Thinking & Reasoning

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/ptar20

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To cite this article: Paweł Brzóska, Magdalena Żemojtel-Piotrowska, Jarosław Piotrowski, Bartłomiej Nowak, Peter K. Jonason, Constantine Sedikides, Mladen Adamovic, Kokou A. Atitsogbe, Oli Ahmed, Uzma Azam, Sergiu Bălțătescu, Konstantin Bochaver, Aidos Bolatov, Mario Bonato, Victor Counted, Trawin Chaleeraktrakoon, Jano Ramos-Diaz, Sonya Dragova-Koleva, Walaa Labib M. Eldesoki, Carla Sofia Esteves, Valdiney V. Gouveia, Pablo Perez de Leon, Dzintra Iliško, Jesus Alfonso D. Datu, Fanli Jia, Veljko Jovanović, Tomislav Jukić, Narine Khachatryan, Monika Kovacs, Uri Lifshin, Aitor Larzabal Fernandez, Kadi Liik, Sadia Malik, Chanki Moon, Stephan Muehlbacher, Reza Najafi, Emre Oruç, Joonha Park, Iva Poláčková Šolcová, Rahkman Ardi, Ognjen Ridic, Goran Ridic, Yadgar Ismail Said, Andrej Starc, Delia Stefenel, Kiều Thị Thanh Trà, Habib Tiliouine, Robert Tomšik, Jorge Torres-Marin, Charles S. Umeh, Eduardo Wills-Herrera, Anna Wlodarczyk, Zahir Vally & Illia Yahiiaiev (2024) Testing the underlying structure of unfounded beliefs about COVID-19 around the world, Thinking & Reasoning, 30:2, 301-326, DOI: 10.1080/13546783.2023.2259539

To link to this article: https://doi.org/10.1080/13546783.2023.2259539

Published online: 28 Sep 2023.

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THINKING & REASONING
2024, VOL. 30, NO. 2, 301–326
https://doi.org/10.1080/13546783.2023.2259539

Routledge
Taylor & Francis Group

Testing the underlying structure of unfounded beliefs about COVID-19 around the world

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Supplemental data for this article can be accessed online at https://doi.org/10.1080/13546783.2023.2259539.

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ABSTRACT

Unfounded—conspiracy and health—beliefs about COVID-19 have accompanied the pandemic worldwide. Here, we examined cross-nationally the structure and correlates of these beliefs with an 8-item scale, using a multigroup confirmatory factor analysis. We obtained a two-factor model of unfounded (conspiracy and health) beliefs with good internal structure (average CFI = 0.98, RMSEA = 0.05, SRMR = 0.04), but a high correlation between the two factors (average latent factor correlation = 0.57). This model was replicable across 50 countries (total $N = 13{,}579$), as evidenced by metric invariance between countries (CFI = 0.96, RMSEA = 0.06, SRMS = 0.07) as well as scalar invariance across genders (CFI = 0.98, RMSEA = 0.04, SRMS = 0.03) and educational levels (CFI = 0.98, RMSEA = 0.04, SRMS = 0.03). Also, lower levels of education, more fear of COVID-19, and more cynicism were weakly associated with stronger conspiracy and health beliefs. The study contributes to knowledge about the structure of unfounded beliefs, and reveals the potential relevance of affective (i.e., fear of COVID-19) and cognitive (i.e., cynicism) factors along with demographics, in endorsing such beliefs. In summary, we obtained cross-cultural evidence for the distinctiveness of unfounded conspiracy and health beliefs about COVID-19 in terms of their structure and correlates.

ARTICLE HISTORY Received July 10, 2022; Accepted June 25, 2023

KEYWORDS Unfounded beliefs; COVID-19; conspiracy beliefs; health beliefs; cross-cultural

Beliefs influence the way people process information and make decisions. Although some beliefs are helpful, others can be dysfunctional and maladaptive for reasoning (Stanovich et al., 2016). An example of the latter is unfounded beliefs. These have no scientific basis or support (Lundeen & Caldwell, 1930), are widespread (Oliver & Wood, 2014), are harmful (Borges do Nascimento et al., 2022; Douglas & Sutton, 2023), and create a self-reaffirming worldview (Oliver

& Wood, 2014). We focus on two forms of unfounded beliefs, conspiracy (Goertzel, 1994) and (non-conspiracy) health beliefs (Swire-Thompson & Lazer, 2020). Although some researchers favor a unitary construct (Pennycook et al., 2022), different forms of unfounded beliefs have distinct correlates (Rizeq et al., 2021). Here, we tested the underlying factor structure of unfounded conspiracy and health beliefs in a large, multinational sample. Documenting these beliefs' underlying factor structure would increase understanding of why people are susceptible to them, the consequences of holding them, and strategies to immunize against them, while enabling a more comprehensive approach in future research.

The structure of unfounded beliefs

We are concerned, in particular, with conspiracy and health beliefs about COVID-19, as these are the most popular forms of unfounded beliefs about it (Enders et al., 2020). Conspiracy beliefs are "lay beliefs that attribute the ultimate cause of an event or the concealment of an event from public knowledge to a secret, unlawful, and malevolent plot by multiple actors working together" (Swami et al., 2010, p. 1). Conspiracy beliefs about COVID-19 depict the coronavirus as a hoax and/or bioweapon (Imhoff & Lamberty, 2020). Health beliefs are "contrary to the epistemic consensus of the scientific community regarding a phenomenon" (Swire-Thompson & Lazer, 2020, p. 2). In terms of COVID-19, these include claims about the coronavirus' characteristics (e.g., it cannot spread in hot climate; Barua et al., 2020; Enders et al., 2020), its diagnosis (e.g., holding one's breath), or its treatment (e.g., eating garlic, taking Hydroxychloroquine, taking Vitamin C).

Unfounded beliefs about COVID-19 predict maladaptive behavior, such as not wearing a mask or refusing to vaccinate (Bertin et al., 2020; Čavojová et al., 2022; Prichard & Christman, 2020), contributing to the coronavirus' spread (Romer & Jamieson, 2020). However, specific unfounded beliefs about COVID-19 may be part of the more general construct of unfounded beliefs (Georgiou et al., 2019). Therefore, individual differences in unfounded beliefs about COVID-19 might be accounted for by the same latent traits as unfounded beliefs in general. Some unfounded beliefs are culturally specific (Mercier & Altay, 2022), precluding reliable cross-national research on their structure. Researchers have sought to bypass this problem by assessing either a psychological construct that underlies the propensity to endorse conspiracies (e.g., conspiracy mentality; Bruder et al., 2013) or decontextualized generic conspiracy beliefs (Brotherton et al., 2013).

The COVID-19 pandemic created a unique opportunity to investigate the factor structure of unfounded beliefs, as beliefs related to COVID-19 are worldwide while referring to a single topic (De Coninck et al., 2021; Pennycook et al., 2022). Unfounded beliefs about COVID-19 might share their underlying structure with general unfounded beliefs, and can be assessed in a multinational sample. In recent years, scholarly interest in unfounded beliefs, particularly those about COVID-19, has intensified (Erceg et al., 2022; Hammad et al., 2021; Pennycook et al., 2022; Teovanović et al.,

2021), but the relevant literature is limited psychometrically (i.e., does not test factorial structure or between-country invariance) and geographically. Some studies have relied on unidimensional (Pennycook et al., 2022), but most on multidimensional (Hammad et al., 2021; Teovanović et al., 2021), models of unfounded beliefs. Even though the pertinent studies were conducted in a number of countries (i.e., Canada, Croatia, Jordan, United Kingdom, USA), they did not examine the underlying structure of such beliefs nor did they draw cross-national comparisons (Erceg et al., 2022; Hammad et al., 2021; Pennycook et al., 2022; Van Prooijen, 2017). The two approaches to the underlying structure of general unfounded beliefs (i.e., unidimensional vs. multidimensional) were tested only in one sample from a single country (i.e., Canada; Rizeq et al., 2021). We extend this evidence psychometrically and geographically by examining the factorial structure of unfounded beliefs about COVID-19 with multigroup confirmatory factor analysis (MGCFA) in a large, multinational sample. Our research addresses conceptual issues in the measurement of unfounded beliefs, enabling a researcher to scrutinize their role during other crises (e.g., election denialism) and debunk them in a more targeted manner (Ecker et al., 2022).

Antecedents of unfounded beliefs about COVID-19

The cross-national character of our study affords examining some common antecedents of unfounded beliefs about COVID-19. To begin, we tested the relevance of demographic variables. Previous work indicated that both forms of unfounded beliefs, conspiracy (Van Mulukom et al., 2022) and health (Nan et al., 2022), are associated with lower educational levels. As such, we expected more unfounded beliefs among less educated participants. In addition, previous work examining gender differences in conspiracy and health beliefs produced mixed findings: roughly, a third reported higher levels of both forms of beliefs in women, another third reported higher levels in men, and the final third reported no gender differences (Nan et al., 2022; Van Mulukom et al., 2022). Similarly, previous work examining age differences in conspiracy and health beliefs yielded mixed findings: roughly, half of the studies reported that younger people endorse more conspiracy (Van Mulukom et al., 2022) and health (Nan et al., 2022) beliefs, and the other half reported the reverse or no differences (Nan et al., 2022; Van Mulukom et al., 2022). As such, we adopted an exploratory approach regarding the relation between gender and age on the one hand, and unfounded beliefs on the other.

Fear of COVID-19 and cynicism may also be relevant to unfounded beliefs about COVID-19. The pandemic entails fear and related emotions (e.g., worry, anxiety, stress; Ahorsu et al., 2022; Sawicki et al., 2022), which may hinder rational reasoning about the coronavirus. People with a higher fear of COVID-19 might cope with perceived threat through attempts to restore a sense of control. Such attempts would include beliefs about the imaginary risks to one's heath or the elusive forces responsible for the

pandemic (Pan et al., 2021). These beliefs would serve self-protection purposes (Sedikides, 2012, 2021), and endorsing them might constitute a coping response (Leibovitz et al., 2021; Pan et al., 2021). Conspiracy implies hostile intentions of others (Douglas et al., 2016), and conspiracy believers are on alert for hostile others, thus increasing the likelihood of perceiving hostile intent in other when there is none (Van Prooijen & Van Vugt, 2018). Cynical individuals might be concerned with protecting their interests against others whom they regard as hostile or threatening (Andersson & Bateman, 1997; Leung et al., 2010), also increasing the likelihood of misperceiving hostility in others.

Overview

We examined the factorial structure and measurement invariance of the two most popular forms of unfounded beliefs about COVID-19 (i.e., conspiracy and health ones; Enders et al., 2020). To do so, we relied on Pennycook et al.'s (2022) Covid-19 misperceptions scale. These authors provided initial evidence for the utility of the scale in cross-cultural settings. Our study spanned 50 countries, six education levels, two genders (women and men), and age. We tested a one-dimensional versus two-dimensional model in each country with Confirmatory Factor Analyses (CFA). Then, we tested all groups at once with MGCFA to check whether we can compare unfounded beliefs between countries. We implemented measurement invariance, placing certain restrictions on the model tested between countries.

In cross-cultural studies, three levels of measurement invariance are usually analyzed: configural, metric, and scalar. First, we looked for configural invariance, which evaluates whether the number of factors and pattern of item-factor loadings are equal across groups. The second, metric invariance, evaluates whether factor loadings are equal across groups, and is necessary for making comparisons of correlates and regression weights across groups. Scalar invariance assesses whether item intercepts are equal across groups, and is necessary for comparing latent scores between groups. As the scalar level of invariance is rarely obtained, we supplemented this analysis with the alignment procedure that estimated reliably country-level means (Cieciuch et al., 2019; Muthén & Asparouhov, 2014), permitting comparisons at the group level.

We also investigated antecedents of unfounded beliefs about COVID-19, expecting a positive relationship between fear of COVID-19 and cynicism on the one hand, and conspiracy and health beliefs about COVID-19 on the other. Moreover, we were interested in antecedents of unfounded beliefs. We expected a negative relation between education levels and unfounded beliefs. Given the mixed results regarding gender and age differences in unfounded beliefs, we adopted an exploratory approach. We have no competing interests to declare. The project was reviewed and approved by the Ethics Committee of the second author's institution (KeiB – 32/2020).

The dataset can be found at https://osf.io/8tyv2/?view_only=01a4e4bc493a437990a81e2d547ad202.

Method

Participants and procedure

Data collection occurred between April 24 and December 31, 2020 as part of the international project (https://osf.io/hpwbj) spanning 60 countries. We collected data online *via* a snowball technique. We sent the invitation (which included a link to the project's website), written in the local country language, by email or Facebook to national forums devoted to COVID-related topics. Participants reported their nationality and country of residence and selected their preferred language version out of 35 languages. We did not offer remuneration, except for the Republic of South Africa and the United Kingdom, paying each participant 2GBP (approximately 2.5USD). We included only participants above 18 years old, who completed all measures and answered correctly all three randomly displayed attention checks (e.g., "This question is for checking your attention. Please mark number 2"). Also, we excluded from further analyses countries with fewer than 100 participants (Kyriazos, 2018).

The final sample consisted of 50 countries and 13,579 participants (66.72% women, 33.73% men, 0.54% "other" or unreported; Table 1), aged between 18 and 82 years ($M = 31.72$, $SD = 12.28$). Of participants, 0.74% had a Primary level education, 3.66% a Lower Secondary level education, 27.31% an Upper Secondary level education, 38.45% a Bachelor's (or equivalent) degree, 23.60% a Master's (or equivalent) degree, and 6.24% a Ph.D. degree. Participants' reported socioeconomic status was around the scale average ($M = 4.33$, $SD = 1.14$; measured by a single question: "How would you describe the economic status of your family on a scale from 1 = *Much lower than average* to 7 = *Much higher than average*?"). We randomized the scale order for each participant. We display descriptive statistics and estimates of internal consistency for all scales in Table 2.

Measures

As mentioned above, we assessed unfounded (conspiracy and health) beliefs about COVID-19 with the 8-item COVID-19 misperceptions scale (Pennycook et al., 2022). We presented the items, and referred to them, in the same order as the original scale. A sample item for conspiracy beliefs is "Coronavirus was created to be a bio-weapon," and a sample item for health beliefs is "Vitamin C can cure the Coronavirus." Both the conspiracy beliefs subscale (Cronbach's alpha = 0.82; range = 0.70–0.89) and health beliefs subscale (Cronbach's alpha = 0.78; range = 0.69–0.94) were reliable.

Table 1. Sample characteristics and language selected across 50 countries.

Country	*N*	% men	$M(SD)_{age}$	$M(SD)_{SES}$	$Median_{edu}$ (degree)	Dominant Language
Total	13579	32.73[a]	31.72 (12.28)	4.33 (1.14)	Bachelor's	Various
Algeria	160	35.63	33.68 (10.09)	4.58 (1.05)	Master's	Arabian
Armenia	154	33.77	30.19 (10.69)	4.34 (1.09)	Bachelor's	Armenian
Australia	140	44.29	47.06 (18.06)	3.96 (1.27)	Bachelor's	English
Austria	324	46.30	40.23 (12.10)	4.60 (1.29)	Bachelor's	German
Bangladesh	312	53.53	24.65 (6.17)	3.90 (0.70)	Bachelor's	Bangla
Bosnia & Herzegovina	386	39.64	28.70 (11.74)	4.89 (1.15)	Upper Secondary	Bosnian
Brazil	328	23.48	34.73 (12.35)	4.41 (1.14)	Bachelor's	Brazilian Portuguese
Bulgaria	265	29.43	36.19 (9.91)	4.62 (0.99)	Master's	Bulgarian
Chile	193	34.20	30.89 (10.10)	4.44 (1.06)	Bachelor's	Spanish
China	183	31.69	28.13 (11.10)	4.03 (1.00)	Bachelor's	Chinese
Colombia	121	59.50	21.40 (9.46)	5.77 (0.92)	Upper Secondary	Spanish
Croatia	427	39.34	37.94 (14.21)	5.05 (1.10)	Bachelor's	Croatian
Czechia	430	16.98	34.92 (12.72)	4.57 (1.08)	Bachelor's	Czech
Ecuador	515	34.76	25.83 (8.56)	4.21 (0.84)	Upper Secondary	Spanish
Egypt	152	25.66	32.18 (10.10)	4.23 (1.13)	Bachelor's	Arabian
Estonia	253	25.30	40.34 (12.52)	4.59 (1.17)	Master's	Estonian
Germany	146	44.52	35.18 (13.45)	4.81 (1.23)	Bachelor's	German
Greece	106	40.57	39.47 (12.73)	4.33 (0.84)	Bachelor's	Greek
Hungary	114	11.40	38.70 (13.22)	4.59 (1.06)	Bachelor's	Hungarian
India	251	47.41	29.55 (8.87)	4.31 (1.06)	Master's	English
Indonesia	310	21.94	23.28 (7.80)	4.55 (1.01)	Upper Secondary	Indonesian
Iran	180	50.56	26.59 (6.37)	3.99 (1.20)	Bachelor's	Farsi
Iraq	173	61.85	29.79 (7.62)	4.12 (1.07)	Bachelor's	Kurdish
Israel	162	37.65	39.63 (16.29)	5.00 (1.19)	Bachelor's	Hebrew
Italy	111	22.52	38.76 (16.89)	4.30 (0.89)	Bachelor's	Italian
Japan	226	76.11	19.99 (3.68)	4.13 (1.14)	Upper Secondary	Japanese
Kazakhstan	205	40.98	26.84 (9.44)	4.31 (1.09)	Bachelor's	Russian
Latvia	210	31.90	34.18 (13.41)	4.37 (0.97)	Bachelor's	Latvian
Malaysia	228	18.42	24.97 (7.24)	4.30 (0.98)	Bachelor's	English
Nigeria	133	44.36	35.01 (9.89)	4.39 (0.94)	Master's	English
Pakistan	126	42.06	24.49 (6.94)	4.60 (1.04)	Master's	Urdu
Peru	108	29.63	28.65 (11.12)	3.33 (1.20)	Upper Secondary	Spanish

(*Continued*)

Table 1. Continued.

Country	*N*	% men	$M(SD)_{age}$	$M(SD)_{SES}$	$Median_{edu}$ (degree)	Dominant Language
Philippines	167	35.33	34.60 (12.90)	4.71 (0.91)	Bachelor's	Filipino
Poland	269	33.09	31.30 (11.52)	4.71 (1.10)	Bachelor's	Polish
Portugal	1081	2.04	31.58 (8.30)	4.22 (0.90)	Bachelor's	Portuguese
Romania	273	23.44	33.56 (12.17)	4.61 (0.95)	Master's	Romanian
Russia	318	18.24	34.01 (12.52)	3.85 (1.20)	Master's	Russian
Serbia	759	56.13	25.07 (9.58)	4.52 (1.14)	Upper Secondary	Serbian
Slovakia	217	11.98	42.41 (12.46)	4.54 (0.90)	Master's	Slovakian
Slovenia	378	17.99	36.04 (11.20)	4.18 (1.07)	Upper Secondary	Slovenian
South Africa	591	40.95	33.82 (12.25)	3.15 (1.33)	Upper Secondary	English
Spain	524	15.27	38.18 (14.08)	4.08 (1.05)	Bachelor's	Spanish
Thailand	181	38.12	27.90 (8.40)	4.18 (1.07)	Bachelor's	Thai
Togo	128	56.25	32.63 (6.54)	3.96 (1.09)	Bachelor's	French
Turkey	363	28.10	25.23 (7.43)	4.35 (0.96)	Bachelor's	Turkish
Ukraine	347	24.78	27.88 (11.27)	4.21 (1.19)	Bachelor's	Ukrainian
United Arab Emirates	171	29.82	29.40 (6.97)	4.44 (1.27)	Bachelor's	English
United Kingdom	296	28.72	35.12 (11.76)	4.19 (1.13)	Bachelor's	English
Uruguay	143	44.06	44.22 (15.37)	4.93 (0.88)	Bachelor's	Spanish
Vietnam	241	69.29	22.10 (7.05)	4.11 (1.02)	Bachelor's	Vietnamese

[a]0.54% "other" or unreported.

Table 2. Descriptive statistics and reliability coefficients of Studied variables in all countries.

	Health Beliefs		Conspiracy Beliefs		Fear of COVID-19		Cynicism	
Country	*M* (*SD*)	α	*M* (*SD*)	α	*M* (*SD*)	α	*M* (*SD*)	i
Algeria	3.82 (1.20)	0.76	3.90 (1.27)	0.79	3.27 (1.04)	0.72	4.43 (1.15)	0.80
Armenia	2.89 (1.15)	0.74	3.90 (1.32)	0.80	2.42 (1.13)	0.88	4.45 (1.11)	0.79
Australia	1.61 (0.91)	0.85	2.44 (1.32)	0.84	2.91 (1.28)	0.91	4.07 (1.20)	0.86
Austria	1.32 (0.68)	0.77	1.70 (1.02)	0.82	1.94 (0.90)	0.85	3.99 (1.15)	0.80
Bangladesh	3.79 (1.09)	0.73	3.35 (1.06)	0.71	3.42 (1.37)	0.90	4.81 (0.90)	0.63
Bosnia & Herzegovina	2.68 (1.23)	0.82	4.28 (1.58)	0.87	2.17 (1.06)	0.88	4.67 (1.13)	0.79
Brazil	1.90 (0.91)	0.74	2.17 (1.15)	0.82	3.95 (1.21)	0.88	3.89 (0.90)	0.72
Bulgaria	2.48 (1.10)	0.78	3.32 (1.46)	0.87	2.54 (1.04)	0.86	4.09 (1.00)	0.77
Chile	2.12 (1.05)	0.72	3.35 (1.61)	0.88	3.25 (1.31)	0.88	3.94 (1.04)	0.76
China	2.18 (1.45)	0.94	2.30 (1.12)	0.85	3.13 (1.18)	0.88	3.61 (1.25)	0.86
Colombia	1.89 (0.93)	0.73	2.97 (1.49)	0.88	3.08 (1.21)	0.87	4.15 (0.94)	0.69
Croatia	2.37 (1.15)	0.81	3.42 (1.49)	0.87	2.13 (0.94)	0.86	4.13 (1.10)	0.80
Czech	1.81 (0.80)	0.70	2.53 (1.13)	0.81	2.09 (0.88)	0.84	3.56 (0.93)	0.77
Ecuador	2.91 (1.21)	0.81	3.76 (1.32)	0.80	3.56 (1.40)	0.91	4.52 (0.91)	0.71
Egypt	4.21 (1.11)	0.73	3.97 (1.27)	0.78	3.51 (1.01)	0.66	4.72 (1.16)	0.82
Estonia	2.03 (0.87)	0.74	2.39 (1.16)	0.85	2.03 (0.88)	0.87	3.52 (0.92)	0.78
Germany	1.91 (1.21)	0.86	2.57 (1.59)	0.89	2.38 (1.08)	0.86	4.03 (1.13)	0.79
Greece	1.88 (0.86)	0.77	3.35 (1.15)	0.70	2.65 (0.85)	0.73	4.08 (1.05)	0.87
Hungary	1.49 (0.70)	0.75	2.00 (1.11)	0.84	2.35 (1.09)	0.87	3.64 (1.16)	0.85
India	3.41 (1.24)	0.78	3.70 (1.38)	0.82	3.11 (1.32)	0.90	4.53 (1.09)	0.81
Indonesia	2.77 (1.10)	0.81	2.95 (1.10)	0.80	3.17 (1.08)	0.85	4.12 (0.99)	0.70
Iran	3.65 (1.10)	0.72	3.94 (1.30)	0.81	2.97 (1.27)	0.88	4.45 (1.07)	0.79
Iraq	3.42 (1.14)	0.78	3.79 (1.52)	0.86	2.82 (1.22)	0.87	4.79 (1.02)	0.71
Israel	1.92 (1.02)	0.79	2.47 (1.34)	0.87	2.37 (1.05)	0.86	3.44 (1.13)	0.84
Italy	1.80 (0.95)	0.79	2.53 (1.40)	0.86	2.66 (1.03)	0.88	4.14 (0.99)	0.73
Japan	2.32 (1.11)	0.81	2.87 (1.18)	0.75	4.05 (1.09)	0.84	3.91 (1.02)	0.76
Kazakhstan	2.76 (1.14)	0.76	3.57 (1.41)	0.85	2.55 (1.06)	0.85	4.47 (1.06)	0.79
Latvia	2.90 (1.15)	0.72	4.25 (1.26)	0.76	3.35 (1.34)	0.92	4.52 (0.77)	0.70
Malaysia	2.36 (1.15)	0.80	2.91 (1.25)	0.82	3.53 (1.17)	0.88	4.17 (1.03)	0.77
Nigeria	3.00 (1.18)	0.81	3.46 (1.23)	0.76	2.80 (1.36)	0.92	4.23 (1.14)	0.83
Pakistan	4.17 (1.10)	0.69	3.95 (1.42)	0.87	2.91 (1.28)	0.89	4.53 (1.05)	0.70
Peru	3.07 (1.20)	0.77	3.83 (1.46)	0.83	3.67 (1.31)	0.88	4.44 (0.92)	0.71
Philippines	3.05 (1.38)	0.82	3.32 (1.27)	0.78	3.88 (1.32)	0.90	3.77 (1.09)	0.80
Poland	1.49 (0.73)	0.80	2.02 (1.14)	0.86	2.13 (0.89)	0.82	4.19 (1.18)	0.84
Portugal	1.64 (0.81)	0.72	2.65 (1.27)	0.81	3.44 (1.18)	0.86	4.06 (1.00)	0.74
Romania	2.23 (1.14)	0.86	3.34 (1.40)	0.85	2.57 (1.12)	0.89	4.30 (1.08)	0.81
Russia	2.23 (0.97)	0.72	3.11 (1.40)	0.86	2.54 (0.99)	0.83	4.02 (1.08)	0.78
Serbia	2.25 (1.17)	0.80	4.09 (1.69)	0.88	1.86 (0.89)	0.84	4.43 (1.10)	0.77
Slovakia	2.21 (1.03)	0.83	2.67 (1.27)	0.87	2.55 (0.94)	0.86	3.07 (0.99)	0.84
Slovenia	2.30 (1.14)	0.77	3.92 (1.57)	0.87	2.31 (1.11)	0.88	4.25 (1.02)	0.73
South Africa	3.60 (1.42)	0.80	3.69 (1.38)	0.76	4.31 (1.60)	0.92	4.83 (1.15)	0.77
Spain	1.70 (0.87)	0.73	2.63 (1.45)	0.87	2.93 (1.29)	0.89	3.75 (1.12)	0.80
Thailand	2.49 (1.16)	0.82	3.13 (1.08)	0.76	3.18 (1.26)	0.90	4.19 (1.01)	0.80
Togo	2.79 (1.13)	0.73	3.54 (1.20)	0.76	3.49 (1.56)	0.90	4.46 (1.01)	0.69
Turkey	2.89 (1.21)	0.76	3.68 (1.31)	0.82	3.00 (1.32)	0.89	4.13 (1.17)	0.79
Ukraine	2.24 (0.98)	0.73	3.27 (1.30)	0.84	2.42 (0.97)	0.82	4.36 (1.04)	0.77
United Arab Emirates	1.14 (0.61)	0.93	1.59 (0.99)	0.72	4.23 (1.07)	0.87	3.14 (1.09)	0.80
United Kingdom	1.61 (0.80)	0.77	2.21 (1.19)	0.85	2.90 (1.22)	0.90	3.86 (1.05)	0.81
Uruguay	2.28 (1.11)	0.79	3.01 (1.30)	0.87	2.36 (0.97)	0.88	3.20 (0.89)	0.76
Vietnam	2.78 (1.11)	0.70	2.94 (1.08)	0.72	3.69 (1.34)	0.88	4.12 (1.06)	0.78

We assessed fear of COVID-19 with the 7-item Fear of COVID-19 scale (Ahorsu et al., 2022). The scale was validated in a cross-cultural context by Sawicki and colleagues (2022). A sample item is "I am most afraid of Coronavirus-19" (Cronbach's alpha = 0.87; range = 0.66–0.92). Finally, we assessed cynicism with the 5-item Cynical Hostility Scale (Clarke et al., 2008). A sample item is "It is safer to trust nobody" (Cronbach's alpha = 0.78; range = 0.63–0.87).

For all scales, response options ranged from 1 (*strongly disagree*) to 7 (*strongly agree*). Where a local language version of the scale was unavailable, local teams translated and back-translated it using the English original (Brislin, 1970). All scales had been validated and used in cross-cultural research. We did not examine the validity of the somewhat adapted versions of the scales that we used. However, their internal consistency (Table 2) and metric level of between-country measurement invariance (Tables S8–S11, Supplemental Material) suggest that they assess the same construct as the validated originals.

Results

We conducted analyses with the IBM SPSS 26 and Mplus 7.2 (Muthén & Muthén, 1998–2017). In factor analyses, we used the Robust Maximum Likelihood (MLR) estimator to account for deviations from normality and small sample sizes (Yuan & Bentler, 2000). We examined model fit based on common fit indices (i.e., Comparative Fit Index [CFI], Root Mean Square Error of Approximation [RMSEA], and Standardized Root Mean Squared Residual [SRMR]) with the following cutoffs for good fit: CFI > 0.95, RMSEA < 0.08, SRMR < 0.08 and a more liberal RMSEA threshold (between 0.08 and 0.10) for mediocre fit (Hu & Bentler, 1999). The final sample contains many groups; therefore, we used the following cutoffs in the test for metric invariance: ΔCFI = −0.020, ΔRMSEA = 0.030 (Rutkowski & Svetina, 2014). We conducted comparisons between the two-factor and the one-factor model, and comparisons between education and genders with cutoffs for a difference based on Chen's (2007) recommendation: ΔCFI = −0.010, ΔRMSEA = 0.015, ΔSRMR = 0.030. We rejected the model if any of the indicators did not meet the threshold. In the alignment optimization, we used 25% of non-invariant intercepts as a threshold for trustworthy mean estimations (Cieciuch et al., 2019).

Factorial structure across countries

We began by carrying out CFA of the one-factor and two-factor models of unfounded beliefs across all (50) countries (detailed descriptive statistics for each item in the unfounded beliefs scale are available in Table S1, Supplemental Material). We estimated error covariance between items

5 (i.e., "The Coronavirus was created in a lab") and 6 (i.e., "Coronavirus was created to be a bio-weapon") freely as they both assume that Coronavirus is an intentional creation. The one-factor model fitted the data well in only one country (i.e., Austria; Table S2, Supplemental Material), whereas the two-factor model fit the data well in 40 countries (Table S3, Supplemental Material). The two-factor model had a better fit in all studied countries (Table 3). On the basis of modification indices, we released further error covariates in the two-factor model (in Algeria, Chile, China, India, Italy, Japan, South Africa, and Thailand), and obtained a good fit (CFI > 0.95, RMSEA < 0.08, SRMR < 0.08; Hu & Bentler, 1999) in 48 out of 50 countries (exceptions were Latvia and the United Arab Emirates). We present details of the final model, obtained fit in each country, and additional released error covariates in Table 4. Furthermore, the intercorrelation between latent factor scores of conspiracy and health beliefs about COVID-19 exceeded 0.85 only in Austria (Mean intercorrelation = 0.57; Median intercorrelation = 0.57; range = 0.29–0.87; interquartile range = 0.49–0.65; Table 4), suggesting that the two forms of unfounded beliefs might be indistinguishable in this country. Nevertheless, even in Austria, the two-factor model fitted the data better than the one-factor (Table 3).

As the proposed model (Figure 1) fitted the data well in nearly all of the countries (48 out of 50), we tested the cross-national invariance of the two-factor model of unfounded beliefs about COVID-19 with the MGCFA. We found a configural level of invariance (Chi^2 = 1552.79, p < .001, CFI = 0.98, RMSEA = 0.05 SRMR = 0.04), thus confirming that the proposed two-factor structure is similar across countries. We also found the metric level of invariance (Δchi^2 = 862.86, p < .001, ΔCFI = −0.019, ΔRMSEA = 0.010, ΔSRMR = 0.03), meaning that factor loadings were equal between countries; therefore, we could compare correlates obtained in countries. However, we did not find scalar invariance, and so we could not compare country level means (Table 5). Furthermore, we conducted invariance analyses between education levels and the genders, and in both cases we observed scalar levels of invariance (Tables S4 and S5, Supplemental Material).

As we did not find the scalar level of invariance, we performed the alignment procedure on 48 countries using the two-factor model. The procedure yielded 12.24% non-invariant intercepts (i.e., 10.68% in the health beliefs factor and 1.56% in the conspiracy beliefs factor) and 2.34% non-invariant factor loadings (i.e., 1.30% in the health beliefs factor and 1.04% in the conspiracy beliefs factor). The percentage of non-invariant intercept and factor loading was below the 25% threshold; therefore, it allowed for a trustworthy comparison of country-level means of unfounded beliefs, which we depict in Figures 2 and 3. We display further details on the alignment procedure in Table S6, Supplemental Material.

Table 3. Comparison of One-Factor and Two-Factor model of unfounded beliefs about COVID-19.

Country	$\Delta\chi^2$	ΔCFI	ΔRMSEA	ΔSRMR
Average change	−112.33	0.164	−0.094	−0.049
Algeria	−102.35	0.330	−0.118	−0.063
Armenia	−61.84	0.181	−0.089	−0.048
Australia	−59.18	0.109	−0.101	−0.059
Austria	−12.42	0.028	−0.024	−0.010
Bangladesh	−34.84	0.062	−0.033	−0.027
Bosnia & Herzegovina	−291.06	0.287	−0.146	−0.105
Brazil	−71.09	0.108	−0.062	−0.019
Bulgaria	−138.34	0.234	−0.164	−0.077
Chile	−159.25	0.318	−0.141	−0.055
China	−69.04	0.092	−0.072	−0.051
Colombia	−34.11	0.126	−0.097	−0.042
Croatia	−273.10	0.208	−0.129	−0.049
Czech	−168.26	0.182	−0.098	−0.044
Ecuador	−154.12	0.145	−0.098	−0.080
Egypt	−81.06	0.350	−0.130	−0.062
Estonia	−48.00	0.083	−0.062	−0.023
Germany	−45.24	0.110	−0.087	−0.037
Greece	−12.71	0.055	−0.064	−0.034
Hungary	−16.72	0.079	−0.058	−0.022
India	−44.72	0.075	−0.039	−0.019
Indonesia	−74.80	0.112	−0.078	−0.046
Iran	−91.52	0.254	−0.110	−0.086
Iraq	−96.72	0.247	−0.167	−0.077
Israel	−87.90	0.230	−0.166	−0.040
Italy	−64.75	0.227	−0.102	−0.037
Japan	−16.89	0.027	−0.018	−0.017
Kazakhstan	−73.65	0.149	−0.089	−0.048
Latvia	−59.76	0.148	−0.050	−0.038
Malaysia	−60.43	0.119	−0.064	−0.042
Nigeria	−21.02	0.070	−0.051	−0.023
Pakistan	−39.52	0.162	−0.081	−0.052
Peru	−43.51	0.152	−0.141	−0.057
Philippines	−42.00	0.104	−0.061	−0.047
Poland	−85.91	0.162	−0.088	−0.063
Portugal	−325.05	0.156	−0.074	−0.042
Romania	−137.80	0.160	−0.108	−0.079
Russia	−200.13	0.270	−0.150	−0.060
Serbia	−763.54	0.398	−0.178	−0.085
Slovakia	−131.75	0.221	−0.120	−0.062
Slovenia	−323.51	0.359	−0.184	−0.108
South Africa	−81.56	0.077	−0.036	−0.024
Spain	−259.48	0.192	−0.109	−0.051
Thailand	−15.18	0.034	−0.016	−0.016
Togo	−20.72	0.080	−0.047	−0.025
Turkey	−207.29	0.247	−0.153	−0.104
Ukraine	−127.62	0.145	−0.082	−0.034
United Arab Emirates	Covariance Matrix was not Positive Definite			
United Kingdom	−74.01	0.111	−0.065	−0.038
Uruguay	−69.42	0.190	−0.157	−0.050
Vietnam	−31.14	0.085	−0.044	−0.020

Covariance estimated freely: 5 + 6. We calculated change in fit indices by subtracting the index for the 1-factor model from the index for the 2-factor model.

Table 4. Separate Confirmatory factor analyses in all Studied countries: Two-Factor model of unfounded beliefs about COVID-19 with modifications.

Country	χ^2	CFI	RMSEA	RMSEA 90% CI	SRMR	Factor Loadings Magical Beliefs	Factor Loadings Conspiracy Beliefs	Latent Factor Correlations
Algeria[1]	22.86	0.981	0.046	0.000–0.091	0.043	0.74–0.83	0.39–0.95	0.46
Armenia	30.92	0.961	0.070	0.022–0.108	0.049	0.30–0.86	0.59–0.82	0.57
Australia	25.77	0.985	0.056	0.000–0.100	0.038	0.45–0.97	0.59–0.94	0.64
Austria	22.39	0.989	0.027	0.000–0.059	0.038	0.40–0.83	0.58–0.87	0.87
Bangladesh	43.22	0.954	0.067	0.042–0.093	0.043	0.55–0.74	0.29–0.73	0.57
Bosnia & Herzegovina	43.68	0.975	0.061	0.038–0.084	0.041	0.58–0.83	0.72–0.81	0.43
Brazil	38.61	0.968	0.059	0.033–0.085	0.051	0.41–0.88	0.47–0.88	0.67
Bulgaria	16.86	1.000	0.000	0.000–0.051	0.040	0.51–0.85	0.62–0.88	0.47
Chile[2]	33.23	0.967	0.070	0.033–0.106	0.037	0.31–0.83	0.74–0.81	0.62
China[3]	27.19	0.986	0.057	0.000–0.096	0.039	0.86–0.94	0.53–0.96	0.57
Colombia	19.51	0.994	0.026	0.000–0.087	0.041	0.54–0.70	0.73–0.84	0.61
Croatia	50.43	0.975	0.065	0.044–0.087	0.039	0.49–0.86	0.67–0.89	0.64
Czech	40.63	0.976	0.054	0.032–0.076	0.040	0.36–0.83	0.58–0.86	0.57
Ecuador	26.98	0.991	0.031	0.000–0.054	0.028	0.55–0.82	0.56–0.74	0.46
Egypt	22.51	0.980	0.041	0.000–0.087	0.057	0.41–0.79	0.53–0.87	0.39
Estonia	27.91	0.983	0.047	0.000–0.079	0.039	0.56–0.78	0.66–0.87	0.72
Germany	23.89	0.985	0.047	0.000–0.093	0.038	0.66–0.86	0.69–0.87	0.76
Greece	14.41	1.000	0.000	0.000–0.067	0.060	0.59–0.73	0.35–0.85	0.27
Hungary	20.17	0.989	0.033	0.000–0.092	0.050	0.51–0.77	0.60–0.76	0.68
India[4]	36.30	0.967	0.067	0.037–0.098	0.045	0.58–0.84	0.58–0.79	0.69
Indonesia	27.50	0.985	0.041	0.000–0.071	0.039	0.60–0.84	0.50–0.80	0.60
Iran	31.90	0.961	0.065	0.024–0.102	0.052	0.42–0.83	0.58–0.77	0.30
Iraq	13.63	1.000	0.000	0.000–0.049	0.026	0.57–0.81	0.61–0.84	0.54
Israel	16.43	1.000	0.000	0.000–0.064	0.040	0.38–0.84	0.68–0.88	0.66
Italy[5]	27.84	0.961	0.076	0.009–0.125	0.046	0.56–0.79	0.62–0.88	0.62
Japan[6]	33.82	0.971	0.066	0.032–0.099	0.049	0.53–0.83	0.43–0.74	0.68
Kazakhstan	31.46	0.973	0.060	0.021–0.095	0.042	0.38–0.83	0.67–0.85	0.61

(*Continued*)

Table 4. Continued.

Country	χ^2	CFI	RMSEA	RMSEA 90% CI	SRMR	Factor Loadings Magical Beliefs	Factor Loadings Conspiracy Beliefs	Latent Factor Correlations
Latvia[7]	38.15	0.944	0.081	0.048–0.115	0.065	0.33–0.82	0.31–0.83	0.57
Malaysia	39.77	0.956	0.073	0.042–0.104	0.051	0.51–0.84	0.57–0.79	0.60
Nigeria	24.00	0.979	0.050	0.000–0.098	0.048	0.54–0.84	0.44–0.79	0.66
Pakistan	25.51	0.969	0.058	0.000–0.105	0.053	0.55–0.64	0.74–0.84	0.46
Peru	16.28	1.000	0.000	0.000–0.077	0.045	0.38–0.89	0.47–0.84	0.59
Philippines	33.55	0.961	0.072	0.032–0.109	0.050	0.62–0.82	0.43–0.78	0.49
Poland	30.09	0.977	0.050	0.013–0.080	0.033	0.51–0.85	0.65–0.86	0.63
Portugal	104.32	0.959	0.067	0.055–0.079	0.058	0.53–0.82	0.47–0.83	0.48
Romania	40.10	0.974	0.067	0.039–0.095	0.030	0.67–0.83	0.63–0.83	0.57
Russia	24.87	0.991	0.035	0.000–0.065	0.031	0.32–0.84	0.65–0.88	0.57
Serbia	65.34	0.975	0.059	0.044–0.075	0.030	0.54–0.77	0.75–0.82	0.50
Slovakia	37.76	0.967	0.071	0.039–0.103	0.048	0.57–0.84	0.69–0.87	0.56
Slovenia	24.17	0.993	0.030	0.000–0.058	0.027	0.48–0.82	0.70–0.83	0.42
South Africa	51.45	0.967	0.059	0.041–0.077	0.043	0.52–0.81	0.51–0.90	0.56
Spain	55.17	0.972	0.063	0.044–0.082	0.042	0.41–0.84	0.70–0.87	0.56
Thailand[8]	29.17	0.969	0.067	0.025–0.106	0.052	0.53–0.88	0.59–0.81	0.67
Togo	26.26	0.967	0.060	0.000–0.106	0.060	0.48–0.73	0.41–0.79	0.57
Turkey	21.02	0.996	0.021	0.000–0.053	0.038	0.46–0.81	0.49–0.85	0.29
Ukraine	53.02	0.960	0.075	0.052–0.099	0.057	0.40–0.80	0.63–0.82	0.56
United Arab Emirates	Covariance Matrix Was Not Positive Definite							
United Kingdom	41.39	0.965	0.066	0.040–0.093	0.050	0.45–0.83	0.63–0.84	0.63
Uruguay	16.43	1.000	0.000	0.000–0.068	0.029	0.54–0.84	0.65–0.85	0.66
Vietnam	29.89	0.967	0.052	0.012–0.085	0.050	0.53–0.75	0.43–0.69	0.55

Note. Df = 18; Covariance estimated freely: 5 + 6. Addition covariances estimated freely: [1] = 1 + 3; [2] = 4 + 3; [3] = 7 + 8; [4] = 2 + 3; [5] = 2 + 3; [6] = 1 + 2; [7] = 1 + 3 and 5 + 7; [8] = 5 + 7 and 7 + 8.

Correlates of unfounded beliefs about COVID-19

We used our modified measurement model for examining individual differences in unfounded beliefs about COVID-19 in 48 countries where

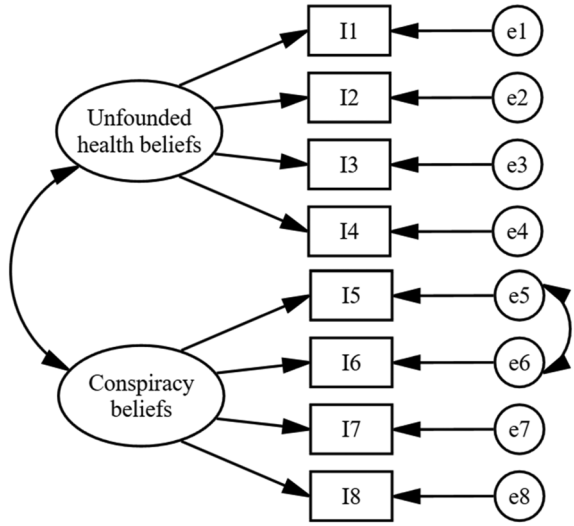

Figure 1. The modified model of unfounded beliefs about the COVID-19 scale tested in factor analyses.

Table 5. Multigroup Confirmatory factor analysis of Two-Factor model of unfounded beliefs about COVID-19 in 48 countries.

Multigroup Confirmatory Factor Analysis					
Invariance level	χ^2	CFI	RMSEA	RMSEA 90% CI	SRMR
Configural ($df = 855$)	1552.79	0.976	0.054	0.050–0.059	0.043
Metric ($df = 1137$)	2415.65	0.957	0.064	0.060–0.067	0.071
Scalar ($df = 1422$)	5966.33	0.847	0.108	0.105–0.111	0.099
Levels of Invariance Comparison					
	$\Delta\chi^2$	ΔCFI	ΔRMSEA	ΔSRMR	Δdf
Configural vs Metric	862.86	−0.019	0.010	0.028	282
Metric vs Scalar	3550.68	−0.110	0.043	0.028	282

$N = 13{,}198$. All χ^2 difference tests were significant at $p < .001$. We estimated freely additional error covariances in Algeria, Chile, China, India, Italy, Japan, South Africa, and Thailand. We excluded samples from Latvia and United Arab Emirates.

the two-factor unfounded beliefs model fitted the data well. We present detailed correlates of unfounded beliefs about COVID-19 with education, age, fear of COVID-19, and cynicism, as well as gender differences in each country, in Table S7, Supplemental Material. Further, we present correlations and gender differences by education levels in Tables S4, Supplemental Material, and by gender in S5, Supplemental Material. In correlational analyses for fear of COVID-19 and cynicism, we used metrically invariant latent means. We present the details on multigroup confirmatory factor analyses of those scales in Tables S8–S11, Supplemental Material.

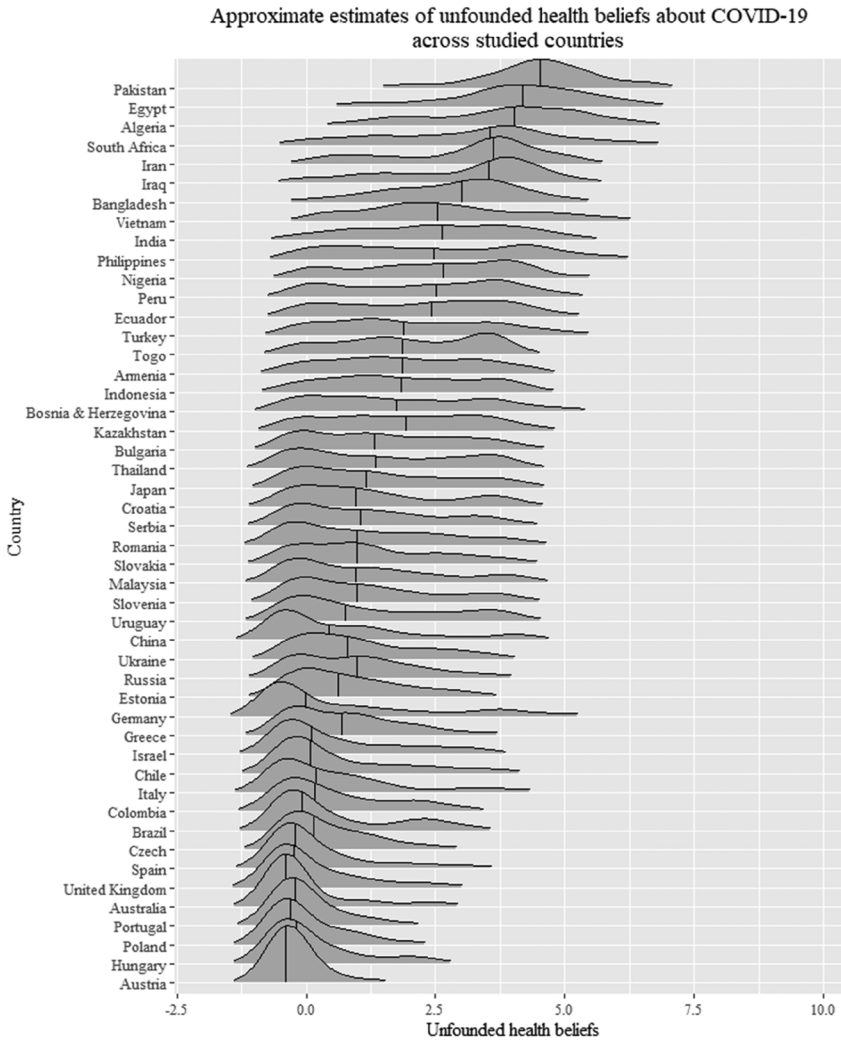

Figure 2. Distributions of Health beliefs about COVID-19 scores estimated with alignment procedure across 48 countries with a good fit Ordered by the means. (Vertical Lines Represent Medians.)

Moreover, we conducted meta-analyses and heterogeneity tests for these effects using JAMOVI's MAJOR 1.2.3 package with a restricted maximum-likelihood estimator and standardized mean difference for gender differences, and Fisher's r-to-z transformation for other effects. We found moderate to high heterogeneity (average I^2 = 63.61%, ranging from 51.33% to 77.87%). As such, the observed variance in effect sizes between countries is not solely attributable to random error; instead, 63.61% of the variance in effect sizes is attributable to genuine differences between countries (Table S7, Supplemental Material).

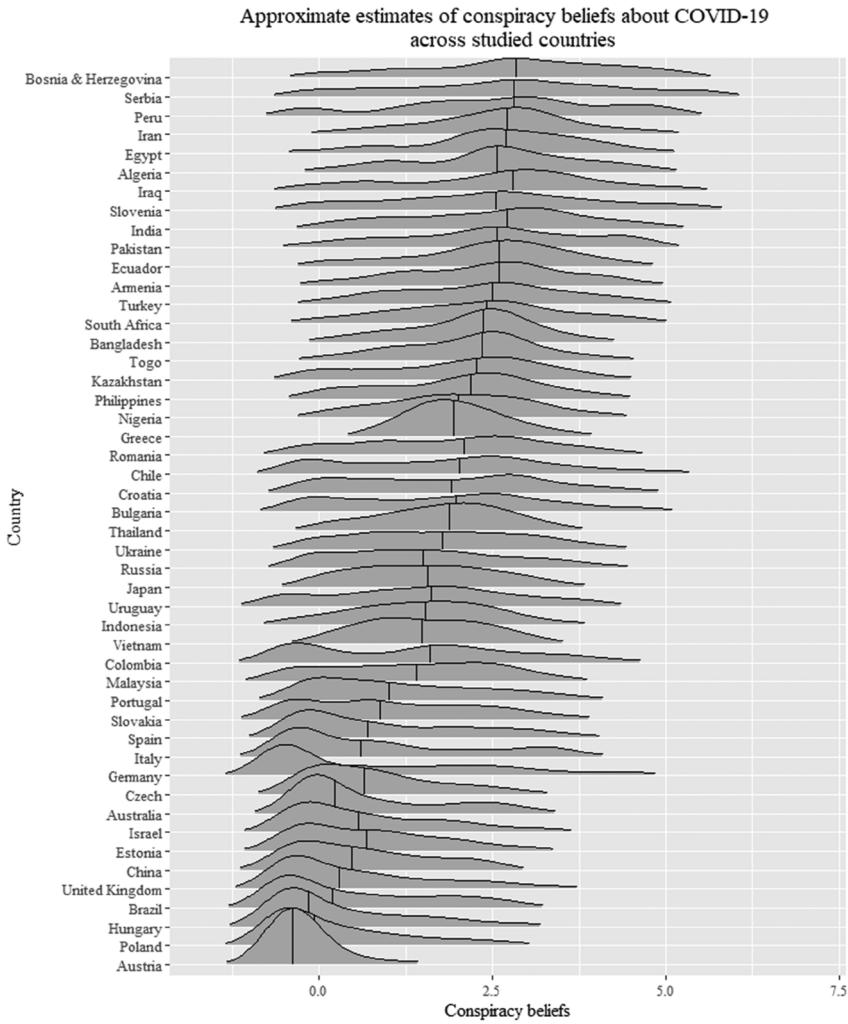

Figure 3. Distributions of Conspiracy beliefs about COVID-19 scores estimated with alignment procedure across 48 countries with a good fit Ordered by the means. (Vertical Lines Represent Medians.)

Lower educational levels were weakly associated with stronger health beliefs about COVID-19 (Meta-analytical $r = -0.08$, 95% CI [−0.11, −0.05], *Range* = −0.27 to 0.14). This negative correlation was significant in 15 countries and was significant in the opposite direction in India. Likewise, lower education levels were weakly associated with stronger conspiracy beliefs (Meta-analytical $r = -0.13$, 95% CI [−0.16, −0.09], *Range* = −0.31 to 0.19). This negative correlation was significant in 24 countries. We observed a very weak positive association between age and endorsement of health

beliefs (Meta-analytical $r = 0.05$, 95% CI [0.01, 0.08], *Range* = −0.21 to 0.29), which was significantly positive in 12 countries and significantly negative in six countries. We also observed a very weak negative association between age and endorsement of conspiracy beliefs (Meta-analytical $r = -0.04$, 95% CI [−0.08, −0.01], *Range* = −0.28 to 0.24), which was significantly negative in nine countries, and significantly positive in four countries. There were few significant gender differences (four in conspiracy beliefs and six in health beliefs), but the direction of the differences was not consistent. We found, then, no obvious pattern in conspiracy beliefs (Meta-analytical $d = -0.05$, 95% CI [−0.11, 0.01], *Range* = −0.72 to 0.46) or in health beliefs (Meta-analytical $d = 0.011$, 95% CI [−0.05, 0.07], *Range* = −0.77 to 0.64). We provide all results by country in Table S7, Supplemental Material.

We turn to individual differences next. Fear of COVID-19 was significantly and weakly associated with greater endorsement of conspiracy beliefs in 17 countries (Meta-analytical $r = 0.11$, 95% CI [0.07, 0.13], *Range* = −0.11 to 0.37) and with greater endorsement of health beliefs in 23 countries (Meta-analytical $r = 0.13$, 95% CI [0.11, 0.16], *Range* = −0.06 to 0.35). Similarly, cynicism was weakly associated with stronger conspiracy beliefs (Meta-analytical $r = 0.22$, 95% CI [0.20, 0.25], *Range* = 0.02 to 0.41) and stronger health beliefs (Meta-analytical $r = 0.11$, 95% CI [0.08, 0.13], *Range* = −0.08 to 0.42). The relationship with conspiracy beliefs was significant in 39 countries and with health beliefs in 21 countries. Further, the 95% confidence intervals indicate that cynicism was associated more strongly with conspiracy beliefs than health belief, and this difference was significant in 25 countries (average Steiger's $Z = 2.31$, *Range* − 1.08 to 6.19; details by country are available in Table S7, Supplemental Material).

In addition, we examined whether the intercorrelation between the latent factors was related to the difference in the relationship between cynicism-conspiracy and cynicism-health beliefs. We found a trending correlation of the intercorrelation between the latent factors and the unstandardized difference ($r = -0.28$, $p = .053$; Figure S1, Supplemental Material), and a null effect for Steiger's Z ($r = .01$, $p = .93$; Figure S2, Supplemental Material). However, even in countries with intercorrelation between the latent factors around 0.70, the difference in correlation with cynicism remained significant, providing further support for the two-factor model.

Discussion

Summary of findings and implications

We were concerned with the underlying structure of unfounded beliefs about COVID-19 and its measurement invariance across countries, education levels, gender, and age. We considered two forms of unfounded

beliefs, conspiracy and health ones (Pennycook et al., 2022). The literature has been inconclusive as to whether unfounded beliefs are homogenous. To this end, we tested their underlying structure in 50 countries, examining their demographic correlates and nomological network. As expected, lower educational levels, more fear of COVID-19, and more cynicism were associated with stronger conspiracy and health beliefs. Additionally, we asked which putative antecedent (cynicism vs. fear of COVID-19) would be related more strongly to unfounded beliefs. Cynicism was more strongly linked to conspiracy than health beliefs.

The two-factor structure of unfounded beliefs about COVID-19 fitted the data better than the one-factor structure in each country, and indicated an acceptable fit in 48 out of 50 countries as well as in all education levels and both genders. The results then converged toward a two-dimensional structure of unfounded beliefs, despite their high intercorrelation (0.57). We obtained a very high intercorrelation (>0.85) only in Austria, suggesting that conspiracy and health beliefs are indistinguishable in this country. However, even in Austria, the two-factor model fitted the data better than the one-factor model. Furthermore, an MGCFA of the two-factor model of unfounded beliefs indicated a metric level of invariance in most countries (48 out of 50 countries), and a scalar level of invariance across education levels, and across men and women. Therefore, the two-factor model allows for reliable comparisons of predictors and consequences of unfounded beliefs between countries, yet it is insufficient in creating any ranking scores. Scalar level of invariance between men and women, and between education levels, allows for comparing mean levels of unfounded beliefs across genders and education levels. In addition, we estimated country-level means of unfounded beliefs with alignment procedures, which allows for approximate comparisons between countries. Hence, the two-factor scale of Pennycook et al. (2022) is suitable for cross-national research, displaying good internal structure and reliability. Despite the topic being the same (i.e., COVID-19), conspiracy beliefs were distinguishable from health beliefs, albeit highly correlated in most countries. Researchers might do well to examine whether different forms of unfounded beliefs (e.g., election denialism, superstition, paranormal beliefs) are also characterized by distinctiveness.

Lower educational levels (Erceg et al., 2022; Hammad et al., 2021; Pennycook et al., 2022), and increased fear of COVID-19 (Ahorsu et al., 2022; Sawicki et al., 2022) and cynicism (Swami et al., 2011; Swami & Furnham, 2012), were weakly associated with endorsement of unfounded beliefs. Also, we observed small (but often statistically significant) differences in the strength of the relationship between cynicism and both forms of unfounded beliefs, with cynicism being more strongly linked to conspiracy beliefs, providing some validation of the two-dimensional structure of unfounded beliefs about COVID-19. Cynicism is related to hostile attribution bias (Andersson & Bateman, 1997), so that highly cynical persons

readily adopt beliefs that assume malevolent forces acting during the pandemic. However, we also observed moderate to high heterogeneity in those effects, meaning that the variability in effect sizes between countries is attributable not only to random error, but also to country-specific characteristics. Future research should identify these characteristics (i.e., include country-level moderators).

In exploratory analyses, we obtained no overall gender differences in unfounded beliefs about COVID-19. We also obtained very weak overall relationships between age and unfounded beliefs: age was very weakly associated with weaker conspiracy beliefs endorsement and stronger health beliefs endorsement. These patterns are similar to those of recent reviews (Nan et al., 2022; Van Mulukom et al., 2022). Moreover, we obtained some country-specific effects ranging from moderately negative to moderately positive, suggesting that the link of gender and age to unfounded beliefs might be driven by country- or culture-specific characteristics. Again, socioeconomic factors and cultural values are candidate moderators.

Limitations

Although we included numerous countries, the data pertained to a convenience sample. As we did not balance educational attainment and gender, well-educated people and women were overrepresented. Also, we carried out data collection in the initial stages of the pandemic. As such, although the structure of the unfounded beliefs seemed to be two-dimensional, the content and degree to which these beliefs are adopted might be different now that knowledge about coronavirus has increased considerably. Moreover, we opted to assess a small set of unfounded beliefs (i.e., eight) in pursuit of larger sample sizes and generalizability. Nevertheless, the two-factor model fitted the data well, showing its comparability between different cultural contexts and the possibility to distinguish between conspiracy and health beliefs in most countries. Still, we relied on a cross-sectional study, which provides limited insight into the within-person system of unfounded beliefs (Brandt & Morgan, 2022).

We did not find scalar levels of invariance, which is typical for large-scale multinational projects (Cieciuch et al., 2019). However, even though we presented means *via* the alignment procedure, this estimation entails a margin of error. Finally, although we used already validated scales, only the fear of COVID-19 scale had been validated in a large number of cross-cultural samples (Sawicki et al., 2022) and the COVID-19 misperceptions scale Pennycook et al.'s (2022) in three cross-cultural samples (i.e., Canada, UK, USA). Nevertheless, as stated previously, we confirmed the between-country measurement invariance

of all the scales, indicating that the scales in each country assessed a similar construct.

Concluding remarks

A two-dimensional structure of unfounded beliefs about COVID-19 (i.e., distinction between conspiracy and health beliefs) fitted our data well in most countries (48 out of 50) and also fitted better than a unidimensional model. Multi-group cross-country analyses indicated a metric level of invariance, which allowed for the comparison of antecedents of unfounded beliefs between countries. A scalar level of invariance between genders and educational levels allowed for a comparison of correlates and means of both. Educational levels were negatively related, whereas cynicism and fear of COVID-19 were positively related, to unfounded beliefs. Moreover, cynicism was related slightly more strongly to conspiracy than to health beliefs. Lastly, no gender differences, and very weak age differences, in unfounded beliefs emerged. Researchers should consider studying forms of unfounded beliefs as rather separate phenomena.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

The work of Magdalena Żemojtel-Piotrowska and Jarosław Piotrowski was supported by the National Science Centre, Poland under Grant [2017/26/E/HS6/00282]. The work of Peter Jonason was partially supported by the Polish National Agency for Academic Exchange under Grant [PPN/ULM/2019/1/00019/U/00001] the National Science Centre of Poland under Grant [2019/35/B/HS6/00682]. The participation of Iva Poláčková Šolcová was supported by the National Plan of Recovery "Systemic Risk Institute" under Grant [LX22NPO5101], funded by European Union - Next Generation EU (Ministry of Education, Youth and Sports, EXCELES). The work of Narine Khachatryan was supported by the RA Science Committee, in the frames of the research project No. 20TTSH-070. In accordance with the national law of several countries, there were no direct collaboration between researchers from conflicting countries.

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