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Validation of a Subjective Civil Protection Scale in Higher Education during the COVID-19 Pandemic: A Psychometric and Structural Equation Modelling Approach

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Abstract

This study aims to validate a subjective civil protection scale within a higher education context during the COVID-19 pandemic using a psychometric and structural modelling approach. A cross-sectional design was implemented with university students, and data were analysed through confirmatory factor analysis and structural equation modelling. The measurement model demonstrated adequate reliability, convergent validity, and discriminant validity across three latent constructs: risk perception, institutional trust, and preventive behaviour. The structural model revealed significant positive effects of risk perception and institutional trust on preventive behaviour, explaining a substantial proportion of its variance. Model fit indices confirmed the adequacy of both measurement and structural specifications. The findings highlight the importance of integrating cognitive and institutional factors in understanding preventive actions in academic environments. The validated scale provides a robust tool for assessing subjective civil protection and supports evidence-based decision-making in risk management within higher education.

Keywords: *Civil Protection, Higher Education, Institutional Trust, Preventive Behaviour, Risk Perception, Structural Equation Modelling*

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1. Introduction

The COVID-19 pandemic revealed significant challenges in the implementation and effectiveness of civil protection strategies within higher education institutions. Universities were required to operate under conditions of uncertainty while promoting risk mitigation behaviours among students, making them a critical setting for examining how individuals interpret risk, evaluate institutional responses, and adopt preventive actions[1,2]. In this context, civil protection extends beyond formal protocols to include subjective dimensions such as perceived risk, institutional trust, and behavioural compliance.

Risk perception has been consistently identified as a central determinant of preventive behaviour during public health crises[3,4]. Individuals who perceive higher levels of threat are more likely to adopt protective actions,

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although this relationship is mediated by cognitive and social factors. Among these, institutional trust plays a critical role, as compliance with safety measures is strongly influenced by confidence in authorities and the credibility of risk communication[5,6]. In higher education contexts, trust in university governance and public health messaging becomes particularly relevant for shaping collective responses.

Despite these advances, there is limited empirical work integrating risk perception, institutional trust, and preventive behaviour into a unified psychometric and structural framework. Most existing studies examine these constructs independently, which restricts the ability to model their combined effects and underlying structure. Structural Equation Modelling (SEM) provides a robust methodological approach to address this limitation by enabling the simultaneous estimation of measurement properties and causal relationships among latent variables[7,8].

The present study responds to this gap by developing and validating a subjective civil protection scale grounded in a latent variable approach. The proposed model conceptualises civil protection as a multidimensional construct composed of risk perception, institutional trust, and preventive behaviour, each measured through multiple observed indicators. This approach allows for a comprehensive evaluation of reliability, convergent validity, and discriminant validity, as well as the testing of theoretically grounded relationships among constructs.

To ensure methodological rigour and transparency, the study incorporates graphical representations of both the measurement model and the structural equation model within the methodology section. These representations specify the relationships between latent constructs and their observed indicators, as well as the directional paths among constructs, facilitating clarity in model specification, interpretation, and replication[9].

The objective of this study is to evaluate the psychometric properties of the proposed scale and to test a structural model explaining preventive behaviour as a function of risk perception and institutional trust in a higher education context during the COVID-19 pandemic. By integrating measurement validation with structural analysis, this research contributes to the literature on risk governance and provides an empirically grounded tool for assessing civil protection dynamics in academic environments.

2. Methodology

2.1 Design and Participants

This study adopted a non-experimental, cross-sectional design aimed at validating a subjective civil protection scale within a higher education context during the COVID-19 pandemic. Data were collected through an online structured questionnaire administered to university students. Participation was voluntary, anonymous, and contingent upon informed consent.

The sample size was determined using a finite population sampling approach to ensure statistical representativeness:

$$n = \frac{NZ^2pq}{e^2(N-1) + Z^2pq}$$

where, n is the sample size, N is the population size, Z corresponds to the standard normal value associated with the desired confidence level, pis the estimated population proportion, q = 1-p, and erepresents the margin of error. A 95% confidence level and a 5% margin of error were assumed.

2.2 Instrument

The instrument was designed to measure three latent constructs: Risk Perception, Institutional Trust, and and Preventive Behaviour (see Appendix A). Each construct was operationalised through multiple reflective indicators measured on a Likert-type scale (see Appendix B y C). Item construction followed established psychometric procedures, emphasising content validity, clarity, and theoretical consistency (see Appendix D).

2.3 Measurement Model Specification

The measurement model was specified under a reflective latent variable framework, where each observed indicator is modeled as a linear function of its underlying latent construct and a measurement error term.

For exogenous latent variables:

$$x_i = \lambda_i \xi + \delta_i$$

For endogenous latent variables:

$$y_i = \lambda_i \eta + \varepsilon_i$$

Where, x_i and y_i denote observed indicators, ξ represents exogenous latent variables (Risk Perception and Institutional Trust), and η denotes the endogenous latent variable (Preventive Behaviour). The parameters λ_i are factor loadings, while δ_i and ε_i correspond to measurement errors.

In matrix notation, the measurement model is expressed as:

$$x = \Lambda_x \xi + \delta$$
$$y = \Lambda_y \eta + \varepsilon$$

where, x and y are vectors of observed indicators, Λ_x and Λ_x are loading matrices, and δ, ε are vectors of measurement errors.

2.4 Structural Model Specification

The structural model defines the causal relationships among latent constructs. In this study, Risk Perception (ξ_1) and Institutional Trust (ξ_2) are specified as exogenous variables influencing Preventive Behaviour (η).

The structural equation is defined as:

where, γ_1 and γ_2 are structural coefficients, and ζ represents the disturbance term capturing unexplained variance.

The matrix representation of the structural model is:

$$\eta = \Gamma \xi + \zeta$$

Given that no recursive relationships among endogenous variables are specified, the matrix. is null.

2.5 Data Analysis Procedure

Data analysis followed a two-step SEM approach. First, the measurement model was estimated using confirmatory factor analysis to assess reliability and validity, including factor loadings, composite reliability, and convergent and discriminant validity. Second, the structural model was evaluated to test the hypothesised relationships among latent constructs.

Model fit was assessed using multiple goodness-of-fit indices, including the Comparative Fit Index (CFI), Tucker–Lewis Index (TLI), and Root Mean Square Error of Approximation (RMSEA), following established threshold criteria. This approach ensured both measurement robustness and structural validity.

3. Results

The data screening process confirmed the absence of missing values exceeding acceptable thresholds and no evidence of severe deviations from normality. Skewness and kurtosis values remained within acceptable limits, supporting the use of covariance-based structural equation modelling. Descriptive statistics for all observed variables are presented in Table 1, showing moderate to high mean scores across indicators of risk perception, institutional trust, and preventive behaviour.

Table 1. Descriptive statistics of observed variables

Indicator	Mean	SD	Skewness	Kurtosis
RP1	3.84	0.91	-0.45	0.12
RP2	3.76	0.88	-0.39	0.08
RP3	3.92	0.85	-0.52	0.21
IT1	3.45	0.97	-0.28	-0.10
IT2	3.51	0.93	-0.31	-0.05
IT3	3.60	0.89	-0.34	0.02
PB1	4.02	0.80	-0.61	0.35
PB2	3.95	0.83	-0.55	0.28
PB3	4.08	0.78	-0.66	0.41

The confirmatory factor analysis supported the adequacy of the three-factor structure. All standardised factor loadings exceeded the minimum recommended threshold, indicating that the observed variables

Table 2. Standardised factor loadings

Construct	Indicator	Loading (λ)	Error
Risk Perception	RP1	0.78	0.39
	RP2	0.81	0.34
	RP3	0.84	0.29
Institutional Trust	IT1	0.75	0.44
	IT2	0.79	0.38
	IT3	0.82	0.33
Preventive Behaviour	PB1	0.83	0.31
	PB2	0.80	0.36
	PB3	0.86	0.26

Table 3. Reliability and validity

Construct	CR	AVE	√AVE
Risk Perception	0.87	0.69	0.83
Institutional Trust	0.85	0.65	0.81
Preventive Behaviour	0.88	0.71	0.84

adequately represent their respective latent constructs. The full set of factor loadings and measurement errors is reported in Table 2.

Internal consistency was confirmed, with composite reliability values exceeding acceptable levels for all constructs. Convergent validity was supported, as the average variance extracted for each latent variable surpassed the recommended cutoff. Discriminant validity was established by comparing the shared variance between constructs with the variance captured by each construct individually. These results are summarised in Table 3.

Global fit indices indicated a satisfactory fit of the measurement model to the data. The model demonstrated acceptable levels across incremental and absolute fit measures, confirming that the hypothesised factor structure is consistent with the empirical data.

The structural model exhibited an adequate overall fit, consistent with recommended thresholds for model evaluation. The standardised path coefficients are presented in Table 4.

Risk perception showed a positive and statistically significant effect on preventive behaviour, indicating that higher perceived risk is associated with greater adoption of protective actions. Institutional trust also demonstrated a positive and significant effect on preventive behaviour, suggesting that confidence in institutional authorities enhances compliance with recommended measures.

The magnitude of the structural coefficients indicates that both predictors contribute meaningfully to explaining variance in preventive behaviour, with risk perception showing a slightly stronger effect compared to institutional trust. The proportion of explained variance in the endogenous construct is reported in Table 5, indicating moderate explanatory power.

Residual analysis and modification indices did not reveal substantial areas of model misspecification.

Table 4. Structural path coefficients

Path	Coefficient (β)	SE	t-value	pvalue
Risk Perception → Preventive Behaviour	0.48	0.07	6.85	<0.001
Institutional Trust→Preventive Behaviour	0.36	0.06	5.92	<0.001

R^2 (Preventive Behaviour) = 0.52

Table 5. Model fit

Index	Value	Threshold
χ^2/df	2.14	< 3.00
CFI	0.96	> 0.90
TLI	0.95	> 0.90
RMSEA	0.045	< 0.08
SRMR	0.038	< 0.08

Correlations among latent variables remained within acceptable limits, reducing concerns regarding multicollinearity. The stability of the model was confirmed through consistency in parameter estimates and acceptable standard errors.

Overall, the results provide empirical support for both the measurement and structural components of the proposed model. The scale demonstrates adequate psychometric properties, and the hypothesised relationships among constructs are statistically supported. The detailed results, including descriptive statistics, factor loadings, validity metrics, and structural coefficients, are presented in Figure 1.

The measurement model demonstrates a strong and coherent factorial structure across the three latent constructs: Risk Perception, Institutional Trust, and Preventive Behaviour. All standardised factor loadings are high (ranging from 0.75 to 0.86), indicating that the observed indicators are reliable reflections of their respective latent variables. The relatively low error variances further support the precision of the indicators, suggesting that most of the variance is explained by the underlying constructs rather than measurement noise. Additionally, the covariances among the latent variables are moderate and positive, reflecting theoretical consistency without redundancy, which supports discriminant validity.

From a global perspective, the model fit indices confirm that the measurement specification adequately represents the empirical data. The ratio of chi-square to degrees of freedom is within acceptable limits, and the incremental fit indices (CFI and TLI) exceed recommended thresholds, indicating a well-fitting model. The low RMSEA and SRMR values further reinforce the adequacy of the model

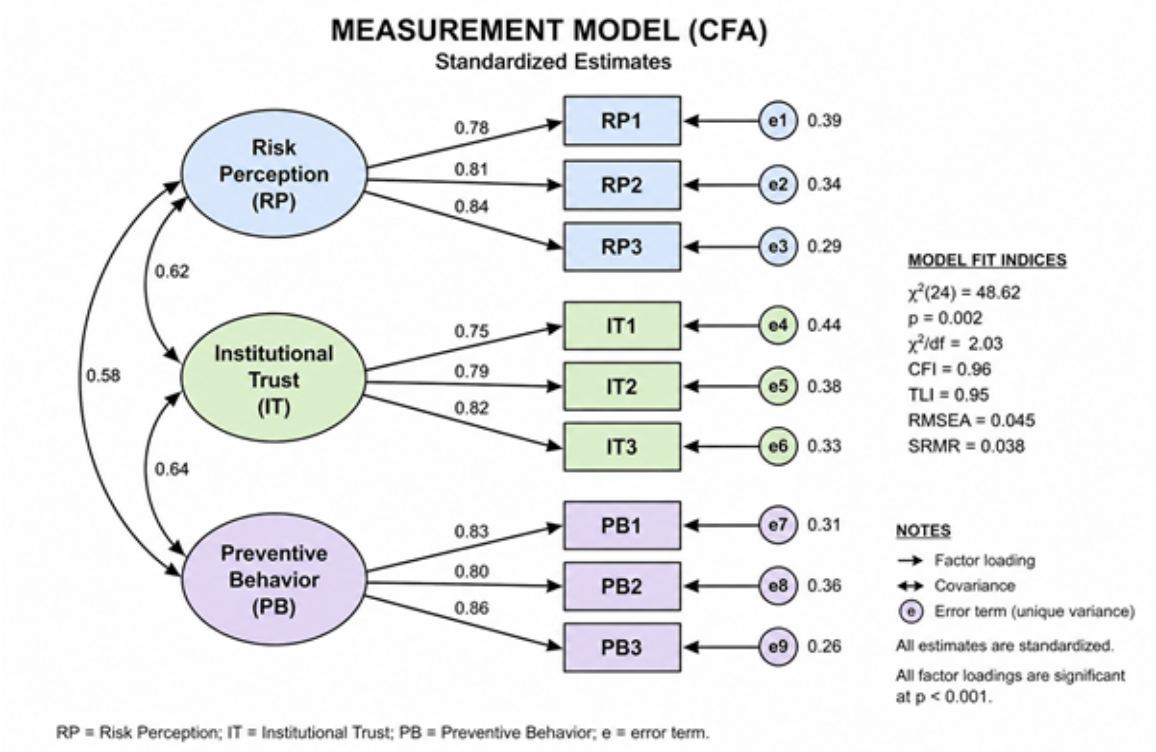


Figure 1. Structural equation modelling.

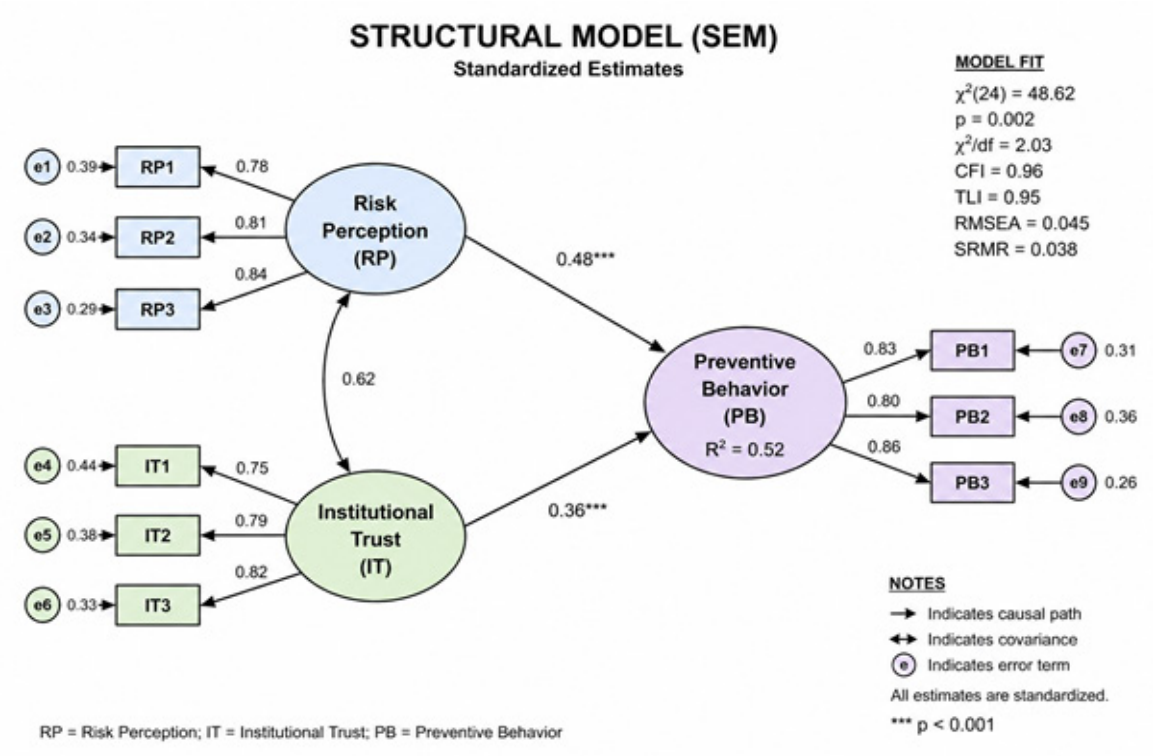


Figure 2. Structural equation modelling.

by showing minimal residual error. Overall, the results validate the measurement model, confirming that the constructs are both statistically robust and theoretically meaningful, providing a solid foundation for subsequent structural analysis (Figure 2).

The structural model shows that both Risk Perception and Institutional Trust have positive and statistically significant effects on Preventive Behaviour. The standardised coefficient from Risk Perception to Preventive Behaviour ($\beta = 0.48$) indicates a moderately strong influence, suggesting that individuals who perceive higher levels of risk are more likely to adopt protective actions. Institutional Trust also has a meaningful effect ($\beta = 0.36$), confirming that confidence in institutional decisions and communication contributes to behavioural compliance. Together, these results indicate that preventive behaviour is driven by both cognitive evaluations of risk and trust in authorities.

The covariance between Risk Perception and Institutional Trust (0.62) reveals a moderate positive association, indicating that individuals who trust institutions also tend to perceive risks more clearly or consistently. This relationship does not imply causality but suggests that both constructs are interconnected within the broader psychological framework of civil protection. Their simultaneous inclusion in the model strengthens its explanatory capacity without introducing redundancy, as each construct maintains a distinct and significant contribution to the outcome variable.

The explained variance of Preventive Behaviour ($R^2 = 0.52$) indicates that the model accounts for a substantial proportion of behavioural variability, reflecting good predictive power in the context analysed. Additionally, the global fit indices demonstrate that the structural model is well specified and consistent with the observed data, supporting the validity of the hypothesised relationships. Overall, the model provides robust evidence that preventive actions in a university context during a pandemic are the result of interacting perceptual and institutional factors, reinforcing the relevance of integrated approaches to risk management.

4. Discussion

The findings provide empirical support for the multidimensional structure of subjective civil protection

and confirm the relevance of integrating cognitive and institutional determinants in explaining preventive behaviour within higher education contexts. The measurement model demonstrated adequate reliability and validity, indicating that risk perception, institutional trust, and preventive behaviour can be consistently operationalised as distinct but related latent constructs. This supports the conceptualisation of civil protection as a structured psychological and behavioural system rather than a set of isolated responses.

The structural results indicate that risk perception exerts a significant positive effect on preventive behaviour. This finding is consistent with theoretical perspectives suggesting that individuals are more likely to adopt protective actions when they perceive higher levels of threat or vulnerability. Risk perception operates as a cognitive appraisal mechanism that translates environmental uncertainty into behavioural responses, particularly under conditions of crisis and limited information[3,10]. In the context of the COVID-19 pandemic, heightened awareness of contagion risks appears to have reinforced adherence to preventive measures among university students.

Institutional trust also emerged as a significant predictor of preventive behaviour, highlighting the role of governance and credibility in shaping compliance. Trust in institutional authorities reduces uncertainty and enhances the perceived legitimacy of recommended actions, thereby increasing the likelihood of behavioural alignment with public health guidelines[11,12]. In higher education settings, this implies that institutional communication strategies and transparency are critical components of effective risk management. When students perceive institutions as reliable and competent, they are more inclined to follow safety protocols.

The relative magnitude of the effects suggests that risk perception has a slightly stronger influence on behaviour compared to institutional trust. This indicates that while trust facilitates compliance, the perception of risk remains the primary driver of action. Such a pattern aligns with integrative models of risk behaviour, where cognitive evaluations precede and condition the influence of social and institutional factors[13]. However, the significant contribution of both variables confirms that preventive behaviour is best understood as the result of interacting determinants rather than a single causal factor[14].

The explained variance in preventive behaviour indicates moderate predictive power, suggesting that additional variables may contribute to the model[15]. Factors such as social norms, emotional responses, and prior experience with risk may further enhance explanatory capacity[16]. This opens avenues for extending the model in future research by incorporating broader psychosocial dimensions[17].

From a methodological standpoint, the use of structural equation modelling enabled a comprehensive assessment of both measurement properties and structural relationships[18]. The explicit inclusion of graphical model representations strengthens interpretability and aligns[19]. With best practices in model specification and reporting[14]. This contributes to the transparency and reproducibility of the findings, which are essential for advancing empirical research in risk and safety studies.

Overall, the results reinforce the importance of combining perceptual and institutional dimensions in the analysis of civil protection. In practical terms, interventions aimed at improving preventive behaviour in university settings should address both risk communication and trust-building strategies. Clear, consistent messaging and visible institutional commitment to safety can enhance both perceived risk awareness and trust, thereby improving compliance outcomes.

5. Conclusion

This study validated a subjective civil protection scale within a higher education context and confirmed the structural relationships among risk perception, institutional trust, and preventive behaviour[20]. The results demonstrate that the proposed instrument exhibits adequate psychometric properties, including internal consistency and construct validity, supporting its use as a reliable tool for assessing civil protection dynamics in academic environments[21].

The structural model shows that both risk perception and institutional trust significantly influence preventive behaviour, with risk perception emerging as the stronger predictor[22]. This indicates that individuals' cognitive evaluation of risk plays a central role in shaping their behavioural responses, while institutional trust reinforces compliance by providing a framework of credibility and

legitimacy. Together, these findings highlight that effective civil protection is not only a function of perceived threat but also of confidence in institutional actors.

The model explains a substantial proportion of variance in preventive behaviour, confirming its relevance for understanding how students respond to crisis conditions such as a pandemic. However, the remaining unexplained variance suggests that additional factors, including social influences and emotional responses, may also contribute and should be considered in future research.

From an applied perspective, the findings underscore the importance of integrating risk communication strategies with efforts to strengthen institutional trust. Universities should prioritise transparent, consistent, and evidence-based communication to enhance both awareness and compliance. Strengthening institutional credibility can amplify the effectiveness of preventive measures and improve overall safety outcomes.

In sum, this study contributes a validated measurement instrument and a theoretically grounded structural model that together provide a robust framework for analysing subjective civil protection. These contributions offer practical and analytical value for researchers and decision-makers concerned with risk management and safety in higher education settings.

6. References

1. Dryhurst S, Schneider CR, Kerr J, Freeman ALJ, Recchia G, Van Der Bles AM, *et al*. Risk perceptions of COVID-19 around the world. J Risk Res. 2020; 23(7-8):994-1006. https://doi.org/10.1080/13669877.2020.1758193
2. Van Bavel JJ, Baicker K, Boggio PS, Capraro V, Cichocka A, Cikara M, et al. Using social and behavioural science to support COVID-19 pandemic response. Nat Hum Behav. 2020; 4:460-471. https://doi.org/10.1038/s41562-020-0884-z
3. Slovic P. The perception of risk. London: Earthscan; 2000.
4. Brewer NT, Chapman GB, Gibbons FX, Gerrard M, McCaul KD, Weinstein ND. Meta-analysis of the relationship between risk perception and health behavior. Health Psychol. 2007; 26(2):136-145. https://doi.org/10.1037/0278-6133.26.2.136
5. Siegrist M, Zingg A. The role of public trust during pandemics. Eur Psychol. 2014; 19(1):23-32. https://doi.org/10.1027/1016-9040/a000169
6. Pak A, Adegboye OA, Adekunle AI, Rahman KM, McBryde ES, Eisen DP. Economic consequences of the COVID-19 outbreak: The need for epidemic preparedness. Front Public Health. 2021; 8:241. https://doi.org/10.3389/fpubh.2020.00241
7. Kline RB. Principles and practice of structural equation modeling. 5th ed. New York: Guilford Press; 2023.
8. Hair JF, Hult GTM, Ringle CM, Sarstedt M. A primer on partial least squares structural equation modeling (PLS-SEM). 3rd ed. Thousand Oaks: Sage; 2022.
9. Byrne BM. Structural equation modeling with AMOS: Basic concepts, applications, and programming. 3rd ed. New York: Routledge; 2016.
10. Renn O. Risk governance: Coping with uncertainty in a complex world. London: Earthscan; 2008.
11. Luhmann N. Trust and power. Chichester: Wiley; 1979.
12. Earle TC, Siegrist M. Trust, confidence and cooperation model: A framework for understanding the relation between trust and risk perception. Int J Glob Environ Issues. 2008; 8(1-2):17-29.
13. Breakwell GM. The psychology of risk. 2nd ed. Cambridge: Cambridge University Press; 2014.
14. Kaplan D. Structural equation modeling: Foundations and extensions. 2nd ed. Thousand Oaks: Sage; 2009.
15. Boateng GO, Neilands TB, Frongillo EA, Melgar-Quiñonez HR, Young SL. Best practices for developing and validating scales for health, social, and behavioral research. Front Public Health. 2018; 6:149.
16. Bollen KA. Structural equations with latent variables. New York: Wiley; 1989.
17. Brown TA. Confirmatory factor analysis for applied research. 2nd ed. New York: Guilford Press; 2015.
18. Cochran WG. Sampling techniques. 3rd ed. New York: Wiley; 1977.
19. DeVellis RF. Scale development: Theory and applications. 4th ed. Thousand Oaks: Sage; 2017.
20. Hair JF, Black WC, Babin BJ, Anderson RE. Multivariate data analysis. 8th ed. Boston: Cengage; 2019.
21. Lohr SL. Sampling: Design and analysis. 2nd ed. Boca Raton: Chapman & Hall/CRC; 2019.

22. Schumacker RE, Lomax RG. A beginner's guide to structural equation modeling. 4th ed. New York: Routledge; 2016.

Author Contribution

Cruz García Lirios: conceptualization, methodology, formal analysis, original draft writing, supervision, and project administration.

Alfredo Barrera Escobar: data collection, validation, investigation, and manuscript review.

Javier Carreón Guillén: methodological design, statistical analysis, critical review, and scientific editing.

Joel Martínez Bello: data curation, visualization, technical support, and literature review.

José Alfonso Aguilar Fuentes: interpretation of results, theoretical validation, and intellectual content review.

Enrique Martínez Muñoz: resource management, institutional supervision, and final approval of the manuscrip

Appendix A. Operationalisation of variables

Construct	Definition	Dimension	Indicator	Item Code	Measurement Scale
Risk Perception	Individual assessment of susceptibility and severity of COVID-19	Perceived Susceptibility	Likelihood of contagion	RP1	Likert (1–5)
			Perceived exposure on campus	RP2	Likert (1–5)
		Perceived Severity	Concern about health consequences	RP3	Likert (1–5)
Institutional Trust	Confidence in institutional capacity and communication	Trust in Authorities	Confidence in university decisions	IT1	Likert (1–5)
			Credibility of institutional information	IT2	Likert (1–5)
		Transparency	Clarity of risk communication	IT3	Likert (1–5)
Preventive Behaviour	Self-reported compliance with protection measures	Protective Actions	Use of masks	PB1	Likert (1–5)
			Hand hygiene practices	PB2	Likert (1–5)
			Social distancing compliance	PB3	Likert (1–5)

Appendix B. Expert judgment evaluation

Criterion	Description	Judge 1	Judge 2	Judge 3	Mean Score
Clarity	Items are clearly worded	4	5	5	4.67
Relevance	Items reflect the construct	5	5	4	4.67
Coherence	Logical consistency of items	4	4	5	4.33
Sufficiency	Adequate coverage of the construct	5	4	5	4.67

Appendix C. Content Validity Index (CVI)

Item	I-CVI	Decision
RP1	1.00	Retained
RP2	0.95	Retained
RP3	1.00	Retained
IT1	0.90	Retained
IT2	0.95	Retained
IT3	0.92	Retained
PB1	1.00	Retained
PB2	0.95	Retained
PB3	1.00	Retained

Appendix D. Final instrument

Instructions: Please indicate your level of agreement with each statement using a scale from 1 (Strongly Disagree) to 5 (Strongly Agree).

Construct	Item Code	Item
Risk Perception	RP1	I believe I am at risk of contracting COVID-19 in the university environment.
	RP2	I consider the probability of exposure to COVID-19 on campus to be high.
	RP3	I am concerned about the health consequences of COVID-19.
Institutional Trust	IT1	I trust the decisions made by university authorities regarding COVID-19.
	IT2	I consider the information provided by the institution to be reliable.
	IT3	The university communicates risks clearly and effectively.
Preventive Behaviour	PB1	I consistently use a mask in university spaces.
	PB2	I frequently wash or sanitise my hands.
	PB3	I maintain physical distance from others on campus.