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Unlocking infodemics and mysteries in COVID-19 vaccine hesitancy: Nexus of conspiracy beliefs, digital informational support, psychological Well-being, and religious fatalism

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ABSTRACT

Guarding against an anti-science camouflage within infodemics is paramount for sustaining the global vaccination drive. Vaccine hesitancy remains a growing concern and a significant threat to public health, especially in developing countries. Infodemics, conspiracy beliefs and religious fatalism primarily fuel vaccine hesitancy. In addition, anti-vaccine disinformation, lack of understanding, and erroneous religious beliefs also trigger vaccine hesitancy. Global behavioral strategies such as wearing face masks and long-term preventive measures (i.e., COVID-19 vaccination) have effectively limited the virus's spread. Despite the alarming rate of global deaths (i.e., over 99% being unvaccinated), a large proportion of the global population remains reluctant to vaccinate. New evidence validates the usefulness of technology-driven communication strategies (i.e., digital interventions) to address the complex socio-psychological influence of the pandemic. Hence, the present research explored the digital information processing model to assess the interface between informational support (through digital interventions) and antecedents of vaccine hesitancy. This research involved two separate studies: a focus group to operationalize the construct of infodemics, which remained ambiguous in previous literature (Study 1), followed by a cross-sectional survey (Study 2) to examine the conceptual model. Data were collected from 1906 respondents through a standard questionnaire administered online. The focus group's findings revealed a multi-dimensional nature of infodemics that was also validated in Study 2. The cross-sectional survey results substantiated infodemics, religious fatalism and conspiracy beliefs as significant predictors of vaccine hesitancy. Similarly, conspiracy beliefs negatively influence an individual's psychological well-being. Furthermore, information support (through digital intervention) affected infodemics and religious fatalism, whereas it inversely influenced the strength of their relationships with vaccine hesitancy. Information support (through digital intervention) also moderated the relationship between conspiracy beliefs and psychological well-being.

1. Introduction

The coronavirus epidemic (COVID-19) has brought the globe severe socio-economic and psychological catastrophe. It has negatively affected the world economy. It raises workers' feelings of insecurity and negatively affects their mental and psychological well-being [1]. When the COVID-19 epidemic broke out in 2019, many nations across the globe enforced lockdowns, and others

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continue to do so. The nations are striving hard to save people's lives by preventing the spread of the virus. The epidemic has affected almost every aspect of people's lives. It has been more than two years since the World Health Organization (WHO) proclaimed the viral spread pandemic on March 11, 2020. Tedros Adhanom Ghebreyesus (WHO Director-General) also named it infodemics. Infodemics refers to an excess of real or untrue information, which makes it challenging to determine what to believe [2].

A major international problem encountered from the onset of the pandemic is the influx of misinformation and conspiracy theories about the virus's origin, cause, and prevention. Scientists, researchers, and pharmaceutical firms worldwide have developed coronavirus vaccines, and more than a dozen vaccines have been approved [3,4]. However, the phenomenon of "infodemics," defined as the rapid spread and amplification of vast amounts of invalid information on the internet, is a tremendous and ongoing challenge in the COVID-19 pandemic. The greatest challenge nations are currently experiencing is vaccine hesitancy and vaccination-related "Infodemic" [5]. Scholars describe it as a "delay to accept or reject vaccinations, although they are available" [6]. With the rise of COVID-19 cases globally, vaccination must be prioritized to promote herd immunity.

However, in addition to the infodemic, religious fatalism is also associated with vaccination hesitancy among the masses across the globe. Past studies noted that religiosity, alongside moral purity concerns, are the best predictors of vaccination hesitancy [7], refuting scientific evidence [8]. In Pakistan, religious scholars play a crucial role in influencing the masses' attitudes toward vaccination [9]. However, COVID-19 infection rates in Pakistan increased rapidly due to societal and religious attitudes regarding the epidemic. As of September 8, 2022, Pakistan had more than 1.57 million confirmed cases and 30,593 deaths.

Moreover, immediately after declaring COVID-19 as a pandemic, numerous wild conspiracy theories sprouted through social media. As a developing nation, Pakistan is quite vulnerable to such conspiracy narratives. For instance, the vaccination campaigns for polio [10] and COVID-19 [11] faced challenges owing to conspiracy theories and beliefs. Because of these conspiracy theories and related beliefs, Pakistan is the only nation that has not yet eradicated polio.

With emerging concerns about vaccine hesitancy owing to the factors mentioned above, the Strategic Advisory Group of Experts (SAGE) on immunization emphasized investigating the critical social, religious and psychological factors. This is a necessary step toward chalking out a counter-strategy to diminish the resistance to a vaccine for COVID-19 by using digital technologies for the welfare of society. Past studies in this regard show that social support is essential for the reduction of hesitancy toward vaccination [12,13]. COVID-19 related infodemics are quite widespread on social media platforms, which is important because people gain social support through these platforms. Health authorities have provided digital informational support to counter the widespread infodemics. However, there are also complicated links between faith and immunization [14], which differ from one religion to another and remain unexplored. For example, many Muslims are worried about the halal status of certain vaccinations [15].

Additionally, the concept of infodemics has remained ill-defined. Some studies define infodemics as a set of digital misinformation and fake facts endangering public health and safety by misleading the public [2]. Others operationalize it as misinformation that can mislead people by providing cures for COVID-19 rather than vaccination. Consequently, after gathering sets of indicators from the literature on infodemics, this research carries out a focus group. In this way, this study adopted a novel and exhaustive approach that was neglected in past studies.

Further, the research contributes to the literature by drawing an analogy from past theories, such as social support theory and inoculation theory, to examine an understudied phenomenon that has been neglected in prior research on COVID-19: how individuals respond to digital informational support (e.g., WHO digital media intervention) in a digital, communicative environment. Therefore, this research elucidates the role of informational support by health authorities in addressing pertinent, intriguing and novel questions, including; how (1) infodemics, (2) religious fatalism and (3) conspiracy beliefs related to COVID-19 influence public hesitancy towards COVID-19 vaccination; (4) how conspiracy beliefs influence the public psychological well-being that can affect vaccine hesitancy in turn, (5) how the technology-driven digital informational support provided by health authorities functions as the moderating factor to diminish the influence of (a) infodemics and (b) religious fatalism on vaccine hesitancy, and lastly, (6) how the technology-driven digital informational support provided by health authorities serve as an effective strategy to lessen the negative influence of conspiracy beliefs (see Fig. 1). To the best of our knowledge, there is a research lacuna in detailing the effectiveness of digital health interventions such as informational messages by health authorities. This research intends to advance the understanding to design a more inclusive strategy to combat the COVID-19 pandemic.

2. Literature review

2.1. COVID-19 vaccine hesitancy

Widespread vaccine hesitancy is a worrying issue, particularly in developing nations [16]. A spectrum of vaccination-related beliefs ranging from cautious acceptors to outright doubters may motivate vaccine hesitancy, defined as patient-level hesitation to get vaccines [17]. Moreover, false information about vaccination's advantages, medicinal composition, and harmful effects is one hurdle to universal vaccination. It hinders patient comprehension and total agreement [18]. The World Health Organization (WHO) already designated vaccine hesitancy as one of the top ten global health concerns in 2019. COVID-19 vaccine hesitancy has been documented in various nations [19,20]. The hesitancy to take the COVID-19 vaccine is associated with conspiracy theories. These conspiracy theories influence people's intention to get vaccinated [21]. These conspiracy theories revolve around vaccine side effects and population control vis-à-vis the COVID-19 vaccination[22,23]. Covid-19 misinformation has had a negative impact on public perceptions of willingness to receive a COVID-19 vaccine [19].

Although disinformation affects socio-demographic groups differently, populations at high risk of severe COVID-19 complications are more susceptible to misinformation [24]. It's no secret that vaccination hesitancy is a global problem. However, the media has focused on Muslim views regarding certain coronavirus vaccines [15]. There have been recent fatwas against the Chinese Covid-19 vaccination issued by clerics in the Far East. Experts point out flaws in media coverage of the Muslim world and explain the fundamental reasons for vaccination hesitancy [14]. Starting with the smallpox vaccination in the 19th century, the issue of hesitation among Muslims may be viewed via the prism of the religion-ethical discourse [15]. To recognize and successfully resolve this problem, it is important to examine the connection between religion and science. As patients increasingly seek health information from the internet and social networks, such as those created on social media, there is rising interest in using interactive social media in public health promotion. However, there is a substantial danger of harmful misinformation propagating across networks, which

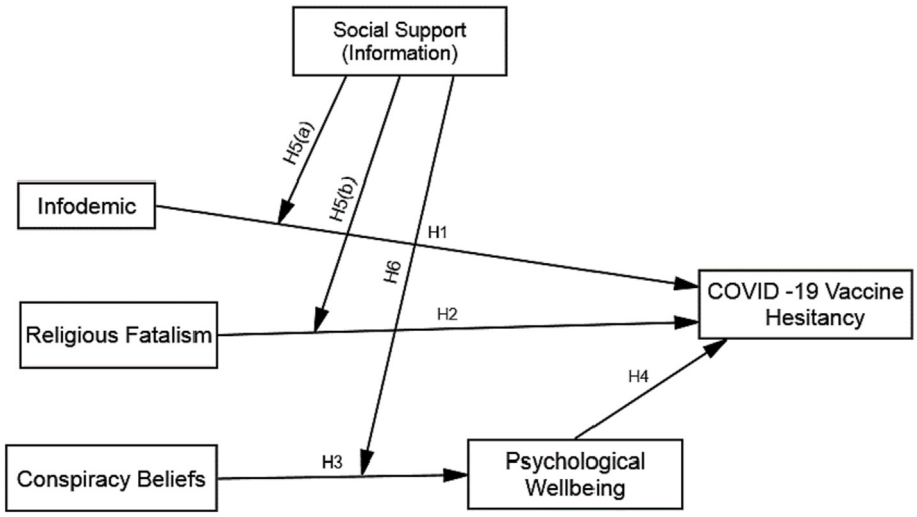

Fig. 1. Analytical model.

the present anti-vaccination movement may be maintained, fueling vaccine hesitancy [25].

2.2. COVID-19 infodemics on social media

Infodemics involve information overload, including both correct and misleading information, which results in creating confusion among the masses [26]. Misleading information is mainly categorized into two types; (a) "disinformation" is described as the spread of misleading information with mischievous intents, and (b) while "misinformation" is described as the spread of misleading information without mischievous intents. From the health communication perspective, regardless of the type, both "disinformation" and "misinformation" harm public health. Therefore, infodemics are a growing concern for public health managers in times of pandemics. For this reason, the WHO stated that the COVID-19 pandemic is supplemented by a phenomenon of "infodemics" and labeled it as a "second disease" accompanying the COVID-19 pandemic.

According to July 2021 stats, more than 4.48 billion people globally use social media [27]. These individuals may turn to social media during a pandemic to enhance their understanding of the disease, the transmission process, and preventative methods [28]. Since its beginning, the COVID-19 pandemic has been overwhelmed by misinformation and disinformation [29,30]. However, academicians and media practitioners' use of the term "misinformation" has been inundated with conceptual fuzziness. It is being used interchangeably with terms such as "disinformation," "rumor," or "fake news" [31,32]. There is a tsunami of misinformation flooding across social media platforms. In this context, the term, infodemic, is devised to outline the harmful effect of the extensive dissemination of misinformation during the outbreak [33]. On the one hand, WHO is leading the effort to slow the spread of the 2019 coronavirus disease (COVID-19) outbreak and a global epidemic of misinformation. In this regard, at the Munich Security Conference on February 15, 2021, WHO Director-General Tedros Adhanom Ghebreyesus claimed, "We're not just fighting an epidemic; we're fighting an infodemic" [26].

Likewise, others cautioned about the "overabundance of information – some accurate and some not – that occurs during an epidemic" [6]. Scientific data does not support many online health-related rumors [34]. Social media may also efficiently disseminate pandemic-related health information [35]. Thus, users seeking health information on internet platforms risk being exposed to disinformation that might jeopardize the public's welfare. User-generated content on social media, such as disinformation, is highly subjective or incorrect [36]. This social media infodemic corresponds to distrust in experts, resulting in vaccine hesitancy [37,38]. Keeping this literature in view, we posited our first hypothesis.

***H1**: Infodemics influence COVID −19 Vaccine Hesitancy.*

2.3. Religious fatalism and COVID −19 vaccine hesitancy

Fatalism refers to various beliefs, ideas, and dogmas that appear to have significantly influenced the health-related behaviors of individuals from a wide range of backgrounds [39,40]. Spiritual beliefs are associated with health-related thoughts and behaviors in either positive or negative ways [41]. Islamic perspective about COVID-19 and other such plagues explicates that such pandemics are a source of trials and punishment for people [42]. And nothing can happen to people without the will of God. In this regard, Nageeb et al. [14] noted that "among Muslims, religious fatalism related to God's control of disease and cure are reported to significantly impact attitudes towards preventive health as well as choices about therapy" (p. 8.).

The association of religious fatalism has been studied in various health-related contexts, such as the use of seat belts [43,44], alcohol consumption [45], smoking behavior [46,47], and cancer screening and treatment adherence behaviors [48]. However, the findings are inconsistent. Some studies indicate that fatalistic beliefs correspond to anti-treatment-seeking behaviors [49,50]. Some others revealed that religious fatalism is associated with increased smoking behavior [46]. Still, some other studies found fatalism not to be a significant predictor of health outcomes [47,51]. However, fatalism has been chiefly associated with poorer health outcomes and decreased healthy behaviors [41]. In the light of this literature, we hypothesize that;

***H2:** Religious fatalism influences COVID −19 Vaccine Hesitancy.*

2.4. Influence of conspiracy belief on COVID-19 vaccine hesitancy

Fear about vaccines has been linked to conspiracy theories [52]. The believers of conspiracy theories distrust science [53,54] and the government [55]. Vaccine uptake has been impacted in the past by negative assertions regarding vaccine efficacy. Nigeria, Pakistan, and Afghanistan saw an upsurge in polio infections as a result of a boycott of the polio vaccination owing to allegations that the vac-

cine caused infertility. These conspiracy beliefs pose a significant challenge to health policies, actions of government and non-government authorities and international health institutions like the World Health Organization (WHO). However, exposure to social media and the online anti-vaccine movement may discourage people from accepting COVID-19 vaccination.

The most prevalent conspiracy theory circulating on social media was that the COVID-19 vaccination might be used as a birth control tool, and the COVID-19 vaccination would be a source of profit for pharmaceutical companies and a bioweapon [53,56–58]. Moreover, conspiracy beliefs influence public behavior toward taking precautionary measures required to reduce the spread of COVID-19, such as social distancing or wearing masks [53,54,59]. Based on the findings of the recent literature, it can be postulated that the more public believes in the conspiracy ideas, the greater extent of adverse effect is expected on their psychological well-being along with the vaccine hesitancy:

***H3**: Conspiracy beliefs contribute to vaccine hesitancy.*
***H4**: Conspiracy beliefs negatively influence the psychological well-being of people.*

2.5. Psychological Well-Being

Psychological well-being is a wide-ranging concept [60]. Theoretically, psychological well-being includes six distinct dimensions of wellness [61]. More explicitly, psychological well-being is a flexible concept that deals with people's feelings about everyday activities [62,63]. Such feelings may range from negative mental states to positive outlooks. Although psychopathology has dominated the scientific exploration of abnormal mental states, people's responses to loss and unpleasant experiences have been found to be diverse [65]. The emergence and spread of the COVID-19 epidemic across the globe posed a severe threat to the population's health, especially the older population [64]. Thus, COVID-19 produces both physical and psychological side effects.

In recent years, academics have become increasingly conscious that well-being encompasses more than just the absence of emotional discomfort. It is described as an attempt to develop oneself and reach our full potential. Differently put, the positive effect of psychological well-being is associated with higher levels of social contact and more exposure to new experiences, leading to a feeling of purpose in life and a sense of direction in life. This corresponds to dealing with obstacles and concerted efforts to overcome and accomplish worthwhile objectives [66]. Personal development and purpose in life are essential components of good psychological functioning. The comparison of elderly, young, and midlife show that personal growth and meaning in life appear to diminish with age [67]. As a result, older individuals are happier in their life when they have personal traits such as resilience and thankfulness [65]. The pandemic was prevalent in Pakistan, and as with other places worldwide, the situation caused fear and anxiety. These factors are associated with a negative effect on psychological well-being, such as various indices of anxiety, fears of a nervous breakdown and physical symptoms of ill health. The literature found that depression and anxiety correspond to poor psychological well-being [68]. Therefore, our fifth hypothesis is:

***H5**: The lower the psychological well-being, the higher the level of COVID −19 Vaccine hesitancy.*

2.6. Digital interventions by health authorities to provide informational support

Social support is the availability of reliable people in our lives who let us know that they care about, value, and love us [69]. It includes support perceptions (perceived support) and supportive behaviors (received support), which can promote overall well-being and increase personal resistance to health problems[70]. Some scholars have broken social support into three categories: emotional support, instrumental support, and informational assistance [12,71]. Others use different categories, such as subjective support, objective support, and support utilization [72]. These social supports come from different sources such as family, romantic partners, friends, community ties, social media and colleagues [73]. In times of pandemic, informational messages such as digital interventions on several social networking sites remained the primary public's main trusted source of information. This informational support is theoretically critical because people look into the solutions in crisis times for the required behavioral cues. The WHO and health departments use the digital platform to raise awareness, educate and direct the people about preventive measures such as vaccination. At the same time, people were being exposed to user-generated content mainly comprised of infodemics, conspiracy beliefs and fatalistic viewpoints.

Literature on social support theory suggests that the action cues provided through informational support improve coping performance [74]. Informational support has been verified to affect numerous health behaviors and self-care positively. In the digital era, social media is growing to provide informational support to enhance positive health behavior [75]. Similarly, scholars have advocated that the social media-enabled healthcare phenomenon proved an effective strategy [74] and supported the benefits of digital media usage in developing health behavior [76]. In this study, we argue that during COVID-19, similar communication strategies have been in place to yield precautionary behaviors among the public. For example, the WHO launched a massive campaign on digital media to exchange the benefits of the vaccination program, mainly targeted at diminishing the infodemics. Many people followed the pages of health authorities and paid attention to the digital information (i.e., Facebook ads) as they perceived it as a source of informational support. Thus, this study draws an analogy from social support theory to examine how effectively these informational interventions correspond to precautionary behaviors among the masses. Hence, we hypothesize that:

H6: Informational support will moderate the relationship between (a) infodemics and (b) religious fatalism and COVID −19 Vaccine Hesitancy so that greater social support lowers COVID −19 Vaccine Hesitancy.

2.7. Influence of informational support on conspiracy beliefs and psychological well-being

The availability of social support improves health-related quality of life [77]. For instance, social support is crucial in treating mental health disorders among individuals [78]. Similarly, social support works as a protective factor against the harmful effects of distress on mental and physical health [12]. Without social support, the overly negative mood caused by unforeseen disasters may become a mental illness. To assist healthcare professionals in properly managing stressful events, such as emergency circumstances, disaster events, and outbreaks of infectious illnesses, adequate social support was also recognized as essential [13]. Increasing fear and anxiety have been linked to the COVID-19 epidemic. During the lockdown period, public media consumption and extensive entertainment content corresponded to stress, loneliness, insomnia, depression and anxiety [68].

The social support theory also postulated that informational support could reduce the adverse impacts of the crisis and traumatic events on one's health [79]. Thus, informational support can serve as a stress buffer. The information outlines supportive

actions such as recommending vaccination to reassure the harmful effects or providing supportive beliefs. Such informational support can lead to assessing possibly intimidating circumstances as less worrying and promote health and psychological well-being. Hence, high levels of social support during a stressful life event, such as the COVID-19 pandemic, may reduce the risk of mental health issues. Social distance and self-isolation during COVID-19 were studied for their effects on emotions of stress or anxiety about the pandemic, the perception and receipt of social support, and mental health difficulties during COVID-19 [80]. In this regard, a lack of social support during the pandemic may raise the risk of mental health problems. This is evident from previous pandemics (HIV/AIDS, H1N1, SARS, and Ebola), showing that social support was related to reduced mental health issues (e.g., depression and anxiety). The COVID-19 pandemic caused people to isolate themselves from others, limiting the amount of social assistance they may get and receive. Differently put, "flattening the curve" may restrict the virus' transmission, but it might also have severe psychological effects. This study presents the following hypothesis based on a literature review:

> ***H7****: Informational support will moderate the relationship between conspiracy beliefs and psychological well-being because the higher the Informational support, the higher the psychological well-being.*

3. Research design

We used two methods based on the nature and objectives underpinned in this research. First, a focus group method was employed to clarify the existing understanding of the novel phenomena of infodemics. Second, a cross-sectional reseach design vis-avis survey method was used to examine the conceptual model of this research. Details of each method are delineated in the following sub-sections and graphically presented in Fig. 2.

3.1. Study 1: Focus group

Focus groups have rapidly emerged as a suitable technique for developing and refining survey items [81,82]. This research employed the focus group to refine a pool of effective items to measure the construct of the infodemics. For this reason, several steps involved in this procedure, ranging from item generation to finalizing the appropriate items through a focus group and are delineated in this section. The rationale for using this focus group includes: (1) there is no census on the attributes of the infodemic construct, (2) infodemic is a quiet phenomenon and needs clarity in terms of operationalization, and (3) previous studies measuring infodemics lack contextual depth. In keeping with these rationales, study 1 followed several steps. Initially, a literature review was carried out to pull prevailing attributes of the infodemics. To do so, a list containing the attributes assigned to the infodemics construct and items in previous literature was formulated. Next, two volunteers were requested to code the social media content containing dense infodemics (misinformation and fake facts). Following these preliminary steps, 12 participants were recruited to carry out the focus group. Past research established that a minimum of 4–6 participants is an adequate sample size to conduct a focus group [83]. Participants were recruited by disseminating online invitations. This procedure ensured feedback from individuals exposed to infodemics during COVID-19. The invitation was sent out through digital media platforms to validate the scale of infodemics spread on digital platforms such as Facebook. The literature also used a non-random sample owing to the applied requirement of performing the focus group [81].

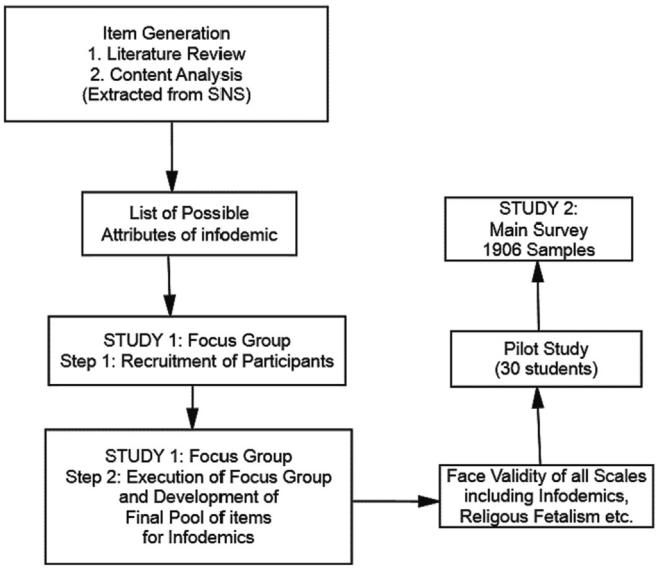

Fig. 2. Overview of the Research design.

The focus group was carried out in two waves to discuss the specific attributes gathered through the literature review. The main criteria for the recruitment of the participants in the focus group were: (1) age (i.e., 18 and above), (2) regular use of social networking sites, and (3) background knowledge about infodemics. After obtaining informed consent from the volunteers, three closed-ended "filter" questions concerning the benchmarks mentioned above were asked. One sample item was "how often do you use social networking sites?" The recruitment procedure reached the desired number of participants. Once desired and suitable participants were chosen, they were invited and gathered at the lab facility to discuss the infodemics about the COVID-19 vaccination. Twelve participants from the south Punjab area agreed to visit the lab facility to discuss the dimensions and facets of the infodemics critically. Necessary COVID-19 safety-related government recommended precautionary steps were taken during the focus group to ensure the participants' safety. The common infodemics on social media and extracted from the literature were on the agenda. The procedure of the focus group involved briefing participants about the objectives and providing the following content: (1) definitions of infodemics construct deducted from literature, (2) a coded list containing the attributes related to infodemics along with items deducted from literature, and (3) a list of items with four-point Likert scale with no neutral.

Once the two waves of 45-minute discussion were completed, the participants recorded their responses on the list of items (each representing a particular attribute). In this way, the content validity index (CVI) procedure was adopted to estimate the level of their agreement about the indicators to measure the infodemics. The responses were calculated using the CVI formula with a threshold of 0.67 [84]. The responses for the list of items provided to the participants after two sessions of the discussions were then evaluated using the CVI. The participants thoroughly discussed and agreed upon nine infodemics (see Appendix A) with two main attributes related to misinformation (1) safety and (2) fake cures. The focus group results demonstrated that these nine infodemics were key elements that have fed the misinformation and confusion regarding the COVID-19 vaccination among Pakistanis. These indicators were used in the subsequent survey study to measure infodemics.

3.2. Study 2: Cross-sectional survey

3.2.1. Method, sample and procedure

Owing to its nature, the study used a cross-sectional research design vis-a-vis an online survey method for the data collection.

Data were collected from 1906 Pakistani digital media users. An online Google form link to the questionnaire was circulated through posting on numerous social networking platforms (i.e., Facebook, Instagram, Twitter, etc.). These sites were chosen because, during the COVID-19 pandemic, these platforms became a vehicle for users to spread infodemics, conspiracy theories and religious content. A total of 1906 responses from adults were collected during three months, i.e., November 1, 2021, to January 31, 2022. A G-power analysis was carried out to confirm the sample representativeness; it revealed that a sample size of 1300 and above would be suitable, with an effect size f = 0.47 and power of 0.90 (p = 0.001), given that the anticipated conceptual model contains six variables (three independent, one mediating, one dependent and one moderating variable). Lastly, to access an ample sample size for national representation, Pakistan's total population of 220 million was considered. Using the established sample size determination formula, 1354 was found to be an appropriate sample size for the said purpose with confidence = 9 9 % and margin of error = 3.5 %.

3.2.2. Measurements

3.2.2.1. Independent variables. The variable of the Infodemics was measured using nine items. These items were extracted from the results of the focus group. These items represent the nine common infodemics and confusion about the COVID-19 vaccines. Conspiracy beliefs were measured using five items adapted from Bogart et al.[85] and Soveri et al.[86]. The Helpless Inevitability Subscale of the Religious Health Fatalism Questionnaire (RHFQHI) was used to measure fatalistic beliefs. This scale is established to tap fatalistic beliefs related to less healthy behaviors among the public. Items of all independent variables were measured on a five-point Likert scale anchoring "(1 = Strongly Disagree to 5 = Strongly Agree).".

3.2.2.2. Mediating variable. The mediating variable of psychological well-being was measured using the critical indicators of mental health like depression, anxiety, stress and insomnia. The PHQ-4 scale (The Patient Health Questionnaire-4) was used to measure depression and anxiety on a 4-point Likert scale "(1 = Not at all, 2 = several days, 3 = more than half the days and 4 = nearly every day)" adapted from Kroenke et al.[87]. This scale contains two items to tap each dimension of depression and anxiety. The subscale, DASS-21, was employed to tap the dimension of stress based on seven items adapted from literature (Oei et al., 2013) on a 4-point Likert scale "(1 = did not apply to me at all, 2 = Applied to me to some degree or some of the time, 3 = Applied to me to a considerable degree or a good part of the time, and 4 = Applied to me very much or most of the time)". Lastly, four-items were employed to tap the insomnia dimension on a 4 point Likert scale " (1 = Always, 2 = Mostly, 3 = Sometimes 4 = and Seldom)" adapted from Crönlein et al.[88].

3.2.2.3. Moderating variable. The four items were adapted from the work of [89]to measure the digital informational support on a five-point Likert scale anchoring "(1 = Strongly Disagree to 5 = Strongly Agree)". The scales were re-worded and rephrased according to the context of this study and forwarded to the eight subject experts for face validity.

3.2.2.4. Dependent variable. The five items were adapted from the literature [90] to measure Vaccine Hesitancy on a five-point Likert scale anchoring "(1 = Strongly Disagree to 5 = Strongly Agree)". This scale was also re-worded and rephrased according to the context of this study and forwarded to the eight subject experts for face validity.

4. Results

Before performing the primary analysis, the data were screened for normality using the software SPSS 24.0. In the first instance, the missing values were adjusted by utilizing the mean adjusted values, and then the analysis proceeded for the outliers' identification. Computation of the univariate, bivariate and multivariate outliers' identified 116 outliers' cases that were removed to attain normality of the data, and 1790 responses were retained. Then we further examined the normality of the data by observing the skewness/kurtosis values and Shapiro Wilk values. We proceeded with the correlation statistics after meeting the normality of the data. The findings of Pearson's correlation validated that all constructs in question were significantly correlated (see Table 1).

4.1. Structural equation Modeling: Confirmatory factor analysis (CFA)

Structural equation modeling (SEM) is a prevailing method widely used to test multifaceted multivariate effects and primarily used to confirm the theory [91]. Additionally, it is a superior and advanced approach to multiple regression as it provides added information (i.e., composite reliability) and can deal with the complex model (i.e., mediation/moderation). The study employed the second-order confirmatory factor analysis (hereafter CFA) to verify the prior theoretical assumptions using the AMOS.24 software based on the six standard indices to assess the model fitness. Table 2 suggests the good fit indices for the proposed measurement model after deleting the five items from the several latent variables.

To address common method variance (CMV), the common latent factor (CLF) procedure was employed. To do so, all observed variables of the latent factors were loaded on a single marker variable, and CLF was computed. The standardized regression weights of the observed variables were compared before and after computing the CLF. However, it was found that there were no CMV issues as the difference between the standardized regression weights before and after the CLF was not greater than 0.2. The common method bias (CMB) is a known problematic issue, mainly when a cross-sectional design has been used and can affect the authentication of the results due to a bias of the instrument estimation. The CMB problem can emerge owing to the survey administration issues, including; (1) independent variables and dependent variables (or indeed all variables) are collected simultaneously and

Table 1
Descriptive and Correlation Analysis.

Constructs	M	SD	α	ID	VH	CB	RF	IF	PW
Infodemics	2.66	0.964	0.89	1					
Vaccine Hesitancy	4.13	0.682	0.91	0.119*	1				
Conspiracy Beliefs	3.86	0.676	0.87	0.077*	0.285*	1			
Religious Fatalism	3.69	1.23	0.96	0.235*	0.193*	0.265*	1		
Informational Support	4.36	0.531	0.78	0.106*	0.265*	0.383*	0.365*	1	
Psychological Well-being	3.77	0.597	0.90	0.002	0.105*	0.213*	-0.037	-0.005	1

* = Significant at a level of < 0.05.

Table 2
Measurement Model Fit Indices.

Model	x^2	x^2/df	CFI	IFI	GFI	TLI	RMSEA
Measurement Model	3196.74	3.59	0.95	0.94	0.91	0.95	0.048

Table 3
Convergent and Discriminant Validity.

Constructs	CR	AVE	ID	VH	CB	RF	IF	PW
Infodemics	0.957	0.763	(0.873)					
Vaccine Hesitancy	0.913	0.681	0.13	(0.825)				
Conspiracy Beliefs	0.908	0.664	0.11	0.29	(0.815)			
Religious Fatalism	0.967	0.880	0.18	0.19	0.29	(0.938)		
Informational Support	0.812	0.592	0.12	0.24	0.41	0.38	(0.769)	
Psychological Well-being	0.947	0.605	0.01	-0.01	0.01	-0.05	0.02	(0.778)

AVE: Average Variance Extracted, CR: Composite Reliability and Values in Parentheses represent the Square root of AVE.

(2) uniform or identical response set usage (i.e., Likert-type scales). The current study has also used a cross-sectional design with the same response set for measuring all variables. Therefore, the model was tested for CMB using a Specific Bias Test.

The zero constraints test results revealed no significant difference (Zero Constrained Model and Unconstrained Model; $x^2 = 2561.558$, df = 535 and p = 1.00) for the specific bias. Therefore, no specific response bias was detected affecting the model, and no further bias distribution test was needed. Hence, the analysis proceeded to evaluate discriminant validities using the HTMT matrix. Moreover, convergent, along with composite reliability (CR), average variance extracted (AVE) values. The results in tables 3 (i.e., HTMT, CR, and AVE) and 4 (i.e., item loadings demonstrated that validities were attained and analysis could proceed for hypotheses testing (see Fig. 2).Table 4..

Table 4
Standardized Regression Weights.

Indicators	Estimates
ID1	0.95
ID2	0.71
ID3	0.77
ID4	0.98
ID5	0.31*
ID6	0.46*
ID7	0.69
ID8	0.99
ID9	0.96
VH1	0.65
VH2	0.84
VH3	0.81
VH4	0.93
VH5	0.87
CB1	0.80
CB2	0.71
CB3	0.84
CB4	0.85
CB5	0.86
RF1	0.93
RF2	0.96
RF3	0.97
RF4	0.89
IF1	0.83
IF2	0.51*
IF3	0.68
IF4	0.79
IS1	0.68
IS3	0.82
IS2	0.70
IS4	0.72
DA1	0.70
DA2	0.86
DA3	0.75
DA4	0.60
ST1	0.37*
ST2	0.21*
ST3	0.78
ST4	0.99
ST5	0.65
ST6	0.98

* Item removed.

4.2. Hypothesis testing

The study proposed seven hypotheses, including (a) four hypotheses postulating the direct influence of infodemics, religious fatalism, psychological well-being, and conspiracy on vaccine hesitancy, (b) one hypothesis postulating the direct influence of conspiracy beliefs on psychological well-being, (c) two moderating hypotheses (H6 a and b) postulating strength of the relationship between infodemics and religious fatalism with vaccine hesitancy, and lastly, (d) one moderating hypothesis (H7) postulating strength of the relationship between conspiracy belief and psychological well-being. Owing to the nested model, the study proceeded with the hypotheses testing using SEM instead of the regression method. To do so, the SEM using AMOS.24. was run in two stages (a) SEM model 1 analyzed the direct path, and (b) SEM model 2 analyzed the moderating effects by including interactional terms of IF (moderating variable) as suggested by Preacher and Hayes[92]. The findings were obtained by using the bootstrapping ML method. To do so, 5000 bootstraps were used along with the 95 % level of confidence intervals.

In the first stage, path analysis was used to examine the direct postulated influences (H1 to H5). Model 1 demonstrated goodness of fit as $\chi 2/df = 2.59$, $p < 0.67$, GFI = 0.96, CFI = 0.98, TLI = 0.98, NFI = 0.96 and RMSEA = 0.04. The model extracted 64 % variance ($R^2 = 0.64$). The findings of the full structural model using 5000 bootstraps and 17 iterations substantiated that infodemics ($\beta = 0.46$), religious fatalism ($\beta = 0.33$) and conspiracy beliefs ($\beta = 0.33$), positively predicts vaccine hesitancy. In other words, the higher the ID, RF, and CB, the greater the extent of vaccine hesitancy among individuals. At the same time, psychological well-being negatively ($\beta = -0.18$) predicts vaccine hesitancy; thereby higher the PW (e.g., stress), the lower the extent of vaccine hesitancy. Thus, H1, H2, H3, and H4 were supported. Similarly, the findings also substantiated that conspiracy beliefs ($\beta = -0.21$) negatively influence the psychological well-being of the individuals (H5). Thus, a greater extent of conspiracy belief threatens one's psychological well-being (see Table 5 and Fig. 3).

Table 5
Standardized Regression.

Model 1	β	Lower	Upper	t-Value	P	Hypothesis	R^2	ΔR^2
ID → VH	0.46	0.442	0.487	12.59	0.001	H1 Accepted	0.64	
RF → VH	0.33	0.318	0.353	15.35	0.001	H2 Accepted		
CB → VH	0.29	0.246	0.374	11.41	0.001	H3 Accepted		
PW → VH	-0.18	-0.165	-0.227	12.43	0.001	H4 Accepted		
CB → PW	-0.21	-0.193	-0.254	15.27	0.001	H5 Accepted		
Model 2							R^2	ΔR^2
ID → VH	0.14	0.055	0.247	8.302	0.015		0.46	-0.18
RF → VH	0.23	0.142	0.316	13.62	0.014			
CB → VH	0.12	0.117	0.132	5.101	0.001			
PW → VH	-0.29	-0.255	0.315	7.679	0.001			
CB → PW	-0.09	-0.050	-0.148	4.398	0.002			
IF X ID → VH	-0.26	-0.035	-0.285	6.892	0.001	H6(a) Accepted		
IF X RF → VH	-0.11	-0.087	-0.135	8.813	0.044	H6(b) Accepted		
IF X CB → PW	0.25	0.237	0.280	7.451	0.001	H7 Accepted		

X = Interaction term.

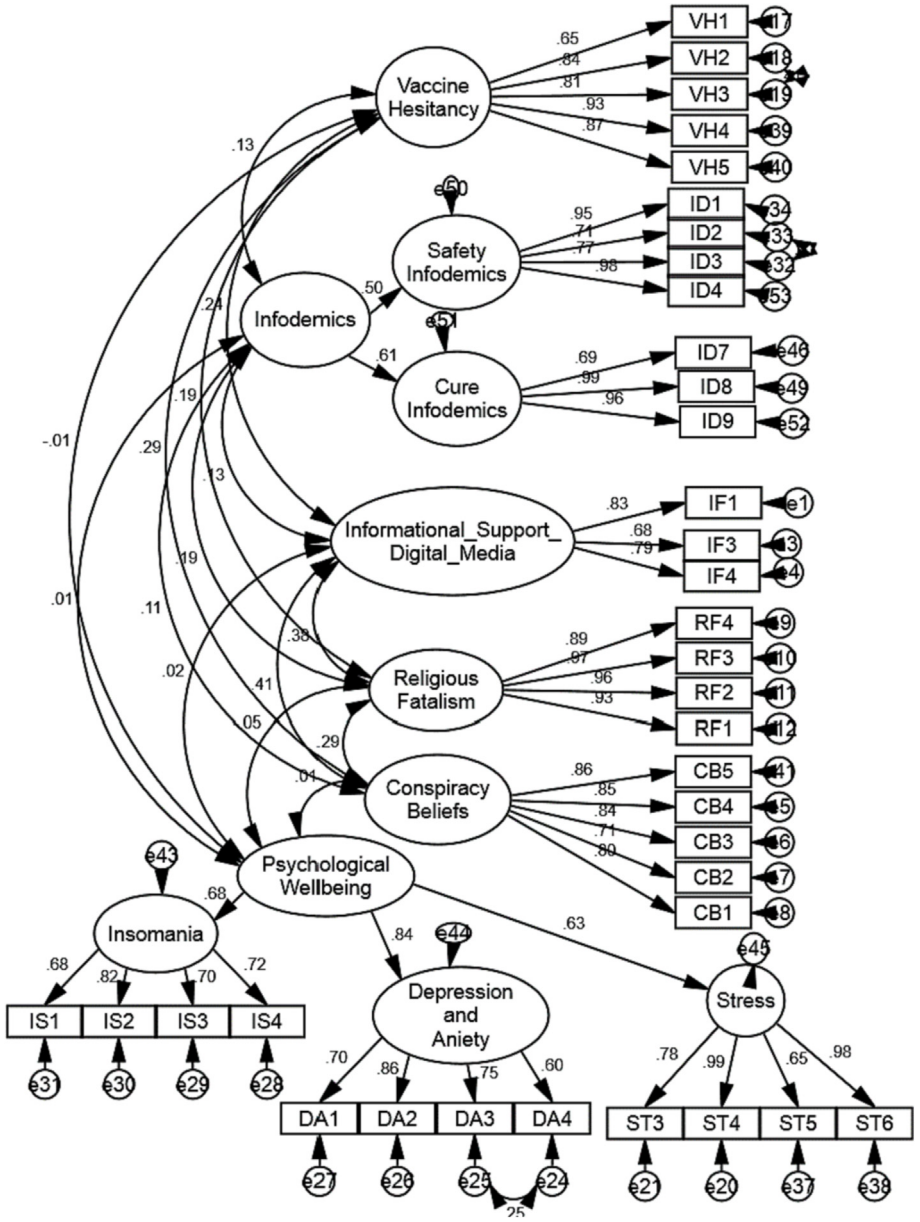

Fig. 3. Measurement Model (Second-order).

Following model 1, another structural model (see Fig. 4) was designed by adding the three interaction terms based on the proposed moderating hypotheses (H6 (a), (b), and H7). The findings demonstrated that information support through digital intervention by health authorities interacts with infodemics (β = -0.26) and religious fatalism (β = -0.11) and inversely and significantly influences the strength of their relationship with vaccine hesitancy. Thus H6 (a) and H6 (b) were supported. Simply put, higher levels of informational support provided by the health authorities using digital interventions can lower vaccine hesitancy. The findings showed that the influence of the infodemics (β = 0.14) and religious fatalism (β = 0.23) diminish in the presence of informational support.

The findings also demonstrated that information support through digital intervention by health authorities positively and significantly moderates the relationship between conspiracy beliefs (β = 0.25) and psychological well-being. Thus, H6 was also supported. In this way, the greater extent of the informational support provided by the health authorities using digital interventions can lower the negative influence of conspiracy beliefs on psychological well-being. Hence, the findings showed that the negative influence of conspiracy beliefs (β = -09) on psychological well-being diminishes in the presence of informational support. Overall, model 2 exhibited changes in variance (ΔR2 = -0.18) that evidently verified our postulations that informational support is a key factor in diminishing the negative influences such as infodemics and valuable tactics to improve vaccine acceptance. These findings are also visualized in a graphical presentation obtained from the slope test using Dawson's approach [93] (see Fig. 5). Exhaustive inferences of these outcomes are deliberated in the discussion section.

5. Discussion

This research used a focus group and cross-sectional research design vis-à-vis an online survey method to examine the influence of infodemics, religious fatalism and conspiracy beliefs on COVID-19 vaccine hesitancy. Additionally, it is the first study that has evaluated the moderation of informational support through digital interventions by health authorities and the underlying mechanism of psychological well-being. The study posed seven hypotheses. Of the seven hypotheses, five are direct hypotheses investigating the influence of infodemics, religious fatalism, psychological well-being and conspiracy beliefs on vaccine hesitancy (H1, H2, H3, H4 & H5); two moderating hypotheses explain the strength of the relationship between infodemics and religious fatalism with vaccine hesitancy (H6a & H6b and one moderating hypothesis showing the relationship between conspiracy beliefs and psychological well-being (H7). The findings of this study supported all seven hypotheses. The findings of hypothesis one (H1) illuminate that social media infodemics influence COVID-19 vaccine hesitancy. These findings are consistent with the previous studies [37,38]. To put it succinctly, social media infodemics correspond to vaccine hesitancy. In the era of digital misinformation, as anticipated by previous literature, people receive negative influences of infodemics from reliable sources of information.

Along the same lines, the results of H2 suggest that religious fatalism influences COVID-19 vaccine hesitancy. The findings of this study also support this proposition, which is consistent with the previous literature [39,40]. To put it bluntly, fatalism is associated with poorer health outcomes [41]. Likewise, religious fatalism emphasizes that pandemics is a source of punishment [42] and that nothing happens without the will of God [14]. In the context of Pakistan, this is a critical factor, as anticipated by the literature.

Similarly, H3 proposes that conspiracy beliefs influence the psychological well-being of people. The conspiracy beliefs range from the virus as a bioweapon [53], as a profit-maker for pharmaceutical companies [58], and as birth control [57]. The conspiracy beliefs were found to impact vaccine hesitancy among the masses positively. The higher the level of conspiracy beliefs, the higher the vaccine hesitancy. These results support the findings of previous studies [53,94,95].

Moreover, conspiracy beliefs shake the public's trust in the government [55] and influence public behavior towards taking precautionary measures required to reduce the spread of COVID-19, such as social distancing or wearing COVID-19 [54,59]. Likewise, the results of H4 suggested that psychological well-being influences vaccine hesitancy. It is found that depression and anxiety correspond to poor psychological well-being [68]. Moreover, poor psychological well-being results in higher vaccine hesitancy among the masses.

In a similar vein, the findings of H5 illustrate that conspiracy beliefs also influence the psychological well-being of an individual. The conspiratorial beliefs induce distrust of scientists, health pro-

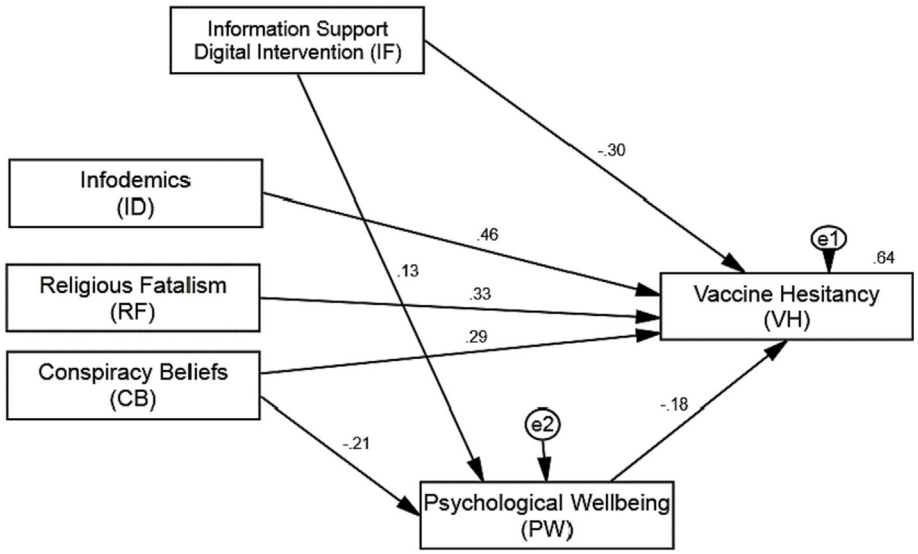

Fig. 4. Structural Model.

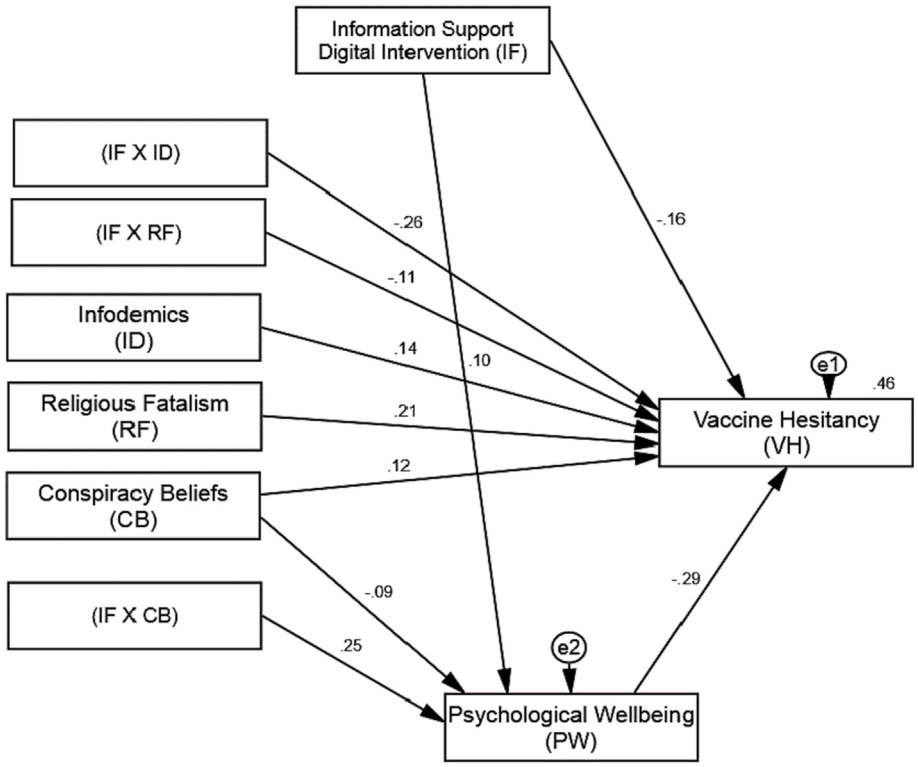

Fig. 5. Structural Model with Interaction terms.

fessionals, and scientific knowledge that corresponds to vaccine hesitancy. These results are consistent with the existing literature [19]. In other words, conspiracy theories influence people's intention to get vaccinated [21,96]. In addition, our hypotheses H6a & H6b posit that informational support moderates the relationship between infodemics, religious fatalism and vaccine hesitancy so that higher social support lowers COVID-19 vaccine hesitancy. These findings are consistent with the previous findings [13]. Social support protects against harmful mental effects [71] and improves health quality [77,80]. To put it more explicitly, the availability of different sources of social support decreases the health problems [70] that are common in situations such as the COVID-19 pandemic. The results of this study also supported the proposition of hypothesis H7, illuminating that the availability of social support in the lives of individuals increases psychological well-being and lessens conspiracy beliefs that correspond to a higher level of acceptance of COVID-vaccine. In sum, the public's vaccine hesitancy could be minimized by offering information on the safety and benefits of the COVID-19 vaccine. In this regard, media framing of health messages significantly promotes a willingness to take COVID-19 vaccines among the general public [97,98].

5.1. Theoretical implications

The findings of this study support the results of the previous studies [42,53,68,94,95]. By doing so, this study has expanded upon the prior literature by re-considering the role of infodemics and tapping the variable of the infodemics by recognizing certain novel attributes that remained minimal in past literature. To do so, a separate focus group study was carried out that identified that the infodemics not only contain negative (e.g., fake news) valence but also contain a positive one (e.g., cures for COVID-19). However, the nature of the infodemics is mainly based on misinformation and, overall, represents a negative slant in terms of public health. However, an alarming attribute of infodemics lies within its presentation by the sender, which is mainly represented in a severe communicative tone. Together with these attributes, infodemics have profound implications, as this study has also validated that it enhances hesitancy among the population.

Additionally, to our knowledge, no prior study has underscored the critical interaction of digital health support provided by the health authorities. Past research has only relied on the role of informational support and media campaigns [98,99]. However, this study proposed that people live in new digital communicative environments. Specifically, people are under a higher degree of digital informational surveillance in the current scenario. This access to digital information is mainly from social networking sites, and no strict control is available on the production of user-generated content that is the primary source of infodemics. At the same time, the health authorities (i.e., WHO) are using these platforms to educate people about infodemics directly by giving them timely, factual information. Albeit these efforts of informational support, there needs to be more empirical evidence of its effectiveness. The current study advances the implications of the social support theory in the digital context by identifying the interaction effect of infodemics and digital informational support. Therefore, the results of this study are pioneering and establish that a higher degree and exposure to informational support, such as public service advertisements provided by health authorities, lessen COVID-19 vaccine hesitancy [97].

Moreover, the religious factor has not been explored in past studies; the research underpinned the more exhaustive aspect of religious fatalism that was commonly observed in the public discourse during COVID-19. For instance, a layperson might rationalize their intention of vaccine avoidance by saying that life is in the hand of God. However, there needed to be more empirical evidence about the effectiveness of the possible communication interventions. The study offers pioneering results in the context of a Muslim nation and justifies that digital interventions can reduce the negative influence of fatalistic views on health-related outcomes.

Furthermore, the results theoretically revealed the nexus and the central underlying mechanism of psychological well-being and conspiracy beliefs. The lower the well-being, the higher the conspiracy beliefs [100]. Past studies failed to examine any possible role of informational support in times of crisis. To illuminate this complex relationship, this research postulated three hypotheses (H4, H5 and H7) to address two critical theoretical questions pertaining; to (1) the underlying mechanism of psychological well-being and (2) how this underlying mechanism is a function of the informational support through digital interventions.

Consistent with prior studies, this study has provided evidence that conspiracy beliefs such as misinformation, disinformation, fake news, and religious fatalism can play a critical role in implanting adverse effects on mental health that can confuse people and trigger reluctance toward precautionary health behavior such as vaccine acceptance [101]. In sum, this study offers novel evidence that the negative influences of the mechanisms mentioned above can be diminished if people are informed by trusted sources vis-à-vis digital interventions.

5.2. Practical implications

This research provides numerous significant managerial and social implications for public health experts and communication managers about technology usage. Firstly, study 1 advances the understanding of the new phenomenon of infodemics by clarifying its dimensions using an idiographic explanation approach. These dimensions give a contextual explanation of how people perceive infodemics and, thus, how communication managers can better plan to tackle the infodemics. Understanding the role of the informational support provided by digital interventions has clarified that the infodemics, conspiracy beliefs and fatalism promote vaccine hesitancy, resulting in reduced public well-being. Therefore, the study recommends that managers focus on tailoring their messages by identifying the local characteristics of religious fatalism, or infodemics could act as better tools to fight infodemics [22]**.** For example, the dynamics of Pakistan are entirely different in terms of religious fatalism views than other nations. The success of the communication campaigns remains reliant on identifying the local context.

It is generally observed that a standardized approach has been employed in several health authorities' digital communication campaigns, ignoring the local factor. Ergo, to this end, the health authorities may consider launching campaigns that are designed after deliberation on the targeted context-driven views and misinformation. The results of this study show that these campaigns remained effective, and their efficacy can be enhanced by paying attention to a more target-orientated and localized context. Notably, recently, new situations have evolved regarding booster doses of vaccines. There needs to be more clarity among the public at large about this, and more specific health communication campaigns are required to address the critical vaccine hesitancy factors. In Pakistan, a rural population that makes up most of the population is still vulnerable due to a meager vaccination rate and misperception.

Hence, **t**he study recommends adopting the communication strategy to develop trust in vaccination. This could be accomplished by using targeted public service advertisements as digital interventions to effectively counter the inverse impacts of misinformation, disinformation, fake news, and religious fatalism on the marginalized and illiterate segments of the populace [101]. By utilizing these digital interventions**,** vaccine acceptance could be cultivated in many people who distrust foreign vaccines and organizations that produce these vaccines. Therefore, a localized strategy of communicating messages through trusted personalities can be more effective in addressing this obstacle.

Furthermore, pulpit communication delivered in religious sermons vis-à-vis influential national and local religious leadership could be beneficial to diminish public uncertainties and doubts regarding vaccines. The social support theory also suggests that people respond more positively to those perceived as more caring and considerate. Therefore, the localized and strategic use of social support theory could help educate and persuade the local rural population to embrace preventive behavior in the context of vaccine acceptance [75].

5.3. Limitations and future directions

This research has contributed to the literature by unpacking the effectiveness of digital interventions in diminishing the COVID-19 vaccine hesitancy, but it has a few restrictions. Firstly, this research used a survey method, which cannot illuminate the causal relationship between the underpinned variables. Future research may use experimental design and longitudinal data collection techniques to provide more sophisticated causal effects. Secondly, future studies may also consider the message valence factor to understand what type of message can be more effective in reducing vaccine hesitancy. Thirdly, future research may use the more generalizable sampling technique by collecting data directly from the field instead of online. Lastly, this research was carried out in only one country. Cross-cultural research would be remarkable to grasp whether these results hold in other backgrounds.

6. Conclusion

Overwhelming disinformation and anti-vaccine campaigns have fueled the prevailing COVID-19 vaccine hesitancy in the global south, a significant problem in its eradication. Health authorities across the globe utilized digital platforms and devised technology-driven interventions to reach and provide informational support to the people. However, the question of the extent to which these interventions are effective in countering the misperceptions fueled by infodemics, religious fatalism and conspiracy beliefs remains understudied. In particular, the combined influence of infodemics and religious fatalism has been largely unknown, and this research provides interesting insight into their influences. This research has evaluated the under-explored effectiveness of technology-driven communication strategies in promoting a greater acceptance of COVID-19 vaccination. We concluded that infodemics, religious fatalism and conspiracy beliefs are significant predictors of vaccine hesitancy. Conspiracy beliefs negatively influence an individual's psychological well-being. Moreover, the results suggest that information support vis-à-vis digital intervention affects infodemics and religious fatalism. To reinstate, information support (through digital intervention) moderates the relationship between conspiracy beliefs and psychological well-being. In contrast, information support inversely influenced the strength of relationships between infodemics and religious fatalism with vaccine hesitancy. In short, this research supports the use of technology to promote actionable preventive behaviors in society. Thereby, digital literacy (informational support) may be provided to the public to evade public health issues such as vaccine hesitancy. In summary, the findings verified that technology-driven digital informational support could reduce the threats to public health, such as infodemics. Therefore, technology-driven digital interventions by health authorities can be an effective communication strategy to combat the prevailing global challenges to public health.

Data availability

Data will be made available on request.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A

Variables	No.	Items
Infodemics	1.	COVID-19 vaccine development didn't involve valid safety testing. (Safety)
	2.	COVID-19 vaccine contains dangerous nanoparticles that will affect human health. (Safety)
	3.	COVID-19 vaccine is a Population Control Mechanism. (Safety)
	4.	COVID-19 vaccine has a bad reaction on human health. (Safety)
	5.	The microchip can be implanted in my body through the COVID-19 vaccine. (Safety)
	6.	Instead of a vaccine, drinking alcoholic beverages can kill the coronavirus. (Cure-related Misperceptions)
	7.	Instead of vaccine, gargling with salt water (if you rinse your mouth) can prevent coronavirus disease" (Cure-related Misperceptions)
	8.	Instead of vaccine, drinking warm water causes the virus to enter the stomach and then to be dissolved in stomach acid" (Cure-related Misperceptions
	9.	Past vaccinations of Tuberculosis would work to combat COVID-19. (Cure-related Misperceptions)

References

[1] De Kock JH et al. A rapid review of the impact of COVID-19 on the mental health of healthcare workers: implications for supporting psychological well-being. BMC Public Health 2021;21(1):1–18.
[2] Dong, H., et al., Internet addiction and related psychological factors among children and adolescents in China during the coronavirus disease 2019 (COVID-19) epidemic. Frontiers in Psychiatry, 2020: p. 751.
[3] O'Connor C, Murphy M. Going viral: doctors must tackle fake news in the covid-19 pandemic. BMJ 2020;369(10.1136).
[4] van Der Linden S, Roozenbeek J, Compton J. Inoculating against fake news about COVID-19. Front Psychol 2020;11:2928.
[5] Nguyen A, Catalan D. Digital mis/disinformation and public engagment with health and science controversies: Fresh perspectives from Covid-19. Media Commun 2020;8(2):323–8.
[6] WHO, Infodemic management. 2020, World Health Organization: Geneva.
[7] Rutjens BT, Sutton RM, van der Lee R. Not all skepticism is equal: Exploring the ideological antecedents of science acceptance and rejection. Pers Soc Psychol Bull 2018;44(3):384–405.
[8] De Figueiredo A et al. Mapping global trends in vaccine confidence and investigating barriers to vaccine uptake: a large-scale retrospective temporal modelling study. Lancet 2020;396(10255):898–908.
[9] Khan YH et al. Threat of COVID-19 vaccine hesitancy in Pakistan: the need for measures to neutralize misleading narratives. Am J Trop Med Hyg 2020;103 (2):603.
[10] Ittefaq M, Abwao M, Rafique S. Polio vaccine misinformation on social media: turning point in the fight against polio eradication in Pakistan. Human Vaccines & Immunotherapeutics 2021;17(8):2575–7.
[11] Ejaz W et al. Factors associated with the belief in COVID-19 related conspiracy theories in Pakistan. Health Risk Soc 2021;23(3–4):162–78.
[12] Giebel C et al. A UK survey of COVID-19 related social support closures and their effects on older people, people with dementia, and carers. Int J Geriatr Psychiatry 2021;36(3):393–402.
[13] Moore SE et al. Disproportionate impact of the COVID-19 pandemic on perceived social support, mental health and somatic symptoms in sexual and gender minority populations. J Homosex 2021;68(4):577–91.
[14] Nageeb S et al. Adapting a religious health fatalism measure for use in Muslim populations. PLoS one 2018;13(11):e0206898.
[15] Padmawati RS et al. Religious and community leaders' acceptance of rotavirus vaccine introduction in Yogyakarta. Indonesia: a qualitative study 2019;19(1):1–6.
[16] Guidry JP et al. willingness to get the COVID-19 vaccine with and without emergency use authorization. Am J Infect Control 2021;49(2):137–42.
[17] Chou W-Y-S, Budenz A. Considering emotion in COVID-19 vaccine communication: addressing vaccine hesitancy and fostering vaccine confidence. Health Commun 2020;35(14):1718–22.
[18] Pulido CM et al. COVID-19 infodemic: More retweets for science-based information on coronavirus than for false information. Int Sociol 2020;35 (4):377–92.
[19] Murphy J et al. Psychological characteristics associated with COVID-19 vaccine hesitancy and resistance in Ireland and the United Kingdom. Nat Commun 2021;12(1):1–15.
[20] Yin F et al. Unfolding the determinants of COVID-19 vaccine acceptance in China. J Med Internet Res 2021;23(1):e26089.
[21] Artime O et al. effectiveness of dismantling strategies on moderated vs. unmoderated online social platforms. Sci Rep 2020;10(1):1–11.
[22] Baines A, Ittefaq M, Abwao M. # Scamdemic,# plandemic, or# scaredemic: What parler social media platform tells us about COVID-19 vaccine. Vaccines 2021;9(5):421.
[23] Loomba S et al. Measuring the impact of COVID-19 vaccine misinformation on vaccination intent in the UK and USA. Nat Hum Behav 2021;5(3):337–48.
[24] Lucia VC, Kelekar A, Afonso NM. COVID-19 vaccine hesitancy among medical students. J Public Health 2021;43(3):445–9.
[25] Brennen JS et al. Types, sources, and claims of COVID-19 misinformation. Reuters Institute 2020;7(3):1.
[26] WHO, Fighting misinformation in the time of COVID-19, one click at a timea-time. 2021, World Health Organization: Geneva.
[27] GSMS, Global Social Media Statistics-DataReportal. 2021, Global Social Media Statistics.
[28] Cinelli M et al. The COVID-19 social media infodemic. Sci Rep 2020;10 (1):1–10.
[29] Bruns A, Harrington S, Hurcombe E. <? covid19?>'Corona? 5G? or both?': the dynamics of COVID-19/5G conspiracy theories on Facebook. Media International Australia 2020;177(1):12–29.
[30] Smith GD, Ng F. and WHC Li, COVID-19: Emerging compassion, courage and resilience in the face of misinformation and adversity. J Clin Nurs 2020;29(9–10):1425.
[31] DiFonzo N, Bordia P. Rumor, gossip and urban legends. Diogenes 2007;54 (1):19–35.
[32] Rojecki A, Meraz S. Rumors and factitious informational blends: The role of the web in speculative politics. New Media Soc 2016;18(1):25–43.
[33] Zarocostas J. How to fight an infodemic. Lancet 2020;395(10225):676.
[34] Tsao S-F et al. What social media told us in the time of COVID-19: a scoping review. The Lancet Digital Health 2021;3(3):e175–94.
[35] Krause NM et al. Fact-checking as risk communication: the multi-layered risk of misinformation in times of COVID-19. J Risk Res 2020;23(7–8):1052–9.
[36] Puri N et al. Social media and vaccine hesitancy: new updates for the era of COVID-19 and globalized infectious diseases. Hum Vaccines Immunotherap 2020;16(11):2586–93.
[37] Germani F, Biller-Andorno N. The anti-vaccination infodemic on social media: A behavioral analysis. PLoS one 2021;16(3):e0247642.
[38] Kennedy J. Populist politics and vaccine hesitancy in Western Europe: an analysis of national-level data. Eur J Pub Health 2019;29(3):512–6.
[39] Franklin MD et al. Religious fatalism and its association with health behaviors and outcomes. Am J HealthBehavior 2007;31(6):563–72.
[40] Straughan PT, Seow A. Fatalism reconceptualized: a concept to predict health screening behavior. J Gend Cult Heal 1998;3(2):85–100.
[41] Franklin MD, Schlundt DG, Wallston KA. Development and validation of a religious health fatalism measure for the African-American faith community. J Health Psychol 2008;13(3):323–35.
[42] Ahmad Z, Ahad A. COVID-19: a study of islamic and scientific perspectives. Theol Sci 2021;19(1):32–41.
[43] Byrd T et al. Seatbelt use and belief in destiny among Hispanic and non-Hispanic drivers. Accid Anal Prev 1999;31(1–2):63–5.
[44] Colon I. Race, belief in destiny, and seat belt usage: a pilot study. Am J Public Health 1992;82(6):875–7.
[45] Natera G, Herrejon M, Casco M. Locus of control in couples with different patterns of alcohol consumption. Drug Alcohol Depend 1988;22(3):179–86.
[46] Schnoll RA et al. Correlates of tobacco use among smokers and recent quitters diagnosed with cancer. Patient Education and Counseling 2002;46 (2):137–45.

[47] Schnoll RA et al. Characteristics of cancer patients entering a smoking cessation program and correlates of quit motivation: implications for the development of tobacco control programs for cancer patients. Psycho-Oncology: Journal of the Psychological, Social and Behavioral Dimensions of. Cancer 2004;13(5):346–58.
[48] Classen C et al. Coping styles associated with psychological adjustment to advanced breast cancer. Health Psychol 1996;15(6):434.
[49] Mohamed IE et al. Understanding locally advanced breast cancer: what influences a woman's decision to delay treatment? Prev Med 2005;41 (2):399–405.
[50] Nelson K, Geiger AM, Mangione CM. Effect of health beliefs on delays in care for abnormal cervical cytology in a multi-ethnic population. J Gen Intern Med 2002;17(9):709–16.
[51] Dettenborn L et al. Cancer fatalism and its demographic correlates among African American and Hispanic women: effects on adherence to cancer screening. J Psychosoc Oncol 2004;22(4):47–60.
[52] Allington D et al. Health-protective behaviour, social media usage and conspiracy belief during the COVID-19 public health emergency. Psychol Med 2021;51(10):1763–9.
[53] Imhoff R, Lamberty P. A bioweapon or a hoax? The link between distinct conspiracy beliefs about the Coronavirus disease (COVID-19) outbreak and pandemic behavior. Soc Psychol Personal Sci 2020;11(8):1110–8.
[54] Rieger MO. What makes young people think positively about social distancing during the corona crisis in Germany? Frontiers. Sociology 2020:61.
[55] Kim M, Cao X. The impact of exposure to media messages promoting government conspiracy theories on distrust in the government: Evidence from a two-stage randomized experiment. Int J Commun 2016;10:20.
[56] Bierwiaczonek K, Kunst JR, Pich O. Belief in COVID-19 conspiracy theories reduces social distancing over time. Appl Psychol Health Well Being 2020;12 (4):1270–85.
[57] Diaz AA, Celedón JC. COVID-19 vaccination: Helping the latinx community to come forward. EClinicalMedicine 2021;35:100860.
[58] Lazić A, Žeželj I. A systematic review of narrative interventions: Lessons for countering anti-vaccination conspiracy theories and misinformation. Public Underst Sci 2021;30(6):644–70.
[59] Karić T, Međedović J. Covid-19 conspiracy beliefs and containment-related behaviour: The role of political trust. Pers Individ Differ 2021;175:110697.
[60] Warr P. A study of psychological well-being. Br J Psychol 1978;69(1):111–21.
[61] Ryff CD, Keyes CLM. The structure of psychological well-being revisited. J Pers Soc Psychol 1995;69(4):719.
[62] Warr, P. and T. Wall, Work and well-being 1978, Harmondsworth: Penguin.
[63] Campbell A. Subjective measures of well-being. Am Psychol 1976;31(2):117.
[64] Gavin B et al. Caring for the psychological well-being of healthcare professionals in the Covid-19 pandemic crisis. Ir Med J 2020;113(4):51.
[65] Anglim J, Horwood S. Effect of the COVID-19 pandemic and big five personality on subjective and psychological well-being. Soc Psychol Personal Sci 2021;12(8):1527–37.
[66] Ruggieri S et al. The role of online social comparison as a protective factor for psychological well-being: A longitudinal study during the COVID-19 quarantine. Pers Individ Differ 2021;171:110486.
[67] Groarke JM et al. Examining temporal interactions between loneliness and depressive symptoms and the mediating role of emotion regulation difficulties among UK residents during the COVID-19 lockdown: Longitudinal results from the COVID-19 psychological well-being study. J Affect Disord 2021;285:1–9.
[68] Raza SH et al. Investigating Binge-Watching Adverse Mental Health Outcomes During Covid-19 Pandemic: Moderating Role of Screen Time for Web Series Using Online Streaming. Psychol Res Behav Managem 2021;14:1615.
[69] Sarason IG et al. Assessing social support: the social support questionnaire. J Pers Soc Psychol 1983;44(1):127.
[70] Haber MG et al. The relationship between self-reported received and perceived social support: A meta-analytic review. Am J Community Psychol 2007;39(1):133–44.
[71] Giebel C et al. Impact of COVID-19 related social support service closures on people with dementia and unpaid carers: a qualitative study. Aging Ment Health 2021;25(7):1281–8.
[72] Xiao S. Theoretical basis and application in research of social support rating scale. J Clin Psychiatry 1994;4(8):98–100.
[73] Hogan BE, Linden W, Najarian B. Social support interventions: do they work? Clin Psychol Rev 2002;22(3):381–440.
[74] Lin X, Kishore R. Social media-enabled healthcare: a conceptual model of social media affordances, online social support, and health behaviors and outcomes. Technol Forecast Soc Chang 2021;166:120574.
[75] He W, Zhang ZJ, Li W. Information technology solutions, challenges, and suggestions for tackling the COVID-19 pandemic. Int J Inf Manag 2021;57:102287.
[76] Bardhan I, Chen H, Karahanna E. Connecting systems, data, and people: A multidisciplinary research roadmap for chronic disease management. MIS Q 2020;44(1):185–200.
[77] Xiao J et al. association between social support and health-related quality of life among Chinese seafarers: A cross-sectional study. PLoS one 2017;12(11): e0187275.
[78] Labrague LJ. Psychological resilience, coping behaviours and social support among health care workers during the COVID-19 pandemic: A systematic review of quantitative studies. J Nurs Manag 2021;29(7):1893–905.
[79] Zysberg L, Zisberg A. Days of worry: Emotional intelligence and social support mediate worry in the COVID-19 pandemic. J Health Psychol 2022;27 (2):268–77.
[80] Yue C et al. Association between social support and anxiety among pregnant women in the third trimester during the coronavirus disease 2019 (COVID-19) epidemic in Qingdao, China: The mediating effect of risk perception. Int J Soc Psychiatry 2021;67(2):120–7.
[81] Nassar-McMillan, S.C. and LD. Borders, use of focus groups in survey item development. The Qualitative Report, 2002. **7**(1): p. 1-12.
[82] Fuller, T.D., et al., Using focus groups to adapt survey instruments to new populations: Experience from a developing country, in Successful focus groups: Advancing the state of the art D.L. Morgan, Editor. 1993, Sage: New York. p. 89-104.
[83] Greenbaum TL. The handbook for focus group research. New York: Sage; 1998.
[84] Polit DF, Beck CT, Owen SV. Is the CVI an acceptable indicator of content validity? Appraisal and recommendations. Res Nurs Health 2007;30 (4):459–67.
[85] Bogart LM et al. Conspiracy beliefs about HIV are related to antiretroviral treatment nonadherence among African American men with HIV. J Acquir Immune Defic Syndr 2010;53(5):648.
[86] Soveri A et al. Unwillingness to engage in behaviors that protect against COVID-19: the role of conspiracy beliefs, trust, and endorsement of complementary and alternative medicine. BMC Public Health 2021;21 (1):1–12.
[87] Kroenke K et al. An ultra-brief screening scale for anxiety and depression: the PHQ–4. J Psychosom 2009;50(6):613–21.
[88] Crönlein T et al. Regensburg Insomnia Scale (RIS): a new short rating scale for the assessment of psychological symptoms and sleep in insomnia; study design: development and validation of a new short self-rating scale in a sample of 218 patients suffering from insomnia and 94 healthy controls. Health Quality of Life Outcomes 2013;11:65.
[89] Hajli MNJTF, Change S. The role of social support on relationship quality and social commerce 2014;87:17–27.
[90] Duong, T.V., et al., Oxford COVID-19 vaccine hesitancy in school principals: impacts of gender, well-being, and coronavirus-related health literacy. Vaccines. **9**(9): p. 985.
[91] Hair Jr, JF, et al., PLS-SEM or CB-SEM: updated guidelines on which method to use. Int J Multivariate Data Anal. **1**(2): p. 107-123.
[92] Preacher KJ, Hayes AF. Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods 2008;40(3):879–91.
[93] Dawson JF. Moderation in management research: What, why, when, and how. J Bus Psychol 2014;29(1):1–19.
[94] Rieger MO, Wang M. Trust in government actions during the COVID-19 crisis. Soc Indic Res 2021:1–23.
[95] Wood MJ, Douglas KM, Sutton RM. Dead and alive: Beliefs in contradictory conspiracy theories. Social Psychological and Personality. Science 2012;3 (6):767–73.
[96] Paul E, Steptoe A, Fancourt D. Attitudes towards vaccines and intention to vaccinate against COVID-19: Implications for public health communications. The Lancet Regional Health-Europe 2021;1:100012.
[97] Jin Q et al. Can communication strategies combat COVID-19 vaccine hesitancy with trade-off between public service messages and public skepticism? Experimental evidence from Pakistan. Vaccines 2021;9(7):757.
[98] Yousaf M et al. Immunity debt or vaccination crisis? A multi-method evidence on vaccine acceptance and media framing for emerging COVID-19 variants. Vaccine 2022;40(12):1855–63.
[99] Wakefield et al. use of mass media campaigns to change health behaviour. The lancet 2010;376(9748):1261–71.
[100] Van Prooijen J et al. Conspiracy beliefs prospectively predict health behavior and well-being during a pandemic. Psychol Med 2021:1–8.
[101] Jin Q et al. Ingraining Polio Vaccine Acceptance through Public Service Advertisements in the Digital Era: The Moderating Role of Misinformation, Disinformation, Fake News, and Religious Fatalism. Vaccines 2022;10 (10):1733.