be constructed to help individuals acquire the right information and change their perceptions.

An individual may seek an expert in the field to ensure that the information he or she gets is genuine. In the context of the pandemic, one way is to obtain information from the designated spokesperson of the

government. The other way is to obtain information from the sharing of experts available on mainstream or social media platforms.

Social media is a powerful and popular platform to obtain information. An individual should fully use the platform to obtain the correct information. It is of utmost importance to determine whether the information acquired is correct. Comparing the information with the other reliable sources online for fact-checking is the best way to determine genuine information.
There is a need to create legislation to prevent an individual from spreading false information to the public. However, the law should be carefully defined to ensure that it does not suppress the freedom of expression and silence critics systematically.

CONCLUSION

Despite limitations with data collection, this review analysed the impact of misinformation according to the SEM. The individual level is more impacted than any other level in this review as it is mentioned in all eleven reviewed articles. Four articles mentioned interpersonal impact, three articles mentioned organisational and public policy impact meanwhile seven articles mentioned community impact due to the dissemination of fake news or misinformation regarding COVID-19. According to each component, further research is needed to obtain evidence-based interventions to reduce misinformation on the pandemic. Political will and commitments from all possible stakeholders are needed to gather all resources and attention to address the issue of misinformation at the global level.

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