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The perceived vulnerability to disease scale: Cross-cultural measurement invariance and associations with fear of COVID-19 across 16 countries

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Abstract

Using cross-sectional data from *N* = 4274 young adults across 16 countries during the COVID-19 pandemic, we examined the cross-cultural measurement invariance of the perceived vulnerability to disease (PVD) scale and tested the hypothesis that the association between PVD and fear of COVID-19 is stronger under high disease threat [that is, absence of COVID-19 vaccination, living in a country with

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lower Human Development Index (HDI) or higher COVID-19 mortality]. Results supported a bi-factor Exploratory Structural Equation Modeling model where items loaded on a global PVD factor, and on the sub-factors of *Perceived Infectability* and *Germ Aversion*. However, cross-national invariance could only be obtained on the configural level with a reduced version of the PVD scale (PVD-r), suggesting that the concept of PVD may vary across nations. Moreover, higher PVD-r was consistently associated with greater fear of COVID-19 across all levels of disease threat, but this association was especially pronounced among individuals with a COVID-19 vaccine, and in contexts where COVID-19 mortality was high. The present research brought clarity into the dimensionality of the PVD measure, discussed its suitability and limitations for cross-cultural research, and highlighted the pandemic-related conditions under which higher PVD is most likely to go along with psychologically maladaptive outcomes, such as fear of COVID-19.

KEYWORDS
culture, disease threat, fear of COVID-19, measurement invariance, perceived vulnerability to disease

1 | INTRODUCTION

Throughout history, infectious diseases have threatened humans. Thus, complementary to the biological immune system, humans have evolved the behavioral immune system (BIS; Schaller & Park, 2011) which enhances sensitivity towards pathogen threats (Kurzban & Leary, 2001) and directs individuals towards behaviors that prevent the transmission of pathogens (Schaller, 2006; Schaller & Duncan, 2007). The concept of *Perceived Vulnerability to Disease* (PVD; Duncan et al., 2009) represents a component of the BIS with two subscales: Perceived Infectability (PI), the subjective perception of vulnerability to infection, and Germ Aversion (GA), the discomfort people feel when contacting pathogens.

PVD describes a disposition to feeling more susceptible to infection, and additionally represents a reactive mechanism, affecting more (vs. less) strongly people's behaviors and cognitions when disease threat within a given context is high (vs. low) (Díaz et al., 2016; Park et al., 2003). Experimental research shows that priming disease threats elicits responses aligned with disease avoidance. For instance, compared to a control group, participants primed with disease threat reported lower extraversion (Mortensen et al., 2010), more xenophobic attitudes (Faulkner et al., 2004), and higher intentions to use condoms (Tybur et al., 2011). Furthermore, geographical region and seasonal period have been argued to promote disease-avoiding behaviors and cognitions (Díaz et al., 2016). For example, Schaller and Murray (2008) found that regional changes in disease prevalence were inversely related to extraversion, openness to experience, and socio-sexuality across 71 geographical regions.

The ongoing COVID-19 pandemic offers a unique opportunity for studying how PVD may operate under various levels of disease threat. While PVD is an adaptive mechanism minimizing infection risk, research also highlighted

that enhanced PVD may link with maladaptive outcomes. For instance, higher PVD correlates with more hypochondria (Díaz et al., 2016), neuroticism and obsessive-compulsive symptoms (Ferreira et al., 2022), anxiety (Mallett et al., 2021), and prejudice (Schaller & Park, 2011). In the context of the COVID-19 pandemic, numerous studies found that higher PVD is associated with higher fear of COVID-19 (e.g., Ahorsu et al., 2022; Eder et al., 2021; Winter et al., 2023) which, in turn, predicted increased anxiety, depression, and hopelessness (Padmanabhanunni et al., 2022).

However, there remains a lack of cross-national investigation on how subjective PVD is associated with disease-avoiding tendencies under conditions where disease threat is low versus high. A core obstacle to study PVD across contexts is related to the PVD measure's low internal consistency (Ahorsu et al., 2022; Duncan & Schaller, 2009; Miller & Maner, 2012; Stangier et al., 2022) and inconsistent factorial structure across different cultural contexts. Consequently, many studies utilized a total score of PVD (the sum of PI and GA scores) often skipping tests of its factor structure (e.g., De Pasquale et al., 2021; Mallett et al., 2021; Stevenson et al., 2021). The few studies that examined the factorial structure of the PVD scale were inconclusive, indicating that the two-factor structure consisting of PI and GA may not be consistently replicated, or that certain scale items may be susceptible to cultural bias. For instance, Díaz et al. (2016) found that a two-factor model of the Spanish PVD with separate PI and GA factors (excluding two GA items) fitted the data better compared to a single-factor 15-item model (see also Moradi-motlagh et al., 2020 for an Iranian, and Ferreira et al., 2022 for a Portuguese adaptation).

The present study addresses these shortcomings: first, it tests the dimensionality and cross-cultural measurement invariance of the PVD Scale (Duncan et al., 2009), and second, it examines how the link between PVD and fear of COVID-19 may be moderated by individual-level and country-level conditions that represent *objectively* high (vs. low) disease threat. We propose that PVD will associate more strongly with fear of COVID-19, when disease threat is objectively high. For the present study, high disease threat was assumed when one may be more likely to catch a COVID-19 infection; and when getting infected would be more likely to result in a severe course. As getting a COVID-19 vaccine reduces the likelihood of infection (see meta-analysis by Zheng et al., 2022), and the threat of suffering from a life-threatening course is less salient in contexts with more developed health and living standards and lower COVID-19 mortality rates, disease threat was operationalized to be high when individuals had not received a COVID-19 vaccine, and when individuals lived in a country with high COVID-19 mortality rates and low Human Development Index (HDI).

Specifically, we hypothesize that the association between PVD and fear of COVID-19 would be stronger among individuals without a COVID-19 vaccine compared to those who had received at least one dose of a vaccine **(Hypothesis 1**), stronger in contexts with low (compared to high) HDI **(Hypothesis 2),** and stronger in contexts with high (vs. low) COVID-19 mortality rates **(Hypothesis 3)**.[1] To keep inter-individual variation in disease threat constant, we conducted the present study with a low-risk population that is unlikely to experience a serious course of COVID-19, namely young adults aged between 18 and 30 years (Ho et al., 2020).

2 | METHOD

2.1 | Participants and procedure

Online self-report data were collected from young adults across 16 countries between September 2021 and March 2022 using convenience sampling. English measures were used in high English proficiency contexts (i.e., the Netherlands, India, and Hong Kong). In all other contexts, measures were adapted into the respondents' local language by using the committee approach for translation, where a small group of knowledgeable individuals translated the measures by discussing and adapting its contents to context-specific meanings (Beaton et al., 2000; see also van de Vijver & Leung, 2021). Ethical approval and informed consent were obtained.

In total, n = 6512 responses were obtained. After excluding data (outside age range: n = 1489; failure to attention checkers: n = 749), the final dataset consisted of n = 4274 responses (M_{age} = 21.6 years, SD = 3.1; 64% female). Table 1 presents descriptive statistics and internal consistencies for all study variables.

2.2 | Measures

2.2.1 | Vaccination status (individual-level)

Respondents were asked about their COVID-19 vaccination status, with three response options: 0 = no, 1 = yes, partially, and 2 = yes, fully. Based on the time- and context-dependency of "full vaccination" (e.g., different vaccines and number of doses across countries), responses were dichotomized as 0 (no vaccination at all) and 1 (at least one dose of vaccine).

2.2.2 | Perceived vulnerability to disease (individual-level)

The 15-item PVD scale (Duncan et al., 2009) was used (*1 = strongly disagree* to *5 = strongly agree*). As the measure comprises two subscales, we calculated McDonald's omega (Hayes & Coutts, 2020) for internal consistency, which ranged between .64 and .86.

TABLE 1 Descriptive statistics of perceived vulnerability to disease (PVD), fear of COVID-19, human development index (HDI) COVID-19 mortality across regions (N = 4274).

	N	Age *M* (*SD*) (years)	% female	% without COVID-19 vaccine	PVD *M* (*SD*)/ Cronbach's α/ McDonald's ω	Fear of COVID-19 *M* (*SD*)/Cronbach's α	HDI total score	Cumulative COVID-19 deaths per million
Australia	131	21.8 (3.3)	70%	4.6%	4.03 (0.89)/.82/.83	1.93 (0.76)/.88	0.94	50.96
Bulgaria	237	23.4 (3.6)	53%	74.3%	4.77 (0.89)/.84/.86	2.96 (0.78)/.89	0.82	3095.72
Germany	270	24.4 (3.3)	82%	3.0%	3.73 (0.93)/.81/.84	1.87 (0.77)/.85	0.95	1124.83
Greece	146	21.4 (3.8)	82%	9.1%	4.33 (0.84)/.79/.79	2.21 (0.76)/.86	0.89	1433.71
Hong Kong	244	20.5 (2.4)	68%	8.6%	4.25 (0.62)/.63/.64	2.45 (0.87)/.86	0.95	28.44
India	349	21.7 (2.0)	28%	0.3%	3.99 (0.55)/.69/.70	2.77 (0.50)/.77	0.65	316.53
Israel	345	24.2 (2.0)	26%	4.1%	3.84 (0.97)/.82/.83	2.09 (0.82)/.85	0.92	821.89
Italy	370	20.6 (2.3)	76%	1.1%	4.32 (0.81)/.70/.70	2.76 (0.81)/.85	0.90	2218.47
Netherlands	264	19.7 (2.0)	88%	9.5%	3.68 (0.80)/.79/.81	1.92 (0.65)/.78	0.94	1038.60
Portugal	165	23.7 (3.7)	73%	9.8%	4.06 (0.87)/.80/.81	2.18 (0.90)/.88	0.86	1750.49
Romania	199	21.0 (2.2)	71%	24.7%	3.99 (0.93)/.78/.78	1.92 (0.80)/.87	0.82	1892.75
Serbia	266	23.3 (3.2)	69%	44.7%	3.82 (0.82)/.75/.78	1.80 (0.70)/.84	0.81	1204.97
Spain	246	22.8 (2.8)	70%	24.1%	3.63 (0.88)/.78/.78	1.77 (0.70)/.83	0.91	1818.03
Türkiye	355	20.8 (1.7)	72%	3.1%	4.52 (0.83)/.76/.76	2.37 (0.89)/.86	0.82	755.40
United Kingdom	327	21.2 (3.4)	67%	3.7%	3.92 (0.89)/.82/.83	2.05 (0.88)/.90	0.93	2436.40
U.S.A.	360	21.2 (2.9)	63%	10.5%	4.13 (0.94)/.83/.84	2.25 (0.97)/.91	0.92	2069.01

Note: Higher scores represent higher PVD, greater fear of COVID-19, a higher level of development (HDI), and higher COVID-19 mortality. HDI scores were extracted from UNDP (2022). The scores for cumulative confirmed COVID-19 deaths per million people were extracted from Our World in Data (2022); numbers represent the cumulative mortality as of October 2021.

2.2.3 | Fear of COVID-19 (individual-level)

The seven-item measure by Ahorsu et al. (2022) was administered in a randomized order to assess participants' fear of COVID-19 (*1 = strongly disagree* to *5 = strongly agree*). Cronbach's alphas ranged between .77 and .91.

2.2.4 | Human development index (HDI) (country-level)

Each country's most recent HDI score was retrieved (UNDP, 2022). The HDI reflects a composite index comprising affluence, educational level, and life expectancy information. Higher HDI reflects a more developed country.

2.2.5 | COVID-19 mortality rates (country-level)

Cumulative deaths per million were used to measure COVID-19 mortality (Our World in Data, 2022). To ensure comparability, we used the cumulative death count as of October 2021, which was the month where most countries began data collection.

The study materials, dataset, and documentation of all analyses are available at https://osf.io/wtm2c/?view_only=3ae5784fd7514c8badf3452989977857.

3 | RESULTS

3.1 | Factor structure of the PVD scale

To investigate the PVD's factor structure, an exploratory factor analysis (EFA) was performed with the pooled sample. The number of factors was decided based on the scree plot (Cattell & Vogelmann, 1977) and Kaiser's criterion. The scree-plot indicated a four-factor solution, which, however, did not provide a good fit to the data, as the fourth factor comprised of only three items (items 1, 4, and 11) all of which showed cross-loadings with at least two other factors. For details, see Figure S1 and Table S1. Using Kaiser's criterion, three factors were extracted with eigenvalues >1.00, explaining 51.5% of the variance. Due to observed cross-loadings on factors 1 and 3 (>0.30), an Oblimin rotation was performed. Extracting three and then two components, the two-factor model demonstrated the clearest structure. In the two-factor solution, the first component represented the GA subscale, while the second component represented the PI subscale. Both PVD subscales exhibited a positive correlation in the pooled sample (r = .27). For PVD item wording and loadings, refer to Table S2.

We then repeated the two-factor EFA using the Oblimin rotation, separately for each of the 16 countries, and found weak loadings on the GA factor for item 11 in Germany, Bulgaria, and Serbia (<0.30), and item 13 in Spain, Australia, Greece, India and Bulgaria (<0.40). Moreover, item 13 cross-loaded on the PI factor in Bulgaria, Australia, and India. Thus, for all following analyses, items 11 and 13 were excluded which we labelled as PVD-r (i.e., reduced PVD), and GA-r (reduced GA).

3.2 | Model comparisons

To investigate the scale's factor structure, we used the Mplus statistical package (Muthén & Muthén, 2021) for structural equation modeling with the maximum likelihood estimator. We compared four models to determine the best fit and interpretation. The first model (M1) was a single-factor CFA model with all items loading on one latent

PVD-r factor. The second model (M2) was a two-factor CFA model with the PI and GA-r items loading on separate factors. However, cross-loadings between factors were found in the EFA, so we specified an Exploratory Structural Equation Modeling (ESEM) model.[2] This ESEM model (M3) included the PI and GA-r items as separate factors, with freely estimated item loadings and cross-loadings close to zero. Additionally, we tested a restricted ESEM bifactor model (M4), where all items loaded on a general factor and group factors representing the two subscales. Orthogonal bi-geomin rotation was applied to this model. The fit indices suggested that M4 showed the best fit (Table 2). Most items (except for items 2 and 8) significantly loaded on the general factor, with loadings ranging from 0.17 to 0.86; and both the PI items and the GA-r items significantly loaded on their respective factors. Thus, the ESEM bi-factor model was retained for further analyses.

3.3 | Measurement invariance

Measurement invariance was assessed at three levels: *configural invariance* (i.e., testing the invariance of the overall factor structure across countries), *metric invariance* (i.e., testing the invariance of factor loadings across countries), and *scalar invariance* (i.e., testing the invariance of item intercepts across countries; Furr, 2018). Goodness-of-fit indices at different invariance levels can be found in Table 3. The findings indicate that configural invariance was supported. The metric invariance model was marginally acceptable with a ΔCFI = −0.033 and a ΔRMSEA = 0.008. Scalar invariance was not established, therefore mean differences across groups cannot be computed (Table 3).

3.4 | Hypotheses testing

To test whether the association between PVD-r with fear of COVID-19 was moderated by vaccination status, HDI, and COVID-19 mortality rate, a mixed-level linear regression analysis using the ML estimator with the Jamovi 2.0 program (The Jamovi Project, 2022) was conducted. The correlations between the study variables are presented in Table S3. The countries' intercepts were added as random effects, and the scores of vaccination status, HDI, and COVID-19 mortality rates (grand-mean centered), PVD-r (group-mean centered), and their two-way interactions were included as predictors. Gender was added as a covariate, because gender effects are common for PVD (Díaz et al., 2016) and fear of COVID-19 (Nino et al., 2021; Sánchez-Teruel et al., 2022), and the gender distribution strongly varied across the 16 countries of the present research.

As presented in Table 4, the mixed-level linear regression (ICC = 0.163) revealed significant associations of fear of COVID-19 with vaccination status (β = .18, $t(4254.2) = 4.36$, $p < .001$, 95% CI [0.10, 0.26]), HDI (β = −3.64, $t(17.4) = -2.53$, $p = .021$, 95% CI [−6.45, −0.82]), and PVD-r (β = .31, $t(4241.2) = 16.57$, $p < .001$, 95% CI [0.27, 0.34]), such that having at least one dose of a COVID-19 vaccine, living in a country with low HDI and having high PVD-r were all associated with greater fear of COVID-19. The proposed interactions between PVD-r and vaccination status

TABLE 2 Model fit statistics for different CFA, ESEM, and bi-factor models (N = 4274).

Model and description	χ^2 (*df*)	CFI	RMSEA	SRMR	AIC	BIC
M1: CFA 1-factor model	5890.584***(65)	0.598	0.145	0.114	210,261.517	210,509.569
M2: CFA 2-factor model	2616.307***(64)	0.824	0.097	0.063	206,989.240	207,243.652
M3: ESEM 2-factor model	2517.895***(53)	0.830	0.104	0.060	206,912.828	207,237.204
M4: ESEM bi-factor model (BI-GEOMIN rotation)	396.315***(51)	0.976	0.04	0.023	204,795.248	205,132.344

Abbreviations: AIC, Akaike information criterion; BIC, Bayesian information criterion; CFI, Comparative fit index; *df*, Degrees of freedom; RMSEA, Root-mean-square error of approximation; SRMR, Standardized root mean square residual.
***$p < .001$.

TABLE 3 Summary of goodness-of-fit statistics and information criteria for ESEM bi-factor measurement invariance model.

Model invariance	χ^2 (*df*)	$\Delta\chi^2$ (Δdf)	CFI	ΔCFI	RMSEA	ΔRMSEA	SRMR	AIC	BIC
Bifactor ESEM model									
Configural	1338.768*** (816)		0.965		0.049		0.039	199,770.875	205,164.414
Metric	2172.337*** (1161)	833.569*** (345)	0.932	−0.033	0.057	0.008	0.072	199,914.444	203,113.677
Scalar	4088.632*** (1311)	1916.295*** (150)	0.814	−0.118	0.089	0.032	0.095	201,530.739	203,775.927

Abbreviations: AIC, Akaike information criterion; BIC, Bayesian information criterion; CFI, Comparative fit index; *df*, Degrees of freedom; RMSEA, Root-mean-square error of approximation; SRMR, Standardized root mean square residual.

***$p < .001$.

TABLE 4 Results of the mixed-linear regression to predict fear of COVID-19.

	β (*SE*)	95% CI lower	95% CI upper	*t*(df)	*p*
Intercept	2.10 (*0.09*)	1.92	2.28	*t*(24.9) = 23.25	.000
Gender (female—male)	.19 (*0.03*)	0.14	0.24	*t*(4253.4) = 7.50	.000
Gender (other—male)	.02 (*0.12*)	−0.21	0.25	*t*(4242.4) = 0.20	.840
PVD-r	.31 (*0.02*)	0.27	0.34	*t*(4241.1) = 16.57	.000
Vaccine	.18 (*0.04*)	0.10	0.26	*t*(4254.2) = 4.36	.000
HDI	−3.64 (*1.44*)	−6.45	−0.82	*t*(17.4) = −2.53	.021
C19 mortality	.0001 (*0.00*)	−0.0001	0.0003	*t*(17.1) = 0.76	.456
Vaccine × HDI	.92 (*0.71*)	−0.46	2.31	*t*(4257.0) = 1.31	.191
Vaccine × C19 mortality	.0001 (*0.00*)	−0.0001	0.0002	*t*(4202.8) = 1.04	.299
HDI × C19 mortality	−.001 (*0.00*)	−0.004	0.002	*t*(16.2) = −0.86	.403
PVD-r × vaccine	.07 (*0.04*)	0.001	0.15	*t*(4241.3) = 1.99	.047
PVD-r × HDI	.36 (*0.19*)	−0.02	0.75	*t*(4241.1) = 1.88	.061
PVD-r × C19 mortality	.00004 (*0.00*)	0.00001	0.0001	*t*(4241.1) = 2.70	.007

Note: R^2 marginal = 0.19; Gender coded as 1 = male, 2 = female, 3 = other; Vaccine coded as 0 = no, 1 = yes; *N* = 4263; PVD-r = perceived vulnerability to disease score based on the reduced item set excluding item 11 and 13.

(*p* = .047), and between PVD-r and COVID-19 mortality (*p* = .007) were significant, while the interaction between PVD-r HDI was not (*p* = .061). Examinations of the interactions showed that PVD-r was more strongly related to fear of COVID-19 for individuals that had at least one shot of a COVID-19 vaccine (*β* = .34, *t*(4241) = 24.20, *p* < .001, 95% CI [0.32, 0.37]) compared to individuals with no vaccine (*β* = .27, *t*(4241) = 7.80, *p* < .001, 95% CI [0.20, 0.34]) (Figure 1); and that the association between PVD-r and fear of COVID-19 was strongest in contexts where the COVID-19 mortality was high, *β* = .35, *t*(4241) = 17.5, *p* < .001, 95% CI [0.31, 0.38], and weakest in contexts where the COVID-19 mortality was low, *β* = .27, *t*(4241) = 10.3, *p* < .001, 95% CI [0.22, 0.32] (Figure 2).

4 | DISCUSSION

The present study makes two contributions to the literature. First, the bi-factor ESEM model revealed a single global factor of PVD that incorporates the sub-factors of PI and GA-r. This adds to previous studies that did not consistently find a clear structure of two separate factors (e.g., Díaz et al., 2016). Configural invariance was achieved in the cross-cultural measurement invariance analysis, but scalar invariance could not be established, preventing cross-country mean comparisons. Notably, not only in the present research, but also in previous studies items 11 and 13 have been problematic and eventually deleted (e.g., Díaz et al., 2016; Moradi-motlagh et al., 2020). These findings suggest that despite the global impact of COVID-19 and the implementation of risk reduction measures by governments worldwide, significant differences across countries in PVD exist. These differences may stem from genuine variations in PVD or cultural and contextual influences on item interpretation (e.g., "My hands do not feel dirty after touching money": different norms for behaviors may exist across different cultural and temporal contexts) and associated practices. Therefore, caution is necessary when interpreting cross-cultural research involving the concept of PVD.

Second, our study offers substantial insights into the association between PVD and fear of COVID-19 across various levels of disease threat. Surprisingly, the absence of a COVID-19 vaccine did not amplify the link between PVD-r and fear of COVID-19 as we expected. Instead, this association was stronger among individuals who had received at least one dose of the vaccine; plus, our data suggest that vaccinated individuals generally reported higher levels of fear of COVID-19 than those who chose not to get vaccinated. This suggests that individuals who

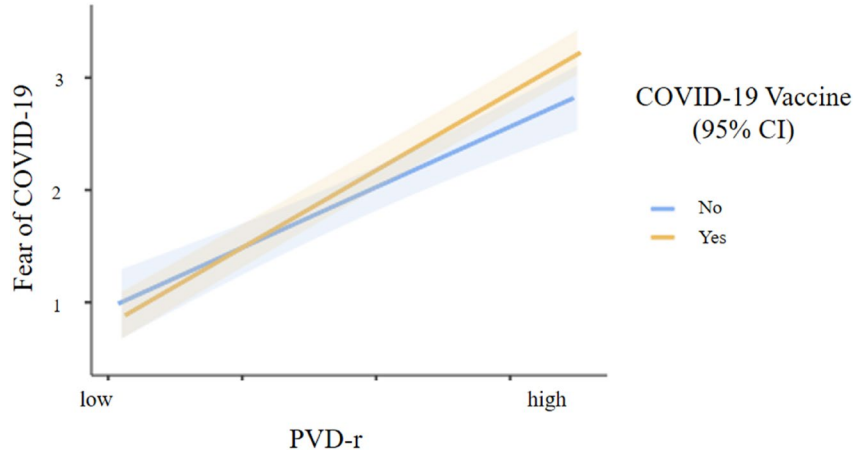

FIGURE 1 The moderation effect of COVID-19 vaccination on the association between PVD-r and Fear of COVID-19. PVD-r = perceived vulnerability to disease score based on the reduced item set excluding item 11 and 13. COVID-19 vaccine = yes refers to respondents who have received at least one dose of a COVID-19 vaccine.

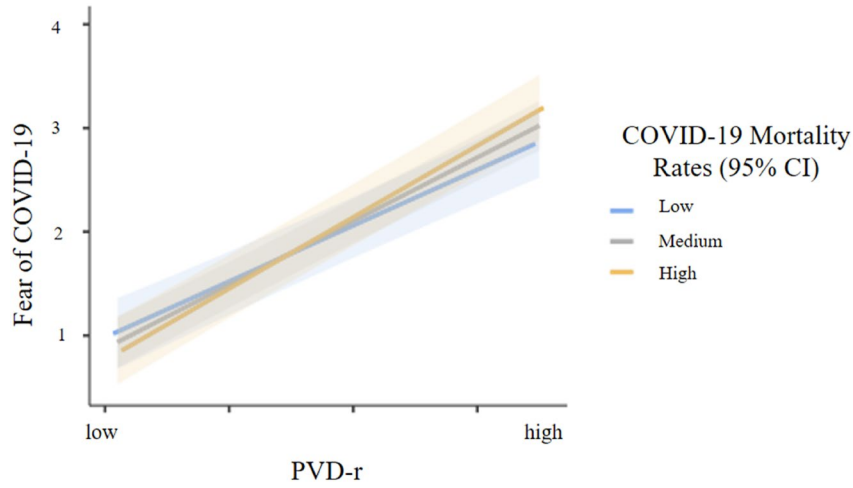

FIGURE 2 The moderation effect of COVID-19 mortality rates on the association between PVD-r and Fear of COVID-19. PVD-r = perceived vulnerability to disease score based on the reduced item set excluding item 11 and 13. COVID-19 mortality reflects the level of cumulative COVID-19 deaths per million by October 2021.

experienced significant fear of COVID-19 took proactive measures by getting vaccinated aligning with the protection motivation theory (Rogers & Prentice-Dunn, 1997). Therefore, while PVD reflects adaptive responses to disease threat cues (Duncan et al., 2009), the association between PVD and feelings of worry appears to be less affected by individual variations.

Regarding country-level effects, we expected that living in regions with higher COVID-19 mortality rates and lower HDI would be associated with higher PVD-r. The latter assumption was not supported, suggesting that HDI and COVID-19 mortality rates may represent two qualitatively different contextual variables in terms of disease threat. As such, our results may account for a (pandemic) specificity (vs. generality) explanation of how each of those country-level variables are associated with PVD-r. Thus, higher levels of disease threat specific to the pandemic (i.e., high COVID-19 mortality rates) may generate a reactive mechanism and strengthen the association between PVD-r

and COVID-19-related fears (see Safra et al., 2021). When being exposed to contextual threats that are less pandemic specific, however, individuals might not have a clear interpretation of their perceived threat, as healthcare circumstances are worse in low compared to high HDI contexts, while reported mortality rates were lower (r = .18 in our research). This association aligns with previous findings involving over 150 countries (Mirahmadizadeh et al., 2022) and may be attributed to better epidemiological monitoring and more accurate reporting of COVID-19 deaths in high HDI contexts (Shahbazi & Khazaei, 2020), as it is unlikely that more deaths would occur in more developed countries.

Several limitations should be acknowledged, and future research directions can be proposed. Firstly, the interplay between various contextual variables, such as HDI, COVID-19 mortality rates, vaccination accessibility, and government policies, may interact differently and shape the perception of COVID-19 within specific countries and timeframes. Understanding these complex relationships warrants further investigation. Secondly, the limitations in sample variability, including skewed gender and vaccination status distributions, and the reliance on convenience samples of young adults, restrict the generalizability of our findings. Future studies should consider contextual differences more comprehensively, examine gender-specific associations, diversify the age range, and employ alternative sampling methods, such as purposive sampling. Lastly, the cross-sectional design hinders causal interpretations, and longitudinal designs would provide valuable insights in future explanatory studies.

In conclusion, our study contributes by examining the factorial structure of the PVD scale across nations and assessing its cross-national validity. Additionally, our findings highlight the role of PVD and country-level disease threat indicators in the appraisal of COVID-19 fear. Further research on this widely used measure can uncover globally relevant factors associated with health-related attitudes, behaviors, and outcomes.

AUTHOR CONTRIBUTIONS

Arzu Karakulak played a lead role in initiating and conceptualizing the project, performing data curation, formal analysis, funding acquisition, investigation, methodology design, project administration, visualization, and writing of the original draft, as well as writing review and editing. Maria Stogianni played a key role formal analysis, project administration, visualization, investigation, methodology, and writing of the original draft. Itziar Alonso-Arbiol played a supporting role in the conceptualization, formal analysis, investigation, methodology, and writing the original draft. Shanu Shukla played a supporting role in the investigation, project administration, writing original draft, and review and editing. Michael Bender played a supporting role in the investigation, methodology, project administration, writing original draft, and writing review and editing. Victoria Wai Lan Yeung played a supporting role in the investigation, project administration, writing the original draft, and writing review and editing. Veljko Jovanović played a supporting role in the investigation, methodology, and writing the original draft. Pasquale Musso and Rosa Scardigno played a supporting role in the investigation and writing original draft. Riley A. Scott, Jaimee Stuart, and Maria-Therese Friehs played supporting role in the investigation and writing review and editing. Zena Toh played a supporting role in the investigation, project administration, and writing original draft. Nihan Albayrak-Aydemir and Alexios Arvanitis played a supporting role in the investigation and writing original draft. Carmen Buzea, Stefanos Mastrotheodoros, Jo-Ann Tsang, Filipa Madeira, Diana Miconi, Nicole Russell Pascual, and Wade C. Rowatt played a supporting role in the investigation and writing, review and editing. Rosemary L. Al-Kire, Moty Amar, Tugce Aral, Guy Itzchakov, Sushanta Kumar Mishra, Roni Porat, Rocco Servidio, Delia Stefenel, Ergyul Tair, and Alexandros Gkomez played an equal supporting role in the investigation.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest concerning the research, authorship, and/or publication of this article.

ETHICS STATEMENT

The current study protocol has been reviewed and approved by the Sabanci University Research Ethics Council (SUREC), protocol number: IPC-2021-71. When not declared as exempt, approvals have additionally been obtained from the local institutional review boards of all other involved countries. Informed consent was obtained from each participant prior to completing the research.

OPEN SCIENCE STATEMENT

Studies materials, data, and analysis outputs are available at https://osf.io/wtm2c/?view_only=3ae5784fd7514c8badf3452989977857.

This project is pre-registered at https://osf.io/yxvc6/?view_only=4bac5dc78f754753b30b4d09bb3b941c.

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ENDNOTES

[1] Preregistrations are available under https://osf.io/yxvc6?view_only=4bac5dc78f754753b30b4d09bb3b941c. The first three hypotheses (i.e., testing PVD differences across contexts) were not tested, as the cross-national measurement invariance analysis was not supportive of scalar invariance.

[2] The Exploratory Structural Equation Modeling (ESEM) approach was preferred over conventional CFA due to its flexibility in handling large samples and multiple cross-loadings. It combines the benefits of exploratory and confirmatory factor analysis by providing goodness-of-fit statistics, accurate parameter estimates, and a broader understanding of the construct under investigation. Unlike CFA, ESEM allows each indicator to load on all other latent variables, and all loadings can be freely estimated using different matrix rotation methods (Xiao et al., 2019).

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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