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Risk perception of contracting COVID-19 among healthcare workers

Percepção de risco de adoecimento por COVID-19 entre trabalhadores de unidades de saúde

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Abstract

Objectives: to evaluate the dimensional validity of the perception scale of the risk of contracting COVID-19 and its association with sociodemographic and occupational factors, as well as with sleep complaints, among healthcare workers. *Methods:* cross-sectional study, carried out between May and August 2020, involving healthcare workers from Rio de Janeiro, Brazil. They filled in an online questionnaire regarding their work activities, risk perception of contracting COVID-19, and health behavior. We used factor analysis and binomial and multinomial regression models, adjusted for confounders. *Results:* 2,996 workers participated. Factor analysis confirmed the scale unidimensionality. Greater chances of high-risk perception were reported by women; caretakers of children/elderly; those with a work journey of more than 40h/week; workers from primary health care and emergency units, and from general and specialized hospitals. High risk perception was associated with altered sleep duration (OR = 2.39; 95%CI = 1.95; 2.94), use (OR = 2.08; 95%CI = 1.67; 2.58) and increased dose of sleep medications (OR = 1.91; 95%CI = 1.47; 2.48). *Conclusion:* risk perception was associated with women, caretakers of children/elderly, longer working hours, sleep complaints, and use of sleeping pills. Investigating factors associated with stressful events, such as the COVID-19 pandemic, can support actions planning aimed at preventing diseases among healthcare workers.

Keywords: COVID-19; health personnel; occupational risk; cross-sectional studies; occupational health.

Resumo

Objetivos: *avaliar a validade dimensional da escala de percepção de risco de adoecimento por COVID-19 e sua associação com fatores sociodemográficos, ocupacionais e com queixas de sono, entre trabalhadores da saúde.* Métodos: *estudo seccional, com trabalhadores da saúde do Rio de Janeiro que, entre maio e agosto de 2020, preencheram questionário online sobre seu trabalho, percepção de risco de adoecimento por COVID-19 e comportamentos de saúde. Utilizou-se análise fatorial e modelos de regressão logística binomial e multinomial, ajustados por variáveis de confusão.* Resultados: *participaram 2.996 trabalhadores. A análise fatorial corroborou a unidimensionalidade da escala. Chances mais elevadas de alta percepção de risco foram observadas entre mulheres, os que cuidavam de crianças/idosos, aqueles com jornada de trabalho > 40h/semana e trabalhadores das Unidades Básicas de Saúde, Unidades de Pronto Atendimento, hospitais gerais e especializados. A alta percepção de risco associou-se à alteração na duração do sono (OR = 2,39; IC95% = 1,95; 2,94), uso (OR = 2,08; IC95% = 1,67; 2,58) e aumento da dose de medicamentos para dormir (OR = 1,91; IC95% = 1,47; 2,48).* Conclusão: *a percepção de risco esteve associada ao sexo feminino, cuidar de crianças/idosos, maior jornada de trabalho, queixas de sono e uso de medicamentos para dormir. A investigação dos fatores associados a eventos estressantes, como a pandemia da COVID-19, pode corroborar o planejamento de ações para a prevenção de doenças entre trabalhadores de saúde.*

Palavras-chave: *COVID-19; trabalhadores da saúde; risco ocupacional; estudos transversais; saúde do trabalhador.*

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Introduction

The World Health Organization (WHO) has considered the COVID-19 Pandemic a public health emergency and international concern since January 30, 2020[1]. The SARS-CoV2 belongs to the coronavirus family, the same as the severe acute respiratory syndrome (SARS) and the Middle East respiratory syndrome (MERS) virus[2]. Data from January 2022 reported more than 5,500,000 deaths from the disease worldwide; 622,000 in Brazil alone[3].

SARS-CoV-2 is transmitted by air, saliva droplets, or direct contact with contaminated people or surfaces. Thus, health professionals, especially those working directly with COVID-19 patient care, are at great risk of falling ill[4,5]. These professionals are fundamental in combating the COVID-19 pandemic, since they guarantee the population's access to essential health services for detection, treatment, and prevention via immunization. In addition to facing a greater risk of infection in their efforts to protect the general population, health care workers are exposed to fatigue due to high workloads, often in inadequate conditions, and psychological distress related to the severity of cases, losses, and uncertainties of a pandemic context[4-6].

Risk perception refers to people's intuitive assessments of the dangers to which they may be exposed[7] and is affected by the unfamiliarity and feeling of lacking control in relation to the dangers involved[8,9]. Long-term events can affect mental health more drastically than brief exposures[10]. Influenced by numerous individual, social, cultural, and contextual factors, perception goes beyond the classical attributes of danger and is based on experiences, beliefs, attitudes, judgments, conceptions, and feelings[11]. Moreover, risk perception is considered a trigger for preventive action[12,13,14], although preventive health behaviors are not merely determined by the awareness of objective risks.

Studies on the perception of risk in the work environment were developed during other epidemics, such as SARS, which also involved strategies of social isolation and increased stress at work[10,15,16]. Healthcare providers experienced high levels of distress due to the perception of a higher risk of infecting loved ones and the concerns of caring for the family in case of illness. Thus, studies were developed on the perceived risk related to SARS among health care workers; the studies showed its association with the occurrence of post-traumatic stress[10], mental health outcomes[15-17], worse working conditions, and lack of preventative measures[17-19]. Similar to SARS, COVID-19 initially presented itself as a new infection of unknown cause, transmitted mostly via the respiratory route, with global spread and high mortality[5], characteristics that generally increased the perceived risk and the mental suffering associated with it[9,10,15,20].

In pandemic situations, in addition to the risks of infection and illness, health workers are subject to chronic stress and long and irregular working hours, factors that can negatively affect their mental health and sleep quality[5,10,21,22,23,24].

The aspects mentioned above and the lack of international or national parameters on the risk perception of contracting COVID-19 at the beginning of the pandemic served as motivation to translate and apply to the Brazilian health context a scale for the risk perception of contracting COVID-19, originally applied to the SARS situation[10,15].

Based on this, this study has the following objectives: i) analyze the suitability of the scale for risk perception using dimensional validity; ii) evaluate sociodemographic and occupational factors associated with risk perception; and iii) to investigate the association between the risk perception of contracting COVID-19 and sleep complaints among workers of health units.

Methods

This is a cross-sectional epidemiological study conducted between May and August 2020 in one of the first Reference Centers for COVID-19 testing in health and public safety workers in Rio de Janeiro. In the municipality where the Reference Center is located, the month of May presented the highest number of cases in 2020 (on May 1, 583 severe cases were recorded with a moving average of 215 deaths). The number of cases and deaths decreased over the period of data collection, remaining with a moving average of deaths around 30, and severe cases ranging from 50 to 100 between July and August[25].

Participants

This study encompassed workers from several professional fields, from all levels of health complexities, including Basic Health Units (BHU), Emergency Care Units (ECU), clinics, Health Departments, general and specialized public and private hospitals, including field hospitals. Non-healthcare workers were excluded.

Recruitment and data collection

All workers from health units that sought our reference unit for COVID-19 testing, during the period from May to August 2020, were invited to fill an online survey that was part of the study "*Saúde mental em profissionais de saúde frente à Pandemia de COVID-19: informação para ações em saúde do trabalhador*." The Survey Gizmo research software platform (current Alchemer – Professional Online

Surveys) was used for data collection, programmed with skipping (in situations of "does not apply") and checking for acceptable/inconsistent values. The questions were mandatory, and the pre-tests and successive improvements occurred with 25 volunteers from May 15 to 21, 2020. The invitations were then sent to health care workers via e-mail and WhatsApp messenger, according to the information from the BHU testing register, containing clarifications about the research and the link to the online form. Additionally, the invitation for the study was widely shared within health care services via electronic posters and invites to eligible participants, according to a list generated at the time of examination. Data collection, with the online forms available to participants, occurred from May 27 to August 12, 2020.

Instruments and variables used

Participants answered a questionnaire that included questions on sociodemographic aspects related to work and health. The following variables were used: sex (female, male); age (in full years); education (secondary education, higher education); marital status (single/separated, married/in union); lives alone (yes, no); caretaker of children and/or older adults (yes, no); workplace (surveillance/telehealth/Health Department, Emergency Care Unit – ECU/Emergency Department – ED/mobile unit, general hospital, specialized hospital, Basic Health Units – BHU, polyclinic/specialized clinic); occupation (licensed practical nurse/nursing assistant, registered nurse, physician, other higher education jobs, other mid-level jobs, laboratory technician, student); workload before the pandemic (up to 40h/week, over 40h/week); workload during the pandemic (up to 40h/week, over 40h/week); use of sleeping medications during the pandemic (does not use, increased the dosage, decreased the dosage, started to use); duration of sleep during the pandemic (no change in duration, with change in duration).

Risk perception at work during the COVID-19 pandemic

The risk perception scale, originally applied in the context of the severe acute respiratory syndrome (SARS) pandemic of 2003[10,15], was translated from English to the Brazilian Portuguese and adapted to the context of COVID-19 by three bilingual occupational epidemiologist researchers with extensive experience in psychometric adaptation of scales, co-authors of this article (Griep, Rotenberg, and Silva-Costa). The scale includes aspects of risk perception, adverse experiences, and strategies used to deal with unexpected or stressful circumstances in the pandemic situation. **Chart 1** shows the nine items of the original scale and their translated and adapted version.

The scale was preceded by the following statement: "Regarding your work during the COVID-19 pandemic, please mark how much you agree with the following statements." The answer options ranged from "totally disagree" (1) to "totally agree" (5). After summing the score for each item, the median score was used to categorize the workers into two groups: "low" and "high" risk perception of contracting COVID-19 at work during the pandemic. For each question, the worker who answered "totally agree" or "partially agree" was individually classified with high risk perception.

Chart 1 Items of the scale for the risk perception of falling ill, original version applied to the SARS pandemic and the Brazilian Portuguese version adapted to the COVID-19 pandemic

Items of the original scale	*Scale items adapted to the COVID-19 epidemic*
1. I believed that my job was putting me at great risk	1. Meu trabalho me coloca em grande risco
2. I felt extra stress at work	2. Estou mais estressado(a) no trabalho
3. I was afraid of falling ill with SARS	3. Tenho medo de ficar doente
4. I felt I had little control over whether I would get infected or not	4. Sinto que tenho pouco controle sobre ser infectado no trabalho
5. I thought I would be unlikely to survive if I were to get SARS	5. Seria improvável sobreviver se eu contraísse o coronavírus
6. I thought about resigning because of SARS	6. Tenho pensado em pedir demissão por causa da pandemia
7. I was afraid I would pass SARS on to others	7. Tenho medo de passar coronavírus para outras pessoas
8. My family and friends were worried that they might get infected through me	8. Família e amigos estão preocupados que eles possam ser infectados por mim
9. People avoided my family because of my work	9. As pessoas evitam minha família por causa do meu trabalho
Response categories – five-point Likert scale: 1-strongly disagree, 2-disagree, 3-nor sure, 4-agree, 5-strongly agree	**Respostas em escala Likert em cinco categorias:** 1-discordo totalmente, 2-discordo parcialmente, 3-nem concordo nem discordo, 4-concordo parcialmente, 5-concordo totalmente

Data analysis

The procedures for evaluating the dimensional validity of the risk perception scale included exploratory factor analysis (EFA) and confirmatory factor analyses (CFA). For EFA, an eigenvalue greater than 1 and adequacy of the factorial structure was used as criteria to obtain the number of factors to be extracted, considering the load and number of items per factor. In the evaluation of the items, those that did not present cross loads and with values greater than 0.40 were considered appropriate. Items with cross loads were identified as those with eigenvalues greater than 0.40 in more than one factor and with a difference of <0.20 between loads[26]. In this analysis, the geomin oblique rotation was used.

Subsequently, the CFA was obtained based on the original model proposed by the authors of the scale[10,15] and the results of the EFA. In this study, we used the robust estimator of weighted least squares (WLSMV), which uses polycoric correlation matrices appropriate for categorical or ordinal variables, available in the statistical package Mplus version 7.1[26]. For the evaluation of model adequacy, three adjustment indexes were used: the Comparative Fit Index (CFI) > 0.90, the Tuckey-Lewis index (TLI) > 0.90, and the standardized root mean square error of approximation (RMSEA) adjustment index < 0.07[26,27].

For the description of the study sample, categorical variables were expressed as frequencies, and quantitative variables as mean and standard deviation (SD). Pearson's chi-square test was used to test the association between categorical variables. Odds ratios (OR) and their respective confidence intervals (CI) of 95% were estimated using binomial and multinomial logistic regression models adjusted for potentially confounding variables, which were associated in bivariate analyses. The significance level considered was of 5%. The quality of the regression model adjustment was evaluated using the Akaike Information Criterion (AIC). All statistical analyses were conducted in the R program 3.6.1.

Ethical Considerations

This study was approved by the Research Ethics Committees of the Oswaldo Cruz Foundation (Fiocruz) (CAAE 31065020.1.0000.5248), on April 27, 2020, and later by the Rio de Janeiro State University (UERJ) (CAAE 31065020.1.3001.5282), on May 27, 2020. The purpose of the research and the requirements for participation were expressed in the invites. The questionnaire was completed after the free and informed consent form was provided and signed.

Results

From a total of 11,600 workers tested at the time of the study, 3,484 (30.03%) worked in a health unit and accepted the invitation to participate in the survey by filling out the online questionnaire. Of these, 2,996 (86%) workers, with complete data on all variables used, were included in the analyses. The participants were on average 40.7 years old (SD = 9.8), most were female, with higher education, married/in union, caretaker of children and/or older adults, and did not live alone. Licensed practical nurse/nursing assistant, followed by registered nurses and other higher-level health care professionals, comprised the largest groups in the sample, and most worked in specialized or general hospitals. Over 60% of the participants reported weekly hours of up to 40 hours before and during the pandemic, over 80% reported some change in sleep duration during the pandemic, about 16% started using sleeping medications, and 10% increased the dosage during the pandemic (**Table 1**).

Table 1 Description of the risk perception of contracting COVID-19 according to sociodemographic, occupational, and sleep-related factors among workers from health care units, Rio de Janeiro, May to August 2020

Selected characteristics	*Risk perception at work during the pandemic*			
	Total (2,996)	*Low 1,512 (50.5%)*	*High 1,484 (49.5%)*	*p-value**
Age (years) – Mean (standard deviation)	40.7 (9.8)	40.7 (9.9)	40.6 (9.7)	0.762
Sex – n (%)				
Male	553 (18.5)	344 (62.2)	209 (37.8)	< 0.001
Female	2,443 (81.5)	1,168 (47.8)	1,275 (52.2)	

(Continued)

Table 1 Continuation...

Selected characteristics	*Risk perception at work during the pandemic*			
	Total (2,996)	*Low 1,512 (50.5%)*	*High 1,484 (49.5%)*	*p-value**
Educational level – n (%)				
Secondary education	632 (21.1)	324 (51.3)	308 (48.7)	0.684
Higher education	2,364 (78.9)	1,188 (50.3)	1,176 (49.7)	
Marital status – n (%)				
Single/separate	1,275 (42.6)	627 (49.2)	648 (50.8)	0.238
Married/in union	1,721 (57.4)	885 (51.4)	836 (48.6)	
Caretaker of children and/or older adults – n (%)				
No	1,392 (46.5)	752 (54.0)	640 (46.0)	< 0.001
Yes	1,604 (53.5)	760 (47.4)	844 (52.6)	
Lives alone – n (%)				
Yes	310 (10.3)	156 (50.3)	154 (49.7)	0.999
No	2,686 (89.7)	1,356 (50.5)	1,330 (49.5)	
Occupation – n (%)				
Licensed practical nurse/nursing assistant	836 (27.9)	405 (48.4)	431 (51.6)	0.457
Nurse	691 (23.1)	346 (50.1)	345 (49.9)	
Physician	222 (7.4)	125 (56.3)	97 (43.7)	
Other higher-level employment	691 (23.1)	360 (52.1)	331 (47.9)	
Other mid-level employment	505 (16.8)	250 (49.5)	255 (50.5)	
Laboratory technician	39 (1.3)	19 (48.7)	20 (51.3)	
Student	12 (0.4)	7 (58.3)	5 (41.7)	
Health Unit - n (%)				
Surveillance/telehealth/Health Department	93 (3.1)	59 (63.4)	34 (36.6)	< 0.001
ECU/ED/mobile unit	154 (5.1)	75 (48.7)	79 (51.3)	
General Hospital	1,042 (24.8)	494 (47.4)	548 (52.3)	
Specialized hospital	808 (27.0)	398 (49.3)	410 (50.7)	
BHU	341 (11.4)	149 (43.7)	192 (56.3)	
Polyclinic/specialized clinic	333 (11.1)	203 (61.0)	130 (39.0)	
Workload before the pandemic – n (%)				
Up to 40h/week	2,052 (68.5)	1,043 (50.8)	1,009 (49.2)	0.587
Over 40h/week	944 (31.5)	469 (49.7)	475 (50.3)	
Workload during the pandemic – n (%)				
Up to 40h/week	1,923 (64.2)	999 (52.0)	924 (48.0)	0.033
Over 40h/week	1,073 (35.8)	513 (47.8)	560 (52.2)	
Sleep duration during the pandemic – n (%)				
Without change in duration	583 (19.5)	399 (68.4)	184 (31.6)	< 0.001
With change in duration	2,413 (80.5)	1,113 (46.1)	1,300 (53.9)	
Sleeping pills during the pandemic – n (%)				
Does not use	2,131 (71.1)	1,165 (54.7)	966 (45.3)	< 0.001
Increased dosage	311 (10.4)	125 (40.2)	186 (59.8)	
Decreased dosage	70 (2.3)	40 (57.1)	30 (42.9)	
Started to use	484 (16.2)	182 (37.6)	302 (62.4)	

*Pearson's chi-square test
ECU: Emergency Care Unit; ED: Emergency Department; BHU: Basic Health Unit.

The analysis of the sociodemographic profile of losses (n = 488) showed that there were no differences in relation to gender (14.5% of losses among women, and 11.8% of losses among men; p = 0.09), marital status (14.8% of losses among married, and 12.9% among singles; p = 0.104), caretakers of children and/or older adults (14.6% losses among caretakers, and 13.3% among those who were not; p = 0.268), and living alone (13.4% losses among those living alone, and 14.1% among those living with someone; p = 0.791). There was a statistically significant difference in relation to schooling (20.1% of losses among participants with secondary education and 12.2% among those with higher education; p = 0.001) and age (mean of 40.7 years of age among the participants, and 42.3 years of age among losses; p = 0.0004).

High frequencies (> 70%) were observed in the positive responses of the vast majority of items on the scale, except for two items: ("I would be unlikely to survive if I contracted the coronavirus" and "I have thought about resigning because of the pandemic"), which presented frequencies around 15%; both had the lowest medians compared to the others (**Table 2**). The adequacy analysis of the dimensionality of the scale items through exploratory factor analysis showed inadequate adjustment indicators. Although there was an indication of two factors by eigenvalue, item nine ("People avoid my family because of my work") showed very low and crossed loads in both factors. After the removal of this item, only one dimension was indicated by the eigenvalue, and the scale presented items with adequate loads and adjustment indexes: all loads > 0.40, incremental adjustment indexes Comparative Fit Index (CFI) = 0.95, Tuckey-Lewis index (TLI) = 0.96, and the parsimonious adjustment index RMSEA = 0.07. Cronbach's alpha of 0.738, and composite reliability = 0.832 were observed (**Table 2**).

Higher frequencies of risk perception at work were observed in women; caretakers of children and/or older adults; in those who work in the BHU, general hospital, ECU/mobile unit, and specialized hospital; and among those who reported weekly workload above 40 hours during the pandemic. Moreover, higher frequencies of risk perception were observed among those who reported changes in sleep duration and those who started using sleeping medications or increased the dosage (**Table 1**).

We observed that after adjustment for the other variables, the highest chances of high risk perception at work during the pandemic occurred among women (OR = 1.70; 95%CI = 1.39; 2.08), when compared to men, and among caretakers of children and/or older adults (OR = 1.28; 95%CI = 1.10; 1.49), compared to those who were not caretakers. Borderline association was observed between weekly workload and risk perception (OR = 1.16; 95%CI = 1.00; 1,37). Moreover, when compared to workers away from the COVID-19 frontline work (surveillance/telehealth/ Health Department), higher chances of high risk perception were observed among BHU professionals (OR = 2.19; 95%CI = 1.37; 3.55), from general hospitals (OR = 1.82; 95%CI=1.17; 2.85), from ECU/ mobile units (OR = 1.78; 95%CI = 1.05; 3.05), and from specialized hospitals (OR = 1.67; 95%CI = 1.06; 2.64) (**Table 3**).

Table 2 Description of the items of the scale for the risk perception of contracting COVID-19, high perception frequency, and results of confirmatory factor analysis among health unit workers, Rio de Janeiro, May to August 2020 (n = 2,996)

Items of the risk perception scale	*High Risk Perception*	*Confirmatory Factorial analysis*	
	n (%)	*Factorial load*	*Residual variance*
1. My job puts me at great risk	2,567 (85.7)	0.517	0.735
2. I feel extra stress at work	2,418 (80.7)	0.697	0.514
3. I am afraid of falling ill	2,470 (82.4)	0.748	0.441
4. I feel I have little control over whether I get infected or not	2,026 (67.6)	0.630	0.603
5. I would be unlikely to survive if I were to contract COVID-19	444 (14.8)	0.491	0.759
6. I thought about resigning because of the pandemic	459 (15.3)	0.643	0.586
7. I am afraid I'll infect others with coronavirus	2,787 (75.3)	0.628	0.606
8. My family and friends are worried that they might get infected by me	2,257 (75.3)	0.572	0.673
Adjustment indicators			
Comparative Fit Index (CFI)		0.945	
Tuckey-Lewis index (TLI)		0.957	
Standardized root mean square error of approximation (RMSEA)		0.070	
Composite reliability		0.832	
Cronbach's alpha		0.738	

Table 4 shows the associations between perceived risk and sleep complaints. Those classified with high risk perception of contracting COVID-19 had twice the chances of using sleeping medications and 91% higher chance of increasing the dosage during the pandemic. In addition, there were higher chances of changes in sleep duration among those classified with high risk perception (OR = 2.39; 95%CI = 1.95; 2,94).

Table 3 Sociodemographic and occupational factors associated with high risk perception at work among professionals working in health units during the COVID-19 pandemic, Rio de Janeiro, May to August 2020 (n = 2,996)

	High perceived risk at work during the pandemic
	OR (95%CI)
Female	1.70 (1.39; 2.08)
Age (years)	1.00 (0.99; 1.01)
Caretaker of children and/or older adults	1.28 (1.10; 1.49)
Works > 40h during the pandemic	1.16 (1.00; 1.37)
Health Unit	
Surveillance/telehealth/Health Department	1
ECU/ED/mobile unit	1.78 (1.05; 3.05)
General Hospital	1.82 (1.17; 2.85)
Specialized hospital	1.67 (1.07; 2.64)
BHU	2.19 (1.37; 3.55)
Polyclinic/specialized clinic	1.08 (0.67; 1.75)

OR: Odds Ratio; 95%CI: 95% Confidence Interval; ECU: Emergency Care Unit; ED: Emergency Department; BHU: Basic Health Unit.

Table 4 Association between high risk perception at work and change in sleep duration and use of sleeping medications among workers from health units, during the COVID-19 pandemic, Rio de Janeiro, May to August 2020 (n = 2,996)

	Sleeping medicine OR (95%CI)				*Change in sleep duration OR (95%CI)*
	Does not use	*Increased dosage*	*Decreased dosage*	*Started to use*	
Perceived risk at work					
Crude model	1	1.79 (1.41; 2.29)	0.90 (0.56; 1.46)	2.00 (1.63; 2.45)	2.53 (2.09; 3.07)
AIC		5101.63			2861.5
Adjusted model*	1	1.91 (1.47; 2.48)	1.07 (0.64; 1.79)	2.08 (1.67; 2.58)	2.39 (1.95; 2.94)
AIC		4669.64			2577.9

*Models adjusted for age, gender, caretaker of children/older adult, workday during the pandemic, health unit.
AIC: Akaike information criterion; OR: Odds Ratio; 95%CI: 95% Confidence Interval.

Discussion

The results demonstrated the appropriate psychometric properties of a scale of unprecedented use in Brazil on the risk perception of contracting COVID-19. Higher chances of risk perception were observed among women, caretakers of children and/or older adults, and those with a higher weekly workload during the pandemic. Moreover, an association was observed between high risk perception and use of sleeping medications, as well as changes in sleep duration.

The initial stages of factorial structure analyses of the scale for the risk perception of contracting COVID-19, adapted for the Brazilian Portuguese, corroborate the unidimensionality of the scale according to its use in other international studies in the context of the SARS pandemic[10,15]. One item, however ("people avoided my family because of my

work") did not present psychometric adequacy and its withdrawal positively affected the adjustment indicators. This item might not have adjusted to the construct due to its rather indirect relation to the risk perception since it relates to the family members. Other studies[10-15] did not present details of the factorial structure of the scale, only the internal consistency through Cronbach's alpha slightly lower than our results (0.71)[15]. However, given the innovative nature of the scale in our context, we recommend for other studies to conduct analyses to corroborate the psychometric performance.

High frequencies of risk perception were observed in most of the items evaluated on the scale, pointing to the suffering of workers when dealing with assistance in the pandemic. These frequencies were even higher than those indicated in the study by Chong et al.[10]. The high transmissibility of the virus, a large proportion of asymptomatic infected patients, lack of drug therapy, insufficient coverage of tests, prolonged duration of clinical conditions, lack of adequate protective equipment, and lack of a vaccine (at the time of data collection) may explain the high numbers identified[5]. We also emphasize that in the period of data collection, Rio de Janeiro was one of the municipalities with the highest number of cases, hospitalizations, and deaths in Brazil[25].

Despite the lower frequencies, items related to fear of not surviving if they acquire the disease and thinking about resigning due to the pandemic possibly reflect situations that generate an even higher degree of mental suffering. They may be related, for example, to situations of preexisting comorbidities associated with a higher risk of aggravation and death[28], or exacerbated suffering that may generate the intention of abandoning their profession[29]. Additionally, seeing other health professionals, often co-workers, falling ill, worsening, having complications, and dying may have enhanced feelings of extreme vulnerability, despair, loss of control, and threat to life[30].

Our findings on the high risk perception among women are similar to the results observed by Rana at al.[14], which highlighted that women had a higher risk perception of contracting COVID-19 and were more active in adopting coping and prevention strategies when compared to men. The fear of transmitting the disease to family members, especially to the most vulnerable, may explain the association of high risk perception among caretakers of children or older adults[15,16]. Some of these results may be related to the greater female representation of the sample, although it is recognized that a large part of the health care workforce is composed of women.

Higher chances of risk perception of contracting COVID-19 were identified among those who reported high workload and among workers from the BHU, ECU, and general and specialized hospitals. Protecting the health of professionals in this area is essential to hinder the transmission of COVID-19 not only in health facilities but also in their homes, to extend the sense of security to family members. In this sense, clear and efficient infection control protocols, in addition to availability of personal protective equipment (PPE), and the protection of mental health of health care workers is essential due to the prolonged stress to which they are subjected[4,5].

In contrast to the findings of other authors[30], we found no statistical differences in risk perception among the professional categories evaluated, suggesting that, regarding the risk perception of contracting COVID-19, the type of health unit is predominant in relation to the professional category. The health sector is considered the riskiest for workers, and reducing this risk is a fundamental step to promote the health of professionals and the provision of quality health care[31,32]. Risk perception can, on the one hand, generate mental suffering and, on the other hand, promote greater adhesion to control measures and the use of PPEs, reducing exposure to risky situations, as highlighted by some authors[12,13,30,32].

Our results showed an association between high risk perception, sleep alterations, and use of sleeping medications. Other investigations[24,33] indicated sleep disorders in frontline workers attending to patients suspected or diagnosed with the disease. Xiao et al.[33] highlighted the negative impact of anxiety and stress levels on sleep quality. Given this context, social support for medical teams was an important resource to reduce anxiety and stress and improve self-efficacy with positive impacts on sleep quality. The importance of these supporting actions in coping with the stress caused by the COVID-19 pandemic was also highlighted in a recent literature review[33]. According to the authors, the problems most commonly related to COVID-19 in health workers are related to mental health issues, especially among women; other aspects, such as the concern of being infected or infecting others, also generate suffering. In the review, the social support received by the workers was correlated with a lower level of mental suffering, anxiety, depression, and sleep problems.

These aspects highlight the importance of implementing organizational strategies promoting support to co-workers and managers, as well as psychological support for coping with a situation of prolonged stress[34]. In this regard, some publications[34,35] recommend measures aimed at

managers to help health care professionals face mental health issues. Those who work directly with infected patients need to have their mental health monitored and psychological support offered, with special attention to health care professionals with comorbidities – which expose them to greater risks – and to those living with small children or older family members.[34,35]

In addition to offering psychological support, measures related to the organization of work cannot be neglected. ICU and emergency stations workers point to the relevance of hiring healthcare professionals during the pandemic, as well as enact changes in work schedules, seeking to reduce overload and enable breaks during duty[36,37], which, by itself, reduces the known wear and tear of the PPE dressing and undressing process[36,37], thus favoring their mental health. In the context of recommendations to managers, the need for an empathic communication and cooperation among workers is also highlighted in the literature of the field [35,36,38,39].

In a country of continental proportions such as Brazil, with great socioeconomic disparity, a history of precariousness of the health system, and where the contagion curve remains prolonged – with moments of collapse in some health services – the situation becomes even more challenging. The complexity of the various levels of service of the Brazilian Unified Health System (SUS) requires different strategies for workers' health care and for local circumstances to also be considered[34]. The situation requires a joint effort for the government and the civil society to recognize the worsening situation of physical and mental exhaustion and effectively promote the health of the frontline wokers[34,36,38,39].

Our study has strengths and limitations. The main strengths are characterized by the innovation of a stress perception measure first used in Brazil, with evidence of good psychometric properties in a relatively large and comprehensive sample represented by several professionals in different health care services. The study is also innovative in that it demonstrates the association of the risk perception of contracting COVID-19 and sleep complaints.

Some limitations may have influenced our findings and deserve to be highlighted. Among them, we note the lack of representativeness of the sample, obtained by voluntary participation in filling out a virtual questionnaire. This strategy, well disseminated during the need for social distancing due to the pandemic, can fail to detect doubts in the filling of items and can promote blank answers, allowing selective losses in some subgroups (in the case of this study, the losses were greater for individuals with low schooling and for older individuals). To minimize such biases, the questionnaire was elaborated by researchers experienced in worker's health, and it was previously tested in several stages until clarity was obtained as to the organization and the best sequence of questions. Moreover, there was a wide distribution among the workers targeted by the study.

Another limiting aspect corresponds to the cross-sectional character of the analyses in which exposure and outcome were obtained at the same time, so that reverse causality cannot be ruled out, especially in the association between risk perception and sleep complaints, limiting the possibility of causal inference. Due to the short window of time initially thought for the pandemic (which was not confirmed over time), steps of cross-cultural adaptation of measurement instruments (e.g., back-translation and consensus version) were suppressed.

Finally, we suggest for future studies to also include the role of uncollected information, such as the presence of comorbidities, the availability of social and psychological support to workers, and the use of public transportation, as well as more detailed information on the coexistence and care of older adults or people more vulnerable to infection and disease complications. Such variables could bring more clarity to the underlying mechanism of the identified associations.

The complexity of actions in the COVID-19 pandemic requires attention toward organizational and individual characteristics. The results point to the need for an organizational culture of resilience that continuously supports health professionals in coping with the various facets that are presented, based on the construction and maintenance of interprofessional relationships with the collaboration of the entire organization. Experiences such as those experienced in the context of the COVID-19 pandemic can also better prepare health services and their professionals for future challenges.

Presumably, COVID-19 will be part of people's daily lives for years to come, significantly changing their lifestyle and work habits. Investigating the psychological impact of stressful events related to dealing with a long-term infectious disease with the dimensions of COVID-19 may corroborate the planning of actions to prevent physical and mental diseases among health care workers. This study aims to contribute to these actions by presenting an instrument with good psychometric properties, which can be used to assess the risk perception of contracting COVID-19, and by pointing to groups potentially more vulnerable to high risk perception of contracting COVID-19.

Authors' contributions

Griep RH, Silva-Costa A, Santos RS, Alves DSB, and Rotenberg L contributed equally to the conception of the study; data collection, analysis, and interpretation; the writing of the draft; the critical reviews of the manuscript; and to the approva of the final published version. All authors assume full public responsibility for this study and the published content.

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