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Research Article

A Systematic Review of Infodemic Effects on Mental Health in the COVID-19 Crisis

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Abstract

Context: Infodemic in the COVID-19 pandemic is referred to as too much information about this disease that spreads quickly. This information can cause various psychological consequences for people. This systematic review studied the effect of the infodemic on individuals' mental health in the COVID-19 pandemic.

Methods: The principles of PRISMA were used to conduct this systematic review. Data were selected using a search strategy in the WOS, PubMed, and Scopus databases on December 31, 2021. The inclusion criteria comprised English-language original articles relevant to the study's purpose. We excluded all short articles, letters to the editor, conference abstracts, review articles, and any articles unavailable in their full texts.

Results: Finally, 17 articles were selected. The results showed that the population of these articles was from China, Singapore, Palestine, Romania, Indonesia, Paraguay, Hong Kong, and Iran. These articles also included health professionals and medical staff (two studies), adults (three studies), citizens and the general public aged 16 or over (eight studies), students (one study), teachers (one study), and the elderly (two studies). The sample sizes varied from 126 to 5,203. Also, these articles examined mental health concerning anxiety (13 studies), depression (eight studies), stress (four studies), sleep disorders (two studies), emotions (two studies), panic, social isolation, and mental health in general.

Conclusions: People more subjected to COVID-19-related information are more prone to psychological consequences and more exposed to anxiety, depression, and stress.

Keywords: COVID-19; Infodemic; Information; Media; Mental Health

1. Context

In today's age of information and related technologies, information eruptions from all over the world bombard the people of the world with information in various forms. Big and small, right and wrong, deceptive and attractive, persuasive and seductive information is available to people from all levels of society. Emerging phenomena and crises are increasingly overshadowed by the media, and relevant and irrelevant information, which is sometimes a concern for people to distinguish right from wrong. The prevalence of the COVID-19 pandemic has led to a rapid increase in information published from various sources, so this unprecedented increase in information has led to an information tsunami (1). This information flows even faster than a virus through social media and unfiltered private networks such as WhatsApp, Facebook, Twitter, YouTube, TikTok, etc. Such information regarding the disease is often obtained from initial observations. Therefore, it is a generally unreliable type of information (1). Also, the information published on social media significantly empowers people throughout the epidemic. It causes public feelings and reactions to fake news in this period so that people on social networks express their opinions and feelings about the epidemic and the news related to it (2).

This condition was described by the World Health Organization (WHO) as "infodemic," a type of information epidemic, as well as a serious problem (3). Infodemic is referred to as over-information that disseminates quickly, possibly intentionally or unintentionally misleading, which motivates ordinary people to take actions that may be harmful to their health (4, 5). This body of contradictory information about COVID-19 also causes widespread confusion and anxiety (6). Infodemic is not a new phenomenon during epidemics and crises.

Infodemiology emerged as a "study of determinants and

distribution of health information and inaccurate information" in the late 20th century and, after a short time, emerged as a field of study (7, 8). Infodemic is also information associated with epidemics; it spread with the spread of SARS and subsequently continued during H1N1, Ebola, and Zika epidemics (9, 10). The importance of this issue became clear when the Director-General of WHO popularized the term in the context of the COVID-19 epidemic and declared: "We are not only fighting an epidemic, we are also fighting an information disease" (11). At the same time, with the spread of COVID-19, information about the symptoms of this disease has been more searched (12). According to the literature, individuals have sought knowledge on government efforts against COVID-19, the number of people diagnosed in the country and worldwide, and the COVID-19 preventative and treatment procedures (13). Many people have used social media to be informed, exchange, send, and search for information, and it has been one of the most prominent tools for obtaining COVID-19 information (14). Some studies also show that throughout the COVID-19 epidemic, individuals are more likely to seek fresh information regarding COVID-19 and its prevalence, causes, transmission, symptoms, and physical health consequences (15, 16). Other studies have also shown that among the various strata of society, the most common goal of seeking information was to be aware of the symptoms and causes of the disease, prevention, and treatment (17-19).

For this reason, it can be said that people are also more exposed to incorrect information, confusing them. In general, misinformation and rumors on social media may spread rapidly and to an extensive range of individuals in various locations, directly impacting people's decisions, actions, and general behavior (20).

False information is also disseminated excitingly, affecting people's mental health (21). This information can change people's behaviors in society (22) and mislead public opinion (23). Since most social networks allow sharing of information to all their users and lack scientific supervision over the health information they publish, publishing false content throughout COVID-19 has been a major concern among users (24).

False medical information, unreliable content, and sometimes even misinformation as evidence-based information regarding the COVID-19 pandemic are disseminated on social media with alarming speed (1). In addition, the wrong home remedies and specific advice shared on social networks can increase the prevalence of coronavirus (25). The rapid spread of unreliable information on virtual social networks and the failure of users to detect true and false information has increased fears and concerns about the prevalence of COVID-19 in the community (26, 27). Accordingly, Wang et al. have proposed a chain mediator model (Figure 1) to explain the relationship between COVID-19 physical symptoms and adverse mental health consequences (e.g., anxiety, depression, and stress) (28).

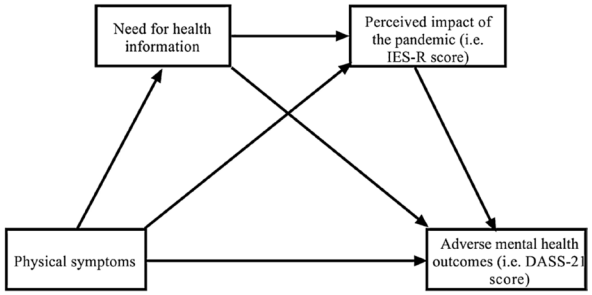

Figure 1. Proposed chain mediation model for the association between COVID-19 physical symptoms and mental health outcomes (28)

This systematic review investigated the impact of the infodemic on the mental health of individuals in the COVID-19 pandemic.

2. Materials and Methods

The present systematic review was conducted per the prescribed reporting guidelines, i.e., PRISMA (29).

2.1. Search Strategy

Web of Science, Scopus, and PubMed were searched. The search strategy addressed in Table 1 was implemented independently by two researchers, and if there was a discrepancy, it was referred to a third person. The searches were conducted from the beginning of COVID-19 to December 31, 2021.

Table 1. Search Strategies in Scientific Databases

Time	**Until December 31, 2021**
Language	English
Database	PubMed 'Scopus' Web of Science
Query #1	Infodemiology OR Infodemic OR Misinformation OR Infoveillance OR e-epidemiology
Query #2	Mental OR Psychological OR Depression OR Anxiety OR Emotional Responses OR Psychology
Query #3	(COVID 19) OR (SARS-CoV-2) OR (SARS CoV 2) OR (SARS-CoV-2) OR (2019 Novel Coronavirus) OR (2019-nCoV) OR (2019 nCoV) OR (2019-nCoV) OR (COVID-19 Virus) OR (COVID 19 Virus) OR (Coronavirus Disease 2019) OR (Coronavirus Disease-19) OR (Coronavirus Disease 19) OR (Severe Acute Respiratory Syndrome Coronavirus 2) OR (SARS Coronavirus 2) OR (COVID-19) OR (COVID19)
Final query	#1 AND #2 AND #3

2.2. Inclusion Criteria

The inclusion criteria included original articles published in English, using valid and reliable instruments relevant to the study objective, and a focus on COVID-19.

2.3. Exclusion Criteria

Non-English articles, review articles, short articles, letters to the editor, and case reports were excluded from the study. In addition, articles not addressing the influence of the infodemic on mental health in the COVID-19 pandemic were also excluded. The authors also excluded articles with unavailable full texts.

The first searches were undertaken by two authors, who separately screened the title, abstract, and full text of the publications retrieved. The papers that matched the inclusion criteria were then selected.

2.4. Quality Assessment and Extraction

After selecting the relevant studies based on the inclusion and exclusion criteria, data were collected using a form aligned with the study objectives. The articles' titles, abstracts, and full texts were independently reviewed by researchers using the STROBE checklist (30).

To be included in the study, the articles had to fulfill at least 20 out of 22 items on the checklist. Subsequently, the required data were extracted from eligible articles and recorded in an Excel spreadsheet. Any discrepancies were referred to another individual.

The data extraction table included authors/year, country, study type, population/sample size, type of mental health, and results.

3. Results and Discussion

A total of 958 articles were retrieved from three databases. Some were eliminated after assessing the article's duplication, types, titles, abstracts, and full texts (Figure 2).

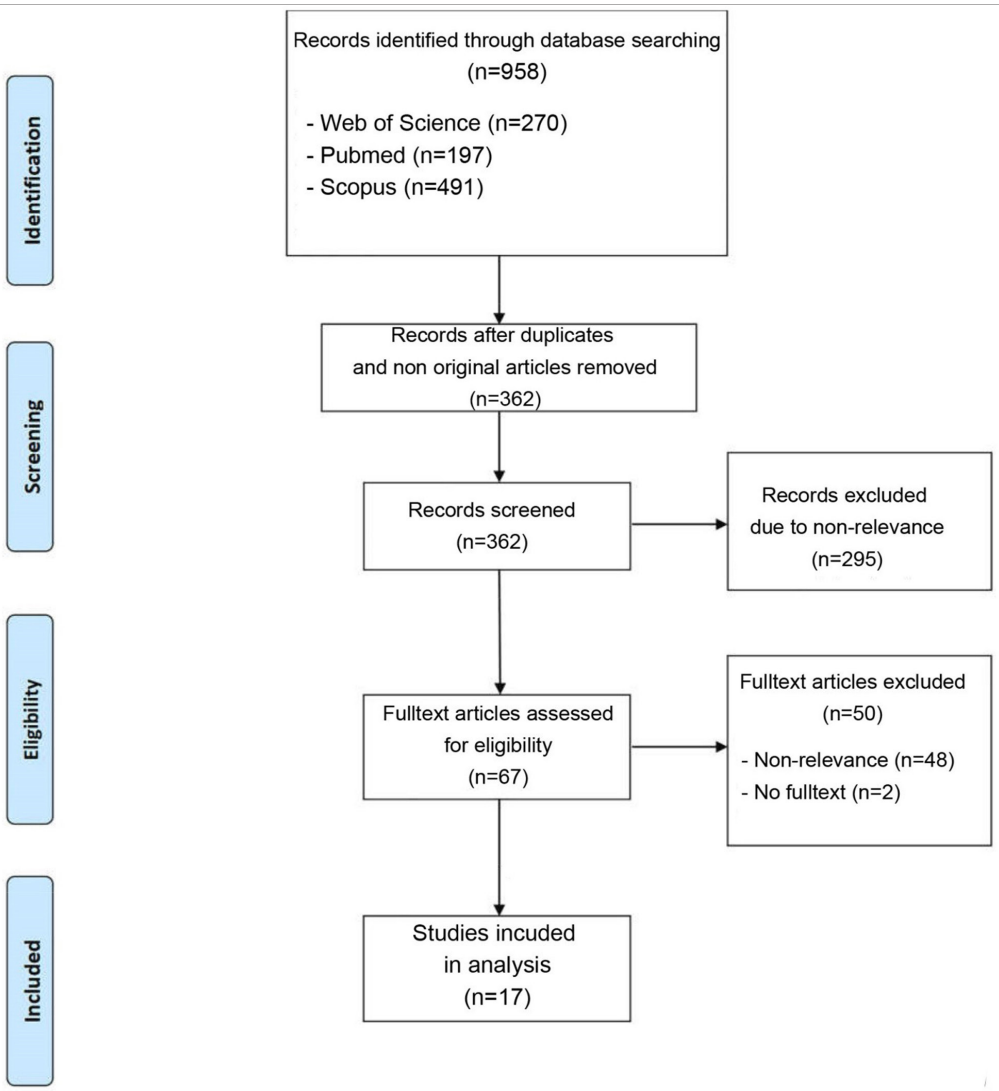

Figure 2. Study identification flow diagram

The characteristics and results of the selected articles are summarized in Table 2.

Table 2. The Results of Reviewing the Selected Studies

Authors/Year	Country	Study Type	Population/ Sample Size	Type of Mental Health	Results
Al-Amad and Hussein (31)	19 countries: The United Kingdom, United Arab Emirates, Syria, Qatar, Egypt, Italy, India, Germany, Canada, Bahrain, Poland, Palestine, Kuwait, Oman, Malaysia, Jordan, Saudi Arabia, Turkey, United States of America	Cross-sectional study	403 dental healthcare workers	Anxiety	Females and individuals who visited social media more often had greater anxiety levels ($P < 0.0005$ and $P = 0.016$). Professional category, years of experience, and age did not affect the relationships between moderate/severe anxiety and females (OR 2.01; 95% CI 1.15 - 3.49; $P = 0.014$) and associations between anxiety and frequency of social media usage (OR 1.75; 95% CI 1.05 - 2.93; $P = 0.032$).
Cheng et al. (6)	UK and US	Prospective study	1270 adults	Anxiety and sleep disturbance	Two groups, namely high distracters who look for COVID-19 material through online channels more often and high monitors (information seekers) who seek news via offline channels less often, are more vulnerable to emotional and sleep issues.
De Coninck et al. (32)	Switzerland, United States, New Zealand, Hong Kong, Philippines, England, Canada, Belgium	Cross-sectional study	806 adults	Anxiety and depression	Traditional media exposure was significantly and adversely related to both anxiety and depression, whereas digital media and personal interactions were favorably correlated with these factors. Being exposed to health professionals was likewise correlated with a lower level of anxiety, while interaction with politicians was negatively correlated to these emotions.
Gao et al. (33)	China	Cross-sectional study	Citizens (≥ 18 years old)	Depression and anxiety	In COVID-19, there was a significant frequency of mental health disorders, which was positively related to being frequently subjected to social media. Following controlling for all covariates, a higher frequency of being subjected to social media was shown to be insubstantial and positively correlated with the adjusted odds of depression. Frequent social media exposure might raise the adjusted odds of anxiety (OR = 1.72, 95% CI: 1.31 - 2.26) compared to less frequent social media exposure after controlling for all covariates.

Guo et al. (34)	Hong Kong	An online self-administrated survey	1501 people aged ≥ 18 years	Anxiety and depression	Frequent usage of social networks as a source of COVID-19 information was linked to less psychological distress symptoms due to a reduction in information overload to some extent. Frequent usage of websites (adjusted OR aOR = 1.59, 95% CI 1.24, 2.04) and online discussion forums (aOR = 1.52, 95% CI 1.16, 1.98) were shown to be associated with increased ORs of psychological distress symptoms. Increased ORs of psychological distress symptoms were related to increased information overload scores (aOR 1.56, 95% CI 1.43, 1.71).
Hammad and Alqarni (35)	Saudi Arabia	Cross-sectional study	450 people aged 16 - 60 years	Anxiety, depression, and social isolation	The correlation coefficients between social media exposure and social isolation, depression, and anxiety were 0.342, 0.355, and 0.368, respectively, and all correlation values were significant at P-value = 0.01. Furthermore, being subjected to social media has a percentage variance of 0.117, 0.126, and 0.135 with the dependent variables, namely social isolation, depression, and anxiety, respectively.
Hossain et al. (36)	Bangladesh	Cross-sectional study	937 people aged 16 years or older	Anxiety	Participants who spent more than 4 hours per day on social media reported 1.52 times (95% CI: 1.01 - 2.31, P = 0.049) more anxiety than those who spent less than two hours. Similarly, those who spent more time on social media had a higher adjusted odds ratio (AOR) of anxiety (AOR = 0.52, 95% CI: 0.28 - 0.99, P = 0.045) than people who continued to use social media as they had before the pandemic (AOR = 0.34, 95% CI: 0.18 - 0.67, P = 0.002) or individuals who diminished their usage of social media.
Jain (37)	US	Survey study	300 people aged between 20 and 73 years	Stress, happiness, satisfaction, gratitude and the moderating impact of interest in COVID-19 news	Interest in COVID-19 news moderated the effect of news exposure frequency on perceived stress (b = -0.03, P < 0.05) such that when the frequency of news access was low, even with high levels of interest in COVID-19-related news, respondents reported having low levels of stress. However, as the frequency of news exposure increased, even with low interest in COVID-19-related news, participants were more likely to experience stress. Frequency of news exposure significantly predicted trust in news, b = -0.10, SE = 0.04, t (291) = -2.79, P ≤ 0.01, and trust significantly predicted perceived stress, b = - 0.09, SE = 0.03, t (290) = -2.70, P < 0.01. The direct effect, b = 0.04, 95% CI (-0.00, 0.08), of frequency of news exposure on stress was not significant, but its indirect effect of through trust on stress was significant, b = 0.01, 95% CI (0.00, 0.02), suggesting partial mediation.

Khan (38)	Pakistan	Online survey study	160 teachers	Anxiety and social media fatigue	Misinformation on social media has a positive correlation with anxiety ($r = 0.57$, $P < 0.001$), and perceived COVID-19 risk has a positive correlation with social media fatigue ($r = 0.42$, $P < 0.001$).
Liu and Tong (39)	Singapore	Cross-sectional study	1145 adults	Depression, anxiety, and stress	Increased time spent receiving COVID-19 updates was associated with lower depression scores ($b = -0.07$, $t(863) = -2.04$, $P = 0.04$). Increased anxiety scores were also linked to updates and rumors ($b = -0.05$, $t(863) = -2.13$, $P = 0.03$). Moreover, the length of hours spent reading updates raised stress symptoms.
Radwan et al. (40)	Palestine	Online survey study	1067 school students (6 - 18 years old)	Panic	A statistically significant positive relationship exists between social media and spreading panic about COVID-19. Social media accounts for 79.3% of the factors influencing the spread of COVID-19 panic.
Secosan et al. (41)	Romania	Survey study	126 healthcare workers	Stress, depression, anxiety, and sleep disorders	Frontline medical personnel who were identified as being impacted by false news ($N1 = 43$) were considerably more anxious ($t = 3.04$, $P < 0.001$) compared to medical personnel who were not influenced by pandemic-related misinformation ($N2 = 83$). Healthcare personnel who are impacted by the infodemic ($N1 = 43$) experience higher levels of stress ($t = 1.91$, $P < 0.05$) than those who are not impacted by false news ($N2 = 83$). There is no difference in depression levels between frontline physicians who claim to be impacted by misleading information ($N1 = 43$) and those who declare not to be influenced by the infodemic during COVID-19 ($t = 1.54$, $P < 0.12$). Frontline personnel who are subjected to false information are more probable to have insomnia and sleep problems ($t = 1.89$, $P < 0.05$) compared to healthcare personnel not subjected to misinformation during the epidemic period ($N2 = 83$).
Syakurah et al. (42)	Indonesia	Cross-sectional study	1508 respondents	Depression, anxiety, stress, and emotional disorder	People updated with COVID-19 news significantly influenced their mental and emotional health (P-value < 0.05). One of the news sources, television, had a considerable impact on participants' sadness, anxiety, and emotional problems (P-value < 0.05). The use of social media to seek COVID-19 information has a significant impact on the participants' mental health. Twitter was shown to have a significant correlation to emotional disorder (P-value = 0.000) and depression (P-value < 0.05), whereas Instagram, Twitter, and Facebook had a significant link to stress and anxiety (P-value < 0.05). Moreover, friends and relatives significantly impacted individuals' stress levels (P-value = 0.45). Even though just a few people used the radio, there was a significant link between emotional distress and radio usage (P-value = 0.038). The participants' mental and emotional health is significantly related to their confidence in COVID-19 news.

Torales et al. (43)	Paraguay	Cross-sectional study	1102 people aged 18 to 84 years	Depression	When researchers looked at the relationship between COVID-19 news exposure (1 - 6 hours and 7 hours or more) and the involvement of depression, they discovered an OR of 1.933 (95% CI 1.48 - 2.52), meaning that 93.3% of ones more subjected to COVID-19 news might have symptoms related to depression.
Wong et al. (44)	Hong Kong	Cross-sectional study	3550 adults aged 60 years or older	Anxiety	More anxiety symptoms were predicted using social media as the primary source of COVID-19-related information (SEM coefficient = 0.036, P = 0.002). Nevertheless, anxiety was linked to decreased social confidence in information (SEM coefficient = -0.093, P < 0.001) and less community engagement (SEM coefficient = -0.043, P = 0.02).
Xu and Liu (45)	China	Cross-sectional study	5,203 members aged >18 < 50	Anxiety	According to a hierarchical regression study of probable pandemic and infodemic causes of psychological anxiety, commercial media exposure ($\beta = 0.147$, P < 0.001) and the infodemic factors of focusing on the COVID-19-related information ($\beta = 0.154$, P < 0.001) are positively related to the anxiety level.
Negarestani et al. (46)	Iran	Descriptive-analytical study	200 individuals (≥ 60 years old)	Mental health	Low frequency of media use (P < 0.001), employment (P = 0.003), and a higher level of education (P < 0.001) were the protective factors against the bad status of mental health. Throughout the COVID-19 epidemic, high-frequency media usage has been a risk to the mental health of older individuals (P = 0.001).

In Table 2, the "authors/year column" shows the names of the authors and the year of study publication, the country column shows the country of the study, the study type column shows the type and method of the study, the population/sample size column shows the community and sample size, and type of mental health and the results columns show the results of the study according to the purpose of the investigation.

The data in Table 2 show that the population of these studies was from China, Singapore, Palestine, Romania, Indonesia, Paraguay, Hong Kong, and Iran. These articles also included health professionals and medical staff (two studies), adults (three studies), citizens and the general public aged 16 or over (eight studies), students (one study), teachers (one study), and the elderly (two studies). The sample sizes varied from 126 to 5,203.

Also, Table 2 shows that these studies examined mental health concerning anxiety (13 studies), depression (eight studies), stress (four studies), sleep disorders (two studies), emotions (two studies), panic, social isolation, and mental health in general (one study each).

Table 1 shows that more usage of social networks and exposure to COVID-19-related news and information increases anxiety (6, 31, 33, 35, 36, 38, 39, 41, 42, 44, 45), depression (6, 32, 35, 39, 42, 43, 47), stress (37-39, 41, 42), psychological distress (34), social isolation (35), panic (40), sleep (41) and mental health (46).

The present systematic review study examined the infodemic's effect on individuals' mental health throughout the COVID-19 crisis. Accordingly, finally, 17 articles were selected to be reviewed.

The articles reviewed in the present study stated that cyberspace and social networks are major sources of information for community members and end-users. Other studies considered social networks and media as the main resource for receiving new information on COVID-19 (48, 49).

A recent study showed that most investigations had reviewed the effect of the infodemic of the COVID-19 crisis on anxiety and showed that anxiety was higher in people more exposed to news, information, and social networks throughout the COVID-19 pandemic. Some investigations in recent years have also shown the effect of using social networks on anxiety (50, 51). Other studies have also indicated that misleading information and inaccurate reports were disseminated through social media throughout the outbreak of COVID-19, which increased anxiety and worry among many users (52, 53). However, over-exposure to misinformation may cause anxiety symptoms (19), as it increases the fear of infection and transmission

among the public (54, 55).

In general, one of the major results of the contagion of COVID-19 is the development of anxiety related to the disease worldwide (56). Research in this area also considers other factors affecting anxiety in people during the COVID-19 era. The onset of illnesses, including respiratory diseases, resulting from major physical problems and patients' lowered quality of life will induce anxiety (57, 58). In the COVID-19 epidemic and home quarantine, people feel no control over their lives and insecurity, resulting in anxiety.

The most fundamental feature of crucial circumstances has been anxiety (59). By all means, the current circumstances, fear of death, financial and economic troubles, and similar concerns may be added to the list of causes for rising anxiety (60). Moreover, Fischhoff claims that most surveys focus on patients' anxiety, but the truth is that throughout an outbreak of a disease like COVID-19, fear of illness and death and disruption of routine activities produces anxiety in healthy individuals, as well (61). According to the present investigation, numerous variables contribute to community members' anxiety, but excessive and erroneous information and news worsen anxiety.

Also, the present study revealed that depression and stress are the other two most important psychological consequences of the infodemic of COVID-19, in line with several studies. The present study has also addressed other consequences, such as mental distress, social isolation, panic, insomnia, and general mental health problems that individuals may experience while facing news, information, and media.

People who are subjected to too much information are more prone to suffer from anxiety, depression, and unhappiness, according to previous studies (62, 63). Furthermore, using social networks as a primary source of COVID-19 information has been correlated with a high risk of social isolation, depression, and anxiety (49, 64). Shimizu also reported that in the COVID-19 epidemic, media outlets focused more on the news related to the disease, perceiving it as a dangerous threat that increased people's fear, stress, and panic (65). Also, infodemic (misinformation) may cause society more fear and severe psychological stress than the disease itself (66).

Wormwood et al. have also shown that when a person is repeatedly exposed to negative news, their brain area, which is responsible for emotional regulation, cannot control the constant influx of bad news, causing mental issues, including anxiety and depression (67). Also, previous studies show that infodemic and exposure to incorrect information and news can increase psychological consequences such as fear (68-71), psychological distress, and social isolation (72, 73). According to other investigations, the fear of spreading information regarding the COVID-19 outbreak on social media grows faster than the virus itself, and it has both long- and short-term effects (74, 75).

Gao et al. stated that a considerable incidence of mental issues in China was correlated to being repeatedly subjected to COVID-19 information (33), although the prevalence of the COVID-19 epidemic had caused psychological symptoms in individuals in China (76). Over time, however, the severity of psychological symptoms in individuals decreased (77).

The release of huge amounts of information about the disease has left the community with an information flood. These conditions can reduce mental health and impose a threat to society (78). The news related to the pathogenicity of the virus, the spread rate, and mortality data through various organizations and media can also affect people's mental health at various levels of society (79). Due to the frequent and extensive application of social media by all people, criminals also use these platforms to disseminate misinformation, false news, rumors, and pessimistic information about the epidemic, which destroys people's mental health (80). Home quarantine has also led more people to be exposed to misinformation through social media, which often exacerbates mental health problems (48).

According to the findings of the present investigation, repeated exposure to COVID-19-related information, including some information published on social networks and unreliable channels, is one of the main causes of psychological consequences in individuals. Furthermore, the information published on social media about the epidemic can cause fear, which also causes psychological consequences in people. These psychological factors can affect people's behaviors regarding the prevention, control, and treatment of the disease.

4. Conclusions

During the COVID-19 pandemic, the media and information have significantly contributed to shaping people's behavior in society. In a way, some people in society adjust their judgments, behaviors, and actions based on the content and information received from the media. Therefore, there is a close relationship between mental health and media. As can be inferred from the findings of this study, people who were most exposed to news, information, and media during the COVID-19 epidemic experienced various psychological consequences, including anxiety, depression, stress, and panic. Accordingly, it is recommended that individuals, while raising their health and media literacy, avoid as much as possible the continuous follow-up of COVID-19-related news, particularly from unreliable sources, and get their information from reliable sources and those introduced by related health organizations and community health centers. It is also suggested that the managers of organizations related to community health, news, and media vaccinate the community by holding training courses to raise the people's health and media literacy to analyze news and information broadcasting correctly.

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Conflict of Interests:
The authors declare no conflict of interest.

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