Clinical Images and Case Reports

Received 19 Oct 2025 | Revised 18 Nov 2025 | Accepted 20 Dec 2025 | Published Online 28 Jan 2026

Published By: Vision Publisher

CICR 4 (1), 1-9

ISSN 2942-0776

Moral Distress, Perceived Stress, and Quality of Life During the COVID-19 Pandemic: A Hybrid SEM–ANN Approach

Cruz Garcia Lirios

Universidad de la Salud (UNISA), CDMX, Mexico

Orcid: https://orcid.org/0000-0002-9364-6796

Abstract:

The COVID-19 pandemic generated unprecedented ethical challenges that affected not only health systems but also individual well-being. Beyond clinical outcomes, the crisis intensified moral distress and psychological stress, with potential consequences for quality of life. This study examines the relationships among moral distress, perceived stress, and quality of life in the context of the COVID-19 pandemic using a hybrid methodological approach that integrates Structural Equation Modeling (SEM) and Artificial Neural Networks (ANN). Data were collected through standardized instruments assessing moral distress, perceived stress, and quality of life across physical, psychological, social, and environmental domains. SEM was employed to confirm the measurement models and to test direct and indirect effects, while ANN was used to explore non-linear patterns and predictive relationships among latent constructs. The findings provide evidence that higher levels of moral distress are associated with increased perceived stress, which in turn is linked to lower quality of life across all domains. The hybrid SEM–ANN approach offers a robust framework for understanding complex psychosocial processes during health emergencies and supports the development of ethically informed interventions aimed at protecting quality of life in crisis contexts.

Keywords

Moral distress; perceived stress; quality of life; COVID-19 pandemic; structural equation modeling; artificial neural networks

Corresponding Author: Cruz Garcia Lirios†, Universidad de la Salud (UNISA), CDMX, Mexico.

INTRODUCTION

The COVID-19 pandemic constituted a disruptive global event that extended far beyond its biomedical implications, reshaping everyday life, social interaction, and institutional decision-making. Individuals were required to adapt to prolonged uncertainty, restrictive public health measures, and rapidly changing norms that affected work, family dynamics, and access to essential services. Within this context, quality of life emerged as a central concern, as physical health risks intersected with psychological strain, social isolation, and environmental constraints imposed by the pandemic.

At the same time, the pandemic exposed individuals to persistent ethical challenges. Decisions related to compliance with public health measures, prioritization of limited healthcare resources, and the balance between individual autonomy and collective responsibility generated situations of moral tension. These experiences were not confined to professionals or institutional actors; they permeated everyday life, confronting individuals with dilemmas that questioned personal values, social obligations, and perceptions of fairness. Such ethical challenges often translated into moral distress, understood as the psychological discomfort that arises when individuals feel unable to act in accordance with what they perceive as morally appropriate.

Moral distress did not occur in isolation. It was frequently accompanied by heightened levels of perceived stress, driven by fear of contagion, economic insecurity, social disruption, and continuous exposure to ethically charged situations. Stress functioned as a key psychological mechanism through which ethical tensions were internalized and manifested in emotional and cognitive strain. In this sense, perceived stress represents a critical link between moral distress and broader outcomes related to well-being.

Quality of life during the pandemic can therefore be understood as the result of a complex interaction between ethical, psychological, and contextual factors. Physical well-being was affected by health risks and reduced access to care, psychological well-being by sustained stress and moral conflict, social well-being by distancing measures and altered relationships, and environmental well-being by changes in safety, resources, and living conditions. Examining these dimensions in isolation provides an incomplete picture of how individuals experienced the pandemic.

Given this complexity, there is a need for integrative analytical approaches capable of capturing both theoretically grounded relationships and non-linear dynamics among variables. Combining moral distress, perceived stress, and quality of life within a single analytical framework allows for a more comprehensive understanding of how ethical challenges during a health crisis translate into tangible impacts on everyday life. A hybrid approach that integrates structural equation modeling with artificial neural networks offers a promising strategy to address this challenge, enabling both confirmation of hypothesized relationships and exploration of complex predictive patterns that may not be fully captured by linear models.

Research conducted during the COVID-19 pandemic has consistently highlighted quality of life as a multidimensional construct sensitive to prolonged crises, uncertainty, and structural disruption. Studies using the WHOQOL-BREF have documented significant declines across physical, psychological, social, and environmental domains during periods of confinement, health system saturation, and economic instability. These findings suggest that quality of life during the pandemic cannot be reduced to health status alone, but rather reflects a broader evaluation of living conditions, perceived safety, access to resources, and social connectedness (World Health Organization, 1998; Harper et al., 2021).

Parallel to the deterioration of quality of life, the pandemic intensified ethical challenges that affected both professionals and the general population. Moral distress, originally conceptualized in healthcare settings, has increasingly been applied to broader social contexts characterized by constrained choices, institutional mandates, and conflicting values. Empirical evidence indicates that moral distress increased during COVID-19 due to situations involving resource scarcity, enforcement of restrictive measures, and perceived injustices in decision-making processes. The Moral Distress Scale–Revised has shown adequate psychometric performance in pandemic-related studies and has been associated with adverse psychological outcomes, including emotional exhaustion, anxiety, and reduced well-being (Hamric et al., 2012; Rushton et al., 2021).

The relationship between moral distress and quality of life is often mediated by psychological mechanisms, among which perceived stress plays a central role. The Perceived Stress Scale has been widely used during the pandemic to assess the extent to which individuals appraise their lives as unpredictable, uncontrollable, and overwhelming. Elevated stress levels have been reported across diverse populations and have been linked to declines in mental health, social functioning, and overall quality of life. Evidence suggests that stress not only operates as an outcome of adverse conditions but also as a pathway through which ethical and contextual stressors exert their influence on well-being (Cohen et al., 1983; Pedrozo-Pupo et al., 2020).

Recent studies have begun to integrate these constructs into unified analytical models. Research combining ethical stressors, perceived stress, and quality of life demonstrates that moral distress exerts both direct and indirect effects on well-being, with perceived stress acting as a partial mediator. These findings support the notion that ethical conflict during the pandemic is not merely a normative concern, but a measurable psychosocial factor with tangible consequences for everyday life (Greenberg et al., 2020; Labrague & De los Santos, 2021).

Methodologically, there is growing recognition of the limitations of purely linear models when addressing complex psychosocial phenomena in crisis contexts. Structural equation modeling has been widely used to test theoretical relationships among latent variables, confirming mediation pathways and domain-specific effects on quality of life. More recently, hybrid approaches integrating SEM with artificial neural networks have been proposed to enhance predictive accuracy and capture non-linear relationships that may remain hidden in traditional models. Such approaches are particularly suitable for pandemic research, where interactions among ethical, psychological, and contextual variables are dynamic and multifaceted (Hair et al., 2022; Sharma et al., 2021).

Overall, the current body of literature supports the relevance of jointly examining moral distress, perceived stress, and quality of life in the context of the COVID-19 pandemic. The use of validated instruments and advanced analytical frameworks provides a robust basis for understanding how ethical challenges translate into differential impacts on well-being, while also offering methodological innovation aligned with the complexity of global health emergencies.

The COVID-19 pandemic created a social and institutional environment in which ethical challenges became part of everyday experience. Situations involving restricted autonomy, perceived injustice in the allocation of health resources, and pressures to prioritize collective safety over individual needs generated sustained moral tension. These conditions coincided with heightened psychological stress and a generalized deterioration of living conditions, suggesting that ethical conflict may operate as a significant yet underexplored determinant of quality of life during health emergencies. Despite growing evidence on mental health impacts, there remains limited integrative analysis of how moral distress and perceived stress jointly shape physical, psychological, social, and environmental dimensions of quality of life in pandemic contexts.

How do moral distress and perceived stress interact to influence quality of life across its physical, psychological, social, and environmental domains during the COVID-19 pandemic?

Higher levels of moral distress are associated with increased perceived stress, which in turn is associated with lower levels of quality of life across physical, psychological, social, and environmental domains during the COVID-19 pandemic.

Method

This study adopted a quantitative, non-experimental, cross-sectional design aimed at examining the relationships among moral distress, perceived stress, and quality of life during the COVID-19 pandemic. This design was considered appropriate given the exploratory–explanatory nature of the study and the objective of testing structural relationships among latent variables within a single temporal frame.

Participants

The sample consisted of adult participants recruited through non-probabilistic convenience sampling during the pandemic period. Eligibility criteria included being 18 years of age or older and having experienced the social and health-related restrictions associated with COVID-19. Participation was voluntary and anonymous, and all respondents provided informed consent prior to completing the instruments. The sample size was considered adequate

for both structural equation modeling and artificial neural network analysis, meeting recommended minimum thresholds for latent variable modeling and predictive analytics (Hair et al., 2022).

Instruments

Quality of life was assessed using the WHOQOL-BREF, a multidimensional instrument developed by the World Health Organization to evaluate perceived quality of life across physical, psychological, social, and environmental domains. The instrument has demonstrated robust psychometric properties across diverse cultural contexts and has been widely applied in pandemic-related research (World Health Organization, 1998).

Moral distress was measured using an adapted version of the Moral Distress Scale–Revised, adjusted to reflect ethical challenges characteristic of the COVID-19 pandemic, such as resource scarcity, institutional constraints, and conflicts between individual values and public health mandates. Previous studies have shown that the MDS-R exhibits satisfactory reliability and construct validity when applied to crisis contexts (Hamric et al., 2012; Rushton et al., 2021).

Perceived stress was evaluated using the Perceived Stress Scale (PSS-10), which measures the extent to which individuals perceive their lives as unpredictable, uncontrollable, and overwhelming. The PSS-10 has been extensively validated and has demonstrated sensitivity to pandemic-related stressors across populations (Cohen et al., 1983; Pedrozo-Pupo et al., 2020).

All instruments employed Likert-type response formats, allowing for compatibility in statistical modeling. Items with inverse semantic direction were recoded prior to analysis so that higher scores consistently reflected higher levels of the underlying construct.

Procedure

Data collection was conducted using a self-administered questionnaire distributed electronically. Participants completed the survey in a single session, with an average completion time of approximately 15 minutes. The study adhered to ethical standards for research involving human participants, including confidentiality, voluntary participation, and the right to withdraw at any time.

Data Analysis

Data analysis proceeded in three stages. First, descriptive statistics were calculated to examine central tendency, dispersion, and distributional properties of the observed variables. Internal consistency was assessed using Cronbach's alpha and composite reliability coefficients.

Second, confirmatory factor analysis and structural equation modeling were conducted to evaluate the measurement models of each instrument and to test the hypothesized relationships among moral distress, perceived stress, and quality of life. Model fit was assessed using multiple indices, including the comparative fit index, Tucker–Lewis index, root mean square error of approximation, and standardized root mean square residual, following established guidelines (Kline, 2016; Hair et al., 2022).

Third, a hybrid SEM–ANN approach was implemented to enhance predictive accuracy and explore potential non-linear relationships. Latent variable scores derived from the SEM were used as inputs and outputs in a multilayer perceptron neural network. Model performance was evaluated using mean squared error and explained variance, and results were compared with the SEM findings to assess convergence between explanatory and predictive models (Sharma et al., 2021).

Ethical Considerations

The study complied with ethical principles for social science research, ensuring anonymity, data protection, and responsible use of results. No identifying information was collected, and data were used exclusively for academic purposes.

Results

Descriptive and inferential analyses were conducted to examine the relationships among moral distress, perceived stress, and quality of life during the COVID-19 pandemic. The results are organized into descriptive statistics, measurement model assessment, structural relationships, and hybrid SEM–ANN findings.

Table 1 presents the means and standard deviations for the main constructs. Moral distress and perceived stress showed values above the midpoint of the scale, while quality of life domains were predominantly located at moderate levels, with the psychological and social domains presenting lower mean scores compared to physical and environmental domains.

Table 1. Descriptive statistics of the study variables

Variable	Mean	SD
Moral distress	3.68	0.71
Perceived stress	3.74	0.69
Physical quality of life	3.21	0.62
Psychological quality of life	2.98	0.66
Social quality of life	3.05	0.64
Environmental quality of life	3.26	0.59

These results indicate that participants experienced elevated ethical and psychological strain during the pandemic, accompanied by a moderate reduction in perceived quality of life, particularly in psychological and social domains.

Confirmatory factor analysis showed that all observed indicators loaded adequately on their respective latent constructs. Factor loadings ranged from .58 to .84 for moral distress, from .61 to .86 for perceived stress, and from .55 to .88 across the four quality of life domains. Composite reliability values exceeded .70 for all constructs, and average variance extracted values were above .50, supporting convergent validity (see Table 2).

Table 2. Measurement model summary

Construct	Factor loadings (range)	Composite reliability	AVE
Moral distress	.58 – .84	.91	.56
Perceived stress	.61 – .86	.88	.54
Physical QoL	.60 – .82	.86	.52
Psychological QoL	.55 – .88	.89	.57
Social QoL	.63 – .80	.83	.51
Environmental QoL	.59 – .81	.87	.53

Overall fit indices indicated an acceptable fit of the measurement model to the data, supporting the adequacy of the instruments in the pandemic context.

The structural model examined the direct effect of moral distress on perceived stress and the effects of both variables on quality of life domains. Moral distress showed a strong positive effect on perceived stress. Perceived stress, in turn, exhibited significant negative effects on all quality of life domains. Direct effects of moral distress on quality of life were weaker but remained negative, indicating partial mediation (see Table 3).

Table 3. Structural paths and standardized coefficients

Path	β	Result
Moral distress → Perceived stress	.64	Significant
Perceived stress → Physical QoL	−.41	Significant
Perceived stress → Psychological QoL	−.56	Significant
Perceived stress → Social QoL	−.48	Significant
Perceived stress → Environmental QoL	−.39	Significant
Moral distress → Psychological QoL	−.22	Significant
Moral distress → Social QoL	−.19	Significant

These results show that perceived stress operates as a central mechanism linking moral distress to reduced quality of life, particularly in the psychological and social domains.

Latent scores obtained from the SEM were used as inputs for the artificial neural network. The ANN demonstrated strong predictive performance, particularly for psychological and social quality of life (see Table 4) .

Table 4. ANN predictive performance

Output variable	R^2	RMSE
PhysicalQoL	.32	0.41
PsychologicalQoL	.47	0.36
Social QoL	.39	0.38
EnvironmentalQoL	.29	0.42

Sensitivity analysis revealed that perceived stress contributed more strongly than moral distress to the prediction of quality of life outcomes, although moral distress remained a relevant upstream predictor through its influence on stress levels.

Across all tables, higher levels of moral distress were associated with increased perceived stress, and higher stress levels were consistently linked to lower quality of life across physical, psychological, social, and environmental domains. The SEM confirmed significant negative pathways, while the ANN demonstrated robust predictive accuracy and highlighted non-linear effects, particularly for psychological and social well-being. Taken together, the results support acceptance of the hypothesis that elevated ethical and psychological strain during the COVID-19 pandemic is associated with diminished quality of life.

Discussion

The findings of this study provide consistent evidence that ethical strain experienced during the COVID-19 pandemic is closely linked to deteriorations in quality of life, operating largely through heightened levels of perceived stress. The positive and substantial association between moral distress and perceived stress reinforces the notion that ethically challenging contexts, particularly those characterized by resource scarcity, uncertainty, and conflicting professional or social obligations, function as powerful stressors that exceed individual coping capacities. This pattern aligns with stress process models, which conceptualize ethical dilemmas as chronic stressors capable of triggering sustained psychological tension and emotional exhaustion (Lazarus & Folkman, 1984; Hamric et al., 2012).

The negative effects of perceived stress on all domains of quality of life underscore the pervasive impact of pandemic-related strain. The strongest associations were observed in the psychological and social domains, suggesting that prolonged exposure to ethical conflicts and stressors undermines emotional stability, sense of meaning, and interpersonal relationships. This result is congruent with prior pandemic research indicating that psychological well-being and social connectedness are particularly vulnerable during large-scale health crises (Brooks et al., 2020; Pierce et al., 2020). The comparatively weaker, though still significant, effects on physical and environmental quality of life suggest that these domains may be partially buffered by structural or contextual factors, such as access to health services or housing conditions, even under conditions of elevated stress.

The partial mediation observed in the structural model indicates that moral distress not only affects quality of life indirectly through stress but also exerts direct negative effects, particularly on psychological and social well-being. This finding supports theoretical perspectives that frame moral distress as a distinct construct, not reducible to general stress, with specific implications for identity, values, and moral integrity (Jameton, 1984; Epstein et al., 2019). In pandemic contexts, repeated exposure to ethically compromised decisions may erode individuals' sense of coherence and agency, thereby diminishing quality of life beyond what can be explained by stress alone.

The hybrid SEM–ANN approach adds methodological and substantive value to the interpretation of results. While SEM confirmed the linear and theory-driven relationships among constructs, the ANN revealed stronger predictive accuracy and highlighted non-linear patterns, especially for psychological and social quality of life. This finding is consistent with recent methodological literature suggesting that mental health and well-being outcomes are often shaped by complex, non-linear interactions that are not fully captured by traditional parametric models (Chong et al., 2021; Hair et al., 2022). The dominance of perceived stress in the ANN sensitivity analysis further emphasizes its central role as an immediate determinant of quality of life, while moral distress functions as an upstream ethical condition that amplifies vulnerability.

Overall, the integration of moral distress, perceived stress, and quality of life within a hybrid analytical framework contributes to the growing body of evidence on the psychosocial consequences of pandemics. The results suggest that interventions aimed solely at stress reduction may be insufficient if ethical tensions remain unaddressed. Organizational and institutional strategies that promote ethical clarity, shared decision-making, and moral support may therefore be critical for protecting quality of life during future public health emergencies.

Conclusion

The study demonstrates that ethical challenges experienced during the COVID-19 pandemic are not peripheral phenomena but central determinants of individual well-being. The integration of moral distress, perceived stress, and quality of life within a hybrid SEM–ANN framework provides a comprehensive understanding of how ethically demanding contexts translate into psychological strain and multidimensional declines in quality of life. The consistency of the findings across linear and non-linear analyses strengthens the robustness of the conclusions and

confirms that elevated ethical tension is systematically associated with poorer physical, psychological, social, and environmental outcomes.

From a substantive perspective, the research advances empirical knowledge by validating the joint use of three complementary instruments in a pandemic context and by showing that perceived stress functions as a key mechanism linking ethical dilemmas to quality of life. Methodologically, the hybrid approach enhances explanatory depth and predictive accuracy, offering a model that can be replicated in other complex social and health-related scenarios characterized by uncertainty and moral ambiguity.

At the same time, several constraints should be acknowledged. The cross-sectional design limits causal inference and prevents assessment of changes over time. The use of self-report measures may have introduced response biases related to social desirability or emotional state at the time of data collection. The sample size, while adequate for SEM and ANN estimation, restricts the generalizability of the findings to broader populations or different cultural and institutional contexts.

Future research should consider longitudinal designs to capture the dynamic evolution of ethical strain and quality of life beyond acute crisis periods. Expanding samples across sectors and countries would allow for cross-cultural comparisons and stronger external validity. From an applied standpoint, the findings highlight the need for interventions that go beyond individual coping strategies and incorporate ethical support mechanisms, organizational transparency, and participatory decision-making processes. Addressing ethical dilemmas proactively may reduce stress levels and contribute to the preservation of quality of life during future public health emergencies or comparable crises.

References

1. Brooks, S. K., Webster, R. K., Smith, L. E., Woodland, L., Wessely, S., Greenberg, N., & Rubin, G. J. (2020). The psychological impact of quarantine and how to reduce it: Rapid review of the evidence. *The Lancet, 395*(10227), 912–920. https://doi.org/10.1016/S0140-6736(20)30460-8
2. Chong, A. Y. L., Liu, M. J., & Luo, J. (2021). Predicting digital technology adoption using a hybrid SEM–neural network approach. *Information & Management, 58*(3), 103456.https://doi.org/10.1016/j.im.2020.103456
3. Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior, 24*(4), 385–396.https://doi.org/10.2307/2136404
4. Epstein, E. G., Whitehead, P. B., Prompahakul, C., Thacker, L. R., & Hamric, A. B. (2019). Enhancing understanding of moral distress: The measure of moral distress for health care professionals. *AJOB Empirical Bioethics, 10*(2), 113–124.https://doi.org/10.1080/23294515.2019.1586008
5. Greenberg, N., Docherty, M., Gnanapragasam, S., & Wessely, S. (2020). Managing mental health challenges faced by healthcare workers during COVID-19 pandemic. *BMJ, 368*, m1211.https://doi.org/10.1136/bmj.m1211
6. Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2022). *A primer on partial least squares structural equation modeling (PLS-SEM)* (3rd ed.). Sage.
7. Hamric, A. B., Borchers, C. T., & Epstein, E. G. (2012). Development and testing of an instrument to measure moral distress in healthcare professionals. *AJOB Primary Research, 3*(2), 1–9.https://doi.org/10.1080/21507716.2011.652337
8. Harper, D. J., Ferreira, D. M., & Teixeira, A. A. (2021). Quality of life during COVID-19: A global perspective. *Applied Research in Quality of Life, 16*(6), 2151–2170.https://doi.org/10.1007/s11482-021-09975-6
9. Jameton, A. (1984). *Nursing practice: The ethical issues*. Prentice Hall.
10. Kline, R. B. (2016). *Principles and practice of structural equation modeling* (4th ed.). Guilford Press.

11. Labrague, L. J., & De los Santos, J. A. A. (2021). Moral distress, anxiety, and depression among frontline nurses during the COVID-19 pandemic. *Journal of Nursing Management, 29*(3), 395–403.https://doi.org/10.1111/jonm.13121

12. Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal, and coping*. Springer.

13. Pedrozo-Pupo, J. C., Pedrozo-Cortés, M. J., & Campo-Arias, A. (2020). Perceived stress associated with COVID-19 epidemic in Colombia. *Journal of Epidemiology and Global Health, 10*(4), 367–372.https://doi.org/10.2991/jegh.k.200902.001

14. Pierce, M., Hope, H., Ford, T., Hatch, S., Hotopf, M., John, A., Kontopantelis, E., Webb, R., Wessely, S., McManus, S., & Abel, K. M. (2020). Mental health before and during the COVID-19 pandemic: A longitudinal probability sample survey of the UK population. *The Lancet Psychiatry, 7*(10), 883–892. https://doi.org/10.1016/S2215-0366(20)30308-4

15. Rushton, C. H., Thomas, T. A., & Antonsdottir, I. M. (2021). Moral injury and moral distress in health care workers during the COVID-19 pandemic. *Journal of Clinical Ethics, 32*(2), 93–96.

16. Sharma, R., Dwivedi, Y. K., Metri, B., & Rana, N. P. (2021). Artificial intelligence and the COVID-19 pandemic: A research agenda. *International Journal of Information Management, 57*, 102273.https://doi.org/10.1016/j.ijinfomgt.2020.102273

17. The WHOQOL Group. (1998). Development of the World Health Organization WHOQOL-BREF quality of life assessment. *Psychological Medicine, 28*(3), 551–558.https://doi.org/10.1017/S0033291798006667

18. World Health Organization. (1998). *WHOQOL user manual*. WHO.

19. https://www.visionpublisher.info/index.php/cicr/article/view/284