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Performance evaluation of occupational health and safety in relation to the COVID-19 fighting practices established by WHO: Survey in multinational industries

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ARTICLE INFO

Keywords:
Coronavirus
Practices to combat the pandemic
Occupational health
Employee safety
World Health Organization

ABSTRACT

The coronavirus pandemic meant that companies had to adapt quickly to survive the challenging scenario and avoid losing market share or even going bankrupt. In this sense, employees dedicated to Occupational Health and Safety (OH&S) activities within organizations played a key role in ensuring that the recommendations of the World Health Organization (WHO) were properly implemented. Even so, no studies were identified in the literature that investigated how the practices to combat COVID-19 improved the performance related to employee safety and occupational health. This is what motivates the accomplishment of this work; evaluate how these practices improve safety and health-related performance. For this, a survey of multinational companies was carried out and, together with this research, a model for structural equations was developed. In the end, a correlation test was performed. The main results showed that practices to combat COVID-19, such as the provision of sanitizers, the adoption of social distance, the creation of new work shifts, and the disinfection of workplaces were related to improvements in safety and health performance through the implementation of a risk management and biological risk mitigation program. Meanwhile, the provision of emergency assistance has found stronger relationships with managerial and strategic actions.

1. Introduction

Occupational health practices based on hazard classifications, determination of requirements for controlled exposure of employees and risk management were initially developed in the pharmaceutical industry (Graham et al., 2020).

On the other hand, the number of deaths due to complications caused by severe acute respiratory syndrome caused by coronavirus 2 (SARS-CoV-2) is extremely high and continues to grow (Zuin et al., 2021) with the emergence of new waves of infection and dissemination of mutated variants of this virus (Mandal et al., 2021). Thus, it is indisputable that this pandemic has a global reach and is having an impact on society and the economy. (Parker, 2020).

The rapid spread of the new coronavirus is causing fanfare, concern and anxiety among company employees about the risks of infection during the course of their activities (Semple and Cherrie, 2020). To offer physical and psychological protection to their employees, health managers are needing to implement strategies to take care of those who occupy the front lines against the pandemic. Ultimately, it is these health professionals who are at the forefront of combating the pandemic (Demartini et al., 2020; Giorgi et al., 2020).

However, it is always important to emphasize that other professionals also perform activities considered essential and, therefore, are also equally exposed to the virus in the workplace (Dennerlein et al., 2020).

In parallel, the World Health Organization (WHO) has been publishing reports since the beginning of the pandemic regarding the fight against COVID-19. In the face of all this scenario, while the guidelines of Organs technical bodies are being updated as scientific research is being published (Spinazzè et al., 2020), there is a challenge for companies to...
instruct their Health and Safety departments (OH&S) to develop safer ways of working in order to mitigate the risks of contagion (Godderis and Luyten; 2020).

In addition, there are already works such as O’Neill (2020) that claim that there are serious gaps in the WHO guidelines on combating COVID-19 - the author cites, for example, the lack of inspections in the workplace.

Add to that the fact that many works on the coronavirus are being published as a brief or pending regarding peer review. This is the case, for example, with the work of Rukuni et al. (2020) who used Partial Least Squares Structural Equation Modelling (PLS-SEM) to investigate the factors that could potentially influence the reduction of the spread of COVID-19 in a South African municipality, and Kiran’s work (2020), which defined the keywords related to health and safety at work and scanned the publications of the last twenty years related to the subject.

The Coronavirus pandemic surprised all companies and forced them to reinvent themselves under the penalty of succumbing. It is a fact that no company was fully ready to face a pandemic. On the other hand, it is also a fact that the OH&S team is fundamental to support companies in the face of this challenge (Gharibi et al., 2020; Garzillo et al., 2020).

The mapping of dangerous agents carried out by OH&S teams in companies aims to identify threats to the health of employees due to chemical agents, such as gases and vapours, physical agents, such as ionizing beams and noise, and biological agents such as viruses and bacteria (Jahangiri et al., 2020). Therefore, when addressing the practices to combat COVID-19, this work will focus on biological agents that are dangerous to the employees’ health.

No scientific studies were identified that investigated the quantitative aspects of safety and health performance evaluation as a result of adherence to practices combating COVID-19 established by WHO (Fig. 1). Thus, the following question emerges: the areas of occupational health and safety have indeed contributed to the confrontation and fight against COVID-19 in the industries? This is exactly what this work seek to evaluate, finding answers also to the level of performance of these areas in relation to the practices to combat COVID-19 established by WHO.

This work aims to fill this research gap and present, in a quantitative way, the positive influences brought by the adoption of practices to combat COVID-19 in the performance of health and safety. The next section makes a systematic review of the literature and presents the conceptual model. Then, the third part of the study clarifies the methods adopted (for example, the statistical tests that will be applied). The fourth section bring the quantitative results of the survey, which are not discussed in the light of the literature in the fifth section. Finally, the last section will present the conclusions and contributions reached.

2. Literature review

A systematic review of the literature was carried out in order to verify the practices to combat COVID-19 in line with WHO definitions, as well as the actions that result in improvements in the occupational health and safety performance of employees. Despite being a theme developed only from the year 2020, 26 relevant works were identified.

2.1. Practices to combat COVID-19 recommended by the World health organization

Since the beginning of the new Coronavirus pandemic, a series of official recommendations for mitigating the risks of contagion and dissemination have been communicated. This study considered five practices to combat COVID-19 established by the World Health Organization and commonly used in the literature (WHO, 2021). These 5 five practices can be seen in Fig. 2 below.

The first practice to combat COVID-19 considered by this work addressed the supply of water and soap (COV1), as well as adequate access to handwashing facilities at work (Dennerlein et al., 2020; Jahangiri et al., 2020; Michaels and Wagner, 2020) with neutral detergent, as well as the use of hospital disinfectants active against the virus (Dufour et al., 2020; O’Neill, 2020), 0.1% sodium hypochlorite solution or solution 70% ethanol (Spinazzé et al., 2020). In addition, COV1 assesses the provision of personal protective equipment (Gharibi et al., 2020; Gibbs and Nonnenmann, 2020) - and the definition of mandatory use in relation to its extensive use (Otañez and Grewal, 2021) - and the use of thermo-flash thermometers for body measurement allows early detection of fever from a safe distance (Ndiaye and Diatta, 2020; Garzillo et al., 2020).
The organization of workstations so that the physical distance between employees and customers is preserved (COV2) is an important practice to combat COVID-19 (Jahangiri et al., 2020; Sönmez et al., 2020). This includes, for example, the establishment of a scheduling policy (Dennerlein et al., 2020), a maximum number of people per shared space, designated and fixed seats (Parker, 2020), that is, changes in work routines that reduce the risk of infection among colleagues (Demartini et al., 2020; Giorgi et al., 2020) (especially among those who work closely) (Gharibi et al., 2020). The best option would be to redesign workspaces to avoid crowding and allow physical distance (Michaels and Wagner, 2020), mainly to ensure that customers and employees are socially distant while eating or drinking (Otanez and Grewal, 2021), including with scheduling and pre-defined duration for meals in cafeterias (Garzillo et al., 2020). In addition, an effective measure is to encourage the home office and participation in meetings in the virtual format (Gallardo et al., 2020; Laroche et al., 2020; Sorensen et al., 2021). However, some low-income communities rely mainly on social distance to fight COVID-19 due to the lack of resources, and, in this sense, small and medium-sized companies are logically more impacted by this problem (Garzillo et al., 2020) – and the fact that outsourced employees, those with fixed-term contracts, have worse working conditions and less access to training (Sorensen et al., 2021). On the other hand, countries that were affected by other respiratory disease pandemics, for example, some eastern countries, had updated manuals and culture of recurrent training in relation to team safety.

2.2. Actions that result in improvements in employee safety performance

To provide a safer work environment for employees, in addition to guiding companies on the actions that should be taken to prevent contamination and mitigate the risks of COVID-19, a series of recommendations have been established by different regulatory bodies. This work considered the Occupational Safety and Health Act (OSHA) because it brings together the measures widely applied by private and government companies since 1970, the year of its creation in the United States. (OSHA, 2021).

It is worth mentioning the actions that improve the performance of companies and have a direct relationship with the safety of employees were also investigated. Thus, on-the-job training (S1) on the importance of personal protective equipment (Gibbs and Nonnenmann, 2020; O’Neill, 2020) and OHS (De Cieri and Lazarova, 2020), with a focus on practice operational, is fundamental for combating COVID-19 (Gharibi et al., 2020; Dufour et al., 2020; Barroso et al., 2020). In addition, protocols for safe training, including those aimed at worker resilience (Giorgi et al., 2020), should be promoted. In times of pandemic, online training is effective and safer, but during face-to-face training, it is important to verify knowledge (Jahangiri et al., 2020; Otanez and Grewal, 2021). In addition, new technologies such as artificial intelligence collaborate to disseminate relevant information (Sarbahiikari and Pradhan, 2020). At this point, it is worth highlighting the challenge of companies when dealing with this lack of internal expertise to carry out specific training to combat the pandemic of the new coronavirus - and, in this sense, small and medium-sized companies are logically more impacted by this problem (Garzillo et al., 2020) – and the fact that outsourced employees, those with fixed-term contracts, have worse working conditions and less access to training (Sorensen et al., 2021).
Table 2

| Code | Actions that positively affect employee safety performance | Authors |
|------|----------------------------------------------------------|---------|
| S1   | Conduct on-the-job training                             | Barroso et al. (2020); Chen et al. (2020); De Giuri and Lazaro (2020); Dufoeur et al. (2020); Garzillo et al. (2020); Giorgi et al. (2020); Giorgi et al. (2020); Gharibi et al. (2020); Gibbs and Nomenmann (2020); Giorgi et al. (2020); Jahangiri et al. (2020); O’Neill (2020); Sarbadhikari and Pradhan (2020); Otamez and Grewal (2021); Sorenzen et al. (2021) |
| S2   | Provide, control and verify the use of PPE (Personal Protective Equipment) | Barroso et al. (2020); Demartini et al. (2020); Dennerlein et al. (2020); Garzillo et al. (2020); Gharibi et al. (2020); Giorgi et al. (2020); Goddess and Luyten (2020); Jahangiri et al. (2020); Michaels and Wagner (2020); O’Neill (2020); Sonmez et al. (2020); Spinazzeto et al. (2020) |
| S3   | Implement and maintain a PGR (Risk Management Program)   | Dennerlein et al. (2020); Dufoeur et al. (2020); Garzillo et al. (2020); Gibbs and Nomenmann (2020); Giorgi et al. (2020); Michaels and Wagner (2020); O’Neill (2020) |
| S4   | Maintain and disseminate safety indicators to all employees | Dufoeur et al. (2020); Gallardo et al. (2020); Parker (2020) |
| S5   | Workstation organization with security                   | Gallardo et al. (2020); Garzillo et al. (2020); Parker (2020); Spinazzeto et al. (2020) |

(Chen et al., 2020). Likewise, the provision of personal protective equipment (PPE) (S2) as an anti-contagious measure to, for example, protect the respiratory tract with N95 and FFP2 masks (Spinazzeto et al., 2020; Giorgi et al., 2020; Michaels and Wagner, 2020), in addition to gloves (Sonmez et al., 2020) and disposable aprons (Garzillo et al., 2020) have been expanded to meet the need for additional protective barriers for employees and customers (Dennerlein et al., 2020). On the other hand, it is not enough to standardize PPE with better protection. It is also necessary to invest in on-the-job training (Jahangiri et al., 2020) to make everyone aware of the correct use, increase the feeling of security and, consequently, reduce the risks of contamination (Demartini et al., 2020; Gharibi et al., 2020). In the same way that it is necessary to consider the correct use of PPE according to the employees’ exposures to the risks in each workplace (O’Neill, 2020), it is important to mention that informal workers and with less purchasing power have less access to health equipment. Adequate personal protection (Godderis and Luyten, 2020) and, with increasing concern about the pandemic, this has resulted in a lack of PPE (Barroso et al., 2020).

The implementation and maintenance of a risk management program (PGR) (S3) establishes safe procedures for the management of contagion risks (Giorgi et al., 2020) by assisting companies in the assessment of risk levels in the workplace, determining adequacy priorities (Dennerlein et al., 2020) and implementing necessary improvements (Dufoeur et al., 2020). It is the employer’s job to carry out a safety management program addressing the risks (Gibbs and Nomenmann, 2020). However, government agencies are still struggling to deal with the risks related to SARS-CoV-2 exposure and infection (Garzillo et al., 2020). This is because there is no Temporary Emergency Standard (ETS) that requires each employer to develop and implement an infection control plan (Michaels and Wagner, 2020; O’Neill, 2020).

In addition, it is part of a worker health and safety program to have and disseminate safety indicators to all employees (S4), encouraging a reduction in the number of accidents at work and the injury prevention for all categories of employees, collaborating to reduce organizational risks (Dufoeur et al., 2020). In addition to these factors, the monitoring of indicators such as the level of occupancy reduces the risk of contagion (Parker, 2020). Regardless, the development of indicators must be evaluated by standardized circumstances (Gallardo et al., 2020).

The organization of workstations considering the safety attributes (S5) allows the risk of transmission of the new coronavirus to be reduced through simple structural changes in the workplace (Spinazzeto et al., 2020; Gallardo et al., 2020). On the other hand, the increasing density of offices and the incentive for shared workstations increase the risks of contamination among employees (Parker, 2020). Therefore, it is essential to carry out planning so that all necessary changes are carried out and in a satisfactory manner (Garzillo et al., 2020).

The actions identified in the literature and found in practice that result in improvements in the safety performance of employees were gathered in Table 2 below.

On the other hand, no studies were identified in the literature that considered the relationship between the practices to combat COVID-19 indicated by WHO that resulted in improvements in the performance related to the safety of employees. Thus, the following research hypothesis (HYPO1) was proposed:

HYPO1: The adoption of practices to combat COVID-19 in the production system has improved performance related to employee safety.

2.3 Actions that result in improvements in occupational health performance

The analysis of the actions related to the improvement of the occupational health performance of the employees of the companies showed that identifying, monitoring, and mitigating biological risks in the workplace (H1) are extremely relevant practices, especially if accompanied by the risk assessment procedures already established in order to analyze whether the prevention and protection measures already adopted adequately control the transmission of the new coronavirus (Spinazzeto et al., 2020; O’Neill, 2020). The establishment of these procedures proved to be a challenge for some companies that did not consider this type of risk assessment (Garzillo et al., 2020). Even so, the return-to-work activities during the pandemic depends on the implementation of the biological cycle management (Jahangiri et al., 2020). In this sense, it is worth emphasizing the importance of providing training ostensibly on the control of biological agents (Gharibi et al., 2020).

In addition, periodically planning and applying an Occupational Health Medical Control Program (PCMSO) (H2) allows companies to implement a series of preventive measures (Jahangiri et al., 2020) to reduce the exposure of workers to the new coronavirus (Dennerlein et al., 2020). Government agencies are responsible for defining the obligation and carrying out inspections (Michaels and Wagner, 2020), while companies are responsible for providing benefits such as medical insurance for their employees (Sonmez et al., 2020). In addition, special measures must be applied to employees over 60 years of age due to the increased risk of developing a more serious version of COVID-19 (O’Neill, 2020).

The analysis and adequacy of washbasins, toilets, and changing rooms to meet the minimum criteria (H3) must also consider the adequate number of bathrooms according to the number of people (Jahangiri et al., 2020). When necessary, social detachment should be imposed in places such as changing rooms (Garzillo et al., 2020). In general, improvements in the infrastructure of these workplaces may be necessary to contain the risks of contagion (Giorgi et al., 2020).

Monitoring the peaks of the absenteeism index individually is another activity that helps to identify problems in the processes that impact the health of employees (H4) and, with this, allows the measurement of the effectiveness of the surveillance mechanisms adopted to control the pandemic. Similarly, the reorganization of the offices resulted in a reduction in absenteeism rates (Parker, 2020). It is noteworthy that employees on sick leave stay at home with financial security while protecting the health of their co-workers (Dennerlein et al., 2020).

In addition, having and maintaining a Technical Epidemiological
Nexus in Social Security (NTEP) helps companies to relate employees’ leave due to COVID-19 with professional functions (H5). The analysis of epidemiological data allows the company to verify whether the containment measures were effective (Garzillo et al., 2020). Likewise, the wide and periodic performance of verification tests of COVID-19, together with the evolution and improvement of these tests, improves the tracking of the disease in the company and offers a safer work environment (Dennerlein et al., 2020). Attributes such as the probability of spreading the virus can take into account vaccinated or already infected employees and their reduced likelihood of contagion (Gallardo et al., 2020). On the other hand, there is no point in having a Technical Epidemiological Nexus in Social Security if the employees are immigrants who pay taxes, but do not participate in social security (Sönmez et al., 2020).

The actions identified in the literature and which led to improvements in occupational health performance were shown in Table 3 below. However, studies that considered the relationship between the practices to combat COVID-19 indicated by the World Health Organization that resulted in improvements in the performance related to the occupational health of employees were also identified. Thus, the following research hypothesis (Hypo2) was proposed:

**Hypo2:** The adoption of practices to combat COVID-19 in the production system improved the performance related to the occupational health of employees.

### Table 3

| Code | Actions that positively affect the performance of occupational health | Authors |
|------|---------------------------------------------------------------|---------|
| H1   | Identify, monitor and mitigate biological risks in the workplace | Garzillo et al. (2020); Gharibi et al. (2020); Jahangiri et al. (2020); O’Neill et al. (2020); Spinazzé et al. (2020) |
| H2   | Plan and implement in a preventive and periodic/emergency manner the OHMCP (Occupational Health Medical Control Program) | Dennerlein et al. (2020); Gallardo et al. (2020); Jahangiri et al. (2020); Michaelis and Wagner (2020); O’Neill et al. (2020); Sönmez et al. (2020) |
| H3   | Have the minimum quantities and criteria for washbasins, toilets and changing rooms | Garzillo et al. (2020); Giorgi et al. (2020); Jahangiri et al. (2020) |
| H4   | Monitor the abscess rate and treat peaks individually in order to identify problems in the processes | Chen et al. (2020); Dennerlein et al. (2020); Parker (2020) |
| H5   | Own and maintain a Social Epidemiological Technical Nexus (SETN) in order to relate accidents and diseases with professional functions | Dennerlein et al. (2020); Gallardo et al. (2020); Garzillo et al. (2020); Sönmez et al. (2020) |

**Fig. 3.** Conceptual model.

### 2.4. Conceptual model

However, there was no identification of studies that related the practices to combat COVID-19 indicated by WHO that result in improvements in the performance related to the occupational health and safety of employees. Thus, the following conceptual model (Fig. 3) was proposed.

### 3. Methods

#### 3.1. Research methods and data collection procedure

The collection of works was made possible by combining the following search terms: COVID-19, Coronavirus, Occupational Health and Safety, Worker Health and Safety, Performance. Six different databases were considered, containing 904 scientific articles published as of March 21, 2021, they are Emerald Insight (621), Science Direct (108), Wiley (92), Taylor & Francis (62), PubMed (12), CAPES (9). On the other hand, it is important to mention that about 75% of the works were discarded because they were repeated.

As presented by Bryman (2016), content analysis is an important step in scientific research to refine theoretical constructs. Thus, through a first content analysis of 227 works in the fields of summary, title, and keywords, 42 relevant works can be reached. Then, a new more detailed content analysis was carried out, with consideration of the full content of the articles, filtering for 26 articles considered in this work. This last stage also made it possible to identify, for example, works that did not deepen the combat practices of COVID-19 or that did not detail the effects on occupational safety and health.

From the systematic review of the literature and the definition of research hypotheses, it was possible to follow Forza’s (2002) methods for conducting the survey. The first step was the elaboration of the research instrument for this work and, subsequently, this material was validated and adjusted by specialists. In this way, >300 Brazilian multinational companies were researched and selected. Each received the questionnaire with the proper documentation explaining the research. After 6 weeks of follow-up, 102 completed and validated questionnaires were received.

The research instrument used in this work was a structured questionnaire that made it possible to collect field information (Bryman, 2016). The instrument for measuring responses used the Likert scale of grade five, as it allows a clear interpretation of the levels of agreement for each proposed statement (Likert, 1932).

The minimum sample size was determined through the calculation performed by the G*Power 3.1.9.7 software according to the parameters proposed by Cohen (1988). For this, the effect size was 0.15 as it is considered appropriate to the type of this research (Hair et al., 2016). According to the proposal by Faul et al. (2009), the level of significance considered was 0.05 and the power of the test was 0.80. This was possible because scientific research has a greater risk of committing type I error, that is, rejecting the true hypothesis, than of accepting the false hypothesis.

#### 3.2. Data analysis procedure

In possession of the data, the quality of this information was assessed along with the relationship between the variables and the performance of the data treatments (Hair et al., 2006). Then, normality was tested using the Kolmogorov-Smirnov test, since it does not depend on the cumulative distribution function and has no restrictions on the sample size (Triola, 2008).

The analysis of the validity of the constructs and the structural model was performed using Structural Equation Modelling (SEM) to understand the relationships between constructs made up of multiple indicators (Hair, 2009). In addition, Partial Least Squares (PLS) was also used because the nature of this work is exploratory (Hair et al., 2019).
Table 4
The nine steps for calculating the path coefficient.

| Stages | Description | Criteria | References |
|--------|-------------|----------|------------|
| 0      | Minimum sample size | Test Power > 0.8 | Cohen (1988); Hair et al. (2016) |
|        |             | Effect Size > 0.15 | Faul et al. (2009); Hair et al. (2015) |
| 1      | Average Variance Extracted (AVE) by convergent validity | AVE > 0.5 | Henseler et al. (2009); Ringle et al. (2015); Hair et al. (2019) |
| 2      | Cross-loads by discriminant validity | Correlation values are higher than other relations | Chin (1998); Ringle et al. (2015); Sarstedt et al. (2016); Hair et al. (2019) |
| 3      | Fornell and Larcker test by discriminant validity | Square roots of AVEs > correlations of constructs | Fornell and Larcker (1981); Ringle et al. (2015); Hair et al. (2019) |
| 4      | Cronbach’s Alpha (AC) and Composite Reliability (CC) | AC > 0.7; CC > 0.7 | Henseler et al. (2009); Ringle et al. (2015); Hair et al. (2016); Hair et al. (2019) |
| 5      | Evaluation of Pearson’s coefficients of determination (R^2) | Small: R^2 > 0.25; Moderate: R^2 > 0.49; High: R^2 > 0.75 | Ringle et al. (2015); Hair et al. (2016); Hair et al. (2017); Hair et al. (2019) |
| 6      | Effect size (f^2) or Cohen indicator | f^2 > 0.02 small; f^2 > 0.15 moderate; f^2 > 0.35 high | Ringle et al. (2015); Hair et al. (2016); Hair et al. (2017); Hair et al. (2019) |
| 7      | Predictive Validity (Q^2) or Stone-Geisser Indicator | Q^2 > 0 small acc. | Hair et al. (2016); Hair et al. (2019) |
|        |             | Q^2 > 0.25 moderate acc. | Hair et al. (2015); Hair et al. (2016); Hair et al. (2019) |
|        |             | Q^2 > 0.5 high acc. | Hair et al. (2015); Hair et al. (2016); Hair et al. (2019) |
| 8      | Student’s t test (bootstrapping) | t ≥ 1.96 (H0: λ = 0 and Γ=0) | Ringle et al. (2015); Hair et al. (2016); Hair et al. (2017); Hair et al. (2019) |
| 9      | Path coefficient (f) | Evaluation of causal relations in the light of the literature | Hair et al. (2015); Hair et al. (2016); Hair et al. (2019) |

The analysis carried out using SEM allows a better understanding of the practical variables while it is a fast and low-cost method (Kotz et al., 1982). Furthermore, PLS makes it possible to treat problems with the effects of collinearities (Geladi and Kowalski, 1986) and, by balancing the information and a calibration model, this method reduces the impacts of large variations (Martens and Naes, 1989).

On the other hand, recent studies such as those by Vandenberg (2006), Rönkkö et al., (2016), and Rönkkö and Evermann (2013) warned about the flexibility of applying the PLS methods resulting in the extrapolation of results, as well as in the overestimation of capabilities of the method resulting in mistaken analyses. Therefore, the limitations must be respected and the use of the PLS method must be properly justified. The combined application of PLS and SEM methods is a more robust alternative when compared to the isolated application of PLS (Rönkkö et al., 2016).

On the other hand, the isolated application of PLS must be respected and the use of the PLS method must be properly justified. The combined application of PLS and SEM methods is a more robust alternative when compared to the isolated application of PLS as shown in the nine steps in Table 4.

From the path coefficient calculations, it was possible to test the hypotheses and, if confirmed, this work intends to deepen the analysis to identify which health and safety variables are best related to the practices to combat COVID-19, as shown in Fig. 4.

Therefore, Spearman’s correlation test was defined because it can be applied when the distribution does not respect normality. The results of the Spearman test vary between –1 and +1 (Fig. 5); values closer to the ends represent strong correlations and values close to zero represent weak correlations (Spearman, 1922; Fowler, 1987).

This study considered the parameters defined by Cohen (1988) regarding the intensities of the correlations: values between 0.10 and 0.29 are considered weak, while those registered between 0.30 and 0.49 are classified as moderate and those above 0.50 as strong.

4. Results and discussion

4.1. Model evaluation

The evaluation of the model in relation to the data collected was obtained using the Smart PLS 2.0 M3 software. The first step was the calculation of the convergent validity to analyse the factorial loads (λ) and the values of the Average Variances Extracted (AVE). For the convergent validity to be ratified, the measurement model was adjusted for the extraction of variable by variable. To ensure convergent validity, adjustments to the measurement model were made and were only possible by removing the variable referring to the aspect “having and disclosing safety indicators to all employees” (S4).

This was because the practices to combat COVID-19 established by WHO did not affect the routine or procedures of the responding companies when the point assessed was the disclosure of safety indicators. In other words, companies that were not used to disclosing indicators to their employees (number of days without accidents with leave, for example), were not motivated to start this disclosure.

Fig. 6 shows the loads of each variable after adjusting the measurement model.

The evaluation of the discriminant validity through the analysis of the factorial load indicators and the square root of the stroke was carried out in sequence. For this, the factor load indicators were analysed to verify if they were larger in their constructs than in relation to the other indicators (Chin, 1998). Table 5 presents the results of this analysis and validates this step.

The next step was to analyse the results of the square roots of the AVE values for each construct. These values were compared with Pearson’s correlations between latent variables. For the model to be valid, the roots must be larger than the correlations (Fornell and Larcker, 1981) - they are shown in the main diagonal of Table 6.

After confirming the discriminant and convergent validities, the values of Composite Reliability (CR) and Cronbach’s Alpha (CA) were calculated. As CR and CA were higher than 0.70, it was confirmed that the model is reliable for data evaluation.

The variance portion of the endogenous variables by assessing
Pearson’s coefficients of determination (R Square) between the two input constructs was also verified. It is worth explaining that this is the reason why the value of the output construct (CombatCOVID-19) is not shown. The calculations of the R Square results for the WorkSafetyPerf construct were 0.563610 (56.36%) and for OccHealthPerf, 0.271075 (27.11%), as shown in Table 7. That is, the CombatCOVID-19 output construct has a great effect on performance Occupational Health and Safety at Work.

The next step was the calculation of the Predictive Validity assessments ($Q^2 > 0$), also known as the Stone-Geisser indicator, which allows assessing the accuracy of the adjusted model. In addition, the effect size ($f^2 > 0.35$) was also calculated, also known as Cohen’s indicator and which allows assessing how much each construct is relevant to the model’s adjustment (Hair Jr. et al., 2016). According to the values presented in Table 8, the predictive validity and the size of the effect are of high importance for the conceptualized model.

Finally, the significance of the correlations and regressions was evaluated. For this purpose, the model adjusted in bootstrapping mode and the Student’s test was generated. Fig. 7 validates the significance of the model since the $t > 1.96$ (Hair Jr. et al., 2016).

In this way, it was possible to confirm that hypotheses 1 and 2 were validated. That is, the practices to combat COVID-19 positively influenced the performance of worker safety (HYPO1) and the performance of occupational health (HYPO2). From this important result, it was identified the need to deepen the investigation to detail which performances were most driven by the practices of combating COVID-19.
Table 5
Analysis of factorial loads.

| CombatCOVID-19 | WorkSafetyPerf | OccHealthPerf |
|----------------|----------------|---------------|
| COV1           | 0.758685       | 0.535592      | 0.411870       |
| COV2           | 0.877850       | 0.660499      | 0.483307       |
| COV3           | 0.840036       | 0.646204      | 0.465739       |
| COV4           | 0.852781       | 0.683604      | 0.472419       |
| COV5           | 0.756845       | 0.521738      | 0.256307       |
| S1             | 0.491547       | 0.660666      | 0.601195       |
| S2             | 0.723954       | 0.883400      | 0.481670       |
| S3             | 0.600493       | 0.788842      | 0.338579       |
| S5             | 0.558204       | 0.850386      | 0.518951       |
| H1             | 0.448506       | 0.461514      | 0.856275       |
| H2             | 0.427335       | 0.576062      | 0.814419       |
| H3             | 0.268902       | 0.488329      | 0.769411       |
| H4             | 0.410155       | 0.364061      | 0.706898       |
| H5             | 0.470932       | 0.490677      | 0.841210       |

Table 6
Discriminant validity.

| CombatCOVID-19 | OccHealthPerf | WorkSafetyPerf |
|----------------|---------------|---------------|
| CombatCOVID-19 | 0.818772      |               |
| OccHealthPerf  | 0.520649      | 0.799477      |
| WorkSafetyPerf | 0.750740      | 0.593745      | 0.801478       |

Table 7
Adjusted quality values.

|                  | AVE Composite Reliability | R Square | Cronbach’s Alpha |
|------------------|---------------------------|----------|-----------------|
| CombatCOVID-19   | 0.670387                  | 0.910163 | 0.876691        |
| WorkSafetyPerf   | 0.647536                  | 0.876660 | 0.563610        | 0.810768       |
| OccHealthPerf    | 0.639164                  | 0.898127 | 0.271075        | 0.858713       |

Table 8
Predictive validity (Q^2 and effect size (f^2)).

|                  | Q^2   | f^2   |
|------------------|-------|-------|
| CombatCOVID-19   |       | 0.502928 |
| WorkSafetyPerf   | 0.347499 | 0.409414 |
| OccHealthPerf    | 0.154636 | 0.456542 |

4.2. Results and discussion of the relationship between COVID-19 combat practices and worker safety performance

Likewise, the investigation was deepened to detail, through Spearman’s correlation test, which worker safety performances (HYPO1) were most driven by the practices to combat COVID-19. These results are shown in Table 9 below.

The practices to combat COVID-19 from COV1 (provision of water and soap or 70% alcohol for hand hygiene, form of self-declaration of symptoms, measurement of body temperature, and distribution of surgical facial masks), positively and strongly influence the practices worker safety related to conducting on-the-job training (S1; 0.5757), providing and verifying the use of PPE (S2; 0.7684) and implementing a risk management program (S3; 0.5242). These results corroborate the research by Dufour et al. (2020), Gibbs and Nonnenmann (2020), Gharibi et al. (2020) and Jahangiri et al., 2020 who point out the importance of providing personal protective equipment, neutral detergents, and hospital disinfectants - and training for their correct use - for the proper fight against the pandemic. Additionally, these results corroborate the research by Dennerlein et al. (2020) who identified that risk management is an important tool for companies to determine the actions that should be prioritized, such as the provision of soap and water or respirators. Therefore, this work contributes to the theory by demonstrating that there is, indeed, a relationship between the availability of water and soap, 70% alcohol, and protective equipment with the realization of the training, verification of the correct use and management of the risks of infection by the new coronavirus. In the same way, practical contributions are recorded for the managers of the companies by emphasizing that on-the-job training and risk management programs are fundamental for investments in protective equipment and sanitizers to result in the expected effect.

The group of actions to fight against COVID-19 that mentions safe distance between workers (COV2) had a positive influence and with a strong intensity with training (S1; 0.5696), with the implementation of a risk management program (S3; 0.6595) and the organization of workplaces safely (S5; 0.5905). These results corroborate the research by Demartini et al. (2020), Gharibi et al. (2020), and Parker (2020) who highlight the importance of putting social distance into practice and guiding employees, customers, and service providers. In addition, Garzillo et al. (2020) state that government agencies are having difficulty providing guidance on risk management programs, even if the social distance is proven to be effective. Finally, this work also confirms the research by Gallardo et al. (2020), which points out that simple structural changes in the workplace are capable of reducing the risk of transmission of the new coronavirus or even implementing the home office. Therefore, this work is configured as a contribution to the theory as it presents the relationship between social distance and training, risk management, and organization of jobs. Likewise, there are contributions to the practice when registering for those responsible for companies that adapting jobs to provide social distance depends on training and makes it possible to manage the risks of contamination.

Combating COVID-19 practices that addresses measures to distribute the workforce throughout the day, that is, in different shifts (COV3), had a positive influence and with strong intensity with the implementation of a risk management program (S3; 0.6328) and organization of workplaces safely (S5; 0.6717). These results corroborate the research by Dufour et al. (2020) and O’Neill (2020) who indicate that opening new shifts or reducing the number of employees per shift can help companies reduce the risk of contamination. However, there is a lack of a temporary emergency pattern that standardizes the adoption of a risk management program. This work also corroborates the research by Parker (2020) that highlights the need to reduce the density in offices and workplaces, being the distribution in work shifts a way to reduce social contacts. Therefore, this work contributes to the theory by confirming the relationship between distributing employees throughout the day and the organization of jobs. There are also contributions to practice in demonstrating to company managers that opening new shifts to reduce the risk of contamination depends on the adequacy and standardization of workplaces and the adoption of a risk management program.

Prevention activities that relate to the disinfection of workstations between shifts or whenever there is a need (COV4), had a positive influence and with strong intensity with the implementation of a risk management program (S3; 0.6229) and organization of workplaces safely (S5; 0.7043). These results confirm the research by Dennerlein et al. (2020) and Ndiaye and Diatta (2020), which reinforce that clean and well-ventilated environments reduce the risk of infection and are quick measures to be adopted by companies and, even if adaptations of the workplace are necessary, Spinazzé et al. (2020) point out that such a measure is simple and quick to adopt. In addition, Michaels and Wagner (2020) and O’Neill (2020) note that water or respirators. Therefore, this work contributes to the theory by demonstrating that there is a relationship between cleaning and the organization of workplaces with safety and the management of contagion risks. Practical contributions arise in the context of simple changes to workplaces to facilitate and maximize hygiene actions and allow management of SARS-VOC-2 contamination...
The practice of combating COVID-19 that emphasizes emergency care for suspected or confirmed cases (COV5) had a positive influence and with strong intensity with the realization of on-the-job training (S1; 0.5051) and with the implementation of a program risk management (S3; 0.5994). These results corroborate with the research by Gibbs and Nonnenmann (2020) who emphasize the importance of providing N95 type masks for professionals who need to have contact with people infected with the new coronavirus and conduct training to explain the importance of this equipment to reduce the risk of contamination. These results also corroborate with the research by Garzillo et al. (2020), which mentions that it is important for companies to inform the competent governmental bodies if any employee is infected by the new coronavirus, specifying the measures taken and where it was sent, in addition to reinforcing that the company’s risk management program must have a channel of communication with the program of government authorities. Therefore, this work contributes to the theory by presenting the relationship between the adoption of an emergency plan and the provision of training and the adoption of a risk management program. In addition, there are practical contributions for company executives, since it is evident the importance of conducting training to adopt an emergency pandemic control plan, in the same way that it is necessary to carry out risk management.

4.3. Results and discussion of the relationship between COVID-19 combat practices and occupational health performance

The Spearman correlation test, shown in Table 10 below, was selected to analyze the correlations between practices to combat COVID-19 and occupational health performances (HYPO2). The practices to combat COVID-19 from COV1 (provision of water and soap or 70% alcohol for hand hygiene, self-reported symptoms form; body temperature measurement; personal protective equipment in terms of surgical face masks), positively and strongly influence the practices worker safety occupational health performance related to the identification, monitoring and mitigation of biological risks in the

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**Table 9**

| Spearman’s Correlation Test | COVID-1 | COVID-2 | COVID-3 | COVID-4 | COVID-5 |
|----------------------------|---------|---------|---------|---------|---------|
| Relation between practices | Make available to its employee’s resources against COVID-19 such as hand hygiene using water and soap or 70% alcohol; self-reported symptoms form; body temperature measurement; personal protective equipment in terms of surgical face masks. | Organize the workplace to maintain a safe distance (1.5 m) between workers, considering the guidelines of the Ministry of Health and the characteristics of the work environment. | Prioritize measures to distribute the workforce throughout the day, avoiding concentrating it in just one shift. | Disinfect workplaces and common areas between shifts or whenever a worker is designated to occupy another person’s job. | Provide emergency care to suspected or confirmed cases of COVID-19, considering the use of PFF2 or N95 respirators or masks. |
| S1: Conduct on-the-job training | 0.5757 | 0.5696 | 0.3897 | 0.4800 | 0.5051 |
| S2: Provide, control and verify the use of PPE (Personal Protective Equipment) | 0.7684 | 0.4624 | 0.4642 | 0.4980 | 0.4621 |
| S3: Implement and maintain a PGR (Risk Management Program) | 0.5242 | 0.6595 | 0.6328 | 0.6229 | 0.5994 |
| S5: Workstation organization with security | 0.4349 | 0.5905 | 0.6717 | 0.7043 | 0.4690 |
workplace (H1; 0.6201) and the provision of the minimum number of washbasins, toilets and changing rooms (H3; 0.5195). These results corroborate the research by Giorgi et al. (2020) that point to the need for investments to face the pandemic (for example, the acquisition of more effective masks, thermometers, or even, as presented by Garzillo et al. (2020), alteration of living spaces as a way to impose social distance). It is important to mention the research by Spinazzè et al. (2020) and O’Neill (2020) who highlight the need to verify whether the measures adopted actually control the transmission of the new coronavirus while justifying the investments made. Therefore, this work contributes to the theory by demonstrating that it is necessary to justify the measures included in COV1 and also with the practice by demonstrating that, in the same way, it is necessary to justify that the investments made are reducing the risks to the employees’ health performance and, consequently, avoiding costs.

The practice of combating COVID-19 that mentions the safe distance between workers (COV2) had a positive influence and with a strong intensity with the identification, monitoring and mitigation of occupational health and accidents with disorders or diseases with occupational health (H1; 0.6099). This result confirms the research by Dennerlein et al. (2020) and Spinazzè et al. (2020), in which practical measures to reduce the biological risks of transmission by separating the hours of coexistence between employees, service providers, and customers were pointed out. According to Parker (2020) and Garzillo et al. (2020), an additional relevant measure is to avoid the contact of people from different shifts in order to, in case of contagion of one of the employees, contain the contamination only in the people of that shift, without the entire production line or a whole department being affected. This work, therefore, contributes to the theory by finding that separating employees into shifts has a direct relationship with the control of COVID-19 contamination. Likewise, it brings practical contributions as it shows the managers of the companies the importance of creating bubbles for employees from different shifts.

COV4, the practice of combating COVID-19 that relates to the disinfection of workstations between shifts or whenever there is a need, presented a positive influence and with strong intensity with the identification, monitoring, and mitigation of biological risks in the workplace (H1; 0.5353). This result corroborates the research by Jahangiri et al. (2020) and Gallardo et al. (2020), who mentions that cleaning and disinfection routines are important activities for the control of biological risks in the workplace, especially those already identified as having the highest risk. Complementarily, this result is in line with Spinazzè et al. (2020), who points out that the already established measures for the control and mitigation of biological risks must be analysed together with the cleaning and disinfection routines already applied. This work, therefore, contributes to the theory by verifying the relationship between cleaning and disinfecting workstations with the control and mitigation of biological risks. In addition, there are practical contributions to highlight for company executives that it is important to analyze whether the cleaning and disinfection procedures already adopted are effective in controlling biological risks.

The activities to combat COVID-19 that emphasize emergency care for suspected or confirmed cases (COV5) had a positive influence and

Table 10
Relation between practices of combat COVID-19 and occupational health performance

| Spearman’s Correlation Test | COVID-1 | COVID-2 | COVID-3 | COVID-4 | COVID-5 |
|----------------------------|---------|---------|---------|---------|---------|
| Make available to its employee’s resources against COVID-19 such as hand hygiene using water and soap or 70% alcohol; self-reported symptoms form; body temperature measurement; personal protective equipment in terms of surgical face masks. | 0.6201 0.6099 | 0.5409 0.5353 | 0.3963 0.4756 | 0.4738 0.5097 | 0.3295 0.5006 0.5065 |
| Organize the workplace to maintain a safe distance (1.5 m) between workers, considering the guidelines of the Ministry of Health and the characteristics of the work environment. | 0.5195 0.3366 | 0.3864 0.4696 | 0.4942 0.4948 | 0.4691 0.4579 | |
with strong intensity with the planning and application of an OHMCP (H2; 0.5097), monitoring the absenteeism index of the individual form (H4; 0.5006) and the maintenance of a SETN (H5; 0.5065). This result is in line with O’Neill’s research (2020), which determines that it is the company’s responsibility to transport symptomatic employees to specialized hospitals, in addition to maintaining monitoring and special care for employees over the age of 60 and classified in risk groups. Thus, to make these requirements feasible, companies need to develop and execute a robust plan. Additionally, the research by Dennerlein et al. (2020) states that the preventive screening of the disease depends on the wide and periodic testing of COVID-19 and the control so that employees with suspected contamination are removed so that the health of their colleagues is preserved. Finally, this work corroborates the research by Sönmez et al. (2020) who asked that the company that seeks to implement a technical epidemiological nexus of social security must consider that all of its employees are correctly employed and linked to social security. Therefore, this work contributes to the theory by realizing that the obligation to provide an adequate referral for suspicious cases is related to activities related to the application of occupational health plans, individualized monitoring, and crossing with social security information. And, in addition, it also brings contributions to the practice by confirming that company executives need to pay special attention to their employees in risk groups and to arrange for the correct hiring of their employees so that they can benefit from social security. When hiring is not possible, executives must ensure that a contingency plan will not leave their outsourced employees unattended the moment they need to be taken in the fight against the pandemic of the new coronavirus. In this way, future research can individually explore these relationships and fill those gaps.

In the same way, this paper contributes to the practice by presenting to those responsible for companies how the five activities to combat COVID-19 improve the performance of occupational health and safety of employees, as shown in Fig. 6. In this way, future research can study application cases to further investigate the relationships found here.

Finally, this work also contributes to society by providing knowledge about the benefits that companies can obtain by adopting practices to combat COVID-19, mainly boosting the safety and occupational health performance of employees. With this, tools have alluded for society to pressure companies to adopt such practices and to support future research to explore these relationships and the organizational effects in companies in more detail.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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