



Original Contribution

**RUMOURS, CONSPIRACY BELIEFS AND COVID-19 VACCINATION
ATTITUDES IN BULGARIA: A CROSS-SECTIONAL STUDY**

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ABSTRACT

Aim. This study aims to examine, in the Bulgarian context, the relationships between vaccination attitudes and acceptance on the one hand, and use of communication channels, trust in medical authorities, and belief in misleading information on the other.

Materials and methods. A cross-sectional study of Bulgarian respondents was conducted between April and May 2022 using a self-administered online survey with 1,200 participants. Logistic regression models were implemented to examine first, the association between conspiracy beliefs and COVID-19 vaccination uptake and second, between susceptibility to misinformation, sociodemographic variables, trust in medical authorities, and the use of information sources.

Results. People who agreed with at least one of the conspiratorial statements were 8.56 times more likely to decline immunization. Belief in rumours and conspiracy theories was associated with a higher perceived risk of adverse events and lower perceived benefits of vaccination. In the logistic regression models, age, residence, and mistrust were associated with believing in rumours and conspiracy theories. Sourcing information from health authorities was negatively associated with belief in rumours while getting information from relatives and friends had the opposite effect.

Conclusions. Misinformation had a significant impact on vaccine uptake. More efforts are needed to dispel myths and rumours surrounding vaccination.

Key words: COVID-19 vaccine, misinformation, conspiracy theories, rumours, vaccine hesitancy, Bulgaria

INTRODUCTION

Public debates about COVID-19 vaccination have been accompanied by contradictory messages, false claims, and negative speculations regarding the political and economic drivers of vaccine development and distribution, fostering vaccine-related concerns. Misinformation, rumours, and conspiracy theories about vaccines are not a recent phenomenon—rumours about the relationship between the measles-mumps-rubella (MMR) vaccine and autism or conspiracies about the intent to control the world population through

the human papilloma virus (HPV) vaccine have undermined the efforts of multiple immunization campaigns (1, 2). Nonetheless, the COVID-19 pandemic spawned an unprecedented new wave of false claims, misleading content, and conspiracy theories around the globe (3), which impeded compliance with anti-epidemic guidance and the adoption of preventive behaviours, including vaccination (4). The COVID-19-related *infodemic* raised concerns about the spread of false information and its influence on pandemic preparedness and control. A growing body of research demonstrated that susceptibility to misinformation and exposure to anti-vaccine conspiracy theories resulted in resistance to preventive measures, casting doubt on the necessity and benefits of vaccination (4-8).

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Although digital communication was instrumental in the efforts to contain the spread of the virus during the pandemic, its misuse contributed to the proliferation of misinformation. Digital channels, particularly social media, play a significant role in disseminating anti-vaccine propaganda, offering an opportunity to transmit misleading information (9) and further amplify its effect through echo chambers (10, 11). The association between social media and COVID-19 vaccine acceptance has been extensively studied with evidence from different countries that exposure to online information negatively affects vaccine attitudes (12-14). Since the COVID-19 outbreak, anti-vaccine content has gained popularity as measured by the number of new followers, user participation in conversations, and content sharing (15-17). A recent study modelling vaccine-related content on Facebook demonstrated that anti-vaxxer groups, despite being considerably smaller than pro-vaccination clusters, are able to attract hesitant individuals (18). If the pandemic served as a fertile breeding ground for misinformation and conspiracy theories, social media and other digital platforms provided the perfect conditions for global distribution.

New technologies and the rapid development of COVID-19 vaccines sparked fears and uncertainty around their effectiveness and safety, giving rise to some of the most widespread myths around COVID-19 vaccination. Rumours about adverse effects, false claims that vaccination causes infertility or vaccines contain DNA modifiers circulated globally over social media and other digital platforms (19). Existing mistrust in health authorities, medical experts, and pharmaceutical companies generated misleading claims linking mass vaccination with political and business interests and many conspiracy theories about nefarious intentions behind vaccine development.

Bulgaria was not an exception to these trends of rumour and conspiracy theories propagation—according to two nationwide polls conducted in 2020, many Bulgarians believed rumours about the virus's artificial origin and shared conspiratorial views that the COVID-19 vaccine could control the population via microchips (20). Concurrently, Bulgaria is last among all EU countries in terms of COVID-19 vaccination rate and coverage (21). In view of this urgent problem, the study aimed to investigate, in the Bulgarian context, the

association between vaccine acceptance and belief in rumours and conspiracy theories, as well as the factors that determine susceptibility to unsubstantiated or false allegations.

MATERIALS AND METHODS

Study design and data collection

A cross-sectional study was conducted between April and May 2022, about one year after the commencement of mass COVID-19 vaccination in Bulgaria. A self-administered online survey was administered to obtain data on factors influencing vaccine acceptance. Using the "snowball" technique, the questionnaire was distributed via social media platforms and emails through the authors' networks. Out of 1,433 filled-out questionnaires, 1,200 were completed and included in the analysis. The Research Ethics Committee of the Medical University-Varna granted ethical approval for the survey.

The 36-item questionnaire assesses beliefs in vaccine-related rumours and conspiracies as well as trust in health professionals and institutions. To investigate misconceptions and conspiratorial beliefs, we included six statements about the COVID-19 vaccine that had already gained popularity in Bulgaria and were widely shared and discussed on digital platforms (*the COVID-19 vaccine may cause infertility; vaccines may cause severe illness and even death; one can get COVID-19 from the vaccine; vaccines can change human DNA; the vaccination is part of a population control plan; the vaccine contains microchips*). The four-point scale measuring credence in these statements was later dichotomized to differentiate conspiracy theories proponents and opponents. Likewise, scored on a four-point scale and rescaled for statistical analysis, was trust in health officials, medical specialists, experts, and pharmaceutical companies. We also studied the preferred sources of COVID-19 vaccine information and the frequency of use of particular communication channels. Three items used a five-point scale (from 1-*non or very small* to 5-*very high*) to assess perceptions of the vaccine's benefits for individuals and society (effectiveness) and the risk of the vaccine (safety). Lastly, sociodemographic data on the respondents were collected.

Statistical analysis

First, we estimated bivariate logistic regressions of vaccine acceptance (vaccinated vs non-vaccinated) to examine the association between misinformation and conspiracy beliefs, and COVID-19 vaccination uptake. As a predictor in the models, we included belief in rumours and conspiracies and examined the relationship between each rumour or conspiracy statement and

vaccination uptake separately. The dependent variable, like the predictors, was dichotomized. Furthermore, we used the Mann-Whitney U test to compare the perceived risk and perceived benefits of the COVID-19 vaccine between conspiracy proponents and opponents, hypothesizing that beliefs in rumours and conspiracy theories may affect perceptions of vaccine safety and effectiveness. For this analysis, the latter dependent variables, measured on a five-point scale, were treated as continuous.

Finally, we employed regression analysis to investigate the factors influencing belief in conspiracy theories and rumours about vaccination. Two binomial logistic regression models were performed using susceptibility to misinformation—operationalized as the endorsement of at least one statement representing misinformation about the vaccine—as the dependent variable. The initial model included sociodemographic variables (age, gender, education, and residence). Trust in medical specialists, health authorities, experts, and pharmaceutical companies, as well as the sources used to obtain information about the COVID-19 vaccine, were added as predictors in the second model. All independent variables, except for age, were recorded in the logistic regression as binary for better effect size comparisons.

The statistical analyses were performed using *jamovi*, ver. 2.2.5.

RESULTS

There were 872 female respondents out of a total of 1,200 people that completed the survey. The majority of the respondents (78.0%) held university degrees. Approximately 59% of those surveyed had already received at least one dose of the COVID-19 vaccine, and 25% had a booster dose.

Almost all respondents had heard of at least one of the rumours and conspiracy theories in the questionnaire. Awareness of the statements ranged from 94.75% to 97.08% among the participants. High awareness was related to a high degree of agreement with the statements about the COVID-19 vaccine—42.92% of participants endorsed at least one of the claims, 15.92% concurred with at least three of the claims, and 1.92% believed in all claims.

The most well-known allegation was that the vaccination may cause SARS-CoV-2 infection, which is also the most accepted—30.25% of participants considered it true. The other statement with high levels of awareness (96.67%) and agreement (25.08%) was about the severe side effects of the COVID-19 vaccination. Of the respondents, 15.17% believed vaccination may cause infertility, while 12.25% thought the vaccine could alter human DNA. The two included conspiracy theories were popular among participants but garnered fewer proponents—14.42% of respondents believed that the purpose of the COVID-19 vaccination is population control, while just 4.48% accepted the conspiracy theory that the vaccine contains microchips.

Bivariate regression analyses revealed that misinformation and conspiracy theories had a significant impact on vaccine uptake. Each endorsement increased the likelihood of refusing the COVID-19 vaccination (**Figure 1**). All odds ratios ($p < 0.001$) exceeded 1.0 at the log scale, indicating that the predictors were associated with a higher propensity to refuse vaccination. The strongest association was observed among respondents who believed the COVID-19 vaccination may cause infertility, followed by those who thought the vaccine could cause severe sickness or death. Those who agreed with at least one of the included statements (i.e., the susceptible to misinformation) were 8.56 times more likely to decline immunization.

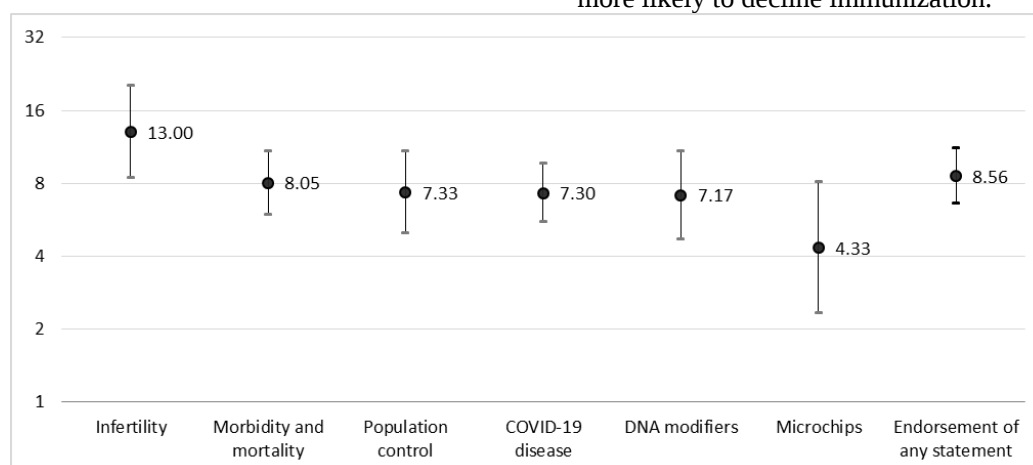


Figure 1. Bivariate logistic regression of vaccine acceptance: odds ratios

As the majority of vaccine-related rumours and conspiracies compromise vaccine safety and effectiveness perceptions, we compared vaccine risk and benefits perceptions among proponents (respondents who endorsed at least one statement) and opponents of false claims. The Mann-Whitney U test showed significant differences ($p < 0.001$) between the two groups. Belief in rumours and conspiracy theories was

associated with a higher perceived risk of adverse events (effect size = 0.65), a lower perceived benefit for individual protection (effect size = 0.61), and a lower perceived benefit for limiting virus spread (effect size = 0.58). **Figure 2** illustrates the mean risk and benefit perception scores of vaccine-related misinformation proponents and opponents.

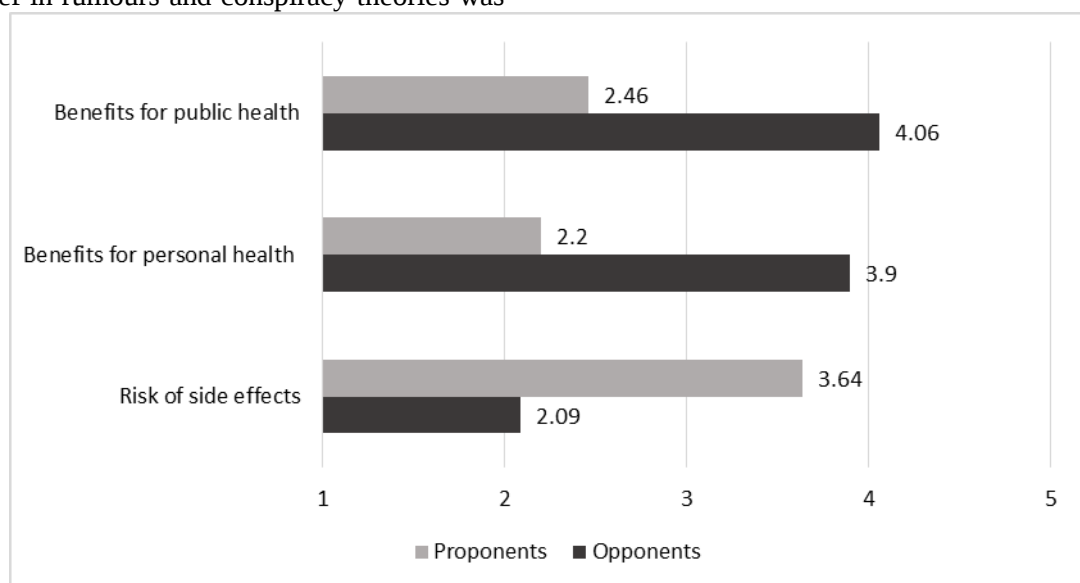


Figure 2. Perceptions of vaccine risk and benefits between proponents and opponents of misinformation: mean values

Table 1. Logistic regression estimates of belief in rumours and conspiracies

Predictors	Odds ratio (95% confidence interval)	
	Model 1	Model 2
Sex (ref. male)	0.840 (0.625 – 1.130)	1.012 (0.719 – 1.423)
Age (ref. 18-24 y.)		
25-34	0.546 (0.321 – 0.930)*	0.567 (0.309 – 1.041)
35-44	0.473 (0.283 – 0.790)**	0.507 (0.282 – 0.911)*
45-54	0.426 (0.252 – 0.719)**	0.509 (0.279 – 0.927)*
55-64	0.502 (0.274 – 0.921)*	0.549 (0.275 – 1.096)
65 +	0.210 (0.086 – 0.514)***	0.305 (0.114 – 0.821)*
Education (ref. high school or lower)	0.958 (0.656 – 1.397)	0.898 (0.584 – 1.382)
Residence (ref. district city or capital)	1.539 (1.014 – 2.335)*	1.536 (0.952 – 2.477)
Mistrust in general practitioner [†]	-	1.138 (0.739 – 1.754)
Mistrust in medical specialists [†]	-	0.980 (0.638 – 1.506)
Mistrust in health officials [†]	-	1.168 (0.782 – 1.744)
Mistrust in health experts [†]	-	1.874 (1.310 – 2.682)***
Mistrust in pharma companies [†]	-	4.377 (3.067 – 6.246)***
Info source medical specialists ^{††}	-	0.858 (0.611 – 1.205)
Info source health authorities' websites ^{††}	-	0.619 (0.440 – 0.871)**
Info source mainstream media ^{††}	-	0.917 (0.650 – 1.293)
Info source social media ^{††}	-	1.232 (0.880 – 1.724)
Info source relatives and friends ^{††}	-	1.761 (1.270 – 2.441)***
Notes: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; [†] ref. trust; ^{††} ref. non-use of source. Estimates represent the log odds of belief in vaccine-related misinformation vs non-belief.		

Next, we examined the factors influencing beliefs in inaccurate and deceptive claims (including conspiracy theories) about the COVID-19 vaccine. First, using binomial logistic regression, we analysed sociodemographic determinants of susceptibility to vaccine-related misconceptions (**Table 1, Model 1**), and then we incorporated trust in professionals and institutions as well as information sources into the model (**Table 1, Model 2**). Using solely sociodemographics as predictors, age and residence were associated with believing in rumours and conspiracy theories. With increasing age, the likelihood of being influenced by vaccine-related misinformation tends to diminish. Being a resident of a smaller town or village was associated with 1.5 times greater odds of endorsing COVID-19 vaccine misconceptions.

In the second model, the significance of some sociodemographic factors is diminished. Respondents who distrust in health experts are more prone to believe in vaccine-related rumours and conspiracies. Those who distrust the pharmaceutical business are nearly four times more susceptible to misinformation than the other group. The source of information about the COVID-19 vaccine is an additional significant predictor of susceptibility to misconceptions. Relying on information provided by health authorities via their official websites reduced the likelihood of being influenced by misleading claims or conspiratorial messages. Those who sourced information from relatives and friends were about 1.7 times more likely to believe in rumours and conspiracies than those who preferred other information sources. The other sources included did not have a significant influence.

DISCUSSION

Our study provides evidence for the relationship between conspiratorial beliefs, receptivity to misinformation, and vaccine acceptance. This association was demonstrated by earlier studies prior to the COVID-19 pandemic (2,22,23) and has been extensively explored since the global spread of SARS-CoV-2 (6-8,19,24). The findings suggest that widespread misconceptions about the COVID-19 vaccine in Bulgaria correlate positively with vaccine reluctance or hesitancy. Long before the vaccine's approval, misinformation, and conspiracy theories misrepresented the benefits

and risks of immunization. As a result, the vaccine rollout in Bulgaria encountered widespread and entrenched societal misconceptions that hampered efforts to achieve targeted immunization coverage. The anti-vaccine rhetoric of some political and community leaders contributed to the propagation of misleading and conspiratorial claims.

Another key predictor of vaccine acceptance is confidence in science, medical professionals, and pharmaceutical companies (7, 12, 25). Lack of trust is frequently associated with resistance to restrictive measures and vaccination (5). We found that trust in experts and science in Bulgaria affects attitudes and perceptions of misinformation and predicts susceptibility to false, unjustified, and biased claims. Similar to previous studies (26), our findings demonstrated the relationship between lack of trust and belief in conspiracies. In Bulgaria, public debates about the COVID-19 vaccination have been marked by inconsistent and contradictory messaging from politicians and health experts, confusing the audience rather than addressing vaccine-related concerns. Lack of trust and poor communication may also pose a threat to future vaccination programmes; therefore, restoring confidence in public health authorities and interventions requires the communication of unambiguous messages in a consistent and transparent manner.

Information spread through unmonitored digital channels, which frequently contain conspiratorial and unsubstantiated claims, significantly impacts vaccine hesitancy. Exposure to unreliable online content and sourcing vaccine-related information from social media is also positively associated with conspiracy beliefs (27). Our findings did not substantiate such a relationship. Nevertheless, the study demonstrates that the source can predict susceptibility to vaccine-related rumours—word-of-mouth information is positively associated with acceptance of conspiracy beliefs. These findings do not rule out the possibility of an indirect influence from digital sources, as rumours and conspiracy theories are propagated via social media and other unmonitored online platforms. In contrast, obtaining health information from official sources maintained by health authorities reduces the likelihood of being exposed to unverified and inaccurate claims. Using

government websites implies trust in health authorities and institutions. In contrast, mistrust usually feeds the vaccine hesitancy conversations on social media (14).

Several limitations should be taken into account when interpreting the study's findings. The cross-sectional design does not allow the identification of a causal relationship between vaccine hesitancy and conspiracy beliefs; it explains some factors influencing susceptibility to misinformation at a specific time point. In addition, our sampling method precludes representativeness; certain groups, such as the elderly, are underrepresented in the sample.

CONCLUSIONS

Rumours, misinformation, and conspiracy theories fuel concerns about the safety, and effectiveness of the COVID-19 vaccine, sowing doubts about the need for vaccination. Anti-vaccination propaganda is rapidly disseminated and shared across the globe via social media and other digital platforms. The infodemic that arose alongside the pandemic may have long-lasting consequences for vaccination adherence, eroding trust in public health officials' recommendations. Therefore, more efforts are needed to dispel the myths and rumours surrounding vaccination. Straightforward and engaging communication addressing vaccine-related concerns and permeating through social media channels as well has the potential to fill the knowledge gaps and encourage the adoption of preventive behaviours.

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