



Conspire to one's own detriment: Strengthening HPV Program Support Through Debunking Epistemically Suspect Beliefs

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Abstract

The study experimentally tested an intervention that debunks epistemically suspect beliefs about vaccines. After answering questions about pre-existing epistemically suspect beliefs (irrational health beliefs and conspiracy mentality), 565 participants were randomly assigned into one of three conditions and exposed either to neutral information about domestic animals, salient epistemically suspect content about vaccination or an intervention that debunks epistemically suspect beliefs about vaccination. Afterwards, the participants answered questions about vaccination-related conspiracy narratives (manipulation check), vaccination attitudes, intentions to vaccinate against HPV, support for an HPV vaccination programme and intentions to seek health guidance. Although the intervention demonstrated the potential to inhibit the endorsement of conspiracy narratives, we found no differences in the other outcome variables. Nevertheless, across the conditions, pre-existing epistemically suspect beliefs were associated with less favourable attitudes towards vaccination, lower intentions to vaccinate against HPV, less support for the vaccination programme and lower intentions to seek health guidance. The results indicate that

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debunking may be futile in curbing long-term negative impacts associated with epistemically suspect beliefs, and they contribute to the debate about assessing the effectiveness of interventions related to highly controversial topics such as vaccination. The study enhances understanding of persistent adverse impacts that epistemically suspect beliefs may have on public health outcomes.

KEYWORDS

conspiracy mentality, debunking, epistemically suspect beliefs, HPV vaccination, irrational health beliefs, public health

INTRODUCTION

In recent years, we have witnessed an unbridled spread of epistemically suspect beliefs (ESB) that may have persistent and adverse effects on public health outcomes. The term ESB covers a wide range of irrational, paranormal, conspiracy and pseudoscientific beliefs that contradict scientific and naturalistic views about the world (Pennycook et al., 2015; Šrol, 2022; Teovanović et al., 2021). Particularly during the COVID-19 pandemic, we observed an increasing popularity of conspiracy beliefs about the origins, spread and severity of the SARS-CoV-2 virus and the vaccines developed to prevent the disease it causes. Previous studies show that more than 20% of people endorsed at least one COVID-related conspiracy belief during that time (e.g., Earnshaw et al., 2020; Šrol et al., 2022). Apart from being a sign of ontological and epistemological biases, the prevalence of ESB is troublesome due to potential negative societal impacts on attitudes, intentions and behaviour.

Negative health-related outcomes associated with ESB

In the health domain, researchers and healthcare professionals worry that the spread of ESB may threaten public health for a long time. For instance, in the US, support for various conspiracy theories claiming that the government is covering up the negative effects of vaccines and preventing people from using natural cures for cancer and other severe diseases ranged from 20 to 37%, while nearly two-thirds of the population was acquainted with these theories (Oliver & Wood, 2014). The authors then pointed out that people who endorsed more such conspiracy beliefs were also more likely to turn to complementary and integrative medicine (CIM) and avoid traditional health care. Indeed, at about the same time, as many as 40% of parents intended to refuse or delay vaccination of their children due to the lack of confidence in the safety and efficacy of vaccines (Smith et al., 2011). Researchers recognised various ESB among the key factors associated with vaccination scepticism – including vaccination against HPV. For instance, irrational health beliefs, endorsement of holistic or spiritual views, rejection of science, general scepticism or distrust towards the healthcare system, conspiracy beliefs and conspiracy mentality as a general tendency to interpret events in a conspiratorial manner were all shown to be correlated with vaccination attitudes and intentions (Briones et al., 2012; Chen et al., 2021;

Jolley & Douglas, 2014a; Kata, 2010; Lewandowsky et al., 2013). During the pandemic such concerns skyrocketed. A series of studies showed that people who endorsed conspiracy beliefs were less likely to be vaccinated against COVID-19 and showed more disregard for containment measures, such as physical distancing, wearing masks and washing hands frequently during the pandemic, and they tended to use more pseudoscientific health practices (Earnshaw et al., 2020; Šrol et al., 2021; van Mulukom et al., 2022; Žeželj et al., 2023). This not only put their own health at risk but also endangered other people by potentially spreading the disease.

Although conspiracy beliefs are now in the limelight, the literature offers abundant evidence that other forms of ESB may also have equally gruesome and lasting consequences for public health. For instance, ESB are believed to be associated with maladaptive health-related choices, such as a reluctance to use sunscreens, avoidance of regular preventive and dental checkups, lower intentions to get vaccinated against various diseases and more frequent use of herbal supplements and vitamins instead of standard medication (Browne et al., 2015; Oliver & Wood, 2014). Pseudoscientific beliefs, such as calls for naturalness (as opposed to artificial products offered by pharmaceutical companies) and spirituality, may hamper preventive screening and vaccination programmes, as well. People who rely on their *natural* immunity rather than *synthetic* vaccines and on the wisdom of the common man were shown to be less likely to be vaccinated but more likely to use pseudoscientific practices, such as consuming garlic, honey or colloidal silver, drinking herbal teas, using scientifically unproven supplements and homoeopathy, meditation, hypnosis and prayer in addition to or, more troubling, instead of traditional treatments and preventive check-ups (Browne et al., 2015; Natoli & Marques, 2021; Oliver & Wood, 2014; Teovanović et al., 2021; Žeželj et al., 2023). All of this indicates that ESB may affect the health-related attitudes, intentions and behaviour of large groups of people from the non-clinical populations and may have adverse consequences for public health far beyond the COVID-19 pandemic.

Interventions aimed at debunking ESB and mitigating associated adverse outcomes

The alarming results, though mostly correlational, led researchers and professionals to recognise that ESB – once studied mainly as a curio and a fringe phenomenon – threaten public health outcomes by inclining people to disobey healthcare recommendations and reject potentially life-saving vaccinations. Consequently, they called for targeted preventive measures that would debunk ESB, mitigate their consequences and restore confidence in science and the healthcare system (Jolley et al., 2022). Alas, studies show that ESB may be resistant to correction and have a lasting impact on people even after being rectified (Ecker et al., 2022; Pennycook et al., 2015). Consequently, Jolley and Douglas (2017) warned that pre-bunking may be more effective, specifically in the case of vaccination, but perhaps also other types of health-seeking behaviour.

However, in the current climate of conspiracism around the world – when the majority of people have already been exposed to some form of conspiracy theorising (Earnshaw et al., 2020; Oliver & Wood, 2014; Šrol et al., 2022) – pre-emptive strategies may not always constitute a feasible option. What's more, regularly emerging specific ESB urge the need for targeted strategies to refute dangerous misconceptions that threaten public health programmes (Ecker et al., 2022). If the spread of ESB and medical conspiracism – even unrelated to HPV vaccination directly – is associated with the above-mentioned negative health-related outcomes, the effectiveness of HPV prevention programmes and standard screenings will be at peril. This adds

an urgency to understanding how various ESB and health-related attitudes, intentions and behaviours are intertwined and to exploring the efficacy that interventions aimed at curbing the immediate endorsement of conspiracy narratives and redressing any long-term adverse effects of ESB may have in the health domain.

THE PRESENT STUDY

Building on the existing literature, the present study experimentally investigated the potential of a one-shot intervention that debunks common misconceptions about vaccines to curb the negative health-related impacts that ESB may have (pre-registration at https://osf.io/7c8vk/?view_only=b3b2b2a4821c440490b396da9ed2c57c). We compared the effectiveness of an intervention among people with various levels of pre-existing ESB and under conditions that presented either fact-checking content (intervention, anti-ESB condition), salient vaccine-related ESB (ESB condition) or neutral content about the advantages of having dogs and cats as domestic animals (neutral condition). First, we tested the effectiveness of debunking ESB to enhance general attitudes towards vaccines, intentions to vaccinate against human papillomavirus (HPV) seek health guidance, and to increase support for the HPV vaccination programme (see Figure 1 for the study flowchart). Second, once the debunking intervention turned out to be ineffective, we explored whether pre-existing ESB – operationalised as the conspiracy mentality (Bruder et al., 2013) and irrational health beliefs (Christensen et al., 1999; Pitel & Ballová Mikušková, 2021) – are associated with health-related attitudes and intentions across the conditions.

In line with previous studies, we hypothesised that the tendency to endorse conspiracy narratives associated with vaccination under the anti-ESB condition would be lower compared to the ESB and neutral conditions (H1). Moreover, recognising the need not only to refute ESB but also to curb the adverse health-related choices they may prompt, we further expected that general attitudes towards vaccines (H2a), intentions to vaccinate against HPV (H2b), support for the HPV vaccination programme (H2c) and intentions to seek health guidance (H2d) would be stronger after the intervention compared to the neutral and ESB conditions. Finally, the literature stresses the role of well-being and sociodemographic data (e.g., gender, age, education, income and subjective socioeconomic status) on the endorsement of ESB and health-related behaviour. Therefore, after exploring the effectiveness of the intervention, we added a hierarchical regression analysis that had not been previously registered and explored how pre-existing ESB are associated with health-related attitudes and intentions, also taking into account sociodemographic characteristics and well-being. We expected that pre-existing ESB would be consistently associated with and explain the variation in general attitudes towards vaccines (H3a), intentions to vaccinate against HPV (H3b), support for the HPV vaccination programme (H3c) and intentions to seek health guidance (H3d) above the impact of well-being and sociodemographic characteristics.

METHODS

Participants

Participants were recruited by an external agency (complying with the ESOMAR Code of Ethics), such that the sample mimicked the representation of individuals from the general

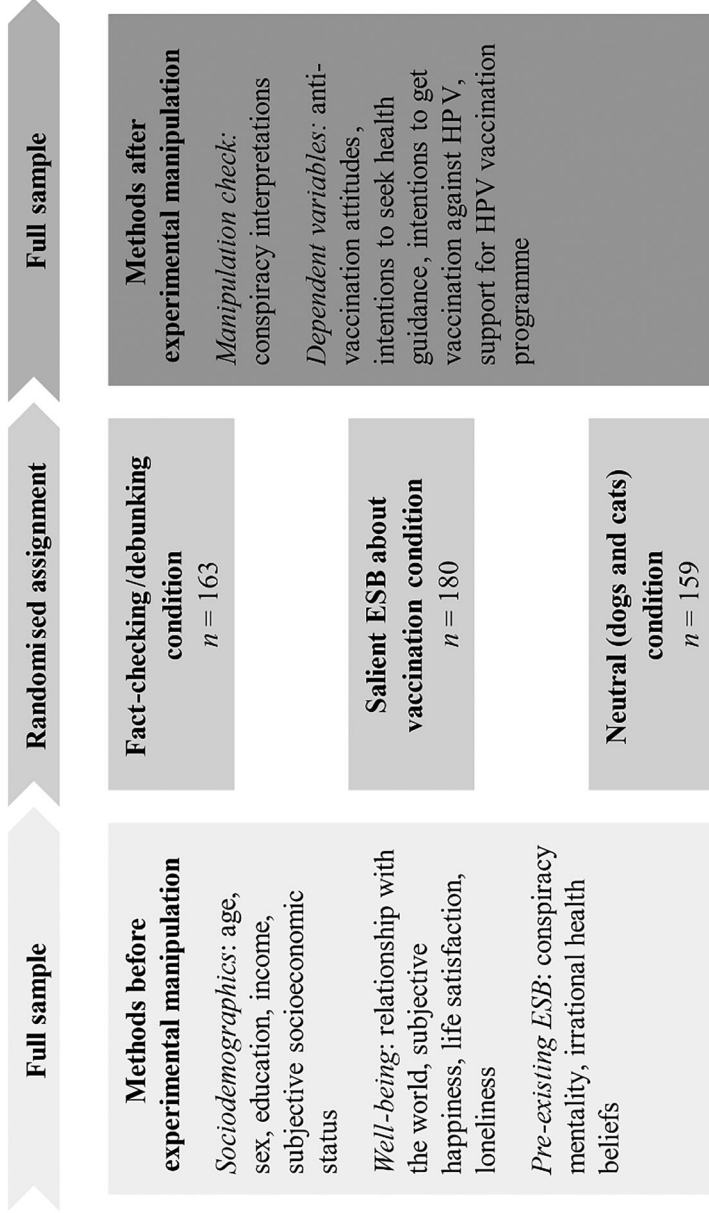


FIGURE 1 Study flowchart.

population in terms of age, sex and education. The study was approved by the Ethics Committee of the Centre of Social and Psychological Sciences, Slovak Academy of Sciences. Only participants who explicitly agreed to take part in the research and to the terms of the data management and publishing of the results continued to the survey.

A total of 772 respondents agreed to participate in the survey, though 207 were excluded due to not finishing the survey or failing to answer the attention check item. Thus, data from 565 participants (286 men, 279 women) were included in the analyses. Participants were aged 18 to 81 years ($M = 45.60$, $SD = 15.99$); 13.8% had a primary or secondary school education without a diploma; 45% had a secondary school education with a diploma; and 6.9% had an undergraduate and 34.3% a graduate or postgraduate college/university education.

Design

The experiment was prepared in Qualtrics, starting with demographic questions and one questionnaire which was not used in the present study. This was followed by a block of instruments measuring well-being, conspiracy mentality and irrational health beliefs (random order of instruments, with random order of items). We decided to use a measure of conspiracy mentality rather than specific conspiracy beliefs, because if the intervention showed efficacy among people scoring high in this more general, stable and less malleable disposition (Imhoff et al., 2022) that would mark a considerable step ahead in the battle against ESB and their adverse consequences (Leman & Cinnirella, 2013). Moreover, given the study objectives, we also measured pre-existing irrational health beliefs that could be associated with attitudes towards vaccines and the intention to be vaccinated against HPV.

Participants were then randomly assigned to one of the three conditions (conspiracy, anti-conspiracy and neutral). In the ESB and anti-ESB conditions, participants read the text, which was designed to either stimulate or counter any conspiracy narratives about vaccination. In the anti-ESB condition (fact-checking), epistemically suspect beliefs about vaccination were thoroughly refuted by scientific arguments. The text used in the anti-ESB condition came from a college journal (Hubčíková, 2021) and explained and refuted the most common concerns about vaccinations, e.g., the global increase in cancer or the composition of vaccines. In the ESB condition, the same text was modified to suggest that vaccines contain harmful and toxic additives that cause serious illness and damage to the human body. In the neutral condition, participants read a brief essay about whether it is better to have a cat or a dog as a pet (Natoli & Marques, 2021). The text about pets was added to imitate cognitive load in the two other conditions and was intentionally kept as general as possible and was not intended to support any opinion. All three texts are available at <https://osf.io/a6vkk>.

After reading one of the texts, each participant answered the same questions about the endorsement of conspiracy narratives regarding vaccination (manipulation check). Then, each participant completed questionnaires on anti-vaccination attitudes, health-seeking intentions, the intention to be vaccinated against HPV and support for HPV vaccination (random order of instruments, with random order of items). All measures used in the experiment are available at <https://osf.io/7c8vk/>.

Finally, all participants were thoroughly debriefed and informed about the aims of the study. Those randomly assigned to the ESB condition were informed that the information they were reading could affect their health-related decisions and attitudes and were therefore asked to read fact-checking material that debunked the false or manipulative content to

which they were exposed. They were then asked to confirm that they had read and understood the explanation. Participants who did not do so or dropped out of the study after reading the material in the ESB condition were contacted individually—first by e-mail and then by phone—and properly debriefed. To ensure anonymity, debriefing was conducted by the agency that recruited the participants, so the researchers had no knowledge of participants' personal information (while the agency had no access to the responses the participants gave during the study).

Instruments

Measures administered before the experimental manipulation

Control variables

Sociodemographic data and well-being were measured as control variables. Participants were asked to indicate their *age*, *sex* (man, woman, I do not wish to indicate), *education* (elementary, secondary school without diploma, secondary school with diploma, undergraduate/graduate/postgraduate college/university), *income* (net monthly income) and *subjective socioeconomic status* using the Cantril ladder (Cantril, 1965). To assess the participants' level of well-being, we measured their *relationship with the world* (Circles of Life; [Kjell et al., 2016]), *global subjective happiness* (Subjective Happiness Scale; [Lyubomirsky & Lepper, 1999]), *life satisfaction* (Satisfaction with Life Scale; [Diener et al., 1985]), and *feelings of loneliness* (Loneliness Scale; [Roberts et al., 1993]). Higher scores indicate a higher level of well-being.

Pre-existing epistemically suspect beliefs

To observe individual differences in pre-existing ESB before the experimental manipulation, we measured *conspiracy mentality* (Conspiracy Mentality Questionnaire; [Bruder et al., 2013]); participants indicated their agreement with five general conspiracy statements; scale from 1 = strongly disagree to 5 = strongly agree) and *irrational health beliefs* (Irrational Health Beliefs Scale; [Christensen et al., 1999]); participants indicated the level of agreement with rationalisations in 21 short vignettes describing specific health situations and experiences). For both scales, the higher the score, the higher the level of conspiracy beliefs.

Measures administered after the experimental manipulation

Manipulation check

For the *manipulation check*, after reading one of three the texts, the participants were presented with eight conspiracy interpretations and narratives, and they had to indicate the extent to which they agreed with them (1 = strongly disagree; 5 = strongly agree). The higher the score, the more likely they were to agree with the conspiracy explanations and narratives.

Anti-vaccination attitudes

To measure *general anti-vaccination attitudes*, we used six items adapted from Wallace et al. (2019). Participants indicated their agreement with anti-vaccination statements on a 5-point

scale (1 = strongly disagree, 5 = strongly agree). A higher score indicates stronger anti-vaccination attitudes.

Intentions to seek health guidance

Intention to seek health guidance was measured using five items (Natoli & Marques, 2021). Participants indicated whether they intend to engage in various health-conscious behaviours in the next 12 months (1 = definitely no, 5 = definitely yes). The higher the score, the greater the intention to engage in health-seeking behaviours.

Vaccination intentions

We also asked participants if they were *vaccinated against HPV* (1 item; yes/no). To assess *intention to be vaccinated against HPV*, we asked participants whether they wished to be vaccinated with the HPV vaccine, if the vaccine was not covered by their health insurance/if the vaccine was covered by their health insurance (2 items; 1 = definitely yes; 5 = definitely no).

Vaccination support

As *support for HPV vaccination*, we measured the willingness to support relatives to be vaccinated with the HPV vaccine if the vaccine was not covered by health insurance/if the vaccine was covered by their health insurance, and also if they support making the HPV vaccination mandatory (for children aged 12 years) (3 items; 1 = definitely yes; 5 = definitely no). The higher the score, the greater the intention to be vaccinated against HPV and to support HPV vaccination.

RESULTS

Descriptives and group comparisons

The descriptives of the variables used for the full sample and each group separately are presented in Table 1. Firstly, to ensure the equality of the groups, we compared them in terms of age, subjective social status, subjective well-being, conspiracy mentality and irrational health beliefs using ANOVA. The results were not significant, meaning that the compared groups did not differ in these variables.

The results of ANOVA regarding the first hypothesis showed that the groups significantly differed in the tendency to endorse conspiracy narratives, although the effect is small ($F_{[2, 562]} = 4.33, p = 0.014, \eta^2 = 0.02$). The results of Tukey's post-hoc tests showed a significant small difference between the anti-ESB and ESB conditions ($t_{[562]} = 2.94, p = 0.009, d = 0.30$). Although participants in the ESB condition scored higher and participants in the anti-ESB condition scored lower in conspiracy narratives compared to the neutral condition, no significant difference was found between the neutral and ESB conditions ($t_{[562]} = -1.46, p = 0.311, d = -0.15$) nor the neutral and anti-ESB conditions ($t_{[562]} = 1.40, p = 0.009, d = 0.15$). Based on these results, our first hypothesis was partially confirmed.

Our second hypothesis was not confirmed, as the results of ANOVA showed no significant differences between groups in general attitudes towards vaccines ($F_{[2, 562]} = 0.10, p = 0.909$), intentions to vaccinate against HPV ($F_{[2, 499]} = 0.29, p = 0.749$), support for the

TABLE 1 Overall and group specific descriptives of the variables used.

Variable	M	SD	α	Group					
				Control		ESB		Anti-ESB	
				M	SD	M	SD	M	SD
Age	45.60	15.99	-	45.38	16.85	45.14	15.87	46.31	15.36
Subjective social status	5.59	1.58	-	5.48	1.62	5.58	1.56	5.69	1.56
Circles of life	6.10	2.47	-	5.94	2.63	6.18	2.37	6.15	2.41
Subjective happiness	3.33	0.79	0.78	3.23	0.82	3.36	0.79	3.37	0.74
Satisfaction with life	3.01	0.88	0.87	2.99	0.85	3.00	0.92	3.03	0.85
Loneliness	2.23	0.75	0.82	2.21	0.72	2.26	0.78	2.20	0.73
Conspiracy mentality	3.52	0.95	0.87	3.53	0.94	3.44	0.99	3.60	0.92
Irrational health beliefs	1.85	0.57	0.86	1.81	0.55	1.86	0.59	1.88	0.56
Conspiracy narratives	2.88	1.04	0.93	2.87	1.06	3.03	1.04	2.72	1.00
Anti-vaccination attitudes	2.69	1.10	0.89	2.69	1.12	2.71	1.12	2.66	1.07
Intentions to seek medical advice	3.13	0.93	0.76	3.13	0.90	3.18	0.94	3.06	0.93
Intentions to vaccinate ¹	2.69	1.13	0.84	2.63	1.11	2.70	1.17	2.72	1.12
Support for HPV vaccination	2.93	1.18	0.87	2.94	1.23	2.91	1.18	2.95	1.15

Note: 1 - $N = 502$, $N_{\text{control}} = 159$, $N_{\text{ESB}} = 180$, $N_{\text{anti-ESB}} = 163$.

TABLE 2 Correlations between pre-existing ESB and health-related attitudes and intentions.

	1	2	3	4	5
1. Conspiracy mentality	-				
2. Irrational health beliefs	0.38***	-			
3. Anti-vaccination attitudes	0.56***	0.49***	-		
4. Intentions to seek medical advice	-0.10*	-0.19***	-0.18***	-	
5. Intentions to vaccinate ¹	-0.46***	-0.41***	-0.67***	0.29***	-
6. Support for HPV vaccination	-0.46***	-0.38***	-0.73***	0.25***	0.87***

Note: 1 - $N = 502$. * - $p < .05$, ** - $p < .01$, *** - $p < .001$.

HPV vaccination programme ($F_{[2, 562]} = 0.06$, $p = 0.942$) nor intentions to seek health guidance ($F_{[2, 562]} = 0.82$, $p = 0.440$).

The effect of pre-existing ESB on health-related attitudes and intentions

Table 2 presents Pearson's correlations between pre-existing ESB and health-related attitudes and intentions. The results showed a moderately strong positive correlation of both conspiracy mentality and irrational health beliefs with anti-vaccination attitudes, and a negative correlation with intentions to vaccinate and support for the HPV vaccination programme. The

correlations with the intention to seek health guidance were negative and weak overall. Further, health-related attitudes and intentions are strongly correlated, with the exception of the intention to seek health guidance.

The results of hierarchical linear regression are presented in Table 3. More detailed results are presented in a supplementary material (Tables A1–A4). Overall, pre-existing ESB had a significant effect on all dependent variables – a positive one on anti-vaccination attitudes and a negative one on intentions to vaccinate, support for HPV vaccination and intentions to seek health guidance – with explained variance ranging from 4% to 36%. The conspiracy mentality had the strongest effect on all the dependent variables except intentions to seek health guidance, where the effect was non-significant. Irrational health beliefs significantly predicted all the dependent variables. Hypothesis H3a – H3d were thus confirmed. Apart from pre-existing ESB, education, age, gender and well-being played a significant role for some of the health-related attitudes and intentions. The anti-vaccination attitudes were significantly stronger for younger, less educated and happier people. Moreover, more educated people reported slightly stronger intentions to vaccinate and support for the HPV vaccination programme. Being a woman, educated and more in harmony with the world positively predicted intentions to seek health guidance. Subjective social status and loneliness did not play a significant role for any of the dependent variables.

DISCUSSION

The primary aim of the present study was to experimentally test the efficacy of an intervention that debunks ESB about vaccines. The intervention was expected to decrease the endorsement of conspiracy narratives, to enhance attitudes towards vaccines and the intentions to vaccinate against HPV, to increase support for the HPV vaccination programme, and to encourage people to seek health guidance. Second, in an exploratory analysis, the study investigated how pre-existing ESB – comprising conspiracy mentality and irrational health beliefs – are associated with the series of maladaptive attitudes, beliefs and intentions in the health domain.

Associations between pre-existing ESB and health-related behaviour

In accordance with our expectations and previous literature (Browne et al., 2015; Natoli & Marques, 2021; Oliver & Wood, 2014; Teovanović et al., 2021; Žeželj et al., 2023), we found that pre-existing ESB are associated with all four dependent variables (attitudes towards vaccines, intentions to vaccinate against HPV, support for the HPV vaccination programme and intentions to seek health guidance). The only exception to this general rule, however, was that the conspiracy mentality did not correlate with health-guidance seeking. Although our data do not allow us to explain the result, we could speculate that seeking medical advice or health guidance is more strongly associated with patients' current health status or the medical conditions they have (e.g., Elnegaard et al., 2015). In other words, regardless of the tendency to endorse conspiracy beliefs, people who feel unwell tend to seek help, including traditional medical advice and browsing through the Internet for sources of information. Future studies could delve deeper into these intentions and try to disentangle involvement in standard medical procedures from CIM practices and carefully control for any pre-existing diseases the participants may suffer from. For instance, a recent study by Čavojsková et al. (2023) showed that cancer-diagnosed

TABLE 3 *The effect of pre-existing ESB on the health-related attitudes and intentions controlled for demographics and well-being.*

Predictor	Standardised beta and 95% confidence interval		
	Anti-vaccination attitudes	Intentions to vaccinate	Support for HPV vaccination
<i>Demographics and well-being</i>			
Gender (women - men)	-0.09 [-0.22, 0.04]	0.11 [-0.04, 0.26]	0.14 [0.00, 0.29]
Age	-0.09* [-0.15, -0.02]	-0.03 [-0.11, 0.05]	0.06 [-0.01, 0.14]
Education	-0.10** [-0.17, -0.03]	0.13** [0.05, 0.21]	0.10** [0.03, 0.18]
Subjective social status	-0.01 [-0.09, 0.06]	0.08 [0.00, 0.17]	0.06 [-0.02, 0.15]
Circles of life	0.04 [-0.04, 0.11]	0.04 [-0.05, 0.12]	0.02 [-0.06, 0.10]
Subjective happiness	0.11* [0.01, 0.20]	0.01 [-0.10, 0.12]	-0.02 [-0.13, 0.08]
Satisfaction with life	-0.06 [-0.15, 0.04]	-0.02 [-0.13, 0.09]	0.01 [-0.09, 0.12]
Loneliness	0.00 [-0.08, 0.08]	0.09 [-0.01, 0.18]	0.07 [-0.02, 0.16]
<i>Epistemically suspect beliefs</i>			
Conspiracy mentality	0.44*** [0.37, 0.52]	-0.31*** [-0.39, -0.22]	-0.35*** [-0.43, -0.27]
Irrational health beliefs	0.32*** [0.25, 0.39]	-0.26*** [-0.35, -0.18]	-0.24*** [-0.32, -0.16]
<i>Demographics and well-being R²</i>			
	0.07***	0.11***	0.07***
<i>Epistemically suspect beliefs ΔR^2</i>			
	0.36***	0.19***	0.21***
<i>Full model R²</i>			
	0.43***	0.31***	0.28***
<i>Intentions to seek medical advice</i>			
			0.43*** [0.26, 0.59]
			0.19*** [0.11, 0.28]
			0.03 [-0.05, 0.12]
			0.01 [-0.09, 0.10]
			0.10* [0.01, 0.20]
			-0.06 [-0.18, 0.06]
			0.00 [-0.12, 0.11]
			0.04 [-0.06, 0.14]

Note: * - $p < 0.05$, ** - $p < 0.01$, *** - $p < 0.001$.

women reported more pseudoscientific beliefs and were more willing to use CIM compared to healthy women. Interestingly, diagnosed women showed neither more positive attitudes towards CIM nor a preference for alternative over standard medical procedures and used CIM mostly as an addition to traditional treatment. Nevertheless, although patients with a life-threatening diagnosis could turn towards any source of potential relief and hope – be it alternative or traditional – ESB remained the most significant predictor of using CIM. Concurrently, our results show that participants who endorsed more irrational health beliefs – the second component of our pre-existing ESB measure – were less likely to seek health guidance, which shows that, overall, the endorsement of ESB is not inconsequential in the health domain.

The efficacy of anti-ESB intervention

Unfortunately – and contrary to our hypotheses – the study offers less promising results concerning the experimental part of the research. Although the data indicate that debunking may curb the immediate tendency to endorse conspiracy narratives associated with the vaccination, the effects were small. More troubling, despite the minor effect on the endorsement of conspiracy narratives, the intervention remained unrelated to any of the four dependent variables and failed to enhance attitudes towards vaccines and intentions to vaccinate against HPV, to increase support for the HPV vaccination programme and to encourage people to seek health guidance. Although troubling, our results are not unique. Similar trends were reported by Nyhan et al. (2014), who found that despite reducing misconceptions about vaccines, the interventions were futile in increasing parents' intentions to vaccinate a future child. Concurrently, a series of experimental studies (Jolley & Douglas, 2014a, 2014b; Jolley & Paterson, 2020; Šrol et al., 2023) shows a disturbingly similar pattern that the intentions regarding vaccination and engaging in pro-environmental behaviour, trust, a sense of efficacy as well as prejudice against immigrants did not change after an anti-conspiracy intervention compared to control conditions. In all cases, the interventions were at best only partly effective.

Taken together, the results suggest that the effect of interventions that debunk ESB may not easily extend to associated attitudes, intentions or behaviour. The findings contribute to knowledge about mechanisms driving vaccination hesitancy and refusal and points out the urgency to better recognise factors that could hamper the interventions' effectiveness. For instance, theories of continued influence explain that even after being corrected, ESB may have a lasting effect on reasoning and behaviour. This may happen because people often rely on fast and intuitive cognitive strategies in situations when more deliberate thinking would be appropriate. Asking people to rethink their decisions or take time to carefully consider the available options often triggers more conscientious information processing and helps avoid emotion-driven or biased responses (Ecker et al., 2022). Also, memory failures and cognitive biases tend to interfere with the decision-making process, thus skewing the evaluations of trustworthiness and veracity of information towards what people are already familiar with or agree with (Čavojská et al., 2018). When cognitive biases activate, false beliefs may have a lingering impact on behaviour, because the correction – as a new piece of information – may not be sufficiently integrated into a person's knowledge and, thus, more challenging to retrieve (Ecker et al., 2022). Apart from cognitive aspects, the literature also points to trustworthiness of informational sources (or lack thereof), rather than their expertise, as an important barrier in ESB correction (Ecker & Antonio, 2021). If a person is distrustful towards the *mainstream*, they may be suspicious of informational content that mainstream sources provide. Finally, people may be vigilant

about messages that attack their worldviews and thus threaten important aspects of their identity (Ecker & Ang, 2019; Nyhan & Reifler, 2010; Trevors, 2022). Therefore, in the future all of these factors should be carefully considered when attempting to prevent the persistent impact of ESB on health-related attitudes, intentions and behaviour.

Limitations

As with every empirical study and despite our best efforts, the study is not free from limitations. For instance, although questions about endorsement of conspiracy narratives (manipulation check) indicated that the manipulation had been effective, we did not openly ask participants about their perceptions of the trustworthiness or persuasiveness of the intervention, nor did we control for cognitive skills and biases people may have. Although given the randomised condition assignment we could assume a balanced distribution of people with various characteristics between the conditions, the current design does not allow us to draw conclusions about specific drivers of the ESB resistance to correction.

Also, an important factor in the task of combatting ESB is timing. Unlike the present study, past research that used a similar design showed that neutral and anti-conspiracy conditions were alike, while the exposure to conspiracy theories increased the endorsement of conspiracy narratives *and* enhanced maladaptive social or health-related behaviour (Bartoš et al., 2022; Jolley & Douglas, 2014b, 2014a; Jolley & Paterson, 2020). We need to remember, however, that those past studies were mostly conducted before the pandemic and before real-life exposure to ESB became common. Therefore, the epistemically suspect content read during those past experiments was most likely novel to the participants. Thus, it cannot be surprising that exposure to ESB fostered a response. Our study, in turn, was conducted in 2022, in the climate of widespread ESB about vaccination (SAS, 2021; Šrol et al., 2022). The results could indicate that people were already saturated with ever present ESB. Thus, such a one-shot exposure during the experiment managed to only slightly change the endorsement of conspiracy narratives and had no effect whatsoever on health-related intentions, beliefs and attitudes. Concurrently, a one-shot intervention was too weak to debunk ESB that were already well-known and to a large extent accepted at that time. The results may be interpreted as corroborating the view that in the case of vaccination, pre-bunking could be more effective than debunking (Jolley & Douglas, 2017) or that the earlier we start fact-checking, the greater the chance for interventions to be successful. Alas, at the time we conducted our study, pre-bunking was no longer a viable option, and the damage had already been done by the ESB. Perhaps a similar intervention performed earlier would have turned out to be more effective.

Practical implications and recommendations for health communication strategies

Despite the limitations, the study has important practical implications. Like other forms of fact-checking, our intervention had a limited effect on the immediate endorsement of conspiracy narratives, indicating that debunking – although not perfect – could be seen as one of the potential tools in the fight against ESB. In purely statistical terms, we could conclude that our experiment delivered significant results. Is it enough, however? In terms of practical impact, we see this as far from satisfactory. Although fact-checking could mitigate conspiracy narratives

associated with interpretations of events, it can hardly be a cure to the long-term consequences of the endorsement of ESB. We need to remember that while some ESB may seem to be harmless curiosities, there is an ample evidence that health-related pseudoscientific practices may cause irreversible damages or even death, such as in the case of people who believed that methanol could be a cure for COVID-19 (Teovanović et al., 2021). If we do not have effective interventions that debunk ESB *and*, at the same time, reduce their impacts on health-related behaviour, the damages caused by ESB may be much more unyielding and difficult to curb. This could further threaten existing and future vaccination programmes and increase a risk of the spread of new diseases and the re-emergence of old ones, such as measles or whooping cough.

Therefore, we should pose an even more important question in this context – what does it take for an anti-conspiracy intervention to be effective, when fact-checking turns out to be a failure? Answering this question will have a far-reaching impact on the communication strategies adopted by practitioners and policy-makers. Our results show that it is not enough to refute misconceptions and misinformation about vaccines or more broadly about health. Although simple, and thus appealing and cost-effective, the strategy is unlikely to have sufficient efficacy. The study shows that it will take more complex and long-term measures to achieve tangible and durable effects. For instance, Ecker et al. (2020, 2022) pointed out that interventions should provide an alternative explanation in addition to pure refutation of inaccurate statements, that an intervention needs to be provided by a trustworthy party, should be communicated in an easily understandable language and in a way that does not threaten an individual's identity. Moreover, particularly in the context of vaccination, Bartoš et al. (2022) proposed to refer to injunctive (e.g., the call to protect vulnerable people) and descriptive (e.g., the majority of parents vaccinate their children or most doctors agree that vaccines are safe and beneficial) norms, and to communicate doctors' consensus about vaccination benefits.

Finally, there could be some deeper socio-cultural factors that shape responsiveness to the intervention that fact-checking does not account for. Taking a closer look at international differences, we can see a considerable variation in the type and strength of endorsed ESB between the countries. This indicates that apart from individual characteristics, some larger-scale factors can play a considerable role in the process of spreading and endorsing ESB. Also, Lyons et al. (2020) found that there is considerable heterogeneity in the acceptance of fact-checking among European countries. Those where institutional trust is high show more acceptance for such interventions, and notably Slovakia has systematically scored low in institutional trust for a long time (Grežo et al., 2022). Apart from institutional trust, recent studies increasingly point to other structural conditions as contributing to the endorsement of ESB (Adamus et al., 2024). The literature shows that while objective measures of structural conditions may be key in cross-country comparisons, their subjective appraisal may be vital in understanding differences between subjects. Specifically, the quality of democratic institutions and governance, corruption, socioeconomic inequality, slower economic development and low GDP per capita, as well as subjective perception of them, could all be used as indicators of the vulnerability to ESB (Alper, 2023; Cordonier et al., 2021; Hornsey et al., 2023; Hornsey & Pearson, 2022; Jetten et al., 2022).

Therefore, future interventions and communication strategies could combine various intervention techniques, take into account structural conditions people live in and make an attempt to test the same interventions in several countries to compare their effectiveness depending on the socio-cultural context. Practitioners and communicators need to remember that no matter how well designed, no debunking intervention or communication strategy can be fully effective

in curbing ESB, and/or the impact of an intervention may not be lasting. Perhaps repeated regularly, longitudinal programmes offered in combination with other types of measures, such as educational activities that develop cognitive skills and scientific thinking (Georgiou et al., 2020; Swami et al., 2014; van Prooijen, 2017) and efforts to enhance the importance of social norms and institutional trust (Adam-Troian et al., 2023; van Mulukom et al., 2022; Wagner-Egger et al., 2022), interventions could have not only a more prolonged but also more widespread impact on actual vaccination behaviour that goes beyond the mere endorsement of conspiracy narratives. Although in the political realm, results are demanded immediately, building trust in the healthcare system and healthcare providers is necessarily a long-term endeavour. Boosting the trustworthiness of the source of educational or fact-checking materials will require patience, but also empathy and understanding for people's concerns and living circumstances (Drażkiewicz, 2022).

CONCLUSIONS

Although not free from limitations, our results corroborate the view that ESB may have adverse impacts on the intention to seek health guidance and support for prevention programmes and, thus, future public health outcomes, such as HPV vaccination. According to the CDC (CDC, 2023), many men are infected with HPV, often without any symptoms, and about 80% of women will be infected at some point in their life. Since about 10% of those infected will develop some form of cancer, it would make sense to eliminate those perfectly preventable cancer cases with a vaccination that shows up to 97% effectiveness if administered before the infection (Department of Health and Social Care, 2021). Moreover, we are observing the advent of a pseudoscientific and spiritual wellness industry that attempts to sell people miraculous treatments for each and every condition that troubles modern society. Companies exploit failures of healthcare systems and prey on people's vulnerability, fears and pain. When alternative medicine does not aggravate a patient's condition and is added as a supplementary method to a standard treatment, then perhaps it may not be worrisome. However, when alternative procedures fail to prevent a preventable condition or treat a progressing disease and are harmful in and of themselves, it is time to call them out. Nothing less than long-term programmes that curb potential maladaptive and lasting consequences of ESB and ease people's vulnerability to fraudulent health and wellness traders should be considered satisfactory. Therefore, our findings should urge us to develop interventions that could not only inhibit the immediate endorsement of conspiracy narratives but also curb any long-term negative impacts ESB may have in the health domain. Whatever the solution to the threat of ESB may be, it seems clear that we cannot stick with the endorsement of imminent conspiracy narratives as a criterion of effectiveness. Until we find a way to combat the maladaptive behavioural consequences that ESB may have in various domains, our battle against ESB is not over.

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CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest to disclose.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study, materials and appendices are openly available at https://osf.io/7c8vk/?view_only=b3b2b2a4821c440490b396da9ed2c57c.

ETHICS STATEMENT

The research was approved by Ethical Committee of the Centre of Social and Psychological Sciences, Slovak Academy of Sciences.

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