

Myths and Misinformation about COVID-19 on Social Media: Insights into Individual Beliefs

Avi Mendiratta¹, Surbhi Mendiratta¹, Akshita Sharma¹, Preeti Agarwal¹, Reema Mishra^{1*}, Renu Soni^{1*}

¹Gargi College, University of Delhi, New Delhi, 110049, India

avimendiratta97@gmail.com; surbhimendiratta238@gmail.com; akshitasharma0247@gmail.com; preeti.agrawal@gargi.du.ac.in

*Joint corresponding authors: reema.mishra@gargi.du.ac.in; renu.soni@gargi.du.ac.in

Abstract: SARS-CoV-2 causing COVID-19, started spreading its roots across the world in December 2019. Its severity and death numbers created a panic that flooded social media with various myths and misinformation. Our study included two parts, survey-based research, and a bibliographic review. The survey based research focused on the exposure and beliefs of individuals about the myths and misinformation since the beginning of the COVID-19 pandemic. Secondly, the aim of the bibliographic review was to focus on the various types of social media platforms, studies on myths/misinformation, and their major highlights. A data-driven survey methodology was employed for the analysis of individual beliefs regarding myths and misinformation associated with COVID-19 using Google forms. Publications were searched on PubMed®, APA PsycNet® (PsycArticles), and Nature Portfolio and were analyzed in the bibliographic review. From the results of the survey, it can be concluded that in the situation of the COVID-19 pandemic, the society held a mixture of various individual perceptions or beliefs. Certain myths/misinformation has gained clarification among people from 2019 to 2022 and some new updates are leading to new myths/misinformation. The present study and bibliographic review highlight that different types of information on COVID-19 myths have been reported from the period 2020 to 2022 and how they are different/similar.

Index Terms: Awareness, COVID-19, Myths, Misinformation, Social media

I. INTRODUCTION

Coronaviruses belong to the category of positive-stranded RNA viruses. They are large and enveloped with the potential to infect Mammals and Aves (Li, 2016). Coronaviruses (CoVs) come under the subfamily Coronavirinae which in turn comes in the

family Coronaviridae (Chen et al., 2020). Due to the presence of spike-like glycoproteins on their surfaces, they are called coronaviruses (a crown-like appearance when viewed under an electron microscope) (Mittal et al., 2020). CoVs primarily damage the respiratory and gastrointestinal systems of hosts (De Felice et al., 2020). HCoV-229E, HCoV-NL63, HCoV-OC43, HCoV-HKU1, SARS-CoV, MERS-CoV and SARS-CoV-2 are the human coronaviruses (HCoVs) (Kawana, 2016).

SARS-CoV-2 causing COVID-19 belongs to the category of coronaviruses. The SARS-CoV-2 is classified under the order Nidovirales, family Coronaviridae, genus Betacoronavirinae and subgenus Sarbecovirus (Ravi et al., 2022). The first case of COVID-19 was reported in December 2019. COVID-19 was proclaimed a global pandemic by the World Health Organization (WHO) on March 11, 2020. The unanticipated terror of SARS-CoV-2 walked the streets with exponentially high death numbers occurring every day or on daily basis. As of 27th February 2023, 75,83,90,564 confirmed cases of COVID-19 have been reported to WHO along with 68,59,093 deaths (*WHO Coronavirus (Covid-19) Dashboard 2023*; <https://covid19.who.int/>).

With the lack of awareness, symptoms associated with several complexities and ascending death numbers, social media messages about the mechanism of infection, methods of prevention, treatment measures, the decimation of SARS-CoV-2, and post-effects of vaccination transmitted faster than the viral infection of SARS-CoV-2 itself. Initially, when the virus started spreading its roots in the world, nobody realized that they all were building a home of myths and misinformation. Unresolved droplets of queries in the air of the pandemic, fallacious practices masking the correct preventive measures, and breathing in misleading information constructed this home brick by brick. The trendy social media platforms like WhatsApp,

* Corresponding Author

Facebook, Instagram, Twitter, YouTube, TikTok, and various others along with the flow of information via family and friends served as the most common vectors for the spread of myths and misinformation. Various myths took over social media like intake of rock salt along with raw onions would recover COVID-19 patients (*MyGovIndia-Busting myths, 2021*; <https://twitter.com/mygovindia/status/1385462084268269568>), drinking water every 15 minutes kills the novel coronavirus (*Fact or Fiction, n.d*; <https://www.who.int/southeastasia/outbreaks-and-emergencies/covid-19/What-can-we-do-to-keep-safe/fact-or-fiction>), COVID-19 vaccines contain microchips (*Myths and Facts about COVID-19 Vaccines, 2021*; <https://www.cdc.gov/coronavirus/2019ncov/vaccines/facts.html>), etc. The healthcare sector of different countries wasn't prepared to handle a pandemic that spread in the blink of an eye which led to emotional and psychological disturbances among people.

Despite the launch of global campaigns like "Stop the Spread" initiated by WHO along with the Government of the United Kingdom, a large number of myth bubbles persisted (*Countering misinformation about COVID-19, 2020*; <https://www.who.int/news-room/featurestories/detail/countering-misinformation-about-covid-19>). As the pandemic situation progressed from year to year, the nature of myths and misinformation kept on varying. With the advent of vaccines and the occurrence of new variants, new misbeliefs on social media posed a challenge to the healthcare sector and created hurdles for government organizations to reduce the panic about SARS-CoV-2. RNA viruses tend to mutate at a faster rate in comparison to DNA viruses and the same is the case with single-stranded viruses that mutate faster than double-strand viruses (Sanjuán & Domingo, 2016). SARS-CoV-2 has mutated exceptionally over the past two years, which can be attributed to its single-stranded RNA genome. Currently spreading Variants of Concern (VOC) are Delta and Omicron which have taken over the previously spreading VOCs labeled by WHO as Alpha, Beta, and Gamma (*Tracking SARS-CoV-2-variants, 2023*; <https://www.who.int/en/activities/tracking-SARS-CoV-2-variants/>). Along with these mutant variations, misconceptions have also mutated and have taken a different form.

In the first part of the paper, our survey research focused on the exposure and beliefs of individuals about the myths and misinformation since the beginning of the pandemic. Individual beliefs were observed to vary with age group, gender, occupation, geographical location, and literacy. We believe that due to different degrees of exposure to these myths and misinformation via different social media platforms in different age groups and gender, individual beliefs and behaviors tend to vary (Alsukah et al., 2021) Occupation and literacy are two key factors that can contribute to biased opinions on the incorrect

information circulating in the vicious internet circle. COVID-19 has impacted some areas more acutely as compared to others, with key reasons being high population, exposure to different lifestyles, and urbanization (*COVID-19 and Urban Health, (n.d)*; <https://www.who.int/teams/social-determinants-of-health/urban-health/covid-19>). Geographical differences can also serve as potential sources of a variety of perspectives for these myths and misinformation. Public perception during a healthcare crisis is particularly affected by narrative communication (Caulfield et al., 2019). Emotional factors have taken over the scientific basis in the race of finding quicker solutions and hearing positive news. This in turn has made individuals more prone to believe that pseudoscience could be fatal as well. Believing in personalized social media solutions has led to the birth of even more variation in individual points of view. However, as we are living through the pandemic, a huge degree of transformation in individual beliefs about myths has been noticed. We have covered how myths are being debugged with reality/facts.

Due to the prominent level of unpredictability and high mutation rates of SARS-CoV-2, an exuberant number of rumors have been reported by various publications. The aim of the review was to focus on the various types of social media platforms, studies on myths/misinformation, major highlights, and different measures to prevent the spread of myths/misinformation if any to draw a comparison between the studies considered. In the second part of the paper, our review considered the myths and misinformation that have spread through social media during the pandemic period.

II. METHODOLOGY

A. Survey-based research

To conduct this study, we employed a data-driven survey methodology for the analysis of individual beliefs regarding myths and misinformation associated with COVID-19. The survey was conducted from January 31, 2022, to March 12, 2022. To establish intelligible research and a user-friendly self-explanatory questionnaire, we used Google forms as our survey-based research tool. The form had two sections, where the former had personal details. The latter had a total of twenty-three objective questions based on the circulating myths and misinformation about SARS-CoV-2 on social media, three subjective questions based on certain aspects of COVID-19 in daily life (concerning psychological effects, immunity, and sanitation), and one question to specify the source of exposure to the information in the questionnaire. The objective questions were of the multiple-choice type including three options, "yes", "no", and "can't say" to gather insights on individual perceptions of these false rumors. The Google form was circulated via WhatsApp, LinkedIn, and

Instagram among people of different age groups, different gender, various geographical locations, and belonging to various educational backgrounds and occupations. Google sheets were used as a tool for creating data tables, computing, and analyzing the results. Finally, mapchart.net was used to create a visual representation of the percentage of respondents from different geographical areas across India.

B. Bibliographic review

Another objective was to perform a bibliographic review of publications on myths and misinformation about COVID-19 circulating on social media. Bibliographic analysis was carried out by following the methodology outlined in the study by (Gabarronet al.,2021). Publications were searched on PubMed®, APA PsycNet® (PsycArticles), and Nature Portfolio on 11.04.2022 at 12.00 PM that included keywords- myths, misinformation, COVID-19, social media, etc. The complete publication selection process is summarized in Fig. 1, which was done as per preferred reporting items for systematic reviews in the PRISMA statement that includes a four-phase flow diagram. The whole purpose of the PRISMA statement is to allow the authors to report systematic reviews and meta-analyses in a better manner (Moher et al., 2009). Complete details of keywords for publication selection are summarized in Table I. Publications that were focused on myths and misinformation/rumors on COVID-19 (spread through social media) which were global (not related to local studies) and were primary in origin were included in the review, the rest of them were excluded.

Fig. 1: Publication selection process for bibliographic review on myths and misinformation about COVID-19 via social media

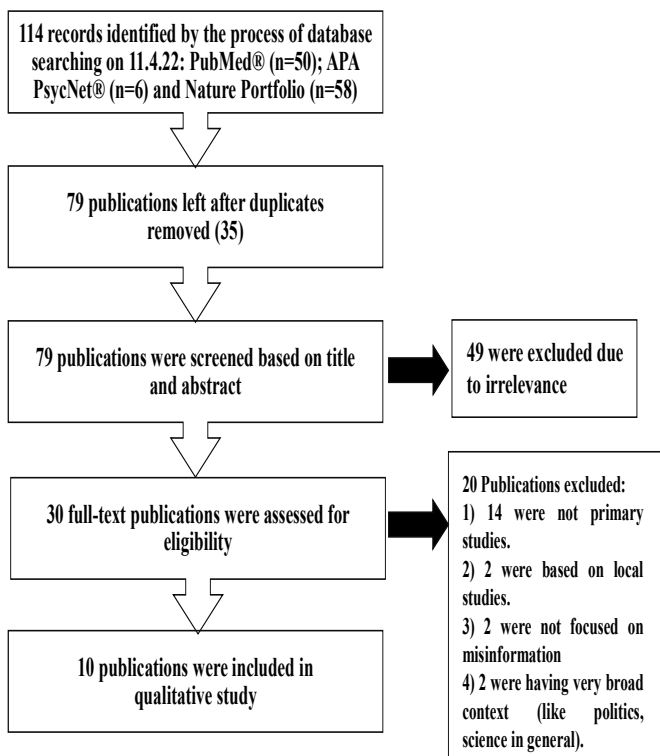
Table I. Keywords, bibliographic review on myths and misinformation on COVID-19 via social media, 2020-2022

Database	Search Items	No. of Publications found (11.04.2022)
PubMed®	Myths' OR 'misinformation' OR 'rumours' AND 'COVID-19' AND 'social media' OR 'Twitter' OR 'Facebook' OR 'TikTok' OR 'Instagram'	50
APA PsycNet®	Myths' OR 'misinformation' AND 'COVID-19' AND 'social media' OR 'Twitter' OR 'Facebook' OR 'TikTok' OR 'Instagram'	6
Nature Portfolio	Myths' OR 'misinformation' AND 'COVID-19' AND 'social media' OR 'Twitter' OR 'Facebook' OR 'TikTok' OR 'Instagram'	58
Total publications found		114

III. RESULTS

A. Survey-based research

Analysis was done based on the data obtained through a survey questionnaire about the individual beliefs on myths/misinformation about COVID-19 circulating on social media. The sample size was 372. Most of the respondents (67.7%) belonged to the age group 18-25. The percentage of remaining respondents belonging to different age groups is summarized in Table II. Most of the respondents were female. Amongst the respondents, the graduate and undergraduate groups had the highest percentage (51.6%). 32.3% were postgraduates (including those pursuing), 10.5% were school students and 5.64% were doctorate Table II. The next parameter of the survey-based research was occupation, where students ranked the highest percentage (61.2%). Respondents had varied types of occupations Table II. The responses to the survey questionnaire were received from all over India except for Andhra Pradesh, Meghalaya, and Tripura Fig. 2.



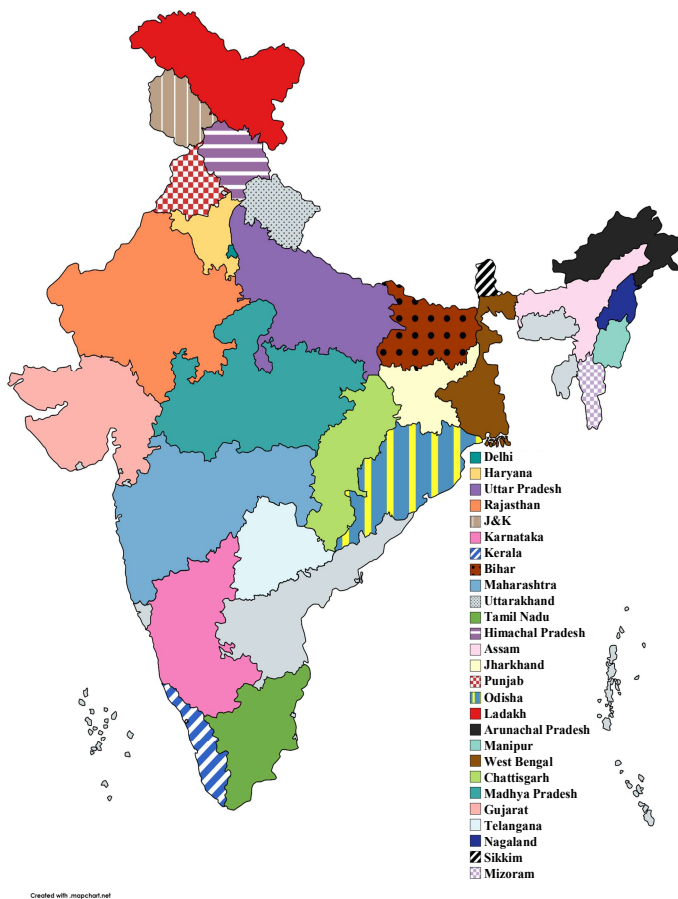


Fig. 2: Geographical location of the respondents

Table II. Age groups, Education status, and Occupation of respondents (sample size-372)

Personal information	Parameter	Percentage (%)
Age	i) Under 18	4.30%
	ii) 18-25	67.70%
	iii) 26-35	13.40%
	iv) 36-45	6.20%
	v) 46-55	5.60%
	vi) 56-65	2.20%
	vii) Above 65	0.50%
Education Status	i) School Students	10.50%
	ii) Graduates & Undergraduates	51.60%
	iii) Post graduates (includes pursuing)	32.30%
	iv) Doctorate	5.64%
Occupation	i) Students	61.20%
	ii) Education industry	26.10%
	iii) Businessperson	2.20%
	iv) Engineers	2.20%
	v) Housewife	1.60%
	vi) Service and Salaried	2.68%
	vii) Retired	0.80%
	viii) Others	3.20%

The responses to twenty-three objective questions of the questionnaire are summarized in Table IIIa and Table IIIb. Since these twenty-three objective questions were based on myths, the reality/facts behind twenty-three myths/misinformation are shown in Table IV. Fig. 3 summarizes the percentage of respondents (out of 372) who chose the respective options in Q1-Q23.

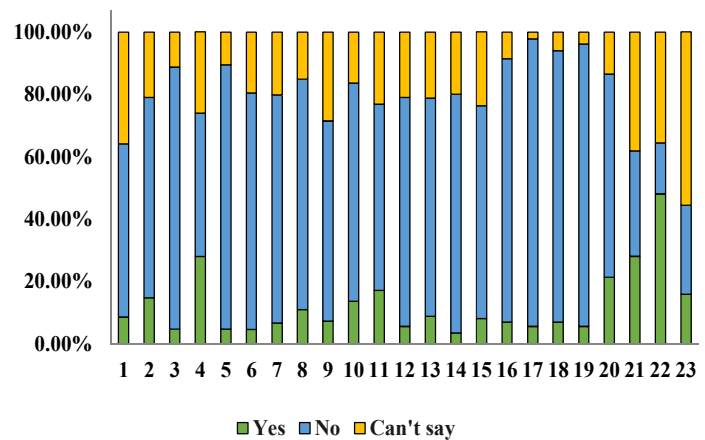


Fig. 3: Graphical representation of data obtained from objective questions (Q1-Q23)

Based on the responses, it can be concluded that a certain percentage of the population is aware of the myths/misinformation related to COVID-19 like their mechanism or mode of infection, methods of prevention, treatment, the decimation of SARS-CoV-2, and post-effects of vaccination. In the case of Q1-Q20, the number of respondents who opted for “no” in the objective-type questions relating to myths is more than those who opted for “yes” or “can’t say” Table III a. The majority of the respondents (83.90%) believe that drinking alcohol protects one from contracting COVID-19 is a myth Fig. 4a. 73.10% of people in the current study are aware that eating garlic prevents COVID-19 completely is a myth Fig. 4b. An important observation was that 84.70% of the respondents were aware that there is no transmission of SARS-CoV-2 via mosquitoes or mosquito bites Fig. 4c. 69.90% of respondents knew that taking steam three times a day does not prevent us from catching COVID-19 Fig. 4d.

Table III (a). Survey questionnaire along with options and the percentage of responses for each question

S.No.	Questions about Myths and Misinformation	Options	Option Yes	Option No	Option Can't Say
Q1	Do you think patients infected with COVID-19 disease would recover from intake of rock salt along with raw onions?	Yes, No, Can't Say	8.60%	55.60%	35.80%
Q2	Do you believe drinking water every 15 minutes kills the novel Coronavirus?		14.80%	64.20%	21%
Q3	Do you believe that drinking alcohol protects you from contracting COVID-19?		4.80%	83.90%	11.30%
Q4	Do you think Vitamin C kills the novel Coronavirus as soon as you are infected with it?		28%	46%	26.10%
Q5	Do you think COVID-19 spreads via mosquitoes?		4.80%	84.70%	10.50%
Q6	Do you think standing in front of UV bulbs kills the novel coronavirus?		4.60%	75.80%	19.60%
Q7	Do you think eating garlic prevents COVID-19 completely?		6.70%	73.10%	20.20%
Q8	Do you think spraying alcohol or chlorine on your body kills the novel coronavirus within?		11%	73.90%	15.10%
Q9	Do you believe that the pneumonia vaccine will protect you from COVID-19 infection?		7.30%	64.20%	28.50%
Q10	Do you believe you will never catch COVID-19 if you take steam three times a day?		13.70%	69.90%	16.40%
Q11	Do you think COVID-19 Vaccines are responsible for emergence of new variants?		17.20%	59.70%	23.10%
Q12	Do you think COVID-19 vaccines contain microchips?		5.60%	73.40%	21%
Q13	Do you think COVID-19 vaccines alter your DNA?		8.90%	69.90%	21.20%
Q14	Do you think COVID-19 vaccines lead to infertility?		3.50%	76.60%	19.90%
Q15	Does COVID-19 infection spread via dogs and cats to humans?		8.10%	68.30%	23.70%
Q16	Do you think hand dryers can kill the novel coronavirus?		7%	84.40%	8.60%
Q17	Do you think there is no need of wearing mask and social distancing after vaccination?		5.60%	92.20%	2.20%
Q18	Do you think children cannot transmit novel coronavirus to others?		7%	87%	5.90%
Q19	Do you think there is no need of precautions for 3rd wave since Omicron only causes mild disease?		5.60%	90.60%	3.80%
Q20	Do you think Omicron is just like a common cold?		21.40%	65.10%	13.50%
Q21	Do you think with Omicron being less severe, we are nearing the end of the pandemic?		28.10%	33.80%	38.10%
Q22	Do you think NeoCoV is a new variant of COVID-19?		48.10%	16.30%	35.60%
Q23	Do you think NeoCoV is killing 1 in 3 humans right now?		16%	28.50%	55.60%

Table III (b). Survey questionnaire along with options and the percentage of responses for each question

S.No.	Questions about Myths and Misinformation	Options	Option 1	Option 2	Option 3
Q24	What do you think of the psychological effects and panic of COVID-19?	1) Psychological effects and panic have reduced from 1st wave to 3rd wave; 2) Psychological effects and panic have increased from 1st wave to 3rd wave; 3) Psychological effects and panic have remained constant from 1st wave to 3rd wave.	68.90%	19%	12%
Q25	What do you think about the role of spices and vitamin C rich fruits in building immunity in a long run?	1) Vitamins have the potential in decreasing load of virus and hospitalization rate for COVID-19; 2) Vitamins have potential antioxidant nature and immunomodulation effects; 3) Ginger, clove, black pepper, neem and giloy are beneficial in COVID-19 due to their antiviral properties.	25.50%	63.20%	61.80%
Q26	What do you think about the role of sanitation during COVID-19 infection?	1) Use of disinfectants and sanitizers are important preventive measures in COVID-19 pandemic; 2) Disinfectant use in excess can be threatenful to living beings and ecosystems; 3) After performing disinfection, washing hands with soap and water must be done.	86%	26.30%	32.80%
Q27	What is the source of above mentioned information for you?	WhatsApp, Facebook, Instagram, Twitter, YouTube, TikTok, Other Social media platform, Friends/Family	Refer to Figure 7.		

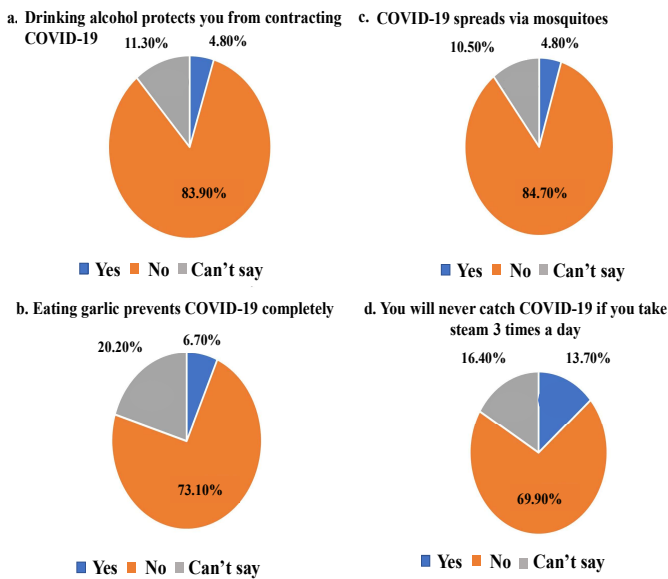


Fig. 4: Pie charts illustrating the percentage of respondents who are aware of the myth a) drinking alcohol protects you from contracting COVID-19 b) eating garlic prevents COVID-19 completely c) COVID-19 spreads via mosquitoes d) you will never catch COVID-19 if you take steam three times a day

A lot of respondents (69.90%) were aware that vaccines have the potential to alter DNA is a myth and vaccines for COVID-19 do not interact with or modify DNA in any manner Fig. 5a. When people were asked about the effectiveness of the Pneumonia vaccine for protection against SARS-CoV-2, 64.2% of people reported it to be a myth. 76.60% of people know that COVID-19 vaccines do not lead to infertility Fig. 5b. This indicates that a high level of awareness exists among the respondents. However, the results also indicate that as the pandemic is unfolding, any trending update on the SARS-CoV-2 virus can lead to an affair of myths/ misinformation. Contrasting results were obtained in the objective questions on Omicron and NeoCoV, they were either answered in favor of the myths or in uncertainty. The supportive evidence can be clearly seen in the results of Q21, Q22, and Q23. When people were asked about their views on the end of the pandemic due to Omicron being less severe (Q21), the results indicate that there is more uncertainty among people about new emerging variants. 38.1% of respondents were uncertain about the end of the pandemic while 28.1% of people believed since the Omicron variant is less severe; we are nearing the end of the pandemic Fig. 5c. Similarly, when people were asked about their view on NeoCoV killing 1 in 3 humans in the current scenario Q23; Fig. 5d, 55.60% of the respondents were uncertain. Moreover, it is seen in the study that when people were asked about NeoCoV as a new variant of COVID-19 in Q22, the number of responses for “yes” were more as compared to “no” or “can’t say”. 48.1% of respondents in the study believe that NeoCoV is a new variant of COVID-19. Thus, the uncertainty among the respondents about

the new variants of SARS-CoV-2 was further explored in this study.

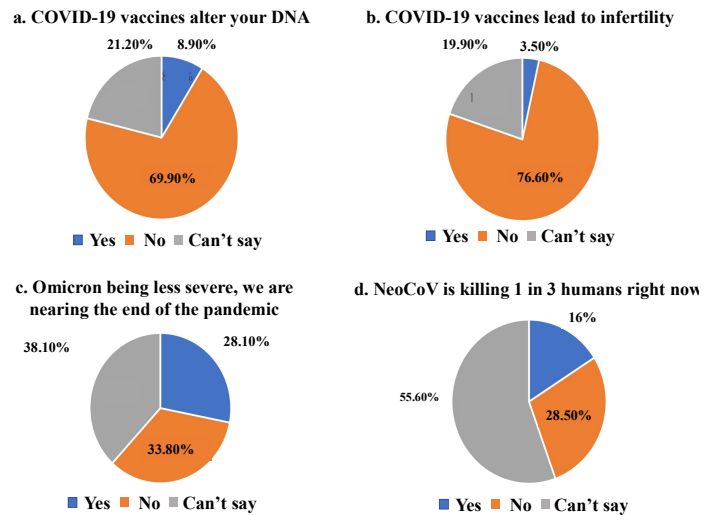


Fig. 5: Pie charts depicting respondent’s beliefs about the myths: a) COVID-19 vaccines alter your DNA b) COVID-19 vaccines lead to infertility c) Omicron being less severe, we are nearing the end of the pandemic d) NeoCoV is killing 1 in 3 humans right now.

The subjective questions, however, showed different results where some of the options were extremely favored. People were asked about their thoughts/views/opinions on the psychological effects and panic of COVID-19 in Q24. Most of the respondents (68.9%) believed the psychological effects and panic have reduced from 1st wave to 3rd wave Fig. 6a. The scenario was different when people were asked about the role of spices and vitamin C-rich fruits in building immunity in a long run (Q25), where two options got approximately equally high percentages. 63.2% of people believed vitamins exhibit an antioxidant nature and immunomodulation effects. 61.8% of people believed that Ginger, Clove, Black Pepper, Neem, and Giloy are beneficial in COVID-19 due to their antiviral properties Fig. 6b. Only 25.5% of the respondents agree that vitamins have the potential in decreasing the load of the virus or decreasing the infection rate Table III b; Fig. 6b.

Table IV. Reality check of myths and misinformation in the survey questionnaire

Q.No.	Questions about Myths and Misinformation	Truth about the myth/misinformation	Verification source
Q1	Do you think patients infected with COVID-19 disease would recover from intake of rock salt along with raw onions?	There is no scientific evidence for the recovery of COVID-19 patients with the intake of a combination of rock salt and raw onion.	MyGovIndia (Busting myths, 2021)
Q2	Do you believe drinking water every 15 minutes kills the novel Coronavirus?	There is no scientific evidence for killing or flushing out of novel coronavirus. Apart from this, drinking ample glasses of water per day is a healthy practice.	World Health Organization (Fact or fiction)
Q3	Do you believe that drinking alcohol protects you from contracting COVID-19?	Any kind of alcoholic drink such as beer, wine, or liquor does not help in preventing the contraction of SARS-CoV-2.	World Health Organization (12 myths about Covid-19)
Q4	Do you think Vitamin C kills the novel Coronavirus as soon as you are infected with it?	No evidence for Vitamin C or any other vital vitamin intake to be a treatment measure for COVID-19.	World Health Organization [Coronavirus disease (COVID-19) advice for the public: Mythbusters, 2022]
Q5	Do you think COVID-19 spreads via mosquitoes?	No studies report the transmission of SARS-CoV-2 via mosquitoes or mosquito bites.	World Health Organization (12 myths about Covid-19)
Q6	Do you think standing in front of UV bulbs kills the novel coronavirus?	UV light is known to irritate the skin and hence should not be used. However, a lot of studies indicate the potential of a broad range of UVC wavelength light to effectively inactivate the SARS-CoV-2 (Biasinet <i>al.</i> , 2021).	World Health Organization (12 myths about Covid-19), Ma <i>et al.</i>, (2021).
Q7	Do you think eating garlic prevents COVID-19 completely?	Garlic is known to have some potential antimicrobial nature, however, consuming garlic is not a	World Health Organization (12 myths about Covid-19)

		preventive measure against COVID-19.	
Q8	Do you think spraying alcohol or chlorine on your body kills the novel coronavirus within?	An action of spraying or even ingesting any disinfectants or bleach does not kill the SARS-CoV-2 virus that has already entered our body, rather it can be a source of irritation on our skin and eyes. If ingested, it can also lead to poisonous effects.	World Health Organization [Coronavirus disease (COVID-19) advice for the public: Mythbusters, 2022]
Q9	Do you believe that the pneumonia vaccine will protect you from COVID-19 infection?	Pneumonia vaccines do not specifically provide any protection against pneumonia which is a stage of acute COVID-19 infection. No conclusive evidence of the relationship of pneumonia vaccines to COVID-19 infections. Although recent studies are going on for co-administration of the COVID-19 vaccine and pneumococcal vaccine by Pfizer.	Harvard Health Publishing (Preventing the spread of the coronavirus, 2022), Pastorino <i>et al.</i>, (2021), European Pharmaceutical review (Promising results for COVID-19 and pneumococcal vaccine co-administration, 2022).
Q10	Do you believe you will never catch COVID-19 if you take steam three times a day?	This action of taking saltwater steam inhalation cannot prevent catching COVID-19. Over steam inhalation can rather lead to burn injuries.	World Health Organization (Q: Is tuob/suob (steam inhalation) a cure for COVID-19, 2020)
Q11	Do you think COVID-19 Vaccines are responsible for emergence of new variants?	Due to mutations in SARS-CoV-2, new variants tend to arise. COVID-19 vaccines are not responsible for the creation and spread of new variants rather the COVID-19 vaccines available in the market can help to prevent the emergence of new variants.	Centers for Disease Control and Prevention (Myths and Facts about COVID-19 Vaccines, 2022)

Q12	Do you think COVID-19 vaccines contain microchips?	Any type of microchips are not reported in COVID-19 vaccines. The motive of developing vaccines is to fight diseases, not for tracking any kind of personal information and movement patterns.	Centers for Disease Control and Prevention (Myths and Facts about COVID-19 Vaccines, 2022)
Q13	Do you think COVID-19 vaccines alter your DNA?	Vaccines for COVID-19 do not interact with or modify DNA in any manner. Their mechanism is developed to aim at providing protection by generating an immune response.	Centers for Disease Control and Prevention (Myths and Facts about COVID-19 Vaccines, 2022)
Q14	Do you think COVID-19 vaccines lead to infertility?	COVID-19 vaccines are not reported to cause infertility.	(Islam et al., 2021)
Q15	Does COVID-19 infection spread via dogs and cats to humans?	As per reports, the risk for spreading SARS-CoV-2 from animals to humans is relatively low.	Centers for Disease Control and Prevention (Animals and COVID-19, 2022)
Q16	Do you think hand dryers can kill the novel coronavirus?	Hand dryers don't have the ability to kill SARS-CoV-2.	World Health Organization [Coronavirus disease (COVID-19) advice for the public: Mytbusters, 2022]
Q17	Do you think there is no need of wearing mask and social distancing after vaccination?	As per CDC recommendations, wearing a face mask is important for fully vaccinated individuals as well.	Johns Hopkins Medicine-Health (COVID-19 Vaccines: Myth Versus Fact, 2022)
Q18	Do you think children cannot transmit novel coronavirus to others?	Children have the potential to transfer the novel coronavirus to others, in fact, especially to those who are immunocompromised. Children can die from COVID-19, although not at the same rate as adults.	Department of Pediatrics, University of Wisconsin, School of Medicine and Public health (Myths about Covid-19 and children, 2021).

Q19	Do you think there is no need of precautions for 3rd wave since Omicron only causes mild disease?	Omicron appears to be comparatively less severe than another variant called Delta. However, it cannot be regarded as mild.	World Health Organization (The Omicron variant: sorting fact from myth, 2022)
Q20	Do you think Omicron is just like a common cold?	Omicron is much more severe than the common cold.	World Health Organization (The Omicron variant: sorting fact from myth, 2022)
Q21	Do you think with Omicron being less severe, we are nearing the end of the pandemic?	Omicron being less severe, the pandemic end is not sighted yet.	World Health Organization (The Omicron variant: sorting fact from myth, 2022)
Q22	Do you think NeoCoV is a new variant of COVID-19?	Although different scientists over the globe have emphasized recently the potential threats related to NeoCoV in humans, no human cases have been reported yet. NeoCoV is not a variant of SARS-CoV-2, rather it is understood to be related to MERS coronavirus. NeoCoV is much more related to MERS-CoV found in bats with 85% similar genome (Hassan et al., 2020).	(Corman et al., 2014)
Q23	Do you think NeoCoV is killing 1 in 3 humans right now?	NeoCoV infection in humans has not been reported yet. Due to this, there is a scarcity of information on NeoCoV and thus its threat to humans can't be confirmed at this stage.	(Dhawan et al., 2022)

Moreover, when people were asked about their opinion on the role of sanitation during COVID-19 infection (Q26), 86% of the respondents believe that the use of disinfectants and sanitizers are important preventive measures to reduce and stop the spread of COVID-19. 26.3% of the respondents believe that excess use of disinfectant can be a threat to living beings and ecosystems. 32.8% of the respondents believed that after performing disinfection/sanitizing, washing hands with soap and water must

be done. Hence, in this question, the first option was favored as compared to other two options Table III b.

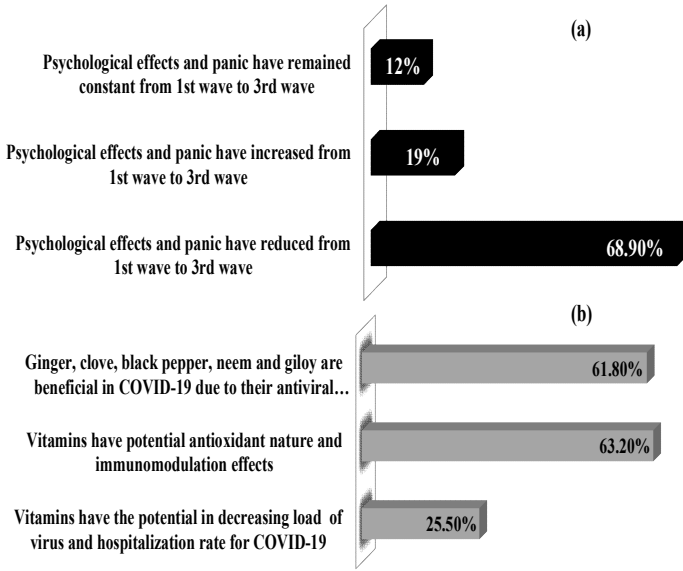


Fig. 6: Graphical representation of the data for the subjective question- a) What do you think of the psychological effects and panic of COVID-19? b) What do you think about the role of spices and vitamin C-rich fruits in building immunity in a long run?

WhatsApp was reported to be the most common source for the spread of myths/ misinformation (51.1% asked in the questionnaire). In the study sample, 46.8% of the misinformation was found to spread via family & friends, 22% via YouTube, 21% via Instagram, 9.4% via Facebook, 7.5% via Twitter, 0.8% via TikTok, and 37.1% via other social media platforms Fig. 7.

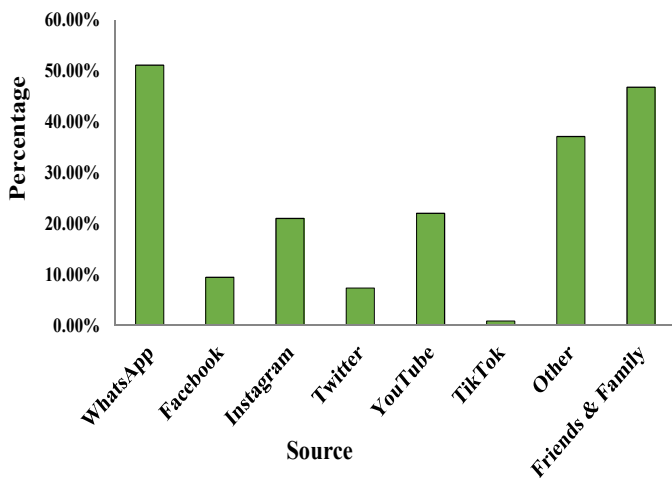


Fig.7:Source of myth and misinformation dissemination

B. Bibliographicreview

In total, 114 publications were identified and after the final selection, 10 publications were included in the qualitative study Fig. 1. Table V summarizes the analysis of 10 publications

included for review. Our systemic review concludes that from the period 2020 to 2022, different types of information on myths and misinformation regarding COVID-19 has been reported in various studies. For instance, myths like heat kills the disease, the origin of COVID-19 as a bioweapon, and vaccines being hidden by the government were reported (Singh et al., 2020). All the publications under review had a common point about the spread of myths via social media platforms, where two studies focused on Twitter exclusively, one study focused on Facebook solely, one study majorly focused on TikTok, while the other study included Reddit, Twitter, Facebook, and Pinterest and the rest of them followed a general approach. Three out of 10 studies had a general approach to studying myths/misinformation while seven studies discussed specific myths. The study by O'Connor et al., 2021, focused on myths about the role of ultraviolet radiation against SARS-CoV-2, and van Westen-Lagerweijetal., 2021 focused on the myths about smoking related to COVID-19. Two studies out of ten (Singh et al., 2020; Vraga & Bode, 2021) revealed a common myth about the effectiveness of heat against the novel coronavirus (one of them discussed the myth of hot baths). Other studies (Basch et al., 2021; Singh et al., 2020) discussed myths related to vaccines, where one of them (former) was concerned about the myth of vaccine development and the other one (latter) included the myths leading to vaccine hesitancy. In the latter, it was reported that a prime reason for vaccine hesitancy could be misinformation or rumor regarding COVID-19. The number of videos on TikTok based on “Discouraged a Vaccine” was slightly more than “Encouraged a Vaccine” (Basch et al., 2021). All ten studies included measures to prevent the spread of misinformation and four studies specifically mentioned the role of health organizations, government, and public health officials. One study from 2022 indicates that people have become more responsible while sharing information about COVID-19 on social media (Obiala et al., 2022).

IV. DISCUSSION

A. Survey-based research

As reported in our result, most of the respondents believe that drinking alcohol protects one from contracting COVID-19 is a myth. The truth is any kind of alcoholic drink such as beer, wine, or liquor does not help in preventing the contraction of SARS-CoV-2 (12 myths about Covid-19, n.d.; <https://www.who.int/docs/default-source/searo/thailand/12myths-final099bfbf976c54d5fa3407a65b6d9fa9d.pdf>). Similarly, no report suggests the transmission of SARS-CoV-2 via mosquitoes or mosquito bites (12 myths about Covid-19, n.d.; <https://www.who.int/docs/default-source/searo/thailand/12myths->

[final099bfbf976c54d5fa3407a65b6d9fa9d.pdf](#)). This is also seen in people's beliefs in our survey. Vaccines for COVID-19 do not interact with or modify DNA in any manner. Their mechanism is developed to aim at providing protection by generating an immune response (*Myths and facts about COVID-19 Vaccines, 2023*; <https://www.cdc.gov/coronavirus/2019-ncov/vaccines/facts.html>). mRNA vaccines do not change a person's DNA and do not affect fertility (Saunders, 2022). This is also evident in the perceptions of respondents in the present study where most of the respondents opted for "no" when asked if vaccines could alter their DNA. Drinking ample glasses of water per day is a healthy practice (Meinders&Meinders, 2010) but drinking water every 15 minutes does not kill the novel Coronavirus and it is a myth spreading on social media (Fact or Fiction (n.d); <https://www.who.int/southeastasia/outbreaks-and-emergencies/covid-19/What-can-we-do-to-keep-safe/fact-or-fiction>). This is also reflected in the current study where most of the respondents opted "no" when asked about their belief on whether drinking water every 15 minutes kills the novel Coronavirus. Moreover, our study indicates that most people are aware that the Pneumonia vaccine does not provide protection against COVID-19 infection. A similar result for the Pneumonia vaccine myth has been reported in the questionnaire-based survey (Rani&Gajapriya, 2021) where 79% of participants reported it to be a myth. Pneumonia vaccines do not specifically provide any protection against pneumonia which is a stage of acute COVID-19 infection (*Preventing the spread of coronavirus, 2022*; <https://www.health.harvard.edu/diseases-and-conditions/preventing-the-spread-of-the-coronavirus>). No conclusive evidence of the relationship between pneumonia vaccines to COVID-19 infections has been seen (Pastorino et al., 2021).

This data on individual beliefs highlights that people are now more conscious/aware of the information flowing through social media which could be potential source for myths/misinformation. The present survey also served as a medium for creating awareness. The current study highlighted the reality/facts behind twenty-three myths/misinformation and correlates with the past findings where most of the participants had the knowledge and were successfully able to differentiate myths from truths/facts (Rani &Gajapriya, 2021). People do hear and are aware of myths about the COVID-19 pandemic (Rani &Gajapriya, 2021). A recent finding by (Challenger et al., 2022), also suggests that a lot of formats and methods are effective for busting COVID-19 myths where the 'question-answer' method is more effective than others. Some other corresponding studies also report the same about people being aware of COVID-19 infection and the possible preventive measure (Roy et al., 2020).

The truth regarding myths about the Omicron variant is that no matter whether it is less severe, the pandemic end is not sighted

yet (*The Omicron variant: sorting fact from myth, 2022*; <https://www.who.int/hungary/home/19-01-2022-the-omicron-variant-sorting-fact-from-myth>). Similarly, as far as reality is concerned on myths of NeoCoV, it should be noted that NeoCoV infection in humans has not been reported yet, thus, there is a scarcity of information on NeoCoV. Therefore, its threat to humans can't be confirmed at this stage (Dhawan et al., 2022). Thus, from the above observations, it can be concluded that as the pandemic is unfolding, any trending update on the SARS-CoV-2 virus can lead to an affair of myths/misinformation.

The subjective questions, Q25 and Q26, were not related to any myth/misinformation and were of the multiple-checklist type. Q25 was based on the role of spices and vitamin C-rich fruits in building immunity in the long run whereas Q26 focused on gathering individual perceptions on the role of sanitation during COVID-19 infection. Respondents could have selected all the 3 options altogether if they believed them to be true, yet there were biases observed for a few options. For instance, only 25.5% of respondents believed that vitamins have the potential to decrease the load of the virus or reduce in decreasing the infection rate and consequently the hospitalization rate for COVID-19, which is however true. Using disinfectants in excess can lead to threatful situations, however, only 26.30% of the respondents agree with this. Thus, along with the battle against myths/misinformation, there is an equal need to educate people regarding immunity, sanitization, and disinfection to reduce the spread of COVID-19. In correlation to the present study, a study by (Nuwagaba et al., 2021) also suggests the importance of educating people about sanitation and hand hygiene. Another correlated study highlights the importance of identifying misleading 'immunity boosting' social media posts (Wagner et al., 2020).

Therefore, in the COVID-19 pandemic situation, there exists a mixture of beliefs where certain myths/misinformation have gained clarification among people from 2019 to 2022. Whereas certain new updates on COVID-19 (such as new variants) are leading to the circulation of new myths/misinformation. As seen in the survey, individual beliefs can vary according to certain parameters such as age group, gender occupation, geographical location, and literacy.

There have been similar studies on individual beliefs which were also based on myths, true facts, and awareness of the prevention methods (Dakhode et al., 2021; Moore et al., 2021). Questions and responses like our questionnaire were reported by a few authors (Swetha&Geetha, 2020). A lot of other studies have also reported similar facts about individuals' interactions and their perceptions of fake news which tend to vary (Hadlington et al., 2022). Similarly, other studies also indicate that individual beliefs play an important role in responses to the COVID-19 pandemic (Moore et al., 2021).

Table V. Main study characteristics and analysis of publications on myths/misinformation about COVID-19 via social media

Source	Year	Social media platform	Studies on myths/misinformation	Major Highlights	Necessary measure to prevent myth/misinformation spread (if any)
Habersaate <i>et al.</i> , (2020)	2020	Social media (general)	In the times of internet, social media, and smartphones, the COVID-19 pandemic is the first reported health emergency on a global level. Anticipating and managing misinformation is one of the key considerations (out of 10 reported here) for effectively managing the COVID-19 transition.	A lot of approaches having prebunking nature (informing people about misinformation even before it spreads) and debunking nature (correcting the misinformation after its spread) will be needed in the future to handle misinformation related to COVID-19.	One possible solution could be conducting research in order to identify the perceptions of people about myths about COVID-19. Advising people about the likeliness of receiving misinformation and informing the public about the sources where truthful facts can be accessible can help. Gaining evidence from social, behavioral and cultural literature is also a suggested measure.
Singh <i>et al.</i> , (2020)	2020	Social media (general), especially Twitter	The study focussed on the increasing conversations about COVID-19 on social media, especially on Twitter. Myths were prevalent on social media about the origin of COVID-19, comparison with Flu, vaccine development, Heat kills the virus and home remedies.	Myths and misinformation were discussed in these Twitter conversations however at a lower volume when compared to other conversations.	A crucial step will be to monitor the myths in social media conversations and have a careful check on who is propagating the myth and who is helping in the debunking of the myth. Furthermore, systems should be developed to combat myths.
Vraga <i>et al.</i> , (2021)	2021	Social media (general), Facebook	Myths about hot baths were focused to test the efficacy of infographics shared by WHO for quashing myths about COVID-19. Infographics do have the potential to reduce misperceptions and this reduction tends to persist over time. Although these graphics do not affect all misperceptions.	The same infographic on myth/misinformation about COVID-19 if shared by WHO has more impact than sharing by an unknown Facebook user.	The promotion of shareable infographics to combat the spread of myths should be encouraged. This action should be taken by health organizations to improve public knowledge.
O'Connor <i>et al.</i> , (2021)	2021	Social media (general), Twitter	Myths on the role of ultraviolet radiations against SARS-CoV-2 were focused on in the study. Some of the trending searches on Twitter were #uvKillsCovid19 and #UVdisinfection. 'Sunlight coronavirus' was an increased search term as depicted by Google Trends.	UVA and UVB are not effective in the elimination of SARS-CoV-2 (poorly virucidal). UVC (germicidal irradiation) may have a role in the fight against COVID-19 with respect to sterilization (Narla <i>et al.</i> , 2020).	Educating and highlighting about UVA, UVB (ineffective nature), and UVC (harmful nature) can help in clearing myths.
Moore <i>et al.</i> , (2021)	2021	Social media (general)	One part of the study included testing 13 statements that were focused on COVID-19 knowledge, either facts or myths.	Findings of such type offer insights for working on interventions in order to slow down the spread of COVID-19 as well as future diseases.	Public Health officials, as well as government officials, should serve as primary potential sources for preventative behavior guidelines of COVID-19.

Baschet <i>et al.</i> , (2021)	2021	Social media (general), TikTok	A prime reason for vaccine hesitancy could be misinformation and disinformation on COVID-19. The number of videos on TikTok based on “Discouraged a Vaccine” were slightly more than “Encouraged a Vaccine”.	Anti-vaccination messages may have a negative impact. Misinformation could be in the form of COVID-19 memes (ideally generated for humor), that could strengthen information that is inaccurate.	Health teams should design as well as implement campaigns for increasing people's awareness about COVID-19 vaccination.
van Westen-Lagerweij <i>et al.</i> , (2021)	2021	Social media (general)	The spread of misinformation on health occurs via social media and there is no particular easy solution to it. The study focussed on the process that led to the misinterpretation of observational research on smoking.	HCPs can play a role in advising youth and young adults about the myth of smoking for protection against SARS-CoV-2 since they are the most prone group on social media.	Primary healthcare providers (HCPs) have a role in mitigating the incorrect claim about the protective effects of smoking against SARS-CoV-2. One instance could be informing patients about the harmful effects of smoking and asking about their smoking history.
Greene and Murphy, (2021)	2021	Social media (general)	There has been a sharp increase in misinformation about COVID-19 spreading via social media. Small measurable effects were seen on behavioral intentions when a single exposure was done on COVID-19 fabricated news. For instance, the study included exposure to a story on the coronavirus contact-tracing app, which was followed by a 5% reduction in willingness to download the app.	Fake news stories could lead to the generation of false memories which might in turn affect behavior decisions. In context with COVID-19, these can have severe consequences. Warnings about online misinformation by governments as well as social media companies are unlikely to be effective against misinformation.	Empirical research should be done for real-world consequences of fake news to reduce its harms.
Obiała, <i>et al.</i> , (2022)	2022	Facebook, Twitter, Reddit, Pinterest	The type of content shared on social media about COVID-19 was analyzed and categorized into 8 categories. There was a lack of myths/misinformation type of content when the most frequently shared content on social media was analyzed.	The category of myths and misinformation was eventually replaced by debunking myths and misinformation since the study did not report any. Users usually share reliable, evidence-based and objective content.	Since social media has billions of users, this potential should be utilized.
Hadlington <i>et al.</i> , (2022)	2022	Social media (general)	The study developed three themes highlighting the interaction of participants with the information being shared on social media about the COVID-19 pandemic. One theme was based on the intention of people for 'staying social'. The second theme highlighted the role of social media and pandemic uncertainty in 'A Perfect Storm for Fake News'. The third theme was based on the role of social media in the 'fact-checking' process for some participants.	Individual interactions with myths/misinformation about COVID-19 on social media vary.	A multistakeholder approach is suggested. The industry, researchers, governments, clinicians, and actual users and their communities play an important role. Guidelines and policies including campaigns for public awareness should be developed. Strategies for identifying and curbing fake news should come up.

More survey-based studies need to be done on the same to understand the pattern of change in individual beliefs about myths/misinformation about COVID-19. However, the small sample size and inclusion of a mostly smartphone-dependent population can act as limitations for the study.

B. Bibliographic Review

Our bibliographic review highlights different types of information on COVID-19 myths that have been reported from the period of 2020 to 2022 in various publications. The initial phase i.e., 2020, witnessed the shooting out of the newly erupted volcano of misconceptions with suggested solutions like anticipating and managing misinformation (Habersaat et al., 2020), monitoring the myths in social media conversations (Singh et al., 2020), etc. In 2021, many solutions were followed such as the use of infographics by WHO along with testing their efficacies (Vraga & Bode, 2021). Many milestones were achieved when COVID-19 myths on UV (O'Connor et al., 2021), and smoking (van Westen-Lagerweij et al., 2021), etc. were broken and reported in 2021. The struggle against anti-vaccination messages and vaccine hesitancy was reported (Basch et al., 2021). Slowly, the role of public health officials, government officials (Moore et al., 2021), and empirical research came forward to assess the real-world effects of these myths/misinformation (Greene & Murphy, 2021). The myths/misinformation category has been replaced by the debunking of false information (Obiała et al., 2022). The psychology of every individual varies and hence individuals' interactions with myths about COVID-19 also tend to differ (Hadlington et al., 2022). Moreover, since Twitter is a growing social media platform, the review of publications indicates that most of the studies are being done on this platform.

Two studies cover in detail the myths about vaccines for COVID-19. One of them (Basch et al., 2021) covered anti-vaccination messages that may have a negative impact. Misinformation could be in the form of COVID-19 memes (ideally generated for humor), which could strengthen information that is inaccurate (Basch et al., 2021). The other study included myths about vaccine development, where people believed that vaccines were initially hidden by the government (Singh et al., 2020). Thus, there should be a special focus on combating myths about vaccines.

All the publications under review suggested various effective measures to prevent the spread of myths. One possible solution could be conducting research to identify the perceptions of people about myths about COVID-19. Advising and making people aware of the likeliness of receiving misinformation and informing the public about the sources where truthful facts can be accessible can offer help (Habersaat et al., 2020). There should be a monitoring process for the myths in social media

conversation (Singh et al., 2020). The promotion of shareable infographics to combat the spread of myths should be encouraged. This action should be taken by health organizations to improve public knowledge (Vraga & Bode, 2021). Health teams should design as well as implement campaigns for increasing people's awareness about COVID-19 vaccination (Basch et al., 2021). As per one of the publications, primary healthcare providers (HCPs) have a role in mitigating the incorrect claim about the protective effects of smoking against SARS-CoV-2. One instance could be informing patients about the harmful effects of smoking and asking about their smoking history. One of the publications indicates a multistakeholder approach to fighting against COVID-19 myths (Hadlington et al., 2022). These measures should be adopted to fight effectively against the pandemic situation.

V. CONCLUSIONS AND FUTURE SCOPE

As responsible individuals, our goal should be to successfully recognize false information and combat its existence. Many wars against myths/misinformation have been won but with the emergence of lineages like BA.1, BA.2, BA.3, BA.4, BA.5, and recombinant variant XE, the future could hold a lot of challenges for us including the possibility of the 4th wave of COVID-19 pandemic. Additionally, people should also refrain from sending fake information to others and more survey-based research should be undertaken to assess the level of awareness.

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