Doctor Facebook: Social Media and Health (Mis)Information

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1. Introduction

Health information is a relevant part of information-seeking behavior [1–4]. Among other subjects, health represents a major concern for citizens, but in most countries, healthcare access is not universal. Even a small piece of advice or a simple conversation with a healthcare professional is not easily achievable. In developed countries, there is also the phenomenon of looking for health information on social media despite having better health systems. Therefore, many rely on online information to satisfy their information needs and are exposed to a diversity of health-related information, often without sufficient quality or accuracy. This scenario worsened with the emergence and development of the coronavirus pandemic: "The digital divide has become much more obvious as a result of the COVID-19 pandemic in 2020. With doctors' surgeries closed or operating only through telephone communication, and hospitals rescheduling even serious conditions because of the need to deal with the pandemic, more people turn to online sources of health information" [5] (p. 35).

These online sources reveal the relationship between information behavior and social media and their strong connection [6]. However, social media exposure may have a significant relationship with information overload as well as information anxiety [7]. This might help to explain the return to traditional mass media during the COVID-19 crisis [8]; an example is television, which has mostly been used by public authorities and health experts to convey hours' worth of what could be considered health information.

In the social media ecosystem, Facebook (founded in 2004) is the leading platform. According to Statista, "With roughly 2.89 billion monthly active users as of the second quarter of 2021, Facebook is the

biggest social network worldwide" [9]. In the last ten years, Facebook has increased its monthly active users from 739 million (Q2 2011) to almost 3 billion. Recently, Facebook Transparency Center published a first quarterly report (Q2 2021) entitled Widely Viewed Content Report: What People See on Facebook [10]. This report "provides an overview of the content that reaches the most people on Facebook" [11] but only "captures views of public content in News Feed, including recommended content, seen in the United States" [10]. Not surprisingly, "most content views in News Feed during Q2 2021 came from posts shared by the friends, Groups and Pages people were connected to (for example, people they had chosen to add as a friend, Groups they had joined, Pages they followed and so on). Only about 9.5% of all News Feed content views in the US during Q2 2021 came from content that was not shared by Groups people joined, friends or Pages people follow" [10]. In this report, Facebook reveals a somehow closed setting for information consumption, as most of the content viewed did not include a link to a source outside the platform: "the majority of News Feed content views in the US were on posts without links and were from content viewers' friends or from Groups they were connected to" [10]. Despite these findings, news sharing is an important social media behavior, as receiving valuable comments on shared news content leads to a sense of influence, and seeking others' opinions increases involvement more than sharing one's own opinion [12].

During the COVID-19 pandemic, online health information behavior became a major issue for governments, public health authorities, and healthcare professionals. The Facebook news feed (personal profiles, pages followed, and group activities) rose as an information channel for many individuals who read and share health information, including fake news and materials from disinformation sources, for different purposes, disregarding basic assessment criteria or fact-checking strategies. Fake news, disinformation, misinformation, infodemics, and other concepts, have emerged or re-emerged as an alert for authorities and academics. A previous review found that "social media platforms, although providing immense opportunities for people to engage with each other in ways that are beneficial, also

allow misinformation to flourish" and that "there is broad consensus that misinformation is highly prevalent on social media and tends to be more popular than accurate information, while its narrative often induces fear, anxiety and mistrust in institutions" [13] (p. 8). The rising pandemic and global lockdowns, together with an increasing degree of online information consumption [14], brought together the ingredients for the degradation of the social media arena, as many users started producing and sharing low-quality content with obvious perils for public health, revealing the "co-existence and interaction of two domains: technology and health literacy" [15] (p. 525).

One of the strongest reactions against misinformation came from the World Health Organization (WHO) [16], which warned of an 'infodemic', mostly consisting of fake news [17]. An infodemic, "simply put, is an overabundance of information, good and bad. Together, it forms a virtual tsunami of data and advice that makes it hard for people in all walks of life to find clear messages, trustworthy sources and reliable guidance when they need them. Some of it is merely confusing, but some of the misinformation can be actively harmful to life" [18] (p. 1). In April 2020, the WHO held a global online consultation on managing the COVID-19 infodemic. Among several specialists, Facebook representatives stated that the company's goal was "to support global public health work and keep people safe through a twofold strategy of (1) connecting people to accurate information from credible sources; and (2) stopping the spread of misinformation and other harmful content" [18] (p. 10). The Facebook strategy consisted of two parts: first, Facebook developed a coronavirus information center connecting user experience with credible sources of information; second, false claims, like cures or conspiracy theories, started being removed. In February 2021, after abundant social debate and a lot of criticism, Facebook announced additional efforts to remove more false claims on Facebook and Instagram about COVID-19 [19]. The COVID-19 policy updates and protections statement announced that the company would "remove misinformation when public health authorities conclude that the information is false and likely to contribute to imminent violence or physical harm" [20].

Besides these efforts, the major problem of misinformation circulation is that despite being false information, it "was not created with the intention of hurting others. Misinformation is often started by someone who genuinely wants to understand a topic and cares about keeping other people safe and well. It is then shared by others who feel the same. Everyone believes they are sharing good information—but unfortunately, they are not. And depending on what is being shared, the misinformation can turn out to be quite harmful" [21]. Much more dangerous is disinformation, that is, "false information created with the intention of profiting from it or causing harm. That harm could be to a person, a group of people, an organization or even a country. Disinformation generally serves some agenda and can be dangerous. During this pandemic, we are seeing it used to try to erode our trust in each other and in our government and public institutions" [21].

The development of fact-checking strategies and tips for navigating the infodemic [21] is important but faces a major challenge, as "beliefs and values do occur in information behavior research, mainly in relation to health information" [5] (p. 36). The problem is not only about the truth but what we want (or do not want) to be the truth. Therefore, truth is no longer related to authority, expertise, or real facts but to interpretation, perception, emotions, and sentiments [22]. Post-truth [23] has emerged as a new information environment and behavior: "The overconsumption of information fueled by the internet has produced a so-called "post-truth" society in which people consume information that reaffirms their pre-existing beliefs and ideologies rather than attempting the difficult task of identifying the truth" [24] (p. 1).

The fake news phenomenon also represents a deeper crisis, as a crisis of truth is principally a crisis of trust [25,26]. Greater problems lie beneath the surface, like the politicization and weaponization of information, the traditional media crisis, and the technological incapacity to control the spread of misinformation [27]. One literature review provided the following typology of fake news: news satire, news parody, fabrication, manipulation, advertising, and propaganda [28]. Anstead refers to three forms of fake news—fake news as satire, fake

news as misleading content, and fake news as populist rhetoric—but observes them as distinct responses to an ongoing and evolving crisis of democratic and media legitimacy [8]. These traditional and authoritative elements were challenged by the consequences of pluralism, which were somehow exacerbated by social media and its different fora of (free) speech. This is a paradox, as fake news is part of democratic life but is profoundly anti-democratic. The future management of fake news on social media sites will probably combine two approaches, namely, high-profile takedowns and discrete changes, thereby adjusting how content is presented and consumed by users [8].

Adopting the user's perspective and shifting away "from the structured information system and toward the person as a finder, creator, and user of information" [29] (p. 6), information behavior studies are useful for assessing this new landscape. Information behavior is "a shortened form of the behavior of humans in relation to information. It denotes how we act towards information, how we seek it or discover it, how we use it, how we exchange it with others, how we may choose to ignore it, and, by extension, how we learn from it and act upon it" [5] (p. 14). It "encompasses information seeking as well as the totality of other unintentional or passive behaviors (such as glimpsing or encountering information), as well as purposive behaviors that do not involve seeking, such as actively avoiding information" [29] (p. 5).

Following previous research [13], this chapter intends to delineate the current knowledge about online health information behavior through social media, focusing on Facebook, COVID-19, and the misinformation phenomenon. Therefore, the main goals of this chapter are to understand online information behavior in the social media setting; assess the landscape of fake or misinformed health information transmitted through Facebook; and evaluate the relationship between Facebook and health information during the COVID-19 pandemic. To achieve these goals, the materials and methods used in this research are outlined in Section 2. Section 3 reports the main findings of the literature review, and Section 4 provides a discussion, followed by the conclusions of this research.

2. Materials and Methods

To analyze current research about online health information behavior exhibited on social media, a non-systematic literature review was performed. The first retrieval used a combination of search terms encompassing the primary concepts of health, Facebook, COVID-19, and fake news, disinformation, and misinformation. An attempt to include the concept of information-gathering behavior in a unique string yielded no results. Therefore, a screening process and analysis were afterward used to refine the dataset. Later, during full-text reading, the citations and references found pointed to other information sources, and the most relevant were included and reviewed.

2.1. Data Extraction

The literature was first retrieved on 6 September 2021, using the *Scopus* database, with regard to its importance, relevance, quality, and inclusiveness, for example, in comparison with *Web of Science* [30]. The scope of the literature review was not limited to one region. Also, there were no limitations concerning the languages of publication, though the search terms were only used in English. The search strategy intended to combine the different research topics. The following query was applied to titles, abstracts, and keywords: health AND Facebook AND (fake OR disinform* OR misinform*) AND (COVID-19 OR coronavirus). This query returned 51 results, which corresponded to papers published between January 2020 and September 2021. The results were refined to include only articles, reviews, and conference papers, as there were no book chapters within the results, thus yielding 48 results. These were exported to an MS Excel spreadsheet. The 48 results included 39 articles, 5 conference papers, and 4 reviews. Afterward, titles and abstracts were reviewed, and the following exclusion criteria were applied: exclude all material not specifically related to Facebook or online information behavior. One of the papers reviewed was withdrawn by the author and therefore also excluded.

2.2. Final Dataset

The core set was reduced to 36 works (Table 1), published between 2020 and 2021, corresponding to empirical studies from the USA, the UK, Australia, Japan, Nigeria, Denmark, Brazil, Philippines, Iraq, and Gaza, among other countries. A global perspective is reflected in this core set; however, during full-text reading, other references emerged, forming a final dataset of 51 works reviewed. Nevertheless, the overall sample is only a part of all the literature published about these subjects, and it was hardly conditioned by the keywords initially used to form the core set of publications.

Table 1. Core set of publications for analysis (n = 36).

Title	Publication	Reference
"Ask a doctor about coronavirus": How physicians on social media can provide valid health information during a pandemic	*Journal of Medical Internet Research*	[31]
A Survey of COVID-19 Information Dissemination Behavior of Library and Information Professionals in Nigeria	*Library Philosophy and Practice*	[32]
Adaptation to SARS-CoV-2 under stress: Role of distorted information	*European Journal of Clinical Investigation*	[33]
Addressing COVID-19 misinformation on social media preemptively and responsively	*Emerging Infectious Diseases*	[34]
Artificial intelligence-enabled analysis of public attitudes on facebook and twitter toward COVID-19 vaccines in the United Kingdom and the United States: Observational study	*Journal of Medical Internet Research*	[35]
Awareness on spread of misinformation and its effect on public with regard to COVID-19	*International Journal of Current Research and Review*	[36]

Table 1. *Cont.*

Title	Publication	Reference
COVID-19 misinformation: Accuracy of articles about coronavirus prevention mostly shared on social media	*Health Policy and Technology*	[37]
COVID-19 on Facebook Ads: Competing Agendas around a Public Health Crisis	*COMPASS 2020—Proceedings of the 2020 3rd ACM SIGCAS Conference on Computing and Sustainable Societies*	[38]
COVID-19 vaccine rumors and conspiracy theories: The need for cognitive inoculation against misinformation to improve vaccine adherence	*PLoS ONE*	[39]
COVID-19, a tale of two pandemics: Novel coronavirus and fake news messaging	*Health Promotion International*	[15]
COVID-19-Related infodemic and its impact on public health: A global social media analysis	*American Journal of Tropical Medicine and Hygiene*	[17]
Detecting fake news on Facebook: The role of emotional intelligence	*PLoS ONE*	[40]
Disinformation and COVID-19: Quantitative analysis through the hoaxes debunked in Latin America and Spain [Desinformación y COVID-19: Análisis cuantitativo a través de los bulos desmentidos en Latinoamérica y España]	*Estudios Sobre el Mensaje Periodistico*	[41]

Table 1. *Cont.*

Title	Publication	Reference
Exploring Sub-Saharan Africa's Communication of COVID-19-Related Health Information on Social Media	*Libri*	[42]
Fact or fake? An analysis of disinformation regarding the COVID-19 pandemic in Brazil [Fato ou Fake? Uma análise da desinformação frente à pandemia da COVID-19 no Brasil]	*Ciencia e Saude Coletiva*	[43]
Health information seeking behaviors on social media during the COVID-19 pandemic among american social networking site users: Survey study	*Journal of Medical Internet Research*	[44]
How do Canadian public health agencies respond to the COVID-19 emergency using social media: A protocol for a case study using content and sentiment analysis	*BMJ Open*	[45]
How social media comments inform the promotion of mask-wearing and other COVID-19 prevention strategies	*International Journal of Environmental Research and Public Health*	[46]
In the midst of the Coronavirus pandemic in Brazil, watch out for snowmen in the north and northeast regions! Post-truth under discussion [Na pandemia brasileira, tá tendo boneco de neve no norte e nordeste do país! Pós-verdade em debate]	*Praksis*	[47]
Infodemic, Misinformation and Disinformation in Pandemics: Scientific Landscape and the Road Ahead for Public Health Informatics Research	*Studies in health technology and informatics*	[48]

Table 1. *Cont.*

Title	Publication	Reference
Knowledge about COVID-19 in Brazil: Cross-sectional web-based study	*JMIR Public Health and Surveillance*	[49]
Learning about COVID-19: a qualitative interview study of Australians' use of information sources	*BMC Public Health*	[50]
Misinformation on social networks during the novel coronavirus pandemic: a quali-quantitative case study of Brazil	*BMC Public Health*	[51]
Paying SPECIAL consideration to the digital sharing of information during the COVID-19 pandemic and beyond	*BJGP Open*	[52]
Peer influence, risk propensity and fear of missing out in sharing misinformation on social media during the COVID-19 pandemic	*ICCE 2020—28th International Conference on Computers in Education, Proceedings*	[53]
Public engagement and dialogic accounting through social media during COVID-19 crisis: a missed opportunity?	*Accounting, Auditing and Accountability Journal*	[54]
Reasons for rejecting official recommendations and measures concerning protection against SARS-CoV-2—a qualitative study of social media posts [Gründe für die Ablehnung behördlicher Empfehlungen und Maßnahmen zum Schutz vor SARS-CoV-2—eine qualitative Studie auf Basis von Beiträgen in sozialen Medien]	*Bundesgesundheitsblatt—Gesundheitsforschung—Gesundheitsschutz*	[55]

Table 1. *Cont.*

Title	Publication	Reference
ReOpen demands as public health threat: a sociotechnical framework for understanding the stickiness of misinformation	*Computational and Mathematical Organization Theory*	[56]
Social media and the COVID-19 pandemic: Observations from Nigeria	*Cogent Arts and Humanities*	[57]
Social media and vaccine hesitancy: new updates for the era of COVID-19 and globalized infectious diseases	*Human Vaccines and Immunotherapeutics*	[58]
The bright and dark sides of social media usage during the COVID-19 pandemic: Survey evidence from Japan	*International Journal of Disaster Risk Reduction*	[59]
The impact of COVID-19-related changes in media consumption on public knowledge: results of a cross-sectional survey of Pennsylvania adults	*Current Medical Research and Opinion*	[60]
The impact of social media on panic during the COVID-19 pandemic in iraqi kurdistan: Online questionnaire study	*Journal of Medical Internet Research*	[61]
The information-seeking behavior and levels of knowledge, precaution, and fear of college students in Iloilo, Philippines amidst the COVID-19 pandemic	*International Journal of Disaster Risk Reduction*	[62]

Table 1. *Cont.*

Title	Publication	Reference
The role of social media in spreading panic among primary and secondary school students during the COVID-19 pandemic: An online questionnaire study from the Gaza Strip, Palestine	*Heliyon*	[63]
User motivation in fake news sharing during the COVID-19 pandemic: an application of the uses and gratification theory	*Online Information Review*	[64]

Source: Table by author.

3. Results

The core dataset revealed two main thematic research lines. On one side, there were studies concerning information behavior analysis, focusing on individual or group behavior; on the other side, there was research on online content analysis, focusing on web content, posts, commentaries, or other kinds of online publications. Some works could be related to both perspectives. This two-fold approach was also used as a framework for the inclusion of other literature beyond the core set of publications.

3.1. Information Behavior Analysis

3.1.1. Information Acquisition

Has online information acquisition increased since the beginning of the COVID-19 pandemic? The previous trend of the prevalence of social media sources seems to coexist with a trend of returning to more traditional sources, like television, during a health crisis [7]. In Australia, analysis of information acquisition behavior revealed "that participants were active users of information sources rather than passively accepting news accounts, government spokespeople or social media content as authoritative". Increasing levels of trust in official

information contrast with feelings of anger and frustration "about the extent of misinformation that was circulating in the community and online and the potential for it to contribute to the spread of the coronavirus and pose a risk to others" [50] (pp. 8–9). This suggests some sort of Facebook avoidance, as one participant reported that the "initial joking on Facebook was countered by the dramatic television news reports of the growing threat posed by COVID-19 to Australians", and another mentioned that "I must admit I've become quite careful about reading conspiracy-type theories on Facebook. Yeah, it's a platform for everyone to have their say, but I've discovered that in my own opinion, some theories are quite farfetched. People can be sincerely wrong" [50] (pp. 4–6). One of the mentioned conspiracy theories was a relationship between coronavirus and 5G [65].

With different results, a US study showed a heavy reliance on social media during COVID-19 with respect to information acquisition behavior together with fewer fact-checking actions. These findings "highlight the increasing importance of social media in health information seeking and thus highlight its potential value to health professionals as a conduit for personal and public health communications". The authors recommend ensuring "more active engagement between health professionals and patients and consumers" [44] (pp. 6–7). Another US study confirmed an increase in the consumption of news from the internet versus television, but "adults whose most trusted information source is government health websites are more likely to correctly answer questions about COVID-19 than those with another most trusted source. Individuals whose most trusted source is television news and those who use Facebook as an additional source of news are less likely to correctly answer COVID-19 questions" [60] (p. 4). Despite having a scope limited to literate people who use social networks, a study conducted in Brazil recruited participants on several social media platforms, including Facebook, and showed "satisfactory knowledge about COVID-19 when true information and fake news are mixed" and an ability "to differentiate the two types of information", suggesting that the impact of fake news on the knowledge of COVID-19 was limited [49] (p. 18).

In Japan, a social media user study demonstrated the bright and dark sides of information acquisition through digital platforms, including Facebook: "The bright side is that it encourages users to take protective measures officially endorsed by the government based on scientific evidence, such as social distancing and use of disinfectants"; simultaneously, "users take measures which are not grounded in scientific evidence, such as eating fermented soybeans" [59] (p. 5). In developed countries, the problem is not the lack of reliable information but the exposure "to rumors from unreliable sources that contain misinformation, presenting an obstacle to appropriate responses [to emergencies]" [59] (p. 5).

Social media use appears to relate to serious mental health issues. Facebook has been associated with fear levels regarding contracting COVID-19. In the Philippines, "fear levels were higher (severe or extreme) among college students who preferred Facebook as a source of COVID-19 information", thus revealing "the adverse effects of social media on the mental and psychological well-being of individuals facing threats caused by epidemics, such as worry, depression, anxiety, anger and fear" [62] (p. 11). Social media consumption seems to have a direct impact on mental health. In Iraq, Facebook was the most used social media network for spreading panic about the COVID-19 outbreak, causing high levels of psychological anxiety and uncertainty about the true/false information disseminated online [61]. In Gaza, similar results indicated that "social media has a significant effect on spreading panic about the COVID-19 pandemic among students, with a potential negative impact on their mental health and psychological well-being" [63] (p. 9). In India, similar mental health problems were reported [36].

Social media seems also to harm health knowledge acquisition, but are Facebook groups' activities mitigating the problem? In an attempt to counterbalance mental health impacts and the negative consequences of misinformation and foster feelings of calmness, trust, and safety, a Facebook group was created in March 2020 in Denmark to provide a direct relationship between more than 200 volunteer physicians and the public. Entitled "Ask a Doctor About Coronavirus", the group has

a rigorous moderation policy, managing inappropriate questions and the dissemination of fake or misinformed facts. This group, with 30.000 daily active users, "provides a proof of concept of a new way for health professionals to communicate and interact with the general public on social media platforms" and reveals "unique insights into the potential of Facebook in health communication; however, we cannot ignore the possibility of the distinctive information-seeking environment of the COVID-19 pandemic providing a favorable foundation for dissemination and upscaling of information" [31] (p. 4). Several studies analyzed Facebook groups' activities, and one identified four key information activities: posting, monitoring, commenting, and searching. As a small network within a larger one, "people report that they are more likely to find information that is more relevant to their specific information needs through these groups than through personal networks" [66] (p. 213).

Another strategy for fighting misinformation was the publication of infographics to debunk coronavirus myths. These shareable materials could provide a good prevention/reaction tool in the social media setting. A test of the efficacy of these infographics—namely, one produced by the WHO about hot baths that raise body temperature and prevent coronavirus infection—indicated that "preemptively sharing these graphics can be effective. Users and organizations can debunk misinformation circulating in society by sharing high-quality information on social media emphasizing the facts without waiting to see it shared directly in their feeds, which expands the opportunities for observational correction to occur" [34] (p. 402). The authors suggest the development of a WHO bot that can respond directly to pieces of misinformation, with a capacity beyond the previous experience of a Facebook Messenger chatbot, that is, a version of the "WHO Health Alert platform—offering instant and accurate information about COVID-19—via Facebook's global reach" [67].

3.1.2. Information Sharing

Sharing social media content is nowadays a behavior similar to content creation. The decision to share is often quick, and its motivation

is not easily acknowledged in information behavior research. The decision to share fake news or misinformed content represents another level of complexity, but a US study found that discernment and a simple accuracy judgment are key factors that can interrupt a sharing chain [68]. University students from the Philippines revealed that peer influence and fear of missing out have a positive influence on the behavioral intention to share misinformation on social media: on "Facebook, content posted by people within a student's social network can influence the decision process to re-share such information" [53] (p. 355). Sharing is not only an individual decision; it is also a social act. To prevent misinformation sharing, authors from the University of Oxford in the UK proposed "a framework to help us be strategic and choose wisely, by paying SPECIAL consideration to the information we share" [52]. This framework recommends attention to source, privacy, evaluation, contribution, intention, audience, and legacy aspects to improve the quality of information shared by researchers and health professionals, but it could also be adopted by a more general audience.

In Nigeria, Facebook and WhatsApp users' motivation for sharing fake news was also analyzed. The social dimension of sharing information in order to help others was again highlighted, as "altruism and instant news sharing had more effect on fake news sharing behaviour compared to socialisation and self-promotion" and "entertainment had no association with fake news sharing on COVID-19" [64] (p. 13). Instant news-sharing behavior is a consequence of the rapid publication that is enabled by digital technologies, causing inadvertent fake news dissemination. Also in Nigeria, research on library and information professionals indicated that this group "disseminated COVID-19 information, fact-checked, corrected misinformation and provided update information majorly through Facebook and WhatsApp channels" [32] (p. 24), reinforcing the informational role of librarians in times of emergency [69]. Another study involving Nigerian undergraduate students identified a positive effect of information literacy competence on curtailing the spread of fake news about the COVID-19 pandemic [70].

Regarding the psychological dimension of misinformation-reacting behavior, a UK-based study explored the association between fake news detection on Facebook, emotional intelligence, and educational attainment, concluding "that individuals who are high in emotional intelligence and who are in receipt of a university education are less likely to fall for fake news than low EQ/School-College educated individuals". These findings suggest that if a user's level of emotional intelligence was rated simply by looking at their Facebook data, "then Facebook could alert low EQ scores that they should be more vigilant about misinformation and fake news that might appear on their platform" [40] (p. 10). In Finland, researchers proposed a model for understanding the effect of information seeking, information sources, and information overload on information anxiety, resulting in information avoidance. Their findings suggest that "individuals who have more exposure to social media sources were more likely to feel information overload and information anxiety during health crisis", and "an individual's level of information anxiety has a significant positive impact on the level of information avoidance" [7] (p. 12). The development of health literacy or eHealth literacy skills, together with information literacy skills, is proposed as one of the possible solutions [71].

3.2. Online Content Analysis

3.2.1. Infodemic

The infodemic situation is probably one of the most interesting phenomena of the COVID-19 period. In Russia, a study combined online content analysis and a survey of healthcare professionals to draw attention to an informational problem surrounding COVID-19 crisis management. The stress, fear, and anxiety experienced by medical personnel were related to a social background of nervousness, mostly derived from the infodemic phenomenon. A content analysis of the personal accounts of a Russian-speaking audience provided on social networks "exhibited high degrees of anxiety and even panic brought about by distorted, exaggerated or false information on COVID-19

disease and its causative agent" [33] (p. 3). The author concluded that the "exaggerated and distorted information on COVID-19 has big negative influence upon Russian society and healthcare system" [33] (p. 5), thus undermining medical workers' performance.

One of the dangerous components of an infodemic is misinformation. In an extensive analysis, an international team identified 2.311 reports of rumors, conspiracy theories, and stigma related to the COVID-19 infodemic in 25 languages from 87 countries. A large majority of the reports were false, which means that these global waves of misinformation had serious consequences for public health. Rumors were the largest category detected, and some examples are provided in the following: "eating garlic, keeping the throat moist, the need to avoid spicy food, and the importance of taking vitamins C and D to help prevent the disease" and "so-called treatments such as miracle mineral solutions that involved mixing sodium chlorite solution with citric acid or drinking bleach or alcohol for immunity and cures" [17] (p. 1622). People died or became sick following the dissemination of these pieces of misinformation; consequently, the pervasive nature of social media consumption has become a significant public health issue. In addition, protective measures to prevent the COVID-19 pandemic were also undermined by misinformation, fueling rejective attitudes through the dissemination of doubts and mistrust in public authorities or science expertise. Following the economic consequences of these protective measures, e.g., lockdowns and social distancing, a German study found that social media misinformation may contribute to underestimating the pandemic [55]. A Nigerian study found a relevant role of religious practices that "significantly influence the spread of false preventive measures of the coronavirus disease" [57] (p. 7). This influence, together with the increasing use of social media, worried public authorities and led to a strong strategy for information dissemination, including daily updates through SMS.

Regarding rumors and conspiracy theories about COVID-19 vaccines, for almost the entirety of 2020, Facebook-only content represented about half of the 637 pieces of misinformation identified in 24 languages from 52 countries, which reveals the social relevance

of the platform and the amount of misinformation in circulation [39]. Misinformation content categories, as a product of human actions, adapt to the course of events: "During the initial months of COVID-19, most of the COVID-19 vaccine claims were related to pre-pandemic vaccine and conspiracy theories. More recent claims were related to efficacy and effectiveness of the vaccine, morbidity, and mortality due to participation in the vaccine trial" [39] (p. 5). An early-pandemic literature review identified social media as a terrain for anti-vaccination messaging possibly leading to COVID-19 vaccine hesitancy, comparing previous anti-vaxxer movements and this ideology's online dissemination [58]. However, a study developed using an artificial-intelligence-based approach to analyze public sentiments on social media in the UK and the US toward COVID-19 vaccines showed mostly positive attitudes [35].

As Facebook remains the leading platform for sharing content, information accuracy is naturally a relevant issue. The 30 most frequently shared articles in April 2020 about COVID-19 prevention were analyzed, and Facebook accounted for the most shares [37]. Most of the articles were considered accurate yet less likely to be shared, which may strengthen the argument that false information is spreading online more easily than truth [72]. Facebook ads are also a relevant means for information dissemination. Despite some efforts to control this content [20], researchers have found traces of misinformation "ranging from bioweapons conspiracy theories to unverifiable claims by politicians, to the sale of face masks which may not necessarily protect the wearer" [38] (p. 22).

Many of the misinformed stories on social media are fact-checked by media outlets or independent organizations. A quantitative approach analyzing Spain and Latin America concluded that most of the examined stories were false, and Facebook accounted for half of the share of dissemination. Half of the fact-checked sample was health-related information [41]. Fact-checking systems or platforms remain one of the technological solutions to combatting misinformation and fake news. In Brazil, an application entitled Eu Fiscalizo (I check) received users' notifications of circulating fake news about COVID-19.

The main dissemination channel was WhatsApp, followed by Facebook. Regarding content, "65% of them taught homemade methods to prevent the spread of COVID-19; 20% showed homemade methods to cure the disease; 5.7% referred to banking scams; 5% mentioned scams on fundraising for a research institution; and 4.3% concerned the use of the New Coronavirus as a political strategy" [43] (p. 4204). A similar study observed misinformation data from the Brazilian fact-checking service Lupa Agency, most of which was disseminated through Facebook. The research found that 92.9% of the misinformation classified as fabricated content consisted of health tips, and "43.8% of the pieces of misinformation classified as misleading/imposter/manipulated have a scientific/epidemiological content" [51] (p. 8).

Infodemics will be an important research field in the next years. In an attempt to determine the structural components of infodemics, a research team proposed a taxonomy of fake news. First, two separate groups were identified: health- and non-health-related fake news. Health-related fake news (more than 60%) "included fake prevention, fake medicines and treatments, fake SARS-CoV-2 information, hoax or fake pandemic and anti-vaccine messages, and home remedies recommendations". The non-health-related group "included messages generating confusion, phishing/scams, conspiracy theories, political propaganda, pseudo-science and 5G theories along with anti-Bill Gates messages" [15] (p. 527). A bibliometric study depicted a concept mapping of infodemic literature and proposed future research directions, namely, infodemic fabrication context and evaluation, digital tools and the agency of actors, infodemic crisis management, infodemic knowledge and mental health impacts, and the study and modeling of infodemic trends and topics [48].

3.2.2. Social Behavior

The use of social media to convey messages against public authorities or science expertise is not new, but the COVID-19 pandemic was an optimal terrain for its development. One example is The Reopen the States Movement (US). Observing their coronavirus-skeptical Facebook groups, one study revealed a strong connection between

health misinformation and political action, namely, conservative values: "Since members did not trust mainstream media, government, or public health reporting on the COVID pandemic, many returned to the decidedly hermeneutical and conservative scriptural inference process to "do their own research" on the numbers and then share their own individualized, unverified, and often contradictory interpretations of COVID data with their ideological social networks" [56] (p. 11). A qualitative analysis of the content shared in the groups demonstrated the assumption of a serious public health threat.

Facebook was also a space for reactions against preventive measures. When observing 615 Facebook comments drawn from Montana (US) news sources, it was revealed that 63% presented resistance to complying with the mask-wearing measure, as "barriers to compliance with COVID safety precautions are related to both low perceived risk of COVID and low perceived efficacy of the prevention measures" [46] (p. 11). These findings also suggest that such resistance arises not from an informational or misunderstanding-related problem but from conspiracy theories and other social or political perspectives, many of which were already evident before the pandemic. Public health communication should move beyond scientific evidence and adapt itself to fight against previous biases. However, social media echo chambers are not easily disrupted, and "the current atmosphere of distrust and anti-scientific sentiment have undermined the ability of health educators to use informational messages to fight the COVID-19 pandemic" [46] (p. 14).

3.2.3. Public Health Authorities

The COVID-19 crisis forced a rapid change in the way health authorities communicate and engage with the public. An analysis of the official Facebook pages of the leading public agencies for health crises in Italy, the United Kingdom, and New Zealand found that social media was extensively used: "Public agencies mainly released information on the evolution of the epidemic, the correct behaviour to empower citizens in protecting from the virus and the actions taken to face the situation" [54] (p. 11). However, a missed opportunity

was depicted, as some countries were unable to establish dialogic communication, possibly to avoid organizational damages or because of a lack of competencies and resources. Public engagement through social media is not sufficient in a pandemic crisis, as "public agencies establishing an active dialogic communication have a higher level of the tenor of comments index, with a lower incidence of contestation or posts reporting fake news" [54] (p. 11).

For a different perspective, different reactions arose on Facebook when the Brazilian Minister of Health established a connection between winter and the increasing severity of the pandemic in the north and northeast of Brazil. Analyzing Facebook comments and memes, a study found that humor was used to counterbalance post-truth discourse and dismantle misinformed political positions, presenting social media as a space of questioning not only political decisions but also political discourse [47]. Further research is expected on public health authorities' performance regarding social media, e.g., Canadian agencies are being studied using content and sentiment analysis [45].

Most developing countries were not prepared to face a pandemic that demanded new forms of communication. Extensive research concerning the public health authorities of 23 anglophone Sub-Saharan African countries demonstrated that a presence on social media, mostly on Facebook, is not enough. To convey trusted information and fight against misinformation, authorities must have social media legitimacy (e.g., verified accounts), the capacity to reach audiences, strategies, and expertise [42].

4. Discussion

The literature reviewed shows the global nature of the health misinformation problem and its impact on a platform as popular as Facebook [13]. The various countries addressed in the different studies also reveal the efforts of scientific research in addressing the misinformation problem and the concerns raised by public health issues, which have been aggravated by the COVID-19 pandemic. Both user information behavior perspectives and content analysis approaches, focusing on published content as the result of users'

interactions with social media, converge to indicate the relevance of research being conducted around the world.

This review has demonstrated a bright and a dark side of online health information [59]. From the results emerge certainties and uncertainties, perhaps more uncertainties than certainties, as the short space of time and the speed of events do not make it possible to have a completely clear view of the various social and communicational phenomena that are occurring.

As for certainties, the results show that the impacts of misinformation exposure and the associated risks in the social media context are multiple following the increase in online information consumption [5,14]. Information is abundant and satisfies most users' needs; however, social media exposes people to several risks. Despite the revival of traditional media [8], this review has shown social impacts that generate fear and panic as well as increase and worsen the social perception of the pandemic emergency. Myths, conspiracy theories, false cures, and rumors of vaccines' ineffectiveness are components of a global wave of low-quality information, often conflicting with the official perspective of the authorities (including the WHO), who have reacted and showed concern about the infodemic [16,17]. Studies confirm political impacts, as misinformation reveals previous tensions, and it has also fueled a feeling of revolt against the authorities and undermined the sense of trust that should unite society and its leaders, especially during a pandemic that has killed millions of people worldwide [8,25,27]. Also, there were impacts on health, as misinformation led to risky behavior due to following content without any scientific basis, or, on the other hand, a disregard for the seriousness of the pandemic and the information transmitted by official channels. Impacts on mental health, with reports of information overload and information anxiety [7], were also pointed out.

As for the uncertainties, research shows that there are still many problems to acknowledge and to help solve. It is not yet clear what the most effective methods to fight misinformation are and how society can control the role of social media, in which people behave based on freedom of expression and in a post-truth environment, where

feelings and emotions come up against truth and facts [22,23]. It is also still uncertain how public health authorities can improve their way of communicating with the public, especially with respect to making use of social media, thus coexisting with the public in the same digital ecosystem. It is also uncertain how platforms such as Facebook will improve their systems to combat misinformation. At this point, it should be noted that the various impacts on mental health are among the aspects that social media companies should consider and on which they should act in the future. Another deep crisis is in the process of becoming serious. It is also uncertain if health literacy is a solution for misinformation, because, on the one hand, information behavior studies show that the way people share information has emotional components, which are difficult to address in the development of literacy skills; on the other hand, misinformation is often consumed within an echo chamber, helping to confirm what people wanted to have confirmed [24]. Finally, it is also uncertain whether countries will be able to develop effective legal mechanisms to counter misinformation, a global phenomenon of unknown authorship that is viral and without borders.

Future research should discuss the role of user education and the ability to prepare individuals against these pitfalls. Other solutions to preventing disinformation and fake news should also be researched, as health information is critical to decision making and public health.

5. Conclusions

This chapter sought to explore the most recent research on the problem of misinformation in the context of social media. The case of Facebook was chosen due to its social relevance and large community of users. The scope was also focused on the pandemic period, brought about by COVID-19, to try to isolate and observe the analyzed phenomenon's acceleration that, although not new, has worsened since the beginning of 2020. In this sense, health was the main theme analyzed.

Recent research has shown the danger of trusting social media as a source of health information. Nevertheless, the popularity and massive

use of Facebook pose a challenge to health literacy, as the quantity of information channeled make some sort of human cognitive or automatic machine-based counter-reactions almost impossible. Even fact-checking strategies appear to have several limitations.

The results show two dominant research approaches: information behavior analysis, mostly acquisition and sharing, and online content analysis, focusing on infodemics, social behavior, and public health authorities' communication strategies. Despite serious concerns about misinformation, researchers have revealed an uncertain scenario regarding solutions to countering this public health issue.

The main research goals were achieved. Regarding online information behavior in the social media setting, the results demonstrated its key active features, like acquisition and sharing, along with the passive ones, such as being subject to mental health issues, like anxiety and fear. This review assessed the landscape of fake or misinformed health information transmitted through Facebook, showing its diversity and impact. The relationship between Facebook and health information during the COVID-19 pandemic was strong, as the most popular platform was largely used for health information activities (ranging from support groups promoted by healthcare professionals to groups of activists against preventive protection measures), revealing the bright and the dark sides of social media.

The main limitation of this study concerns the way the first information retrieval process was carried out since it is certain that a different query could have led the review along other paths. Thus, this review should be read with caution and attention paid to the methodological assumptions presented.

Online health (mis)information remains an open research topic and a global challenge, as it does not seem that the associated problems will diminish or be mitigated in the coming years.

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