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Risk perception, psychological effects, and social support in health care workers with COVID-19 patients in Mexico

Percepção de risco, efeitos psicológicos e apoio social em profissionais de saúde com pacientes com COVID-19 no México

Abstract

Objective: to identify the association between risk perception and various negative and positive psychological effects, as well as the moderating effect of social support, in a sample of health care workers with COVID-19 patients in Mexico. **Methods:** this study has an ex post facto and instrumental design. Responses were obtained by means of an online survey using snowball convenience sampling. The association of risk perception with various psychological outcomes was examined using monotonic correlations (Spearman, r_s), and a regression model was estimated for each psychological effect to test the moderating effect of social support. **Results:** a total of 269 health care workers took part, 75.5% of them women. The findings show that risk perception tended to be high, especially in relation to the "risk of serious harm from SARS-CoV-2". Social support had a moderate to high trend, and negative mental health symptoms had a trend below theoretical average points. **Conclusion:** social support plays a moderating role in the magnitude of the association between risk perception and psychological effects. Despite the acknowledged limitations, this work aimed to help explain the complex mechanisms of the study variables by analyzing exploratory interactions.

Keywords: risk perception; mental health; engagement; burnout; social support; occupational health.

Resumo

Objetivo: identificar a associação entre percepção de risco e vários efeitos psicológicos negativos e positivos, bem como o efeito moderador do apoio social, em uma amostra de trabalhadores de saúde com pacientes com COVID-19 no México. **Métodos:** trata-se de um desenho *ex-post-facto* e instrumental. As respostas foram obtidas por meio de questionário online, utilizando a estratégia de bola de neve. A associação entre percepção de risco e vários resultados psicológicos foi examinada por meio de correlações monotônicas (Spearman, rs), e um modelo de regressão foi estimado para cada efeito psicológico a fim de testar o efeito moderador do apoio social. **Resultados:** participaram 269 trabalhadores da saúde, sendo 75,5% mulheres. Os achados mostram a percepção de risco com uma tendência elevada, especialmente em relação ao "risco de dano grave pelo SARS-CoV-2". O apoio social apresentou uma tendência de moderada a alta, e os sintomas negativos de saúde mental tiveram uma tendência abaixo das médias teóricas. **Conclusão:** o apoio social desempenha papel moderador na magnitude da associação entre a percepção de risco e os efeitos psicológicos. Apesar das limitações reconhecidas, este trabalho visa ajudar a explicar os mecanismos complexos das variáveis em estudo por meio da análise exploratória de interações.

Palavras-chave: percepção de risco; saúde mental; engajamento; burnout; apoio social; saúde do trabalhador.

Introduction

One of the most vulnerable groups in the workplace due to COVID-19 has been healthcare workers (mainly doctors, nurses, and orderlies). They are in the first line of patient care, at imminent risk of contagion, and have been exposed to high psycho-emotional demands[1]. The repercussions of these conditions are reflected in an alarming increase in mental health problems such as depression, anxiety, stress, somatic symptoms, burnout syndrome, and sleep problems[2-5].

Among health care workers, the fear of contagion has been identified as one of the main stressors[6-8]. This has been referred to as "coronaphobia"[9]. Uncertainty, unpredictability, novelty, the lack of knowledge of transmission patterns, the epidemiological profile, vulnerability to contagion and death, along with the lack of institutional preparation for the arrival of the deadly SARS-CoV-2 virus, are characteristics that have intensified this fear or phobia[10].

Psychological phenomena such as risk perception (interpretation of a stimulus as threatening, fear of being harmed) play a fundamental role in coronaphobia, since the uncontrollable fear of contagion not only harms workers' well-being and mental health, but also affects their ability to make decisions, their performance, and their capacity to effectively communicate risk, etc., which worsens the effects of the pandemic in hospital and clinical settings[10,11].

Despite the high perception of risk and the psychological problems experienced by health care workers, some studies have found no differences in the anti-contagion precautions taken by these health care workers at home compared to those taken by the general population. In addition, the infrequent use of personal protective equipment has been noted, even when this equipment is available[12]; and most health care workers do not seek or receive mental health care, despite their situation[13].

Although the relationship between risk perception and mental health seems inevitable[14], the associations between this perception and its effects on safety behaviors and various psychological aspects are not entirely clear. Furthermore, there are few studies that address protective or positive factors in the circumstances experienced by these workers, including engagement and social support.

During the pandemic, protective effects of social support have been found for sleep problems in health care workers in China[15,16], post-traumatic stress in Spain[17], and COVID-19 anxiety in the Philippines[18]. However, there are also studies with contradictory results, i.e., those that found that social support has been a risk factor for perceived stress[19] or has played an irrelevant role in its relationship with secondary post-traumatic stress in Italian health care workers[20].

These conflicting results may be due to the interaction effects of social support with other variables, i.e., its role as a moderating or effect-modifying variable[21,22]. Although theoretically social support fundamentally has a moderating role rather than being a predictor with only main effects[23], a global systematic review of recent research on coping and social support in health care workers during the COVID-19 pandemic shows a scarcity of studies on this support as a moderating variable, as most only explore its main effects[24]. In addition, there is practically no research in Latin America on the mechanisms of the relationship between risk perception and mental health (negative and positive) with social support as a moderating or interacting variable.

The main objective of this study is to identify the association between risk perception and various negative and positive psychological effects, as well as the moderating effect of social support, in a sample of health care workers with COVID-19 patients in Mexico.

Method

Design

The design of this study is ex post facto and instrumental[25,26]. Following the guide Improving the Quality of Web Surveys: The Checklist for Reporting Results of Internet E-Surveys (CHERRIES), an open survey was carried out to obtain a convenience sample using a snowball approach, in the absence of a sampling frame for the target population.

Sample

Using non-probability and network sampling, health care workers were sought, including physicians, nurses, and operational personnel from different hospitals and clinics in central Mexico where patients with COVID-19 were being treated.

The sampling strategy was decided this way in response to social distancing measures in the face of the COVID-19 health emergency. Data were collected using an open survey from June to July 2020, during one of the waves with the highest risk of infection in Mexico. All participants were digitally invited to take part in a "seed" group and were asked to forward the invitation to other colleagues, from the same work center and from other health institutions.

Data collection and instrumentation

Based on validated scales (described below), a Google Forms template was created. The free version of Google Forms was used to collect the information, a tool that has been used in developing countries for academic purposes. This form was structured so that the participants were informed about the objective of the study and their rights as participants (informed consent). Once they accepted to participate, they were given access the questionnaires and the information was collected, ensuring that each participant sent only one response, according to the option selected in the platform.

The survey link was shared with a small number of participants (seeds) via WhatsApp, emails, and the social networks of the researchers (mainly Facebook), who then helped us by sharing the link with other health worker colleagues, who would then forward it to other colleagues. All participants were asked to share the link with their health worker colleagues once they completed the questionnaire.

The data were stored and downloaded for cleaning, recording (e.g., from string to numeric), and undergoing analysis from Google forms to a CSV file that was developed in SPSS 25.

The sociodemographic information collected represents basic technical knowledge of activities in the health sector, which, in a way, also served as a tool to screen and verify the participants.

Participation in the study was completely voluntary, with no penalty for participants who decided to leave the study at any time. No incentives were offered to those who participated, but a free and low-cost psychological care directory was offered in case psychological support was needed to cope with the challenges of the pandemic.

The survey questions were not randomized since each participant only had the opportunity to respond once.

Conditionals were included in the form sections to facilitate the completion of the questionnaires. If people did not consent to participate (if they ticked "disagree"), the survey was closed and moved on to final information about the possibility of receiving the free psychological care directory, if desired.

Locks were included to ensure that there were no missing data before moving from one scale to another. For sociodemographic data, such as sex, the option "I do not wish to specify" was included. Participants had the option of returning to previous screens of the questionnaire to corroborate or correct their information.

Variables

Sociodemographic data sheet: Questions on age, sex, schooling, marital status, and state of residence were asked.

Risk perception: : An adaptation was made of the dimensional evaluation of perceived risk (EDRP in Spanish) scale proposed by Vidal and Gómez[27], which assesses the perception of occupational risk in general, considering characteristics such as: knowledge, novelty/familiarity, effect, voluntariness, controllability, lethality, fear, and catastrophic

potential. The scale was adjusted to the context of the perceived risk of the SARS-COV-2 virus. The version had 11 questions, the first 10 of which were classified with a 5-option response set, which changed according to the risk assessed. For example, "*To what extent do you know the risk associated with SARS-COV-2?*", with response options ranging from 1 ("very low level of knowledge") to 5 ("very high level of knowledge").

In addition, eight ad hoc questions were developed to assess the perceived risk of contagion due to exposure to various sources of contact, such as: 1) infected patients, 2) infected partners, 3) blood, tissues or fluids of patients, 4) bodies of deceased persons, 5) contaminated materials, surfaces, and environments, 6) inadequate or insufficient medical or protective equipment, 7) equipment not properly sterilized, and 8) "others." The response options for the first seven questions ranged from 0 ("no risk of contagion") to 10 ("very high risk of contagion").

Psychological effects: The Psychosocial Work Processes PROPSIT survey was used[28], specifically the psychosocial effects subscale (12 items) and the perceived health-illness consequences subscale (25 items). The psychosocial effects subscale includes the dimensions of "burnout" and "work engagement." The subscale of perceived health consequences has the dimensions of "Somatic Symptoms," "Mental Disturbance Symptoms," "Reality Dissociation Symptoms," and, in its positive aspect, "Vitality." All subscales have six response options: from 0 ("never") to 6 ("always, every day").

Social Support: The Oslo Social Support Scale (OSS-3) was used[29]. This scale consists of 3 items that unidimensionally measure the social support received by a person and contains five response options that vary depending on the question (1= "very difficult" to 5= "very easy").

Data analysis

The distribution properties and descriptive statistics of the risk perception items and of the psychological effects and social support subscales were analyzed. SPSS-25 and some specific syntactic algorithms were used for all estimates. To detect outliers or multivariate extremes, the D^2 distance was also calculated with the normtest algorithm. Patterns of missing values were identified and analyzed, and Little's test was used to determine the randomness of their absence (missing at random: MAR or MCAR vs. missing not at random MNAR). Lastly, once the randomness of the missing data was confirmed, they were imputed using the iterative multiple imputation regression method, which uses the parameter estimators obtained from multiple imputation to estimate parameters based on the expectation maximization (EM) algorithm, combining the best of the different methods available and generating much more accurate estimates, especially in cases in which the variables have low variance.

Since the risk perception scale was originally designed for use at the item level, we first examined the association of each item, with all the risk perception indicators, with social support and the six psychological effects studied (burnout, enthusiasm, somatic symptoms, symptoms of mental disturbance, symptoms of dissociation, and vitality), using monotonic correlations (Spearman, r_s).

In a next step, given the expected theoretical multidimensionality of the risk perception scale items in the study (11 EDPR items and seven ad hoc items), a data reduction strategy was also carried out by means of an exploratory factor analysis (EFA) to identify fewer complex dimensions or indicators, parsimonious associations, and better theoretical interpretation qualities. For the EFA, the method of unweighted least squares by oblimin rotation was used, and the number of dimensions was decided by parallel analysis and theoretical congruence. Loadings greater than 0.40 were considered, and reliability was calculated using Cronbach's alpha and omega.

To test the moderating effect of social support on the association between the obtained dimensions of risk perception and the psychological effects, a regression model was estimated for each psychological effect, introducing in each model (6) the variables of risk perception, social support, and the interaction terms of the different combinations as continuous variables in a stepwise hierarchical procedure. A probability of $F<0,05$ was used as the entry criterion[21,22].

Significant interaction effects were plotted by separating the lines of the regression equation in the relationship between risk perception and psychological effects when levels of social support were low (-1 standard deviation), moderate (M), or high (+1 standard deviation), in accordance with previous recommendations[30].

Ethical considerations

This project was approved by the ethics committee (IRB) of the Centro de Investigación Transdisciplinar en Psicología of the Universidad Autónoma del Estado de Morelos in Mexico, under registration number 161220-50. Informed consent was obtained using the Google Forms platform, in which the objective and characteristics of the study were described, as well as the amount of time to be dedicated to the study (15 minutes), the researchers responsible and their contact information. If people agreed to participate, they were asked to tick the appropriate box to continue with the survey. No personal information or personal identifiers (e.g., telephone number, email, etc.) were collected. Participation was voluntary, anonymous, and confidential. Data editing and download links were shared only by the principal investigators.

Results

A total of 269 health workers took part. The sample of participants was drawn from the following locations in central Mexico: State of Morelos (33.1%); Mexico City (29.7%); State of Mexico (24.5%); and others (12.6%). In total, 85% of participants worked in the public sector. In addition, 75.5% were women and their mean age was 39.54 years (51.6% from 33 to 46). Furthermore, 61% of participants lived with a partner, 13.4% had technical or high school education, 42.4% had a bachelor's degree, and 44.2% had postgraduate studies.

Imputation results, data normality, and outliers

In the analysis of missing data, it was found that the item "Contact with contaminated materials, surfaces, and environments" had the highest count, with four pieces of missing data; however, this represents only 1.5% of the total. We also found five participants with one piece of missing data and another two with six pieces of missing data, which represented 24% of their information, so they were removed from the database, leaving 267 participants. The rest of the missing data (5) were identified as MAR (Little $X^2 = 98.92$, $p = 0.29$), and were therefore imputed, according to the chosen method.

Regarding the distribution and normality of the data, although the standard deviations were relatively homogeneous and the skewness and kurtosis did not have very high raw values, the Kolmogorov-Smirnov test showed statistical significance for all the study variables (**Table 1**). In addition, with the Mahalanobis distance, two cases that exceeded the critical value (Bonferroni-$\alpha = 0.05/n > 54.57$) were identified and removed from the database (n=265) for further analysis. The multivariate Omnibus test (sig. <0.05) and Mardias test (sig. <0.05) also resulted in a discrepancy with multivariate normality (p<0.001).

Table 1 Descriptive statistics of the risk perception items and study scales

Study variable	M	SD	Sk	Ku	K-S	Missing
Risk perception						
Dimensional scale of risk perception (EDPR) (Scale 1 to 5)						
1.1. To what extent are you aware of the risk associated with SARS-CoV-2 (knowledge of the harm it causes, possibility of experiencing it, etc.)?	4.25	0.80	-1.20	2.11	0.25***	-
1.2. To what extent do you consider that the managers or leaders of the institution where you work are aware of the risk associated with SARS-CoV-2?	3.84	1.14	-0.77	-0.21	0.21***	-
1.3. To what extent do you consider that your coworkers are aware of the risk associated with SARS-CoV-2?	3.81	1.01	-0.56	-0.22	0.20***	-

(continues)

Table 1 Continuation

Study variable	M	SD	Sk	Ku	K-S	Missing
1.4. To what degree are you afraid of SARS-CoV-2?	3.94	1.16	-0.88	-0.17	0.24***	-
1.5. What do you consider to be the possibility that you personally could be infected by SARS-CoV-2?	3.80	1.08	-0.59	-0.30	0.19***	-
1.6. If a risk situation occurs and you become infected, what do you think would be the severity of the harm that SARS-CoV-2 could cause you?	3.34	1.17	-0.20	-0.66	0.19***	-
1.7.To what degree do you consider that you can avoid a situation of personal risk due to SARS-CoV-2?	3.28	1.02	-0.34	-0.15	0.20***	-
1.8. If you become infected, to what extent do you think you can intervene to control (or reduce) the harm that SARS-CoV-2 may cause you?	3.30	1.04	-0.33	-0.16	0.20***	-
1.9. What do you consider to be the degree of damage that SARS-CoV-2 can cause to a large group of people?	4.41	0.81	-1.32	1.11	0.34***	-
1.10. If exposed to the risk of SARS-CoV-2 infection, when do you experience the most harmful consequences of this source of risk?	2.97	1.07	0.04	-0.40	0.20***	-
1.11.- How do you rate the risk of serious harm (including death) from SARS-CoV-2 (note that 0 represents very low to no risk and 10 represents very high to extreme risk) (Scale 0 to 10)?	8.02	2.09	-1.18	0.94	0.18***	-
Perceived level of risk by source of contact (Scale 0 to 10)						
2.1. Contact with infected patients	5.11	3.72	0.07	-1.62	0.18***	3
2.2. Contact with coworkers who may be unknowingly infected	5.70	3.51	-0.11	-1.60	0.18***	1
2.3. Contact with infected blood, tissues, and body fluids	4.21	3.91	0.39	-1.49	0.21***	1
2.4. Contact with contaminated materials, surfaces, and environments	5.48	3.58	-0.01	-1.61	0.17***	4
2.5. Medical equipment and personal protective equipment that is inadequate or of poor quality	5.29	3.70	0.07	-1.65	0.19***	3
2.6. Medical equipment or material in general that has not been properly sterilized	4.44	3.73	0.36	-1.47	0.20***	2
2.7. Contact with the bodies of individuals who have died from COVID-19	3.11	3.92	0.91	-0.90	0.25***	3
Psychological effects (Scale 0 to 6)						
Burnout	2.86	1.40	0.85	0.03	0.12***	-
Engagement	5.10	1.64	-0.84	-0.31	0.15***	-
Somatic symptoms	2.33	1.28	1.22	1.01	0.14***	-
Symptoms of mental disorder	2.30	1.30	1.32	1.23	0.15***	-
Reality dissociation symptoms	1.58	1.07	2.72	7.92	0.30***	-
Vitality	4.48	1.71	-0.25	-1.06	0.10***	-
Social support						
Social support (scale from 1 to 5)	3.56	0.80	-0.46	0.19	0.11***	-

***p≤0,0001; item 2.8 corresponded to "others", with qualitative responses noted in the text.M: mean; SD: standard deviation; Sk: skewness; Ku: kurtosis; K-S: Kolmogorov-Smirnov.

Descriptive analysis

The descriptive statistics show that: on the Risk Perception Dimensional Scale, the highest values were found for item 1.11 (*"How do you rate the risk of serious harm [including death] from SARS-CoV-2?"*) ($\overline{X}$ = 8.02); item 1.9 (*"What do you consider to be the degree of harm that SARS-CoV-2 can cause to a large group of people?"*) ($\overline{X}$ = 4.41); and item 1.1 (*"To what extent do you know the risk associated with SARS-CoV-2?"*) ($\overline{X}$ =4.25). On the other hand, the lowest values were found for item 1.10 (*"In case of exposure to the risk of SARS-CoV-2 infection, when do you experience the most harmful consequences of this source of risk?"*) ($\overline{X}$ = 2.97), cfor which values close to 1 meant "immediately" and values close to 5 meant "in the very long term." Similarly, item 1.7 (*"To what degree do you consider that you can avoid a situation of persoal risk due to SARS-CoV-2?"*) and item 1.8 (*"If you become infected, to what extent do you consider that you can intervene to control [or reduce] the harm that SARS-CoV-2 can cause you?"*) were among those with the lowest values ($\overline{X}$ = 3.28 and $\overline{X}$ = 3.30, respectively, which implied that the controllability of perceived risk was lower in relation to other risk characteristics.

Regarding the perceived level of risk due to exposure to various sources of contact, item 2.2, on "contact with colleagues" ($\overline{X}$ = 5.70) and item 2.4, on "contact with contaminated materials, surfaces, and environments" ($\overline{X}$ = 5.48), were the highest, but with scores close to the theoretical mean of the scale (0-10). In contrast, those with the lowest scores were item 2.7, on "contact with the bodies of persons who have died from COVID-19" ($\overline{X}$ = 3.11) and 2.3, on "contact with infected blood, tissues, and body fluids" ($\overline{X}$ = 4.21).

In the same group of items on sources of contact, item 2.8 corresponded to the "others" category, with an open space for responses on sources of contagion. In total, 22 participants indicated "no" additional sources of contact, five answers were incompatible with the question, and, among the rest, the most frequent answers were: contact with triage areas and risk zones in hospital facilities, contact with documents, with patients, with patients' relatives, with colleagues, with the general public and in the street or public transport, and with food or in supermarkets. The participants also reported: a lack of supplies, materials, personal protective equipment (PPE), personnel (colleagues), and training.

Considering the original scale of psychological effects (0-6), higher scores were observed in for positive aspects, including work engagement ($\overline{X}$ = 5.10) and vitality ($\overline{X}$ = 4.48); while the lowest scores were observed for symptoms of dissociation from reality ($\overline{X}$ = 1.58) and of mental disturbance ($\overline{X}$ = 2.30). Social support also showed a slightly favorable trend, considering the theoretical scale (0-5) ($\overline{X}$ = 3.56).

Correlation analysis

The Spearman correlation coefficients between indicators of risk perception and psychological effects were moderately low (r_s between 0.123 and 0.363). Most of them were statistically significant and in the expected directions. For example, the greater the "fear of SARS-CoV-2" (item 1.4), the greater the symptomatology of job burnout (r_s = 0.272), somatic symptoms (r_s = 0.363), and mental disturbance (r_s = 0.363); and, on the other hand, the lower the scores for work engagement (r_s = -0.183) and vitality (r_s = -0.141). In addition, the risk perception items "knowledge of risk of leaders" (item 1.2), "possibility of contagion" (item 1.5), and "severity of personal harm" (item 1.6) showed higher and significant correlations with the different psychological effects (**Table 2**).

Some of the items with weaker or absent correlations (≈ 0, p>0.05) for risk perception and psychological effects were "personal knowledge of risk" (item 1.1), "knowledge of peers" (item 1.3), "personal avoidance power" (item 1.7), "experimentation time" (item 1.10), and "risk of serious harm" (item 1.11). Among the low correlations were those related to ad hoc items, in particular "contact with bodies" (item 2.7) and "contact with blood, tissues, and fluids" (item 2.3), which had only one and two low and significant correlations, respectively (**Table 2**).

Social support maintained low correlations with several risk perception items (r_s between 0.121 and -0.211), and most were not significant. However, it did correlate significantly with all psychological effects (r_s between 0.222 and 0.333)

Table 2 Correlations between risk perception and psychological effects items

	Burnout	Work engagement	Somatic symptoms	Symptoms of mental disturbance	Symptoms of dissociation from reality	Vitality	Social support
1.1.You are aware of the risk posed by SARS-CoV-2	0.104	0.059	-0.027	0.085	0.106	0.030	0.023
1.2. Leaders are aware of the risk posed by SARS-CoV-2	-0.126*	0.200**	-0.204**	-0.125*	-0.200**	0.199**	0.041
1.3. Peers are aware of the risk posed by SARS-CoV-2	0.033	0.054	-0.005	0.065	-0.111	0.069	0.055
1.4. Fear of SARS-CoV-2	0.272**	-0.183**	0.363**	0.363**	0.060	-0.141*	-0.177**
1.5. Possibility of SARS-CoV-2 contagion.	0.286**	-0.257**	0.343**	0.310**	0.075	-0.121*	-0.167**
1.6. Severity of damage by SARS-CoV-2	0.144*	-0.134*	0.185**	0.205**	0.165**	-0.237**	-0.211**
1.7. Extent to which the risk can be avoided	-0.128*	0.112	-0.106	-0.074	-0.072	0.050	0.016
1.8. Extent to which it is possible to intervene or control	-0.123*	0.179**	-0.097	-0.130*	0.003	0.060	0.104
1.9. Degree of damage that can be caused by SARS-CoV-2	0.204**	-0.016	0.152*	0.117	0.003	-0.041	-0.174**
1.10. Time to experience the consequences	-0.056	-0.059	0.029	-0.086	0.124*	-0.089	0.059
1.11. Assessment of the overall risk of damage	0.071	-0.035	0.160**	0.126*	0.031	-0.029	-0.108
2.1. Contact with infected patients	0.201**	-0.022	0.219**	0.147*	0.000	0.066	-0.075
2.2. Contact with colleagues	0.170**	0.048	0.219**	0.155*	0.018	0.130*	-0.094
2.3. Contact with blood or fluids	0.166**	-0.026	0.168**	0.112	-0.031	0.037	-0.046
2.4. Contact with materials, surfaces, and environment	0.208**	0.020	0.210**	0.150*	0.058	0.084	-0.090
2.5. Inadequate or insufficient equipment or PPE	0.211**	-0.014	0.183**	0.152*	0.026	0.082	-0.070
2.6. Medical equipment or material not properly sterilized	0.198**	-0.012	0.155*	0.106	0.056	0.041	-0.123*
2.7. Contact with bodies of persons who died from COVID-19	0.189**	-0.114	0.108	0.072	0.053	-0.039	0.021
SOCIAL SUPPORT	-0.223**	0.256**	-0.275**	-0.333**	-0.303**	0.253**	

*p = ó < .05, ** p = ó < .001.

Exploratory Factor Analysis (EFA) of Risk Perception Scales

The KMO measure of sampling adequacy (0.845), Barlett's test of sphericity (x2=2304.751, gl=153, sig.<0.001), and the determinant of the correlation matrix (<0,001) confirmed that the data were suitable to proceed to the AFE. The parallel analysis suggested four theoretically congruent factors, which together explained 60.92% of the variation.

The first factor (F1), which included the seven items generated ad hoc for this study, was called "Contact with sources of risk". The second factor (F2), comprised five items referring to fear, contagion, or harm from SARS-CoV-2, was called "Perceived risk". The third factor (F3), called "Knowledge of risk," clearly referred to the degree of knowledge of personal, peer, and leader risk. The fourth factor (F4), consisting of only one item referring to the degree of intervention or control of risk, was called "risk control." The mean was very similar between F2, F3, and F4 (3.90; 3.97; 3.28, respectively), with the mean for factor 1 being slightly higher (4.77).

The communalities were moderate to high, except for items 2.6 (*medical equipment or material not properly sterilized*) and 2.4 (*contact with materials, surfaces, and environment*). The items showed moderate to high saturations (up to 0.91), conceptually consistent within their respective factors. The factor correlation matrix showed that F1 and F2 had the highest association (0.31), whereas F1 and F3 had a practically null relationship (-0.01).

F1 showed high reliability, with coinciding alpha and omega coefficients (0.95), both with very homogeneous confidence intervals. F3 had acceptable levels of reliability (α=0.71, ω=0.73), with reasonably homogeneous intervals, but F2 showed marginal reliability indexes (0.67). It was not possible to estimate the reliability of F4 because it only had one item. It was decided to include these last two factors in the subsequent analyses since, in the case of F2, the lower confidence interval (0.60) had more systematic variance than error; and, in favor of F4, it should be considered that single-item studies are currently highly feasible[31].

Table 3 Exploratory Factor Analysis and Reliability of Risk Perception items

Analyzed items	Factor 1 (contact sources of risk)	Factor 2 (perceived risk)	Factor 3 (risk awareness)	Factor 4 (risk control)	h^2
1.1. You are aware of the risk posed by SARS-CoV-2	-0.06	0.07	**0.62**	0.17	0.59
1.2. Leaders are aware of the risk posed by SARS--CoV-2	-0.02	0.02	**0.70**	0.07	0.50
1.3. Peers are aware of the risk posed by SARS-CoV-2	0.03	0.10	**0.72**	-0.02	0.48
1.4. Fear of SARS-CoV-2	-0.07	**0.66**	0.13	-0.21	0.57
1.5. Possibility of SARS-CoV-2 contagion	0.11	**0.44**	0.00	-0.18	0.75
1.6. Severity of SARS-CoV-2 damage	-0.12	**0.52**	-0.04	-0.02	0.75
1.7. Extent to which the risk can be avoided	-0.06	-0.08	0.10	0.28	0.90
1.8. Extent to which it is possible to intervene or control	0.07	-0.00	0.04	**0.42**	0.82
1.9. Degree of damage that SARS-CoV-2 can cause	0.05	**0.55**	0.06	0.18	0.63
1.10. Time of experience of the consequences	-0.04	0.10	-0.14	0.16	0.94
1.11. Assessment of the overall risk of damage	0.12	0.55	0.07	0.20	0.58
2.1. Contact with infected patient	**0.88**	-0.01	0.01	-0.12	0.19
2.2. Contact with colleagues	**0.84**	0.04	0.05	-0.04	0.27
2.3. Contact with blood or fluids	**0.84**	-0.03	0.01	-0.03	0.30
2.4. Contact with materials, surfaces, and environment	**0.91**	-0.02	0.04	-0.06	0.16
2.5. Inadequate or insufficient equipment or PPE	**0.90**	-0.04	-0.04	0.04	0.20
2.6. Medical equipment or material not properly sterilized	**0.90**	-0.01	-0.08	0.34	0.13
2.7. Contact with bodies of individuals who died from COVID-19	**0.70**	-0.01	-0.04	0.01	0.51

(continues)

Table 3 Continuation

Analyzed items		Factor 1 (contact sources of risk)	Factor 2 (perceived risk)	Factor 3 (risk awareness)	Factor 4 (risk control)	h^2
Mean (SD)		4.77 (3.22)	3.90 (0.68)	3.97 (0.79)	3.28 (1.03)	N/A
Confiabilidad	Ômega (ω) (95%CI)	0.95 (0.93-0.95)	0.67 (0.61-0.73)	0.73 (0.67-0.78)	N/A	N/A
	Alfa (α) (95%CI)	0.95 (0.93-0.95)	0.67 (0.60-0.73)	0.71 (0.65-0.77)	N/A	N/A
Correlations between factors	Factor 1	1.00	0.31	-0.01	-0.11	N/A
	Factor 2	0.31	1.00	-0.07	0.10	N/A
	Factor 3	-0.01	-0.07	1.00	0.01	N/A
	Factor 4	-0.11	0.10	0.01	1.00	N/A

Promax rotation. SD: standard deviation; CI: confidence intervals; N/A: not applicable.

Regression and moderation analysis

Table 4 shows the standardized and non-standardized regression coefficients with statistical significance in the relationship between the different dimensions of risk perception and each of the psychological effects studied, as well as the interaction effects or moderators of social support that were also relevant according to the stepwise method.

For the psychological effect of Job Burnout (JB), the dimensions of "perceived risk" (PR), "contact with sources of risk" (CSR), and "social support" (SS) were the only significant predictors, in the expected directions and with moderately low effect sizes (β=0.15–0.22), which together explained 14% of the variance of LB, with no confirmed moderating effect of SS.

For the psychological effect of Work Engagement (WE), the variables PR and SS were also significant, and CSR was not significant. In addition, the dimensions of "risk awareness" (RA) and "risk control" (RCL) were added as statistically significant predictors, resulting in 12% of the variance explained by WE. The predictive weights were moderately low for the most part and in the theoretically expected directions, i.e., the higher the SS, RA, and RCL, the higher the WE, while the higher the PR, the lower the WE. For the outcome of WE, no moderating or interaction effect of SA was significant (**Table 4**).

Table 4 Regression of psychological effects by risk perception and moderation of social support

Psycological Effect	Predictor in the model	b	σ	β	t	Sig.	95%CI		r_p	Tolerance	VIF	F	R^2	Durbin-Watson
							Inf	Sup						
Job Burnout	(Constant)	2.864	0.080		35.823	0.000	2.706	3.021						
	Perceived Risk (PR)	0.462	0.124	0.227	3.730	0.000	0.218	0.705	0.310	0.880	1.136			
	Social Support (SS)	-0.495	0.171	-0.171	-2.888	0.004	-0.832	-0.157	-0.241	0.936	1.068	14.85***	0.14	1.84
	Contact with Sources of Risk (CSR)	0.066	0.026	0.153	2.580	0.010	0.016	0.117	0.225	0.934	1.071			

(continues)

Table 4 Continuation...

Psycological Effect	Predictor in the model	b	σ	β	t	Sig.	95%CI		r_p	Tolerance	VIF	F	R^2	Durbin-Watson
							Inf	Sup						
Work Engagement	(Constant)	5.102	0.095		53.803	0.000	4.915	5.289				9.56***	0.12	2.04
	Social Support (SS)	0.605	0.204	0.178	2.961	0.003	0.203	1.008	0.234	0.925	1.081			
	Contact with Sources of Risk (CSR)	0.399	0.121	0.192	3.299	0.001	0.161	0.637	0.199	0.988	1.012			
	Perceived Risk (PR)	-0.358	0.143	-0.151	-2.505	0.013	-0.640	-0.077	-0.178	0.928	1.078			
	Risk control (RCL)	0.214	0.092	0.135	2.318	0.021	0.032	0.396	0.160	0.983	1.017			
Somatic Symptoms	(Constant)	2.279	0.073		31.353	0.000	2.136	2.422				24.11***	0.21	1.95
	Perceived Risk (PR)	0.626	0.107	0.336	5.859	0.000	0.416	0.837	0.372	0.912	1.096			
	Social Support (SS)	-0.547	0.155	-0.205	-3.529	0.000	-0.852	-0.242	-0.322	0.885	1.129			
	PR X SS	-0.615	0.220	-0.158	-2.789	0.006	-1.049	-0.181	-0.165	0.936	1.068			
Mental Disturbance Symptomatology	(Constant)	2.237	0.073		30.711	0.000	2.094	2.381				24.98***	0.22	1.92
	Perceived Risk (PR)	0.604	0.107	0.322	5.635	0.000	0.393	0.815	0.360	0.912	1.096			
	Social Support (SS)	-0.590	0.155	-0.220	-3.798	0.000	-0.896	-0.284	-0.336	0.885	1.129			
	PR X SS	-0.687	0.221	-0.175	-3.111	0.002	-1.122	-0.252	-0.187	0.936	1.068			
Dissociation from Reality	(Constant)	1.535	0.062		24.688	0.000	1.413	1.657				12.87***	0.16	1.99
	Social Support (SS)	-0.539	0.128	-0.246	-4.229	0.000	-0.791	-0.288	-0.306	0.949	1.054			
	CRS X SS	-0.097	0.039	-0.152	-2.479	0.014	-0.175	-0.020	-0.232	0.854	1.171			
	RCL X SS	-0.289	0.117	-0.141	-2.462	0.014	-0.519	-0.058	-0.175	0.985	1.016			
	PR X SS	-0.403	0.199	-0.126	-2.023	0.044	-0.795	-0.011	-0.242	0.833	1.201			
Vitality	(Constant)	4.457	0.099		45.174	0.000	4.262	4.651				8.53***	0.14	1.97
	Social Support (SS)	0.698	0.212	.197	3.295	0.001	0.281	1.115	0.246	0.926	1.079			
	RCL X SS	0.474	0.194	.143	2.441	0.015	0.092	0.857	0.181	0.965	1.037			
	Risk Awareness (RA)	0.320	0.126	.148	2.528	0.012	0.071	0.569	0.163	0.971	1.030			
	Perceived Risk (PR)	-0.419	0.153	-.169	-2.742	0.007	-0.719	-0.118	-0.174	0.875	1.143			
	Contact with Sources of Risk (CSR)	0.084	0.032	.158	2.645	0.009	0.021	0.146	0.087	0.931	1.075			

r_p =Zero order correlation; VIF: Variance Inflation Factor. The stepwise method was used to introduce variables in each model

For Somatic Symptoms (SomS), PR and SS, together with an interaction term, were the only significant predictors, and they accounted for 21% of the variance explained. PR had the largest effect size (β=0.33); and, given the significance of the interaction effect, the moderation of SS was confirmed for this outcome. **Figure 1a** shows that the relationship between PR and SomS varied according to the levels of SS, with a more vertical trend in the regression line and therefore a stronger relationship between PR and SomS when SS was low and a weaker relationship when SS was high.

The predictors of mental disturbance symptomatology (MDS) were the same as those of SS, with similar effect sizes and practically equal explained variance (R2=0.22). Similarly, there was a stronger relationship when SS was lower and vice versa (**Figure 1b**).

In the psychological effect of Dissociation from Reality (DR), the only significant main effect was that of AS and the remaining three significant predictors were the following interaction terms: CRS x SS, RCL x SS, and PR x SS. Together, these variables explained 16% of the total variance of DR. The interaction effect of SS was more marked compared to previous analyses, since SS inversely moderates the relationship between DR and the different dimensions of risk perception that were significant, which means that when SS was low, the relationship between CRS and DR was positive (a theoretically expected result), whereas when SS was high, the relationship between CRS and DR tended to be negative (the more contact with risk sources, the less dissociation from reality), which shows the potential and authentic moderating effect of SS (**Figure 1c**). For the interaction terms PR x SS and RCL x SS, the effect sizes, directions, and, in particular, the trend patterns in the regression lines in the plots are very similar to those shown in **Figure 1c**, so they were omitted due to space.

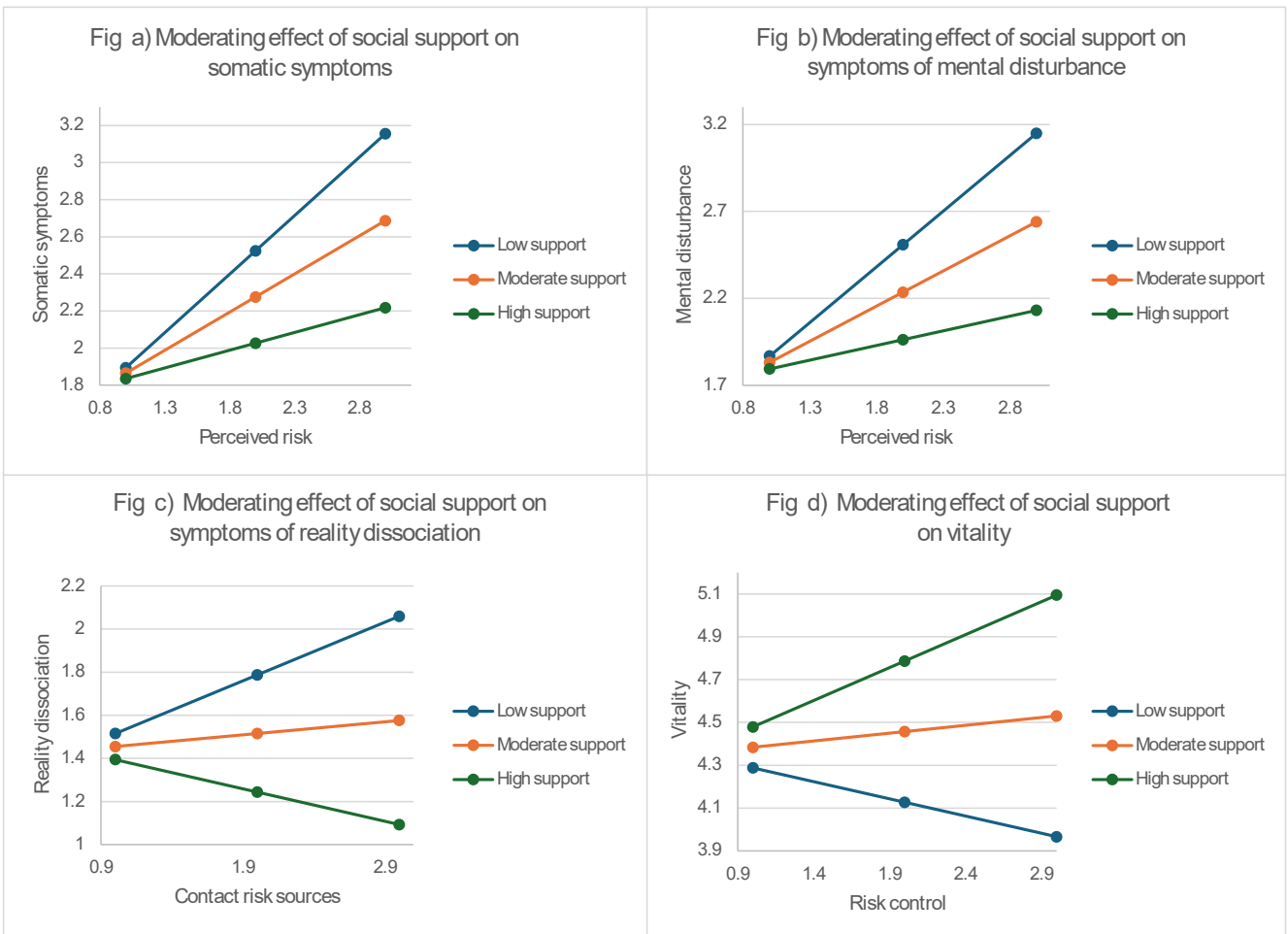

Figure 1 Moderating effects of social support on the relationship between risk perception and mental health

Lastly, for the psychological effect of Vitality (VI), SS, RA, and PR had significant results, with the latter having the largest effect size (β=-0.169). SS also had significant main effects (β=-0,197). Additionally, the interaction term RCL x SS was the only significant moderating effect. Together, these variables explained 14% of the variation.

As shown in **Figure 1d**, when SS was high, the relationship between RCL and VI was positive (the higher the CLR, the higher the VI), whereas when SS was low, RCL became counterproductive, as the relationship becomes negative (the higher the RCL, the lower the VI).

The overall fit indices of all estimated models met the assumptions of homoscedasticity (variance with constant residual patterns), linearity (R2 =0.12–0.22), mean and normality of residuals (0), the Durbin-Watson (DW) independence of residuals (DW=1.84–2.04), and non-multicollinearity (VIF <1.20, tolerance >0.10). The last two factors can be seen in **Table 4**.

Conclusion

The main objective of this study was to identify the association between risk perception and various negative and positive psychological effects, as well as to determine the moderating effect of social support on this relationship, in a sample of Mexican health care workers. In addition to this main objective, some necessary specific analyses were carried out, such as the exploration of frequencies and levels of each of the variables studied and of the risk perception scale. In addition to the item-level estimates, a factor analysis was performed to allow for the reduction of data and concentration of fewer variables, which facilitated the exploration of the estimated associations and regression models. The findings are discussed below in the corresponding order.

Levels of risk perception, social support, and mental health

Regarding risk perception, both at the item and factor level, the highest trends coincided with the "perceived risk" factor (fear of SARS-CoV-2 and fear of harm from it). This factor, which has been linked to the concept of "coronaphobia," was also frequently observed in previous international studies during the COVID-19 pandemic among health care personnel[6,8,9]. Similarly, the high trends in the "knowledge of risk" factor coincided with previous studies[32], although this does not mean that the safety practices of health care personnel are also high[33].

Regarding the "perception of exposure to various sources of contact," although there is a moderate to low trend in most of the items, "contact with colleagues" and "contact with contaminated materials, surfaces, and environments" appear to be the sources of greatest perceived risk during work, which coincides with previous studies[34,35]. This may partly explain the increased rates of absenteeism among health care personnel during the worst periods of the emergency.

On the other hand, negative mental health symptoms trended below mean values, social support trended moderate to high, and the positive variables of work engagement and vitality had the highest scores of all the variables. Although these results are consistent with other studies[36,37], they are unexpected considering the circumstances faced by these workers during the pandemic (**Table 1**).

There may be several explanations for this, but two of them are the most plausible in the context of this study. The first is that, in the absence of standardized cut-off points in the total population, the mean theoretical values of the scales used as a reference to identify high or low levels may have overestimated (in the case of positive effects) or underestimated (in the case of negative effects) the real reference values for a more accurate interpretation. Similarly, the second possible explanation refers to the healthy worker bias, which alludes to the tendency of workers with positive attitudes to take part in studies, without suffering any risks or being affected, that is, the workers most burdened by the pandemic situation may not have had the time or disposition to take part in the research. However, further studies are needed to explore these interpretations.

Variable reduction and factor analysis

An additional contribution of this study was the underlying identification of the dimensions contained in the dimensional scale of perceived risk (EDRP, in Spanish)[27] and the ad hoc questions used. The analysis reveals and confirms that the phenomenon of risk perception (and the instruments used) represents a rather multidimensional phenomenon. The four categories that emerged in the analysis (contact with risk sources, perceived risk, knowledge of risk, and control over risk) are constructs that are not new to this subject, but are promising in terms of practical

use. This means having a new or more evolved instrument, with the minimum theoretical and psychometric support, which can assess and differentiate the association of risk perception with health and performance indicators in healthcare personnel more adequately and thus contribute to future taxonomies and reconceptualizing processes on the subject. Likewise, further studies and improvements to the scale analyzed, such as the incorporation of new items and dimensions, could facilitate a more standardized use in practice, as has occurred in other recent cases[35].

Correlation between study variables and moderating effects of social support

The strength of the associations between risk perception and psychological effects was low for most of the variables studied (**Tables 2** and **4**), but statistically significant and in the theoretically expected directions. This was confirmed by the multivariate regression models, which may have relevance in the context of practical or clinical significance, rather than statistical and epidemiological significance. At the item level, the fear of SARS-CoV-2, possibility of contagion, and severity of harm were the most damaging aspects according to their correlations with psychological effects (**Table 2**). The dimensions of perceived risk and social support were the variables with the highest and most consistent predictive weights among the different psychological effects; therefore, they undoubtedly represent the most important factors in mental health, in their nature of risk and protection, respectively (**Table 4**), which is in line with the international data[6,8,19].

In general, the expected importance of social support was confirmed by its moderately high levels in health care workers, by the correlation and regression coefficients with the different psychological effects, and by the confirmation of its potential moderating role in the relationships between risk perception and the psychological effects studied. The contribution of social support in preserving the mental health of health care personnel was demonstrated in a meta-analysis conducted with the same population during the pandemic[38]. The buffering role of social support in the mental health of health personnel has also been demonstrated in other countries[16,39]. Notably, this study does not explore the mechanisms by which this association between social support and health occurs, but there is research that explores the mediation of other variables such as resilience, and the role of social support in the mental health of health care personnel[16,39].

The findings revealed six highly significant interaction terms for four psychological effects, which could provide alternative explanations for the contradictory results found in previous studies[19,20]. Particularly, it is necessary to realize that in order to be better understand the mechanism of the relationships of factors associated with mental health a multidimensional view needs to be adopted, in which the triad "stressors-mental health-social support" plays a relevant role. In this study, the change in the magnitude of the relationship between risk perception and psychological effects depending on the level of social support (**Figures 1a** and **1b**), along with the radical change in the directions of the relationships between risk perception and psychological effects depending on the level of social support (**Figures 1c** and **1d**), prove the importance of this variable.

It is evidently necessary to consider the synergies of specific variables for any attempt at practical intervention, at the risk of increasing a potential problem by thinking that the elimination of a stressor (risk perception) alone is always favorable and sufficient, ignoring the role of social support in such interventions. In this sense, further explorations of the moderating effects of different variables on psychosocial processes in health care workers are needed to offered more effective alternatives in prevention and intervention programs for well-being and mental health.

This study has some limitations: the sample size and selection method, the use of self-report health questionnaires, the trans-sectional or cross-sectional design, and the low reliability found in some of the constructs studied. Nevertheless, the sample size is within acceptable margins for the estimated parameters and self-reports of psychological effects and mental health at the screening level are still widely accepted tools even in the clinical setting. In turn, the study, far from aiming for a population-based epidemiological scope with emphasis on causality, seeks to understand the complex mechanisms of the study variables by analyzing exploratory interactions.

The contributions of this research may have theoretical, methodological, and practical aspects, adding to the broad conceptual understanding of the components of risk perception (including positive and protective aspects), confirming synergies in the relationship of the triad "stressors – mental health – social support," requiring a multidimensional conceptual visions, by favoring the supply of methodological or instrumental tools to evaluate risk

perception and, in practice, to consider evaluations and interventions for psychological well-being applied under the diagnosis and understanding of the interaction effects of stressors and social support, for the benefit of health workers in our region.

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