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Alternative Medicine, COVID-19 Conspiracies, and Other Health-Related Unfounded Beliefs: The Role of Scientific Literacy, Analytical Thinking, and Importance of Epistemic Rationality

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We examined how scientific literacy (scientific reasoning, scientific knowledge, and trust in science), analytical thinking and the importance of epistemic rationality relate to the belief in the efficacy of complementary and alternative medicine (CAM) and other health-related unfounded beliefs (COVID-19 conspiracies, pseudoscientific and magical beliefs, and cancer myths). A representative sample of 1038 Slovaks (M_{age} = 42.08, *SD* = 13.99) participated in the study. While CAM belief correlated with COVID-19 conspiracy theories, pseudoscientific beliefs, magical health-related beliefs, and cancer myths, it appeared that belief in CAM was primarily driven by lower trust in science, lower analytical thinking, and, interestingly, a higher need to be epistemically rational. Other components of scientific literacy did not significantly predict CAM belief but they did predict other health-related unfounded beliefs, which may suggest that a more fine-tuned approach to studying CAM beliefs is needed.

Key words: scientific literacy, health-related unfounded beliefs, alternative medicine, analytical thinking, importance of rationality

Introduction

The recent pandemic of coronavirus-related misinformation has highlighted long-term problems with susceptibility to a range of health-related misinformation (not just related to the new virus). Susceptibility to believing health-related misinformation poses a serious public health problem because such beliefs lead to potentially harmful behaviors, such as vaccination refusal (Bertin et al., 2020), nonadherence to preventive measures (Soveri et al., 2021), and prefer-

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The materials and the dataset generated and/or analyzed during the current study are available in the OSF repository https://osf.io/942vh/

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ence for alternative medicine over standard medicine (Johnson et al., 2018). The negative health effects of unfounded beliefs (i.e., beliefs that are not based on currently known evidence and are not in line with currently available body of knowledge) affect not only individuals but also society as a whole. For example, refusal to vaccinate in childhood leads to a decline in collective immunity and causes an outbreak of an epidemic of preventable diseases, such as the recent increase in measles and rubella epidemics in Italy or Romania (European Centre for Disease Prevention and Control, 2018). Similarly, according to the World Health Organization ([WHO] n.d.), between 30-50% of all cancer cases are preventable through healthy lifestyles and avoidance of risk factors. However, many people are unaware of the relatively simple lifestyle choices that would prevent cancer and instead believe in mythical causes of cancer such as stress, genetically modified foods, or food additives (Shahab et al., 2018).

The role of analytic/rational thinking and scientific reasoning in susceptibility to unfounded beliefs have already been identified (Čavojová et al., 2020; Pennycook et al., 2012; Ståhl & van Prooijen, 2018; Swami et al., 2014; Šrol, 2022). In recent years, the focus has been mainly on unfounded beliefs related to coronavirus (Čavojová et al., 2022; 2023). In this paper, we aim to extend existing research about the role of scientific reasoning in susceptibility to unfounded beliefs (Čavojová et al., 2020; 2022; 2023; Čavojová & Ersoy, 2020; Georgiou et al., 2021) in two ways: First, we will examine the role of scientific literacy and all of its facets (scientific reasoning, trust in science, scientific knowledge; Miller, 1983) in susceptibility to health-related unfounded beliefs. To our knowledge, no research has examined the relationships between unfounded beliefs and all components of scientific literacy together to assess their respective roles. Second, we expand the variety of health-related unfounded beliefs under our examination. While previous studies focused either on pseudoscientific remedies/CAM or specific conspiracy theories (mostly related to COVID-19 or Big Pharma), in the current study we include a wider range of culturally specific CAM treatments, COVID-19 related conspiracy theories, pseudoscientific beliefs, magical health beliefs and cancer myths. In the next section, we define what we mean by health-related unfounded beliefs and briefly review the evidence to date that underlies our research.

Complementary and Alternative Medicine (CAM) as Part of Health-Related Unfounded Beliefs

Beliefs that are not justified by the totality of available evidence and knowledge are referred to as unfounded beliefs and include conspiracy, paranormal, and pseudoscientific beliefs (Lobato et al., 2014). In our research, we focused specifically on health-related unfounded beliefs because they were among the most frequently trusted even before the pandemic (for a review, see Wang et al., 2019). More recent research has focused primarily on COVID-19 conspiracy theories and their negative consequences (for a review, see van Mulukom et al., 2022), as well as pseudoscientific beliefs related to COVID-19 treatment (Čavojová et al., 2022). Moreover, many pseudoscientific treatments are often based on magical beliefs – i.e., beliefs that have no empirical, logical, or scientific basis, but have intuitive appeal by invoking naturalness, contagion or other spiritual beliefs (Bryden et al., 2018). Such beliefs could negatively impact public health by predicting, for example, vaccine skepticism and positive

attitudes toward complementary and alternative medicine (Bryden et al., 2018). Complementary and alternative medicine (CAM) "refers to a broad set of health-care practices that are not part of a country's own tradition and not integrated into the dominant health care system" (WHO, 2004, p. 13) and often rely on pseudoscience. Pro-CAM attitudes are often related to rejection of vaccination (Bryden et al., 2018) and standard medicine (Browne et al., 2015) and therefore it is important to better understand why people are inclined to prefer CAM over conventional treatments. Moreover, failure to disclose information about CAM use to attending physician may cause potential side-effects (Davis et al., 2012).

Different types of unfounded beliefs, i.e., conspiracy, paranormal and pseudoscientific beliefs, tend to be related to each other, from moderate to strong correlation (Čavojová et al., 2020; Lobato et al., 2014), so we can assume that people with one type of unfounded belief are more prone to believe in others as well. For example, positive attitudes and beliefs toward CAM are positively predicted by pseudoscientific and magical beliefs about health (Bryden et al., 2018; Čavojová et al., 2021) and also by paranormal beliefs (Lindeman, 2011). Belief in pseudoscience and other conspiracy theories is associated with higher endorsement of COVID-19 conspiracy beliefs (Čavojová & Šrol, 2022). However, CAM beliefs have either been studied separately from other unfounded beliefs or have been considered as a result of other unfounded beliefs (Lindeman, 2011). Therefore, in this study, we include different types of health-related unfounded beliefs, COVID-19 conspiracy theories, and beliefs about the efficacy of CAM and examine the role of analytical thinking and scientific literacy in their endorsement.

The Role of Scientific Literacy, Analytical Thinking and Importance of Epistemic Rationality in Health-Related Unfounded Beliefs

Science is sometimes seen as a vaccine against unfounded beliefs (Fasce & Picó, 2019), and especially in modern society, at least a basic understanding of science is necessary to make informed decisions and evaluate evidence. It is interesting that the majority of studies have focused on only one of the dimensions of scientific literacy: either knowledge (Miller, 1983), scientific reasoning (Čavojová et al., 2020; 2022), or trust in science (O'Brien et al., 2021).

While scientific reasoning was a significant negative predictor of unfounded beliefs (paranormal, conspiracy, and pseudoscientific), COVID-19 conspiracy beliefs, and generic health-related unfounded beliefs (Čavojová et al., 2020; 2022), belief in CAM (Čavojová & Ersoy, 2020), and higher acceptance of scientific consensus about the safety of vaccines or genetically modified foods (Drummond & Fischhoff, 2017), the results of the other two components of scientific literacy are less clear.

In the case of scientific knowledge, specific knowledge about a controversial topic tended to be associated with acceptance of the scientific consensus. For example, pregnant women with more knowledge about vaccination had more positive attitudes toward vaccination and higher intentions to have their children vaccinated (Rosso et al., 2019). Similarly, more knowledge about the safety of genetically modified foods correlated with more positive attitudes toward them (McPhetres et al., 2019), and knowledge of psychological facts was negatively related to susceptibility to pseudoscience and misinformation related to psychology and paranormal beliefs (Bensley et al., 2014). On the other hand, some

studies did not find any correlation between scientific knowledge and pseudoscientific beliefs (Johnson & Pigliucci, 2004; Lundström & Jakobsson, 2009).

In general, trust in science was a significant negative predictor of susceptibility to COVID-19 conspiracies and nonadherence to preventive measures in several studies (Erceg et al., 2022; Roozenbeek et al., 2020). On the other hand, O'Brien et al. (2021) showed that participants with higher levels of trust in science were significantly more likely to believe pseudoscientific messages with scientific content than messages without scientific content.

One of the other well-documented factors negatively related to unfounded beliefs is analytical thinking (Ballová Mikušková, 2021; Pennycook et al., 2012; Swami et al., 2014). Studies that examined both analytic thinking and scientific reasoning (Čavojová et al., 2020; 2022) found that scientific reasoning is a stronger negative predictor of unfounded beliefs. According to other studies (Adam-Troian et al., 2019; Ståhl & van Prooijen, 2018) analytic thinking is a stronger protective factor against unfounded beliefs when accompanied by the motivation to be rational, i.e., valuing epistemic rationality. Valuing epistemic rationality refers to the personal importance of forming beliefs based on logic and evidence (Ståhl & van Prooijen, 2018). Therefore, we examine the role of scientific literacy along with analytic thinking and importance of epistemic rationality to assess its unique contribution to the overall variance of the unfounded beliefs studied.

The Present Study

In the present study, we examined scientific literacy, analytic thinking, and the importance of epistemic rationality as predictors of health-related unfounded beliefs. As health-related unfounded beliefs, we examined beliefs in efficacy of CAM, COVID-19 conspiracy beliefs, magical health beliefs, pseudoscientific beliefs, and beliefs in mythical causes of cancer. Based on the aforementioned previous research findings, we expected negative correlations between the components of scientific literacy (scientific knowledge, scientific reasoning, and trust in science) and health-related unfounded beliefs. Next, in line with our study goal to examine the role of scientific literacy, analytic thinking and the importance of epistemic rationality in predicting health-related unfounded beliefs we are going to explore and compare the unique predicting power of all these factors.

Methods

Participants

Participants were recruited through an external research agency to represent the Slovak population in terms of gender, age, and education. The final sample consisted of 1038 adults aged 18 to 80 years (M = 42.08, SD = 13.99); 490 (47.2%) of them were men, 1 participant did not state the gender. 38.2% of participants had only primary education (10 years of compulsory education), 39.4% had full secondary education, and 22.5% had a college education or higher. Participation in the research was compensated by an external research agency by gift vouchers.

Procedure

Data were collected in November 2021, through an online survey created in Qualtrics. The data collection was part of a larger research effort under the project "Integrative strategy in the development of personalized medicine for selected malignant oncologic diseases and its impact on quality of life".

The entire survey was divided into 3 blocks of research methods. The first block included an experimental method on health behaviors (not reported in this study), the second block included methods to measure psychological predictors related to health and oncologic diseases (not reported in this study), and finally, the third part, which is the core of the present study, consisted of methods to measure predictors of health-related epistemically unfounded beliefs. All materials in this final block are described in detail below. Before completing the survey, participants read the informed consent form and agreed to participate in the study.

Materials

All materials used in this study can be found in the Supplementary data to this article available at: https://osf.io/942vh/

Health-Related Epistemically Unfounded Beliefs

To measure a wide range of health-related unfounded beliefs, we used several questionnaires:

The Complementary and Alternative Medicine Questionnaire (CAM) included 26 complementary and alternative treatments; sixteen items were compiled from previous questionnaires (Lindeman, 2011 (6 items); Quandt et al., 2009 (10 items)) and the remaining items from the published book on ineffective treatments most relevant to the Slovak population (Oravský, 2019). This measure consisted of two parts. First, we asked the participants how much they believed in the efficacy of each CAM treatment, using the scale 0 = *do not know the treatment* (these responses were treated as missing values because they do not represent beliefs), 1 = *do not trust at all*, 5 = *trust very much*. We then asked participants how often they used these treatments: 1 = *I never used them*, 2 = *almost never*, 3 = *occasionally*, 4 = *often*, 5 = *regularly*. Because the main goal of this study was to examine unfounded beliefs, in our analyses we only included scores for beliefs in CAM[1;2].

Magical health-related beliefs. We used the General Magical Beliefs subscale of the Magical Beliefs about Food and Health Scale (Lindeman et al., 2000). The subscale contained 10 questions about health, e.g., "Colours change the energy vibration of the organism in a direction that is beneficial to health". Participants responded on a 5-point scale (1 = *strongly disagree,* 5 = *strongly agree*) and the mean score was used.

Pseudoscientific beliefs. We used a short 8-item version of the Fasce et al. (2021) Pseudoscientific Belief Scale. Participants indicated their agreement on a 5-point scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Two items of the scale related to an alternative treatment (osteopathy, reflexology) were excluded from the analysis because of this overlap. The reliability of the edited scale was still good (α = .83) compared to full version of the scale (α = .86). The mean value for the 6 items scale was used.

Cancer myths. The Cancer Awareness Measure Mythical Causes Scale (Smith et al., 2018) was used to measure unfounded beliefs about cancer causes. Scale contains 12 items, e.g., "eating genetically modified foods". Partici-

[1] Six participants from the entire sample indicated that they were not aware of any of the CAM treatments, so they had missing values in the entire scale. Therefore, the analysis of the data for belief in CAM is based on 1032 participants.

[2] We used a confirmatory factor analysis to check unidimensional factor structure of the beliefs in CAM measure. Chi-Square = 1248; df = 299. Indices SRMR = 0.068 and RMSEA = 0.056 represent a good fit, while indices CFI = 0.86 and TLI = 0.85 are not ideal and represent a marginal fit. However, all items loaded into one factor and the reliability of the scale is very good (Cronbach's α = 0.97).

pants indicated their agreement on a 5-point scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*), and the mean score was used.

COVID-19 conspiracy beliefs. The COVID-19 conspiracy subscale from the COVID-19 Unfounded Beliefs Scale (Teličák & Halama, 2022) was used to measure participants' belief in COVID-19 related conspiracy theories. Participants indicated their agreement on a 5-point scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*), and the mean score was used.

Scientific Literacy

Scientific reasoning. We used a Slovak adapted version of the Scientific Reasoning Scale developed by Bašnáková et al. (2021), which contains a total of 6 items. The original scale was developed by Drummond & Fischhoff (2017) and contains 11 items. Participants answer whether they agree or disagree with the scientific scenario, for example, the item „Causality vs. Correlation" was about increasing the birth rate: "A researcher wants to find out how to increase the birth rate. He asks for statistical information and finds that more children are born in cities with more hospitals. This finding implies that building new hospitals will increase the birth rate of a population. Agree/Disagree". Each correct answer was assigned 1 point and the total score was calculated as the sum of all correct answers; thus, a higher number indicates better scientific reasoning.

Scientific knowledge. We used 7 items (National Science Board [NSB], 2018) to measure general scientific knowledge. These were true/false questions, e.g., "Antibiotics kill both viruses and bacteria". Each correct answer was scored 1 point, and the total score was calculated from the sum of the correct answers. A higher number indicated better scientific knowledge.

Trust in science was measured using a six-item scale (Hartman et al., 2017), e.g., "People trust scientists much more than they should". Participants responded on a 7-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). All six items were reverse coded so that higher scores indicated more positive attitudes, and the mean score was used.

Other Predictors

Analytical thinking was measured with four items. Two items were from the numerical Cognitive Reflection Test (Frederick, 2005), e.g., "A pencil and an eraser cost a total of 1.10 Euros. The eraser costs 1.00 Euro more than the pencil. How much does the pencil cost?") and two tasks from the Verbal Cognitive Reflection Test (Sirota et al., 2021), e.g., "If you run a race and pass the person in second place, in which place are you?"). For each correct answer, 1 point was awarded, and the total score was calculated from the sum of the correct answers. A higher score indicates that you prefer analytical rather than intuitive thinking.

The importance of epistemic rationality was measured using a seven-item scale (Ståhl et al., 2016). The scale measures the extent to which participants consider epistemic rationality to be personally important, e.g., "It is personally important to me to be skeptical of claims that are not supported by evidence.". Participants responded on a 7-point scale ranging from 1 *(strongly disagree)* to 7 *(strongly agree*), and the mean score was used.

Results

Analytic Strategy

Data were analyzed using IBM SPSS Statistics 23 software.

Pseudoscientific/magical component: to reduce the number of regression analyses, we calculated a composite score for other health-related unfounded beliefs except beliefs in CAM and COVID-19 conspiracy beliefs. The variable was created as a regression score extracted from principal component analysis with three indicators-magical health beliefs, pseudoscientific beliefs, and cancer myths (a single component with eigenvalue > 1 accounted for 63% of the variance)[3]. In summary, we had three dependent variables representing health-related unfounded beliefs: Belief in efficacy of CAM, COVID-19 conspiracy belief, and pseudoscientific/magical component. Dataset is openly available at: https://osf.io/942vh/

Correlations between components of scientific literacy and health-related unfounded beliefs

Correlations between the main variables are shown in Table 1.

The components of scientific literacy (scientific reasoning, trust in science, and scientific knowledge) correlated positively with each other, which is in line with previous studies (Bašnáková et al., 2021; Fasce & Picó, 2019). They also correlated positively with analytical thinking and importance of rationality – with exception of trust in science that showed weaker correlations with analytical thinking and no correlations with importance of rationality.

[3] Because we compiled a questionnaire for belief in CAM with the additional aim to identify prevalence of individual treatments in Slovakia and consider COVID-19 conspiracy beliefs to be conceptually distinct from the other measured variables tapping more on pseudoscience, we decided to evaluate their specific contribution. To address the question whether all measured variables load into a single factor we performed additional principal component analysis which included all five variables representing health-related unfounded beliefs. All variables loaded onto one factor, but they accounted only for 49.8% of the variance, therefore we adhered to our initial analytic choice.

Next, we examined how components of scientific literacy correlated with health-related unfounded beliefs. As expected, scientific reasoning, trust in science, and scientific knowledge correlated negatively with COVID-19 conspiracy beliefs, magical health, pseudoscientific beliefs, and cancer myths. The same pattern of negative relationships was found with analytic thinking. On the other hand, we did not find all of the expected correlations between components of scientific literacy and CAM – only trust in science correlated negatively with belief in efficacy of CAM and these correlations were rather weak. We return to this point in discussion.

We also checked inter-relationship among the individual measures of unfounded beliefs and mostly we replicated previous findings: positive correlations were found between belief in CAM, COVID-19 conspiracy theories, magical health beliefs, pseudoscientific beliefs, and cancer myths.

Components of Scientific Literacy, Analytical Thinking, and the Importance of Rationality as Predictors of Health-Related Unfounded Beliefs

To test the predictive role and strength of the components of scientific literacy, analytic thinking, and the importance of epistemic rationality, we conducted a hierarchical multiple linear regression analysis. Thus, analytical thinking was entered in the first step, scientific reasoning in the second step, and finally, in the third step, we controlled for other predictors – scientific knowledge and trust in science as the two remaining components of scientific literacy and the importance of epistemic rationality. The results are presented in Table 2.

Belief in CAM was negatively predicted by analytic thinking and trust in science (about equally strong) and positively predicted by

Table 1 *Correlations between the main variables*

Variable	*M*	*SD*	*α*	*ω*	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Scientific reasoning	3.64	1.45	.42	.46	1								
2. Trust in science	4.41	1.27	.90	.90	**.23*****	1							
3. Scientific knowledge	4.38	1.62	.51	.53	**.37*****	**.24*****	1						
4. Analytical thinking	1.68	1.30	.63	.63	**.39*****	**.19*****	**.46*****	1					
5. Importance of rationality	4.95	1.15	.90	.91	**.19*****	-.01	**.20*****	**.18*****	1				
6. Belief in CAM (*N* = 1032)	2.56	0.74	.97	.97	-.04	**-.12*****	-.03	**-.08****	**.15*****	1			
7. COVID-19 conspiracies	2.84	1.31	.96	.96	**-.26*****	**-.50*****	**-.32*****	**-.26*****	-.04	**.16*****	1		
Pseudoscientific/magical component:													
8. Magical Health beliefs	2.89	0.77	.87	.88	**-.26*****	**-.26*****	**-.24*****	**-.26*****	-.00	**.50*****	**.33*****	1	
9. Pseudoscientific beliefs	2.97	0.79	.83	.83	**-.19*****	**-.22*****	**-.19*****	**-.23*****	.02	**.41*****	**.36*****	**.63*****	1
10. Cancer myths beliefs	3.10	0.64	.89	.89	**-.16*****	**-.22*****	**-.09****	**-.10*****	**.10*****	**.23*****	**.27*****	**.36*****	**.34*****

Note. Correlations are based on 1038 observations except for the variable belief in CAM where correlations are based on 1032 observations.

*** $p < 0.001$; ** $p < 0.01$; *$p < 0.05$; α – Cronbach's alpha coefficient; ω – McDonald's omega coefficient.

Table 2 *Summary of the regression analysis*

	Belief in CAM		COVID-19 conspiracies		Pseudoscientific/magical component	
Predictors	*β*	*p*	*β*	*p*	*β*	*p*
Step 1						
Analytical thinking	**-.08**	**.010**	**-.26**	**<.001**	**-.26**	**<.001**
	$F(1,1030) = 6.69$, $R^2 = 0.006$, $p = .010$		$F(1,1036) = 72.56$, $R^2 = 0.065$ $p < .001$		$F(1,1036) = 74.08$ $R^2 = 0.07$ $p < .001$	
Step 2						
Analytical thinking	**-.08**	**.022**	**-.18**	**<.001**	**-.19**	**<.001**
Scientific reasoning	-.01	.816	**-.19**	**<.001**	**-.18**	**<.001**
	$F(2,1029) = 3.37$, $\Delta R^2 = .000$, $p = .035$		$F(2,1035) = 55.39$, $\Delta R^2 = 0.031$ $p < .001$		$F(2,1035) = 54.36$, $\Delta R^2 = 0.03$ $p < .001$	
Step 3						
Analytical thinking	**-.09**	**.013**	**-.07**	**.016**	**-.15**	**<.001**
Scientific reasoning	-.02	.654	**-.08**	**.006**	**-.14**	**<.001**
Scientific knowledge	.01	.722	**-.16**	**<.001**	**-.07**	**.031**
Trust in science	**-.10**	**.001**	**-.43**	**<.001**	**-.21**	**<.001**
Importance of rationality	**.17**	**<.001**	-.02	.568	**.11**	**<.001**
	$F(5,1026) = 9.96$, $\Delta R^2 = 0.040$, $p < .001$		$F(5,1032) = 90.77$, $\Delta R^2 = 0.21$, $p < .001$		$F(5,1032) = 38.36$, $\Delta R^2 = 0.06$ $p < .001$	

Note. The table shows standardized (*β*) regression coefficients with their significance. R^2 and ΔR^2 denote the adjusted R^2 for the initial model and changes in R^2 at the second and third steps of the regression with the appropriate statistical change. Significant predictors are presented in bold.

the importance of rationality. Neither scientific reasoning, nor scientific knowledge predicted belief in CAM. All predictors together explained only 4.6% of the total variance.

In the case of belief in COVID-19 conspiracy, all variables entered as factors, except importance of rationality, were significant negative predictors and together explained almost 31% of the total variance. Trust in science was the strongest negative predictor. There was a minimal difference in the predictive strength of scientific reasoning and analytical thinking, both of which lost much of their predictive power after scientific knowledge and trust in science were included in the model in the third step.

Finally, the pseudoscientific/magical component was predicted by all factors. There was a minimal difference between the predictive strengths of analytical thinking and scientific reasoning, and trust in science was again the strongest predictor. All significant factors together explained nearly 16% of the total variance. As in the case of belief in CAM, the importance of epistemic rationality played a significant positive role in predicting this variable.

In summary, trust in science was the strongest predictor in all three types of unfounded beliefs. Scientific reasoning and scientific knowledge predicted COVID-19 conspiracy beliefs as well as pseudoscientific/magical component, but not belief in CAM. Analytical thinking predicted negatively all three types of unfounded beliefs, and in cases of COVID-19 conspiracy beliefs and pseudoscientific/magical component it had about the same strength as scientific reasoning. Interestingly, the importance of epistemic rationality positively predicted both belief in CAM and pseudoscientific/magical component.

Discussion

One of the main goals of this work was to extend the study of health-related unfounded beliefs to include wider range of culturally specific CAM treatments, COVID-19 related conspiracy theories, pseudoscientific beliefs, magical health beliefs and cancer myths so that we could examine the role of scientific literacy, analytical thinking, and importance of epistemic rationality in more types of unfounded beliefs. The results showed that CAM was moderately related to magical health beliefs and pseudoscientific beliefs and only weakly related to COVID-19 conspiracy theories. However, the weak association between CAM and conspiracy beliefs is in line with previous findings (Mijatović et al., 2022; Vujić et al., 2022). Similar to previous studies (Fasce & Picó, 2019; Lobato et al., 2014), we found that different unfounded beliefs tend to correlate with each other. However, it appears that COVID-19 conspiracy beliefs are distinct from magical and pseudoscientific beliefs (as evidenced by weaker correlations), whereas CAM beliefs overlap more with magical health and pseudoscientific beliefs. CAM beliefs correlated positively with all types of unfounded beliefs, from low to moderate levels (*r* values between -.16 and -.50) but did not have the same predictors.

Contrary to previous findings about the stronger predictive power of scientific reasoning compared to analytical thinking in unfounded beliefs (Čavojová et al., 2020; 2022), our results point to more balanced strengths, except for belief in CAM, which was not predicted by scientific reasoning. One of the possible explanations lies in the very low reliability of the Scientific Reasoning Scale in this study. On the other hand, other studies using the same scale showed only slightly higher reliability (e.g., Bašnáková et al., 2021, Čavojová et al., 2020; 2023; Čavojová & Ersoy, 2020) and it predicted both COVID-19 conspiracy theories, as well as pseudoscientific/magical component, similarly to the results of previous studies.

Based on the pattern of correlations and predictors, our results suggest that we need to approach the study of belief in efficacy of CAM with more caution. The weak association in our results could also be caused by the extensive questionnaire for CAM that we used, which included a wide range of CAM treatments. CAM is becoming increasingly popular among lay people as well as medical professionals despite the lack of sufficient scientific evidence for its efficacy and safety (and therefore it is considered part of pseudoscience) and the included CAM practices varied in their extent of use, possible danger, and evidence base. According to Li et al. (2018), even experts respond to some extent to the demands of the "market", i.e., the demand for CAM, which is reflected in their higher promotion. CAM practices and products can be considered as common healing practices rather than questionable tools. At the same time, various types of CAM are not necessarily harmful to health (as they are ineffective) and are used more for preventive reasons. Therefore, maybe more fruitful approach would be to examine the individual CAM treatments and their correlations with the components of scientific literacy.

On the other hand, it is quite surprising that the belief in CAM was positively predicted by the importance of rationality. This may seem paradoxical, since we would have expected a negative relationship. One possible explanation lies in the description of a typical user of CAM treatments. According to MacArtney and Wahlberg (2014), people who believe in and use CAM are not satisfied with the conventional passive role of a patient merely accepting doctors' recommendations but they want to actively participate in the healing process and understand what is happening in their body and why. This need could be the reason for seeking more information about health and diseases, as well as more (alternative) healing methods that are more individualized. This is related to another important personality trait – openness, which is positively related to the use of CAM (Honda & Jacobson, 2005) and according to Ståhl and Turner (2021) openness to experience is also positively related to the trait of personal importance of rationality.

One of the novel contributions of this study was examining the role of all three components in predicting different types of health-related unfounded beliefs. Our study showed that all three components are important in relation to conspiracy theories and pseudoscientific/magical health beliefs. These findings support the notion that both dispositions for analytic thinking and specific skills such as the ability to evaluate evidence are necessary for the formation of accurate and rational beliefs. Moreover, analytic thinking correlated negatively with all types of unfounded beliefs, so these results support the notion that susceptibility to different types of such beliefs is related to intuition rather than reflection in cognition (Aarnio & Lindeman, 2005; Ballová Mikušková, 2021; Budžak & Branković, 2022; Lindeman, 2011; Pennycook et al., 2012; Swami et al., 2014).

Consistent with previous findings (Fasce & Picó, 2019; Roozenbeek et al., 2020), trust in science was the most important factor in susceptibility to all of the unfounded beliefs we examined. Promoting positive attitudes toward science, particularly public trust in science, has far-reaching positive consequences for public health. For example, in countries with high levels of trust in science, people are more confident about vaccination, as shown in the study by Sturgis et al. (2021), which analyzed data from 126 countries and more than 120,000 respondents. Regarding the COVID-19 pandemic, trust in science positively predicts intent to engage in preventive behaviors and adherence to COVID-19 preven-

tion guidelines (Pagliaro et al., 2021; Plohl & Musil, 2021).

Our results are generally encouraging for the promotion of scientific literacy as it relates to lower susceptibility to unfounded beliefs. It is important not only to know facts about scientific theories, but also to develop scientific reasoning skills and build positive attitudes toward science. However, building public trust in science is not an easy task, in which education plays an important role. We should focus on fostering positive attitudes toward science from the school years onward. School interventions that focus on improving scientific reasoning skills are also effective in improving attitudes toward science (Lieskovský & Sunyík, 2022).

Limitations and Open Questions

It is necessary to mention several limitations of our study. First, the design was cross-sectional, therefore, we were unable to draw any causality. Experimental design would help to establish causal link between scientific literacy and epistemically unfounded beliefs. Second, our measures of scientific reasoning scale and scientific knowledge had very low reliability (α = 0.42 and α = 0.51), which is even lower than previously reported alphas for the SRS (Bašnáková et al., 2021; Čavojová et al., 2022; 2023). On the other hand, in one study by Čavojová et al. (2021) the alpha coefficient was 0.45. In case of measuring scientific knowledge, previous studies used a different number of items from the NSB (e.g., 15 or 11) and knowledge and performance measures do not always report reliability coefficients (Fasce & Picó, 2019; Majima, 2015) and those that do report them found similarly low reliability (e.g., α = 0.35 in Bašnáková et al., 2021 study using 9 items). Nevertheless, the items based on NSB are considered an established tool as it covers multidisciplinary basic knowledge and is frequently used in assessment of general scientific knowledge. Importantly, our results are generally in line with previous findings and extend our understanding of scientific literacy, analytical thinking, and importance of epistemic rationality as predictors of a wider range of health-related unfounded beliefs. As we have shown, belief in the efficacy of CAM is conceptually related, yet distinct from other health-related unfounded beliefs, and we need better understanding and more general consensus as to the defining features between acceptable albeit uncommon medical practices and potentially harmful treatments.

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