

University of Groningen

Impact of the COVID 19 Infodemic on Knowledge, Attitude and Social Behavior in India

Chakraborty, Trishnika; Subbiah, Gireesh Kumar; Kulshrestha, Rohit; Subbiah, Krithika; Swathi, Gadadasu; Damade, Yogesh

Published in:

International Journal of Intelligence, Security, and Public Affairs

DOI:

[10.1080/23800992.2021.1956777](https://doi.org/10.1080/23800992.2021.1956777)

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version

Publisher's PDF, also known as Version of record

Publication date:

2021

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Chakraborty, T., Subbiah, G. K., Kulshrestha, R., Subbiah, K., Swathi, G., & Damade, Y. (2021). Impact of the COVID 19 Infodemic on Knowledge, Attitude and Social Behavior in India: A Mixed Method Survey. *International Journal of Intelligence, Security, and Public Affairs*, 23(3), 197-215. <https://doi.org/10.1080/23800992.2021.1956777>

Copyright

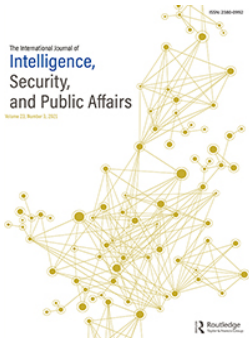
Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

The publication may also be distributed here under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license. More information can be found on the University of Groningen website: <https://www.rug.nl/library/open-access/self-archiving-pure/taverne-amendment>.

Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.



Impact of the COVID 19 Infodemic on Knowledge, Attitude and Social Behavior in India: A Mixed Method Survey

Trishnika Chakraborty, Gireesh Kumar Subbiah, Rohit Kulshrestha, Krithika Subbiah, Gadadasu Swathi & Yogesh Damade

To cite this article: Trishnika Chakraborty, Gireesh Kumar Subbiah, Rohit Kulshrestha, Krithika Subbiah, Gadadasu Swathi & Yogesh Damade (2021) Impact of the COVID 19 Infodemic on Knowledge, Attitude and Social Behavior in India: A Mixed Method Survey, The International Journal of Intelligence, Security, and Public Affairs, 23:3, 197-215, DOI: [10.1080/23800992.2021.1956777](https://doi.org/10.1080/23800992.2021.1956777)

To link to this article: <https://doi.org/10.1080/23800992.2021.1956777>



© 2021 The Author(s). Published with license by Taylor & Francis Group, LLC.



Published online: 30 Sep 2021.



[Submit your article to this journal](#)



Article views: 1536



[View related articles](#)



[View Crossmark data](#)



Citing articles: 2 [View citing articles](#)



Impact of the COVID 19 Infodemic on Knowledge, Attitude and Social Behavior in India: A Mixed Method Survey

Trishnika Chakraborty ^a, Gireesh Kumar Subbiah^b, Rohit Kulshrestha ^c,
Krithika Subbiah^d, Gadadasu Swathi ^e, and Yogesh Damade ^f

^aDepartment of Conservative Dentistry and Endodontics, I.T.S Dental College, Chaudhary Charan Singh University, Meerut, India; ^bDepartment of Health Sciences, University of Groningen, Groningen, Netherlands; ^cDepartment of Orthodontics and Dentofacial Orthopedics, Terna Dental College and Hospital, Navi Mumbai, Maharashtra, India; ^dPublic health Dentistry, Tamil Nadu Dr MGR Medical University, Chennai, India; ^eDepartment of Oral Medicine and Radiology, Anil Neerukonda Institute of Dental Sciences, Dr NTR University of Health Sciences, Visakhapatnam, India; ^fDepartment of Conservative Dentistry and Endodontics, Maharashtra Institute of Dental Sciences and Research Dental College, India

ABSTRACT

India, which has a growing base of 350 million social media users and large proportion of which are unaware about fact checking of the sources. This study aims to assess the impact of COVID-19 misconceptions on knowledge, attitude and preventive (KAP) practices in India using an online cross sectional survey and using semi-structured interviews. The 5 sections of the e-form collected the demographic profile, COVID-19 information profile, knowledge, preventive practices and attitude toward COVID-19. Also, this study aims to assess the impact of misinformation on individual and social behavior through 24 semi structured open ended interview questions and suggests mitigation measures. The misinformation question included “Coronavirus is airborne disease,” Frequent washing clothes can reduce spreading of COVID-19”, “Consuming herbal products, home cures and supplements can prevent COVID-19” and “Gargling with salt water or vinegar can prevent COVID-19.” Among the 520 responses, 44%, 51%, 44% and 32% agreed to these questions respectively. Binomial regression model was fitted to identify the predictors of KAP of COVID-19 prevention by taking the level of KAP separately and it revealed that the predictors for poor knowledge, negative attitude and noncompliance to preventive measures were associated with the misconceptions. The descriptive analysis in Tableau revealed that the trusted sources of information is majorly mass media. The content analysis of the interviews revealed that religious preventive methods, consumption of daily supplements, risk factors of the infection, disease statistics; treatments and conspiracy theory, are the subjective categories of the current outbreak. The consequences of misconceptions include stigma of discrimination, psychological distress and increased hygiene practices. The antidote to infodemics should include analyzing the information propagation and understanding the cognition and behavior of the population. In the era of the internet, health bodies can educate and address the people’s concern with the help of digital and e- health literacy.

ARTICLE HISTORY

Received 20 October 2020

Revised 18 April 2021

Accepted 13 July 2021

KEYWORDS

COVID-19; misinformation; infodemics; rumors; stigma; social behavior

CONTACT Trishnika Chakraborty  trishnikasrija1@gmail.com  I.T.S Dental College, Ghaziabad, India

© 2021 The Author(s). Published with license by Taylor & Francis Group, LLC.

This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivatives License (<http://creativecommons.org/licenses/by-nc-nd/4.0/>), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited, and is not altered, transformed, or built upon in any way.

Introduction

For low-income and low-middle income countries such as India, a lack of public health infrastructure, a high population and wide geographic areas added to the burden of the COVID-19 pandemic. Although the Indian government made the most stringent, rapid decision of nationwide lockdown to prevent community transmission, currently India has the second highest registered cases (Pai, Bhaskar, & Rawoot, 2020). Additionally, the prolonged period of lockdown caused increased psychological distress in the population (Dubey et al., 2020).

Due to the limited scientific evidence and ongoing research, disinformation and misconceptions on the transmission and treatment of SARS-CoV-2 have widely surfaced and circulated in non-peer reviewed social and mass media platforms. India is well known for its indigenous medicine alternative practices, AYUSH (Ayurveda, yoga, & Naturopathy, Unani, Siddha and Homeopathy). There are many false claims on herbal products, home remedies and immunity booster medicines, and spiritual ways for prevention and cure widely circulate among all parts of the country, which adds to the pandemic burden (Kadam & Atre, 2020). These unverified claims have impacted the knowledge, attitude and practice of general population. There have been many newspaper claims of novel medical emergencies faced by health professionals (such as, Vit. D toxicity due to self-medicated overconsumption, liver injury from herbal juices, excessive bleeding from turmeric, ginger and garlic), as a result of COVID-19 misinformation (Business Insider, 2020; Times of India, 2020). The rumor of transmission of coronavirus in air was followed by panic purchasing of N95 face masks by the public, which led to a shortage of facemasks for frontline health workers (Diwanji, 2020; Kumar et al., 2020). Currently, as a result of negative sensational news on vaccines, there is an impact on attitudes and sparks of hesitation among the public regarding vaccination.

There is also evidence of psychological impact due to misconceptions in India. The first case of suicide linked to misconception was of a 50-year-old man in A. P, who killed himself because contracting COVID-19. The family mentioned that the feeling of guilt and shame of contracting COVID-19 and unwittingly transmit to family members along with an impression of how society will react to that has caused him to take such action (Goyal, Chauhan, Chhikara, Gupta, & Singh, 2020).

Data show that people are most likely to trust misinformation because they trust the sources. There is mounting evidence suggesting that fake news spreads more easily than truths in online sources (Bastani and Bahrami, 2020; Vosoughi, Roy, & Aral, 2021). The most acceptable sources of infodemiology include mass media and social media (such as Twitter, Facebook and Instagram and search engines, health websites, blogs and forums) (Mavragani,

2020). Additionally, the information shared by family, friends and colleagues is more likely to be perceived as accurate by the public than an article by some organization, which is a matter of social behavior (Broniatowski et al., 2018; Chou, Oh, & Klein, 2018). Even before the detection of first COVID-19 case in India, sudden spurt in demand for surgical face masks and hand sanitizers led to a 20 times increase in prices (Times of India. Fact check: truth behind fake news on times of India, 2020). India has an outgrowing base of more than 350 million users of social and mass media, and a large proportion of these users follow uncredited sources.

Infodemic is defined as “an overabundance of information- some accurate and some not- that makes it hard for people to find trustworthy sources and reliable guidance when they need it, was coined to categorize some of the common features of rumors, stigma and conspiracy theories during public health emergencies. Hence, there is an urgent need to understand the predictors of misinformation and the impact of infodemics on the social behavior of the public, which will provide a framework for mitigation measures. The main aims of this study are to assess the impact of COVID-19 misinformation and rumors on knowledge, attitudes and social behaviors in India and to determine the trusted sources of information in different demographic profiles. This research was guided by the following objectives:

- 1.To determine the sources of information that the respondents recommend/trusts.

- 2.To determine the impact of misconception and sources of information on KAP.

- 3.The impact of rumors related to COVID-19 on individual and social behavior.

Assessing the knowledge, attitudes and practices toward COVID-19 would provide better insight to address the misconceptions about the disease and the development of preventive strategies and health promotion programs in India. Additionally, this survey will provide a baseline for use in future assessments on Indian COVID-19 prevention practices, and this can better prepare the government to address future health crises involving infectious diseases. Furthermore, the findings of this study will aid in developing strategies that will reflect regional and cultural factors that will be best suited to the Indian population.

Methodology

Study Design

A cross-sectional study, including quantitative survey and qualitative interviews, was conducted to achieve the objectives of this study. Data collection for quantitative cross sectional survey was performed using the platform

kobotoolbox.org. Interviews for the qualitative data was done through phone calls. Based on the interviews taken, a content analysis was performed. The call for participation was made on various social media platforms, NGO groups and college groups.

Ethical approval

Ethical approval for the study was sought and obtained from the Human Research Ethics Committee of the TDC| EC| | 21 × 2020. The study adhered to the tenets of the declaration of Helsinki regarding research involving human subjects, and informed consent was obtained from all participants prior to completing the survey and interviews. For the online survey informed consent was taken online and then directed to the main questionnaire. For the interviews, informed consent was taken by online scanned signature after explaining the objectives and voluntary nature of the research.

Recruitment procedure

The survey was conducted in India between 14th and 30th September 2020. Any Indian resident (currently living in India) above the age of 15 years were eligible for participation. Refugees and immigrants were excluded from this study.

Distribution process

For the quantitative method, various strategies were used to reach out to as many respondents as possible. Apart from using various social media platforms (Facebook, WhatsApp, Instagram, Twitter and Reddit), NGO groups, healthcare networks, college groups were used to disseminate the survey form. The sample size of 10 for the qualitative arm was determined by data saturation. Each interview lasted about 30 minutes on average. Among these, 5 were outdoor workers and the rest were either household workers or currently working from home. To calculate the sample size of the quantitative arm, 50% of precision from the previous studies was considered, with 80% of power and 5% level of significance, the study estimated a sample size of 450 using Open Epi software.

Study instrument

The questionnaire included a brief overview of the context, purpose, procedures, nature of participation, privacy and confidentiality statements and notes to be filled out. The survey instrument is an adaptation of the questionnaire developed based on the guidelines from the UNICEF, Cambodia for

clinical and community management by understanding the people's perception around the new virus and COVID-19 (UNICEF CAMBODIA, 2020). The questionnaire was modified as per the Indian population to obtain information on misconceptions and the respondent's attitude toward the mitigation practices, and their potential impact on compliance with strategies to control the spread of the novel coronavirus and risk perception of contracting COVID-19. A pilot study was completed prior to the launch of the questionnaire to ensure clarity and understanding as well as to determine the duration for completing the questionnaire. Participants (n = 25) who took part in the pilot were not part of the research team and did not participate in the final survey as well. The pilot also informed the misconceptions/disinformation to be included in the final survey.

It was sectioned into 5 parts apart from feedback: 1. *Demographics of the respondents*, 2. *Sources of Information*, 3. *Knowledge on COVID-19 (subsection on misconceptions)*, 4. *Attitude toward COVID-19 and*, 5. *Compliance to the precautionary COVID-19 practices*. The survey form was offered in English and four regional languages, namely Bengali, Hindi, Marathi and Tamil. The discrepancies in regional versions of the questionnaire were rectified through consultation with bilingual researchers. In order to further minimize response bias, this online survey used a Likert scale with provisions for neutral responses, so that the answers were not influenced in one way or another. Questions in the qualitative arm were semi-structured, open-ended and in depth regarding the participant's demographics, sources of rumor, sources of information they trust, psychological and socio-behavioral consequences due to COVID-19 and the psychosocial impact of misconceptions (Eysenbach, Yihune, Lampe, Cross, & Brickley, 2000).

Demographics

The demographics surveyed the socio demographic of the respondents, including age, gender, current work settings (outdoor/indoor), last academic qualification (schooling/college graduate/ post graduate) and location of residence (North India, South India, West India and East India).

Sources of Information

This collected the information on the respondent's trusted sources of COVID-19 information, language preference for information (English/regional language) and the main messages the respondents were interested in gathering about COVID-19. The groups: Mass media (TV, Radio, Newspaper (print/e-paper), Social media (WhatsApp, Fb, Instagram, Twitter, Health blogs/websites and others), Family and friends and Community workers (Health workers, Government workers, NGO, regional ministers, teachers, religious leaders).

Knowledge

The questions were adopted from previous studies from India and modified based on rumors and misconceptions on COVID-19. A total of 6 items, each being assigned a single point for a correct response to each item. These questions included the participant's knowledge about clinical presentations [items 1,2], transmission routes [items 3–4], prevention and control [items 5,6]

Misconceptions on transmission and prevention of COVID-19

The 4 questions included were “Coronavirus is airborne disease,” “Frequent washing clothes can reduce spreading of COVID-19”, “Consuming herbal products, home cures and supplements can prevent COVID-19” and “Gargling with salt water or vinegar can prevent COVID-19.” The options were: “true,” “false” and “may be/ neutral.”

Attitude

The attitude items in this study measured the five types of practices like hand washing, using hand sanitizer, avoiding crowded places, keeping social distance and avoiding unnecessary traveling. Additionally, assess the viewpoint on prevention based rumor of COVID-19, such as relying on herbal products/home remedies, vitamin supplements. The responses were recorded using Likert-item scale from strongly agree.

Compliance to the precautionary COVID-19 practices

To assess the frequency of practices, the questions were composed of measures to boost immunity against COVID-19, prevention and control measures of the infection. The responses were recorded using a Likert-item scale with options being: never, sometimes, most times and always.

Statistical analysis

Descriptive analysis, including counts and percentages was reported for categorical variables were done using Tableau. Based on the Likert scale used in the questionnaire, aggregate scores for levels of knowledge, attitude and practice of COVID-19 was computed using the mean cutoff of 7 for the knowledge. The assumptions required for the study such as normal distribution of data and adequacy of sample size has been critically reviewed before the data analysis. In addition, reliability of the questionnaire was performed using Cronbach's α . The 11-items for knowledge and 7-items for attitude had a reliability of 0.832 and 0.835, respectively. In statistical analysis, binomial logistic regression model was fitted to identify the independent predictors of knowledge, attitude and practices of COVID-19 prevention by taking 4 rumor

question as an outcome. Statistical analyses were performed using the IBM SPSS version 25 for Windows.

Content Analysis

The audio recordings were transcribed verbatim by the research team. The analysis of these transcripts included reading the texts several times to gain an understanding of meanings conveyed, identifying significant phrases and formulating meanings by discussion with the research team. The findings were compared and discussed by all the authors until complete agreement on classes, subclasses and coding was achieved for the manual content analysis.

Results

Socio-demographic characteristics

In this study, a total of 520 participants responded to the survey. The participants had a mean age of 34 years. The study population consisted of 287 (55%) males and 232 (45%) females. A considerable number of respondents were graduates 249 (48%). With regard to work settings, 322 respondents (62%) were indoor workers. Participation from all regions of India looks similar, reflecting the demographic density of the regions at 156 (30%), 140 (27%), 148 (28%), and 75 (14.5%). The other details on other demographic features are presented in [Table 1](#).

Table 1.

Variables	Frequency	Percent (%)
Age (years)		
Gender		
Male	287	55.3
Female	233	44.7
Location		
North	156	30.1
South	140	27.0
West	148	28.5
East	76	14.5
Level of Education		
School	94	17.9
Graduate	249	48.0
Postgraduate	177	34.1
Work setting		
Indoor	322	62.0
Outdoor	198	38.0
N = 520		

Information

Sources: According to the respondents, the major source of information was mass media (47%), followed by community workers (21%), social media (17%), family-friends (15%). With regards to location, the tableau graphical analysis depicted that in East India, the respondents mostly recommended mass media (40%), followed by family and friends (22%) and least trusted are social media. In North, most trusted sources are mass media (47%) followed by community workers (majorly, Gov. workers and HCW), followed by social media and family and friends (14%). In South least trusted sources are social media. In West, family and friends are the least trusted sources (12%). Other findings are presented in [Table 5](#).

Comprehensibility of Information

Respondents who were graduates and post graduates found COVID-19 related information easy to comprehend, while respondents with only schooling found it difficult (39%).

Table 2. Predictors of Knowledge outcome.

Variables	Odds Ratio	95% Confidence Interval		p-value
		Lower Limit	Upper Limit	
<u>Location</u>				
North		Ref ⁺		
South	2.092	0.92	4.70	0.074
East	2.411	1.07	5.41	0.033a
West	1.131	0.41	3.10	0.811
<u>Education Level</u>				
School		Ref ⁺		
Graduate	1.327	0.52	3.36	0.551
Post Graduate	1.063	0.50	2.21	0.870
<u>Source of Information</u>				
Community workers		Ref ⁺		
Mass and social media	0.97	0.59	1.61	0.930
Family & Friends	1.41	0.86	0.23	0.171
<u>Comprehensibility of COVID-19 information</u>				
Difficult to understand		Ref ⁺		
Easy to understand	0.56	0.16	1.93	0.364
Little difficult to understand	1.04	0.30	0.65	0.943
<u>Misconceptions regarding COVID-19 transmission and prevention</u>				
COVID-19 is an airborne disease	Ref ⁺			
Frequent washing clothes can reduce spreading of COVID-19	0.084	0.04	0.16	0.000a*
Consuming Herbal products, homecures (turmeric,garlic, Ashwagandha, Giloy, kaadha) and vitamin supplements (Vit C, D, Zn) can prevent COVID-19	12.009	5.95	24.2	0.000**
Gargling with salt water or vinegar can prevent COVID-19	0.029	0.01	0.06	0.000**

a- indicate significant at 5% level of confidence, **-indicates significant at 1%level of confidence

+ reference to odds ratio calculated

Interested subject of COVID-19

Most of the respondents were interested in learning about prevention (48%), followed by nature of the virus (12%) and complications due to COVID-19 (15%) and least interested in information on misconceptions, vaccines (4%).

Concerns of study population

Majority of the respondents (41%) had fear of contracting the infection and transmitting to their family, followed by concerns regarding the financial crisis (18%). A small proportion of respondents were concerned about treatment and prevention awareness (14%) and fear of social discrimination (10%).

Binomial Logistic Regression

Logistic regression based on the outcome of knowledge, good or poor showed that the questions pertaining to misconception were significant predictor of the knowledge, in particular the participants who answered consuming herbal products and vitamins could prevent COVID-19 were more likely to have poor knowledge (OR = 12; CI:5.9–24.2) with reference to those who believed COVID-19 was airborne. People from the East of the country were most likely to have poor knowledge. The other results are illustrated in [Table 2](#).

Similarly, the logistic regression on attitude, the people who believed using herbal products, gargling with salt/vinegar and COVID-19 is an airborne disease were likely to have poor overall scores on the attitude questions. The results are presented in [Table 3](#).

The regression analysis in [Table 4](#), practice outcomes showed that the participants who consumed herbal products, gargled regularly and consumed alcohol to prevent COVID-19 were more likely to have overall poor practice in relation to COVID-19 prevention. Further the location and education level of the participants were also significant predictors of practice in the final model ($p < .01$).

Qualitative Analysis

The demographic, personal characteristics and categories of misinformation related to COVID-19 of the 10 respondents are tabulated in [Figure 1](#). The main subjective categories of misinformation regarding the novel coronavirus outbreak were: Religious preventive methods, consumption of daily supplements, risk factors of the infection, disease statistics; treatments, vaccines and medicines; prevention and protection methods and conspiracy theory (Bioweapon by China, political agenda).

The content analysis reached three main themes, psychological impact due to misinformation, socio behavioral impact and impact of rumors on behavior.

Table 3. Predictors of Attitude toward COVID-19 and its prevention.

Attitude	Odds ratio	95% C.I. for EXP(B)		p Value
		Lower	Upper	
LOCATION				
North	Ref ⁺			
South	2.000	0.988	4.047	0.054*
East	2.640	1.287	5.414	0.008**
West	1.734	0.735	4.094	0.209
EDUCATION LEVEL				
School	Ref ⁺			
Graduate	1.390	0.642	3.012	0.404
Post graduate	1.481	0.789	2.779	0.221
TRUSTED SOURCES				
Community workers	Ref ⁺			
Mass and Social media	1.209	0.644	2.267	0.555
Family and friends	1.584	0.858	2.925	0.142
Misconceptions regarding prevention and transmission of COVID-19				
Relying on herbals products (turmeric,garlic,Ashwagandha, Giloy, kaadha) or vitamins (Vit C, D) for protection against COVID-19				
Disagree	Ref ⁺			
Neutral	9.781	1.744	54.861	0.010*
Agree	5.846	1.066	32.066	0.042*
Gargling with vinegar/salt water for prevention of Covid19				
Disagree	Ref ⁺			
Neutral	7.716	2.182	27.287	0.002**
Agree	3.481	1.030	11.770	0.045*
Strongly agree	1.263	0.343	4.649	0.725
COVID-19 is an airborne disease				
Disagree	Ref ⁺			
Neutral	3.904	0.436	34.963	0.223
Agree	6.384	2.795	14.578	0.000**
Strongly agree	4.904	2.728	8.815	0.000**
Comprehensibility of COVID-19 information				
Easy to understand	Ref ⁺			0.26
Little Difficult	0.710	0.160	3.000	0.640
Very Difficult	1.080	0.250	4.680	0.910

The extracted themes and sub-themes regarding impact of COVID-19 related misinformation, are presented in [Figure 2](#).

Discussion

Along with the high infectivity and fatality rates, COVID-19 has also created psychological and socio-behavioral impact. Previous studies of COVID-19 pandemic suggested that there is an interdependence of socio-behavioral impact of the pandemic with individual and public health (Nlooto & Naidoo, 2016). In general, the Indian population has a good level of knowledge related to prevention and transmission of COVID-19, which is just above 50%. However, there is an urgent attention required towards the misconceptions in regards to transmission and prevention using home cures. The correct knowledge of the respondents could be associated with the sources of information and ease of comprehensibility of the COVID-19 information. A sizable

Table 4. Predictors of Preventive practices toward COVID-19.

	Odds Ratio	95% C.I. for EXP(B)		p- value
		Lower	Upper	
<u>LOCATION</u>				
North	Ref ⁺			
South	2.507	1.422	4.419	0.001**
East	2.483	1.393	4.426	0.002**
West	2.268	1.149	4.476	0.018*
<u>EDUCATION LEVEL</u>				
School	Ref ⁺			
Graduate	2.702	1.432	5.098	0.002**
Post graduate	1.694	1.044	2.750	0.033*
Work setting	0.951	0.603	1.501	0.830
<u>SOURCES OF INFORMATION</u>				
Mass and social media	Ref ⁺			
Family and friends	1.264	0.762	2.097	0.363
Community workers	1.799	1.095	2.957	0.020*
<u>Misconceptions regarding prevention and transmission of COVID-19</u>				
Consuming herbal cures/ herbal products (Garlic, Turmeric, Ashwagandha, Kadha, Ghiloy, /vitamins (Vit C or Vit D) to boost immunity against COVID-19				
Never	Ref ⁺			
Sometimes	3.686	1.483	9.162	0.005**
Most of the times	4.594	2.234	9.445	0.000**
Always	2.668	1.395	5.101	0.003**
Gargling with vinegar or salt for prevention of COVID-19				
Never	Ref ⁺			
Sometimes	4.594	0.000		0.999
Most of the times	7.789	2.053	29.554	0.003**
Always	1.502	0.932	2.419	0.095
Alcohol consumption to boost your immunity or cure COVID-19				
Never	Ref ⁺			
Sometimes	2.114	0.321	13.908	0.436
Most of the times	3.409	1.272	9.140	0.015*
Always	1.914	1.242	2.949	0.003**

proportion of respondents who reported insufficient knowledge about prevention and transmission, trusted social media and mass media as their sources of information about COVID-19. Evidence has shown that disease literacy and attitude of the people shape their practices and preventive measures to control the spread of the disease during an outbreak (Asmundon & Taylor, 2020). The knowledge, attitude and practice (KAP) towards COVID-19 plays a vital role in identifying gaps in knowledge and determining public's

Table 5. Count of preferred sources of information in various locations and age groups.

Sources of Information	Location (%)				Age groups (%)				
	East	North	South	West	15-25 yrs	26-36 yrs	37-47 yrs	48-59 yrs	> 60 yrs
Social media	18	17	16	17	18	19	14	10	20
Community workers	20	21	20	21	21	20	17	23	22
Family and friends	22	14	17	12	16	14	17	18	13
Mass Media	40	47	47	49	45	47	53	48	45

Personal and Demographic Characteristics								
Gender	Age	Location	Living se..	Academics	Trusted sources	Perceived Informati..	Sources of Misinformations	Categories of Perceived Misinform..
Female	23	S.India	Family	Graduate	Org. websites like WHO	Precautions and Prevention	TV, Newspaper (Online)	Producing fake medications by Pharma companies
				School	TV (News Channel), Online Health forums	Precautions and Prevention	TV, Social media (WhatsApp)	Symptoms, clinical signs, prognosis of the disease
	29	N.India	Alone	Post Grad	Org. websites, Webinars by Professionals	General information about Covid-19 and Prevention	Social media (WhatsApp, FB)	Nature of the Coronavirus
	34	E.India	Family	School	Friends , Govt. workers	Vaccination and Prevention	TV , Newspaper, Social media (WhatsApp, FB)	Conspiracy thory (Bioweapon by China,political agenda)
	55	S.India	Family	Graduate	TV (News Channel)	Prevention and Transmission	Social media (WhatsApp)	Risk factors of the infection
Male	28	N.India	Family	Graduate	Org. websites (CDC)	General information about Covid-19 and Daily counts of infec..	Google search, Social media(Twitter)	Recommendation for consuming unconfirmed herbal treatments, Statistics of mortality cases
	29	N.India	Family	Graduate	Friends, TV	Vaccination and Daily counts of infected	Govt. websites (covid19india.org),Social media(Instagram, YouTub..	Social stigma and Discrimination
		S.India	Family	School	Friends, TV , Newspaper	Precautions and Regulation updates from the Gov.	Social media (WhatsApp, FB)	Incidence & recovery rate of infected cases in certain communities
	32	W.India	Alone	Graduate	Newsletter from the Airlines, BMC Twitter	Precautions and Prevention	Social media (WhatsApp, FB)	Religious preventive measures , Consumption of daily supplements
	35	S.India	Family	Graduate	TV, Workshops by office	Precautions and Prevention	Social media (Instagram, WhatApp)	Misinformation about Quarantine

Figure 1. Demographic Characteristics.

Classes, Subclasses and Codes extracted for Qualitative analysis

Non adherence to wearing mask Costly to purchase a good mask	Non adherence to wearing mask Remembering every time to wear a mask	Decreased quality of social activities Feeling absence of travelling		Non adherence to proper hand washing Cumbersome	Social Stigma Isolated if I contract Covid-19	Stress and Anxiety Anger against government	Stress and Anxiety Challenge of future uncertainty	Stress and Anxiety Fear of social
Non adherence to wearing mask Irritating and breathing difficulty	Non adherence to wearing mask Uncomfortable wearing the mask	Decreased quality of social activities No social meetings during the						
High support for face mask use Enjoy wearing a mask	High support for face mask use Simple and responsible way of protect me and my family	High support for face mask use Would protect me and others from contracting the infection	High support for frequent washing of hands Good hygiene	Non adherence to proper hand washing Difficult to find resources everytime	Social Stigma Would be judged socially if mask not worn	Stress and Anxiety Panic	Stress and Anxiety Panic purchasing	
			High support for frequent washing of hands Mandatory for prevention					
Depression Depressed and frustrated	Depression Feeling bored	Depression Lack of motivation to work	Fear of contracting Covid-19 Fear of contracting from	Fear of contracting Covid-19 Fear of contracting infection and	Fear of contracting Covid-19 Fear of family members contracting	Job Concerns Financial issues	Job Concerns Loss of job position	Adherence to frequent showering and washing of clothes Lessen fear of contracting
Depression Difficult to adapt for 3-4 months								Adherence to herbal cures Faith on Government's suggestion
Depression Feeling Upset	Depression Negative impact on mental health		Fear of contracting Covid-19 Fear of infecting other family members			Job Concerns No work/sales for 4 months		Decreased quality of social activities No social relations during the lockdown

Classes
■ Psychological consequences
■ Rumours Impact on behaviour
■ Social behavioural Impact

Figure 2. Content Analysis.

readiness to accept measures with regards to behavioral changes from health authorities and Government (Asmundon & Taylor, 2020). The dissemination of misinformation can trigger behavioral responses which can influence government policy, which has the potential to be fatal (The New Indian Express, 2020; World Health Organization, 2019). This was particularly highlighted during the early 2000 when the Mbeki South African government rejected

HIV medication, costing more than 3,00,000 lives (Young, Park, Tian, Kempner, & Preux, 2009).

Rumors, misinformation and conspiracy theories have the potential to decrease community trust in government and health care systems (Sørensen et al., 2012). A stigmatized person or community tends to seek medical care later which contributes to community transmission (Sallam et al., 2020). India also reported health crimes which originated due to the public's fear of contracting COVID-19 (Vosoughi et al., 2021).

A 2018 study reported that sensational news spreads faster than evidence-based information on social media and other mass media platforms (Giao et al., 2020). A recent article about "Battling the Infodemics" indicated that the rumor mongers who were isolated in their community, could now connect with the like-minded skeptics through social media, who posts non evidence based information to maximize the user engagement (Shi et al., 2020). Also, the voices that distrust health organizations and government authorities have increased in recent times.

One of the important finding of our study revealed that a sizable proportion of the participants were greatly impacted by fear of contracting COVID-19, financial crisis and stigma of discrimination due to the COVID-19 outbreak which can be associated with the negative attitude (67% of the respondents) toward preventive measures against the pandemic. One of the respondents, who is a cab driver, who was extremely concerned about the disease responded

"For any lay man, disease is a problem to worry about. First are the health issues, if we are infected we will be very much worried about our family members. The fear of how long it will take to get relieved from the infection persists. Second thing is money. In case of infection the amount of money spent for its treatment worries me. I have learned from others that the treatment cost is very high for a poor person like myself. I'm worried about how the future will be."

Another response from a student was,

"Nothing is systematic in COVID-19. I am worried about my finances. Also, not everyone is wearing masks and following safe distancing. Many people are asymptomatic who can transmit to others. I'm worried about what will happen next."

Mass fear of COVID-19, recently termed as "coronaphobia," inconsistency in government responses and unpredictable course of the disease can generate negative psychological responses which includes maladaptive behavior, avoidance reaction and mental distress among the population (Wong et al., 2016).

Few of the responses in regards to preventive behavior were,

- *"Uncomfortable wearing a mask, especially when you are sitting in closed rooms of the office."*

- *“Costly to purchase a good mask. Remembering every time to wear a mask before stepping outside.”*
- *“Fogging in the specs causes difficulty during driving.”*
- *“Difficulty in washing hands due to unavailability of water everywhere outside home.”*
- *“It’s additional work to wash all the vegetables which are bought from local street vendors.”*

A majority of the responses who showed good knowledge did not necessarily show good preventive practice measures (58%). While the majority of the respondents with good attitudes (57%) showed good preventive measures in practice. It has been observed that people like to have consistency, which is difficult to maintain during pandemic. Prior evidences with regards to mixed messages, communicated to the public, by different health authorities led to divided attitude toward practicing preventive measures (Eysenbach, 2020; Tangcharoensathien et al., 2020). Many respondents have proactively adopted preventive measures based on the rumors prevailing in their community.

A household worker responded about her recent changes in life after the pandemic

“In in past 4 months, I wash vegetables with turmeric and salt water before cooking. It’s very important to gargle with turmeric or salt water twice a day to prevent the infection. Another important thing is to keep courier packages under sunlight for a few hours before opening them.”

There are studies that conclude that questionable information about the pandemic in social media are at higher risk of developing mental illness. The findings of our study revealed that misconceptions and rumors have not only caused psychological distress, misunderstanding about the disease but also changes in the behavioral outcomes and have raised the trust issues between the patient doctor relationship. Nearly, all the participants in the interview responded about the stress, anxiety and stigma of discrimination. In an interview of a marketing manager responded

“Neighbors whoever stays nearby COVID-19 infected houses are isolated and discriminated against. We are stressed that we will be isolated by our community if we are COVID positive.”

While few others responded

“Among low income group people, COVID-19 is believed to be a political agenda. It triggered anger and rage among the public.”

In fear of contracting the infection, many respondents increased their frequency of washing clothes, consuming herbal products and home cures like turmeric, garlic, Ghiloy, Aswagandha and many more .

The cab driver whose concern is fear of transmitting to his family if he gets infected, responded “*I take hot food and drink hot water only. It will keep me away from the infection.*”

Another response was “*As Govt said, use ginger and garlic in our food, use lemon and the amla, the sources of Vitamin C, you don’t need any validation, you know, it for yourself when you need it, when you bite it, you feel it in yourself that you get the ting of energy. This is one of the easiest and cheapest ways to build immunity against the infection.*”

While some of these preventive measures are good for personal hygiene and health, some have caused serious health implications due to over dosage. A recent news article revealed the new emergency doctors are facing which is driven by fear and disinformations (Mavragani, 2020).

These impacts on psychosocial behavior are influenced by the unreliable information overload at fingertips. A vast majority of the population trusts their mass media and social media for COVID-19 or health related information rather than government authorities. This can be due to lack of trust due to the mixed responses from the Government, different healthcare bodies (AYUSH ministry and Medical council of India) and lack of evidence based information by the health authorities (Business Standard, 2021).

In response to unverified misinformation, misconceptions and conspiracy theories related to COVID-19, the WHO designed a framework to fight infodemics globally. Based on the EPI-WIN five-par framework for infodemic management, we recommend that the following guidelines be adopted in the context of the Indian scenario (BBC News, 2021).

1) *Identifying evidence and gathering the necessary knowledge:* Our study identified that the majority of the population needed information on prevention and protecting oneself from COVID-19. The WHO-Myth Busters have been useful to dissolve a few disinformation in India, but they need to be expanded in regional languages. There should be a unified strategy for disseminating trusted information with constant verification of misinformation based on regional social-behavioral research. Up-to-date information should be propagated to all channels, including communities where there is no internet accessibility and to vulnerable groups. According to the “information cake model,” the largest segment of unfiltered and uncontrolled messages is disseminated through social media and mass media (Luengo-Oroz et al., 2020). In India, where most of the youth uses smart phones which has pre downloaded applications, such as Facebook, TOI News, Google, Twitter and WhatsApp, fact-checking and refinement is the need of the hour. Recently, Twitter launched a R-based tool “epitweetr,” which detects the public health threats early through the unusual count of tweets (35). Similarly, a tool can be incorporated in “AarogyaSetu” (contact tracing application in India), which

will update and correct misinformation prevailing in context to each region in collaboration with local pharmacists' public health authorities (36).

2) *Simplifying knowledge for different audiences*: The knowledge should be translated into actionable “behavior-change” messages and should be expanded to regional languages without any political or commercial distortion or other influences. This adaptation of knowledge should be accessible, easily comprehensible and in all regional languages to the entire population, including marginalized and vulnerable communities. In the internet era, end users can easily access and consume information from any educational background, making eHealth literacy a significant skill and tool to disseminate trusted and correct health-related information (Luengo-Oroz et al., 2020). The Indian government launched a website for e-Health literacy, www.mohfw.gov.in, but it needs to be expanded and promoted. Additionally, visualization tools such as Tableau and SocialMention can be used in government portals to show high-quality health information in the most simplified manner.

3) *Amplifying action*: Our study suggested that a majority of the population between the age group of 22–32 years, trust blogs, health websites and social media for information. A well-coordinated campaign of social media influencers, bloggers and trusted public figures supporting facts and health-related information will harness a wider reach to counter the overburden of misinformation. Proactive engagement calls and creative posts (using free design applications, Canva) could be initiated for private sector employers, educational institutes, telecoms companies, the food and agriculture sector, faith-based organizations, social media influencers, trusted regional leaders and AYUSH workers to amplify the correct public health information. Additionally, the NGO, AYUSH and community health workers could be mobilized with the correct information, graphics and narratives to be shared within communities

(Business Insider, 2020). *Assisting the coordination and governance of all these activities*: A capacity involving health care workers, AYUSH workers, data scientists, regional leaders and other professionals should monitor these actions, which can help them understand the circulating narratives and changes in the flow of information, questions, and misinformation in communities. Moreover, artificial intelligence (AI) methods can help in public socio-behavioral analysis and accelerate the elimination of mass misinformation (37). These analyses can be used systematically to monitor and understand public knowledge, trusted sources of information, the role of spirituality and socio-behavioral changes to develop better tools for preparedness and infodemic management.

Conclusion

Infodemic management is a process and not an end statement. In the face of a pandemic, the antidote to misinformation is transparency and

understanding the psychosocial behavior of each state in India. It is necessary for all political bodies to develop a unified approach for propagating transparent, consistent and honest information to the general population in a simplified approach with evidence without creating panic. In the era of the internet, health bodies can educate and address people's concern with the help of digital and e-health literacy to bridge the level of distrust in scientific research in recent times.

Acknowledgments

We would like to thank everyone who participated in this study. Further, we would like to thank Trupti Ravindra Desai, Vinosree, Gayathri Nair, for the language reviewing and translation; Manjula Neelavanan and Shubhneet Sethi for statistical analysis. We would also like to extend our appreciation to Benjamin Mari Aya for research support and literature findings. We acknowledge Rohit Shrivastava; Rotary Club of Ashoka artisans, Shashi Kumar, Keerthika Gopinath, Elakeya Elanthirian and Shruti KS for their valuable help in survey distribution.

Notes on contributors

Trishnika Chakraborty is a dental graduate from India, currently pursuing her research masters in psychosocial behavior and health systems at the University of Groningen. She recently completed the „WHO Infodemic Manager Training“ in 2021. She is currently associated with George Institute of Global health as a research consultant for data sharing and digital health projects.

Gireesh Kumar Subbiah is a public health and epidemiology graduate from India, currently pursuing his PhD at the University of Groningen in Netherlands. He has more than seven years of experience in clinical practice, public health settings and research. He is interested in global health topics and developing sustainable public health interventions for disadvantaged populations.

Rohit Kulshrestha is a Senior Lecturer in the Department of Orthodontics and Dentofacial Orthopedics at Terna Dental College and Hospital Navi-Mumbai India. He has numerous publications in various national and international journals. His research interests lie in Orthodontics, cleft lip and palate, public health and clear aligner treatment.

Kirthika Subbiah is a dental graduate with 2 years of work experience. Currently she is starting her post graduate studies in clinical research at the University of Waterloo, Canada. Kirthika is interested in addiction research and oral cancer.

Gadadasu Swathi is a senior lecturer in the field of Oral Medicine and Radiology in Anil Neerukonda Institute of Dental Sciences. She has completed projects based on public health in dentistry.

ORCID

Trishnika Chakraborty  <http://orcid.org/0000-0002-1389-2437>

Rohit Kulshrestha  <http://orcid.org/0000-0002-8133-7515>

Gadadasu Swathi  <http://orcid.org/0000-0003-0973-2796>

Yogesh Damade  <http://orcid.org/0000-0003-1959-3320>

References

- Asmundson, G. J. G., & Taylor, S. (2020). Coronaphobia: Fear and the 2019-nCoV outbreak. *Journal of Anxiety Disorders*, 70, 102196. doi:10.1016/j.janxdis.2020.102196
- Bastani, P., & Bahrami, M. A. (2020). COVID-19 Related Misinformation on Social Media: A Qualitative Study from Iran. *Journal of medical Internet research*, 10.2196/18932. Advance online publication. <https://doi.org/10.2196/18932>
- BBC News. Coronavirus: The misleading claims about an Indian remedy. <https://www.bbc.com/news/56172784>. (8th April, 2021)
- Broniatowski, D. A., Jamison, A. M., Qi, S., AlKulaib, L., Chen, T., Benton, A., . . . Dredze, M. (2018). health communication: Twitter bots and Russian trolls amplify the vaccine debate. *American Journal of Public Health*, 108(10), 1378–1384. doi:10.2105/AJPH.2018.304567
- Business Insider. Coronavirus panic grips India, face mask prices surge by twenty times, hand sanitizers go out of stock on Amazon. <https://www.businessinsider.in/science/health/news/coronavirus-panic-grips-india-face-mask-prices-surge-by-twenty-times-hand-sanitizers-go-out-of-stock-on-amazon/articleshow/74489614.cms> (15 April, 2020, last date accessed)
- Business Standard. Ramdev-releases-paper-on-patanjali-s-1st-proof-based-covid-drug-coronil-coronavirus-treatment. https://www.business-standard.com/article/current-affairs/ramdev-releases-paper-on-patanjali-s-1st-proof-based-covid-drug-coronil-coronavirus-treatment-121021900404_1.html (As accessed on 8th April, 2021).
- Chou, W. S., Oh, A., & Klein, W. M. P. (2018). Addressing health-related misinformation on social media. *JAMA*, 320(23), 2417–2418. doi:10.1001/jama.2018.16865
- Diwanji, S. Fake news in India - statistics and facts. 2020. <https://www.statista.com/topics/5846/fake-news-in-india/> (6 October 2020).
- Dubey, S., Biswas, P., Ghosh, R., Chatterjee, S., Dubey, M., Chatterjee, S., . . . Lavie, C. (2020). Psychosocial impact of COVID-19. *Diabetes and Metabolic Syndrome Clinical Research and Reviews*, 14(5), 779–788. doi:10.1016/j.dsx.2020.05.035
- Enders, A.M., Uscinski, J.E., Seelig, M.I., Klofstad, C.A., Wuchty, S., Funchion, J.R., Murthi, M. N., Premaratne, K., & Stoler, J. (2021). The Relationship Between Social Media Use and Beliefs in Conspiracy Theories and Misinformation. *Political behavior*, 1–24
- Eysenbach, G. (2020). How to fight an infodemic: The four pillars of infodemic management. *Journal of Medical Internet Research*, 22(6), e21820. doi:10.2196/21820
- Eysenbach, G., Yihune, G., Lampe, K., Cross, P., & Brickley, D. (2000). Quality management, certification and rating of health information on the Net with MedCERTAIN: Using a medPICS/RDF/XML metadata structure for implementing eHealth ethics and creating trust globally. *Journal of Medical Internet Research*, 2(2 Suppl), 2E1. doi:10.2196/jmir.2.suppl2.e1
- Genberg BL, Hlavka Z, Konda KA, Maman S, Chariyalertsak S, et al. (2009) A comparison of HIV/AIDS-related stigma in four countries: negative attitudes and perceived acts of discrimination towards people living with HIV/AIDS. *Soc Sci Med*68:2279–2287
- Giao, H., Nguyen, T. N. H., Tran, V. K., Vo, K. N., Vo, V. T., & Pham, L. A. (2020). Knowledge and attitude toward COVID-19 among healthcare workers at District 2 Hospital, Ho Chi Minh City. *Asian Pacific Journal of Tropical Medicine*, 13. doi:10.4103/1995-7645.280396
- Goyal, K., Chauhan, P., Chhikara, K., Gupta, P., & Singh, M. P. (2020). Fear of COVID 2019: First suicidal case in India ! *Asian Journal of Psychiatry*, 49, 101989. doi:10.1016/j.ajp.2020.101989

- Kadam, A. B., & Atre, S. R. (2020). Negative impact of social media panic during the COVID-19 outbreak in India. *Journal of Travel Medicine*, 27(3), taaa057. doi:10.1093/jtm/taaa057
- Kumar, J., Katto, M. S., Siddiqui, A. A., Sahito, B., Jamil, M., Rasheed, N., & Ali, M. (2020). Knowledge, Attitude, and Practices of Healthcare Workers Regarding the Use of Face Mask to Limit the Spread of the New Coronavirus Disease (COVID-19). *Cureus*, 12(4), 1–8.
- Luengo-Oroz, M., Pham, K. H., Bullock, J., Kirkpatrick, R., Luccioni, A., Rubel, S., ... Purnat, T. (2020). Artificial intelligence cooperation to support the global response to COVID-19. *Nature Machine Intelligence*, 22, 1–3. doi:10.1038/s42256-020-0184-3
- Mavragani, A. (2020). Infodemiology and Infoveillance: Scoping Review. *Journal of Medical Internet Research*, 22(4) PMID: 32310818, e16206. 10.2196/16206.
- Nlotoo, M., & Naidoo, P. (2016). Traditional, complementary and alternative medicine use by HIV patients a decade after public sector antiretroviral therapy roll out in South Africa: A cross sectional study. *BMC Complementary and Alternative Medicine*, 16(1), 128. doi:10.1186/s12906-016-1101-5
- Pai, C., Bhaskar, A., & Rawoot, V. (2020). Investigating the dynamics of COVID-19 pandemic in India under lockdown. *Chaos, Solitons, and Fractals*, 138, 109988. doi:10.1016/j.chaos.2020.109988
- Sallam, M., Dababseh, D., Yaseen, A., Al-Haidar, A., Ababneh, N. A., Bakri, F. G., & Mahafzah, A. (2020). Conspiracy Beliefs Are Associated with Lower Knowledge and Higher Anxiety Levels Regarding COVID-19 among Students at the University of Jordan. *International Journal of Environmental Research and Public Health*, 17(14), 4915. doi:10.3390/ijerph17144915
- Shi, Y., Wang, J., Yang, Y., Wang, Z., Wang, G., Hashimoto, K. Zhang, K., & Liu, H. (2020). Knowledge and attitudes of medical staff in Chinese psychiatric hospitals regarding COVID-19. *Brain Behavior, & immunity health*, 4, 10064. <https://doi.org/10.1016/i.bbih.2020.100064>
- Sorensen, K., Van Den Broucke, S., Fullam, J., Doyle, G., Pelikan, J., Slonska, Z., & Brand, H. (2012). Health literacy and public health: A systematic review and integration of definitions and models. *BMC Public Health*, 12(1), 80. doi:10.1186/1471-2458-12-80
- Tangcharoensathien, V., Calleja, N., Nguyen, T., Purnat, T., D'Agostino, M., Garcia-Saiso, S., & Briand, S. Framework for Managing the COVID-19 Infodemic: Methods and Results of an Online, Crowdsourced WHO Technical Consultation, *Journal of Medical Internet Research*, 22, [FREE Full text] doi: 10.2196/19659 [Medline: 325586556, 26 Jun 2020, e19659,
- The New Indian Express. Bihar man beaten to death for informing Covid- 19 medical help center about arrival of two people from Maharashtra. <https://www.newindianexpress.com/nation/2020/mar/31/bihar-man-beaten-to-death-for-informing-covid-19-medical-help-center-about-arrival-of-two-people-fr-2123828.html>;(accessed on 1st October, 2020).
- Times of India. Coronavirus in Lucknow: Panic buying spurs N95 mask crisis. <https://timesofindia.indiatimes.com/city/lucknow/panic-buying-spurs-n95-mask-crisis-price-soars/articleshows/74502034.cms> (10 October 2020)
- Times of India. Fact check: truth behind fake news on times of India. <https://timesofindia.indiatimes.com/times-fact-check> (6 October 2020).
- UNICEF CAMBODIA <https://enketo.ona.io/x/RkcfJ8Hj> (4th October, 2020)
- Wong, K. K., Cohen, A. L., Norris, S. A., Martinson, N. A., von Mollendorf, C., Tempia, S., ... Cohen, C. (2016). Knowledge, attitudes, and practices about influenza illness and vaccination: A cross-sectional survey in two South African communities. *Influenza and Other Respiratory Viruses*, 10(5) 12388 PMID: 26987756, 421–428. 10.1111/irv.12388.
- World Health Organization, 2019. Ebola Virus Disease – Democratic Republic of the Congo. Geneva, Switzerland: WHO. Available at: <https://www.who.int/csr/don/28-november-2019-ebola-drc/en/>. Accessed Oct 8, 2020.