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Moderating effect of OHS actions based on WHO recommendations to mitigate the effects of COVID-19 in multinational companies

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Abstract

The objective of this study was to evaluate the moderating effect of Occupational Health and Safety actions based on the World Health Organization (WHO) recommendations to mitigate the negative effect of COVID-19 on the operational, logistical, marketing (OLMP), and health and safety performance (OHSP) of workers in multinational industries. The development of surveys in companies was the method adopted, which had confirmatory evaluations through Structural Equations Modelling (SEM). As a result, it was confirmed that this is one of the few scientific studies that expectedly validates that the COVID-19 pandemic has severely impacted operational, logistical, market, and Occupational Health and Safety (OHS) performance. This is also one of the few research projects to assess the moderating effect of OHS practices based on WHO to mitigate the effects of COVID-19. According to our findings, those practices were able to reduce by at least 50% the effect of the COVID-19 crisis on operational, logistical, and marketing performance. However, they minimize by only 1.8% the negative effects of health and safety performance for the worker, generating absenteeism increasing due to physical and mental problems. This number could be higher if the social distance could be provided in public transportation and if employees were more aware of the risks of COVID-19 contamination during their social activities.

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1. Introduction

The COVID-19 pandemic is still in full growth worldwide, due to the potential for transmission and mutations that New Coronavirus demonstrates. Generating severe acute respiratory syndrome (Zuin et al., 2021; Mandal et al., 2021), the virus negatively affects the world economy (Parker, 2020). As a result, negative effects have infiltrated industries, including low operational performance in terms of productivity (Jahangiri et al., 2020; Sönmez et al., 2020), quality (Dufour et al., 2020) and costs (Godderis and Luyten, 2020); reduced logistical performance (Garzillo et al., 2020); losses in market performance, reducing sales (Gallardo et al., 2020; Godderis and Luyten, 2020).

Related to the Occupational Health and Safety area - COVID-19 is highly contagious and lethal in the workplace (Semple and Cherrie, 2020) and can be transmitted during the performance of the normal functions of an employee’s working day (Spinazzé et al., 2020; Sorensen et al., 2021). It is noteworthy that the COVID-19 pandemic harms not only physical health but also the psychological resources and resilience of employees, causing impacts on mental health (Giorgi et al., 2020; Sarbadhikari and Pradhan, 2020) and on the safety of employees (Michaels and Wagner, 2020; De Cieri and Lazarova, 2020) in terms of uncertainties about the effectiveness of the actions taken (Charibi et al., 2020; Dennerlein et al., 2020). Industries are not prepared to fight the COVID-19 pandemic, making this a significant challenge for the Occupational Health and Safety area (Charibi et al., 2020; Garzillo et al., 2020).
In this context, companies’ Occupational Health and Safety areas are implementing actions to minimize the effect of COVID-19 on the industry, according to Table 1. These guidelines are based on the World Health Organization (WHO) protocol, which includes a redesign of work areas to avoid crowding and allow employees to maintain a physical distance of 1.5 m between them, implementation of new work shifts, personal protective equipment with the use of masks and respirators, temperature measurement, hand hygiene with water, soap and hand sanitizer, and facilities suitable for washing and disinfecting potentially contaminated surfaces (Michaels and Wagner, 2020; Ndiaye and Diatta, 2020; O’Neill, 2020).

No research has been identified to assess the moderating effect of Occupational Health and Safety Practices (OHS) based on WHO to mitigate the effects of COVID-19 on companies’ operational, logistical, marketing (OLMP) and health and safety performance (OHSP). Thus, according to Table 1, there are few studies that link OHS with COVID-19, most of which are exploratory in nature: (i) twelve are literature review works with analyses, for example, of research on occupational therapy (Barroso et al., 2020), works in the health field (Demartini et al., 2020), determination of OHS-related terms with publications from the last twenty years (Kiran, 2020) and presentation of a conceptual model that deals with the changes in work caused COVID-19 (Sorensen et al., 2021); (ii) four editorials (Charibi et al., 2020; Godderis and Luyten, 2020; Michaels and Wagner, 2020; Sarbadhikari and Pradhan, 2020); (iii) two surveys using literature review and document analysis (one surveyed the American hospitality industry (Sönmez et al., 2020) and the other conducted analysis of publications on practices to combat COVID-19 for use in the OHS area) (O’Neill, 2020); (iv) an interview in the American cannabis legal industry (Otañez and Grewal, 2021); (v) an interview with documentary analysis in Italian companies (Spazzè et al., 2020); (vi) a documentary analysis in Thai hospitals (Chen et al., 2020); (vii) a case study in a Spanish company (Gallardo et al., 2020); (viii) two exploratory surveys (one using descriptive statistics to assess the response capacity of Italian companies to OHS emergencies (Garzillo et al., 2020) and the other to propose a simple tool for health professionals in Africa to detect cases of COVID-19 among workers in the formal sector (Ndiaye and Diatta, 2020); and (ix) only two surveys with confirmatory data assessment, one with an assessment of influences to minimize the transmission of the new coronavirus in South Africa with the use of the Partial Least Squares Structural Equation Modeling (PLS-SEM). Rukuni et al. (2020) concluded that the adoption of OHS practices reduced the transmission of COVID-19 in a municipality in South Africa and Oliveira Neto et al., 2021, using PLS-SEM, assessed the performance of the occupational health and safety areas concerning practices to combat COVID-19 established by WHO, without evaluating the moderating effect of WHO-based OHS actions to mitigate the Impacts of COVID-19 (1). Thus, these surveys did not assess the moderating effect of WHO-based OHS actions to mitigate the Impacts of COVID-19 on the Company (ICC) (as seen on Fig. 1), denoting the research gap of our study.

This allows the proposition of the following research question: Do the OHS actions implemented based on the guidelines indicated by WHO moderate (minimize the negative effect) of COVID-19 on the operational, logistical, market, and health and safety performance of multinational industries? The objective of this study was precisely to assess the moderating effect of these actions and to seek answers to this question.

2. Literature review and hypothesis development

In this section, OHS actions will be based on WHO guidelines and the negative impacts of COVID-19 on operational, logistical, and marketing performance and the OHS area. The keywords used to search the papers were: “COVID-19” OR “New coronavirus” OR “Coronavirus” OR “SARS-COV-2” AND “Operational performance” OR “Market performance” OR “Logistics performance” OR “Occupational safety and health” OR “Occupational safety” OR “Occupational health” OR “Worker’s health and safety” OR “Worker’s health” OR “Worker’s safety”. Scopus, Emerald, Science direct, Wiley library, Taylor & Francis and Google Scholar databases were considered. As a result, 87 papers were identified. Next, a content analysis was performed, resulting in 26 papers that relate OHS to COVID-19, as shown in Table 1.

2.1. Negative impacts of COVID-19 on the company’s operational, logistical, and marketing performance

Some studies have found that the industrial sector has been heavily affected by the Coronavirus pandemic (ICC-1). De Cieri and Lazarrova (2020) concluded that COVID-19 generates disaster in the business sector with implications for employers, employees, and the global economy. Indeed, it generates increased costs and lost productivity. Godderis and Luyten (2020) and Parker (2020) found that industries are investing resources in the OHS area to face COVID-19, with a greater impact on human life and economies, harming companies as well. Sönmez et al. (2020) concluded that the economic devastation of COVID-19 impacts on tourism and hospitality industry, reflecting on the reduction in sales volume and loss of market share. Garzillo et al. (2020) indicated negative impacts on purchases, supply, and distribution in the automotive sector, including delays in delivery from suppliers, automakers, and dealerships, affecting customers.
Other studies concluded that companies were strongly impacted by the COVID-19 (ICC-2) pandemic, which undermined operational, logistical, and market performance. Dufour et al. (2020); Charibbi et al. (2020); Gallardo et al. (2020) discussed the adoption of OHS in companies to face COVID-19, since the economic consequences of lockdowns generate intolerable and irretrievable damage, causing marketing and behavioral problems for employees. Jahangiri et al. (2020) added that closing of non-essential businesses to confront COVID-19 had negative consequences for the global economy, production, and employment. Michaels and Wagner (2020) found that American companies face a massive worker safety crisis, affecting operational productivity. Rukuni et al. (2020) found a positive and significant impact on employee performance to ensure productivity, quality, and control of production costs in the pandemic.

Some surveys also mentioned the impacts of the pandemic on suppliers (ICC-3) and the subsequent effect on company performance. Garzillo et al. (2020) mentioned that it was necessary to prevent employees contaminated with COVID-19 to avoid disruptions in the delivery of goods to automakers and customers in the Italian automotive industry. Parker (2020) mentioned how the accelerated contamination damaged the performance of companies throughout the supply chains. Godderis and Luyten (2020) corroborate that maintaining health and safety conditions in the work environment after the lockdowns of COVID-19 is a significant challenge for the OHS area and indicate. It was also found that competitors were strongly affected by the COVID-19 pandemic (ICC-4), denoting the global business problem resulting from government restrictions and the loss of employees due to absenteeism or even death. Godderis and Luyten (2020) emphasized that the pandemic caused a global economic recession with loss of market share for many companies, mainly in foreign trade. Parker (2020) adds that currently, to survive, companies are adopting management strategies that deal with prioritization between OHS and financial returns, weakening the basis for competition.

Other studies indicate that the performance of companies was strongly impacted by the reduction in demand caused by the pandemic of COVID-19 (ICC-5). This was because, even with the OHS action to minimize the contamination of COVID-19, the contagion was accelerated and affected the consumption of society/customers due to the generalized lockdowns of non-essential businesses (Garzillo et al., 2020; Parker, 2020). Godderis and Luyten (2020) concluded that “a global economic recession is expected as a result of COVID-19”, indicating a considerable drop in society’s purchasing power for goods and services.

Other work indicated that some factories have suspended their activities due to the pandemic of COVID-19 (ICC-6). Garzillo et al. (2020) and Jahangiri et al. (2020) found that restrictions and forced closing of work activities represent significant economic losses (reduced productivity and increased costs) across the country. Giorgi et al. (2020) complemented that the pandemic harmed the mental health of citizens and workers and negatively affected productivity due to stress and loss of concentration. Barroso et al. (2020) corroborate the need to perform occupational therapy on employees, especially for those working in the health service area. Otañez and Grewal (2021) found that the adoption of OHS is essential in the

| Authors | Sector | Country | Methodology | OHS actions based on WHO Recommendations | Negative impact of COVID-19 on the company | OLMP 1 - Negative effect on operational performance | OLMP 2 - Negative effect on logistics performance | OLMP 3 - Negative effect on market performance | OHSPP 1 - Negative effect on employee health performance | OHSPP 2 - Negative effect on employee safety performance |
|---------|--------|---------|-------------|------------------------------------------|------------------------------------------|------------------------------------------|------------------------------------------|------------------------------------------|------------------------------------------|------------------------------------------|
| Barroso et al. (2020) | Non-essential | Brazil | Literature review | OHS-1: Prevention measures of personal hygiene OHS-2: Social distancing OHS-3: Pandemic preparedness | x | x | x | x | x | x | x | x |
| Chan et al. (2020) | Essential | China | Literature review | OHS-1: Personal hygiene OHS-2: Social distancing OHS-3: Pandemic preparedness | x | x | x | x | x | x | x | x |
| Dufour et al. (2020) | Essential | Canada and USA | Literature review | OHS-1: Personal hygiene OHS-2: Social distancing OHS-3: Pandemic preparedness | x | x | x | x | x | x | x | x |
| Garzillo et al. (2020) | Essential | Italy | Literature review | OHS-1: Personal hygiene OHS-2: Social distancing OHS-3: Pandemic preparedness | x | x | x | x | x | x | x | x |
| Otañez and Grewal (2021) | Essential | Peru | Literature review | OHS-1: Personal hygiene OHS-2: Social distancing OHS-3: Pandemic preparedness | x | x | x | x | x | x | x | x |

Table 1
OHS actions based on WHO guidelines, impacts on the company, negative effects on operational, logistical, marketing, and occupational health and safety performance.
workplace to avoid contamination, but not enough to keep the company open amid a pandemic.

In this context, hypothesis 1 suggests that:

**H1: Covid-19 outbreak has a negative effect on companies’ performance.**

As pointed out in Table 1, the OHS areas of several companies adopted the WHO protocol, concluding that minimizing the transmission of COVID-19 has a positive and significant impact on the company’s performance (Rukuni et al., 2020). Also, there are many possibilities that OHS actions contribute to mitigating negative consequences and, thus, facilitate safe transitions to a post-corona era (Goderis and Luyten, 2020) either through information, education and communication to workers about the biological risks of COVID-19 (Ndiaye and Diatta, 2020; Sarbadhikari and Pradhan, 2020) or through the adoption of OSHA to reverse the spread of COVID-19 and reduce risk to workers (Michaels and Wagner, 2020). Consequently, industry managers had to deal with biological hazards in the workplace (Jahangiri et al., 2020; Parker, 2020), which leads to hypothesis 2:

**H2: Covid-19 outbreak effects on companies’ performance are moderated by the adoption of OHS.**

### 2.2. OHS-performance impacts on organizations related to the COVID-19 outbreak

Some studies mentioned the worsening of the company’s performance during the COVID-19 pandemic concerning the occupational health indicators of employees (biological risks of contamination, absenteeism, number of notifications to the social security epidemiological control) and the impacts on the medical control program of occupational health (OHSP-1).

Difficulties were identified in identifying, monitoring, and mitigating biological risks in the workplace. Spinazzê et al. (2020), Dufour et al. (2020) and Oliveira Neto et al. (2021) concluded that it is a challenge to control COVID-19 in the work environment through prevention and protection measures based on the analysis of body temperature, a social distance of 1.5 m, and surgical mask. Garzillo et al. (2020) and O’Neill (2020) also agree that assessing biological risks is a challenge. Jahangiri et al. (2020) corroborate that the management of the biological cycle can control the risk of coronavirus infection and provide a good strategy to support the return of employees to work, including to training for the use of personal protective equipment (Gharibi et al., 2020).

There was also a lack of planning for the Occupational Health Medical Control Program (OHMCP) focused on the symptoms of COVID-19, because it is important to increase the frequency of the test (Gallardo et al., 2020; Michaels and Wagner, 2020) with special care with the OHMCP for employees over 60 years (O’Neill, 2020). This should be made in a preventive manner (Jahangiri et al., 2020) to reduce workers’ exposure (Dennerlein et al., 2020). Thus, it would be essential to provide additional benefits for the employees, such as medical insurance paid by the company (Sönmez et al., 2020).

Another critical aspect is the lack of information on the number of notifications to the social security epidemiological control per employee on leave due to COVID-19 contamination, as mentioned by Garzillo et al. (2020) and Oliveira Neto et al. (2021). Dennerlein et al. (2020) concluded that this information is vital for improving tests and greater control in the workplace. Gallardo et al. (2020) indicated that vaccinated employees are likely to have a lower risk of...
contagion. Sönmez et al. (2020) complement that companies should stick to social security epidemiological information, including that referring to foreign employees.

The increase in the absenteeism of employees contaminated with COVID-19 also proved to be a critical aspect. Chen et al. (2020) and Oliveira Neto et al. (2021) concluded that the analysis of the absenteeism index allows measuring the effectiveness of the actions taken to minimize contagion by COVID-19. Parker (2020) indicated that the redesign of work locations (e.g., 1.5 m spacing) reduces absenteeism rates because of possible drop in COVID-19 contamination. Dennerlein et al. (2020) found that medical leave allows those contaminated by COVID-19 to stay at home with financial and labor security, avoiding putting in risk the health of other workers.

Another critical aspect is installing more washbasins, toilets and changing rooms with soap and hand sanitizers with 70% alcohol to attend to. Garzillo et al. (2020) concluded that Italian companies paid special attention to the installation of changing rooms to maintain the recommended interpersonal distance and the access route. Jahangiri et al. (2020) and Oliveira Neto et al. (2021) stressed that it is also necessary to structure more bathrooms to meet the necessary social distance.

In the same way, signs were identified in the literature regarding the improvement of ventilation in closed spaces, ensuring fresh and ventilated air, especially in places with large concentrations of people, such as administrative offices (Garzillo et al., 2020; Parker, 2020). On the other hand, it is worth noting that this issue was usually related to cleaning surfaces or extensive use of protective masks.

Other papers mentioned the worsening performance of the company during the COVID-19 pandemic in aspects related to employee safety. These surveys show that even with the provision of an N 95 mask, the effectiveness of on-the-job training, the risk management program, and the organization of work safely suffered negative impacts (OHSP-2).

Adherence to the standards of personal protective equipment has been insufficient, indicating the need for investment and education in the workplace (Jahangiri et al., 2020; Barroso et al., 2020; Giorgi et al., 2020; Charibi et al., 2020; Garzillo et al., 2020; Oliveira Neto et al., 2021), being necessary hospitality services (Sönmez et al., 2020) and health service (Demartini et al., 2020; O'Neill, 2020). Furthermore, it is noteworthy that informal workers with less purchasing power have less access to personal protective equipment guided by WHO (Godderis and Luytens, 2020). Thus, it is important the insertion OHSAS18001:2007 as the primary control tool (Dufour et al., 2020).

Another critical aspect is the lack of knowledge to apply on-the-job training under COVID-19 prevention and to educate employees on the proper use of personal protective equipment (Gibbs and Nonnenmann, 2020; O'Neill, 2020; Dufour et al., 2020; Oliveira Neto et al., 2021), mainly in small and medium-sized companies (Garzillo et al., 2020), including outsourced workers (Sorensen et al., 2021). However, eastern countries with experiences in respiratory disease pandemics have on-the-job training manuals (Chen et al., 2020), including control and management of viral agents in the workplace (Charibi et al., 2020; Barroso et al., 2020), psychological, physical and physiological health and safety (De Cieri and Lazarova, 2020; Giorgi et al., 2020). In addition, remote training can also be offered to promote social isolation (Jahangiri et al., 2020; Sarbadhikari and Pradhan, 2020; Otañez and Grewal, 2021).

A limitation in maintaining safety in the workplace was also observed even with the most restrictive control of the risk of contagion (COVID-19 is highly contagious) (Giorgi et al., 2020, Oliveira Neto et al., 2020), including the development and implementation of mental health assessments (Demartini et al., 2020). Thus, it is required by legal means that shareholders formalize plans to confront COVID-19 in their industries (Michaels and Wagner, 2020; O'Neill, 2020; Garzillo et al., 2020), based in the OHSAS18001:2007 (Dufour et al., 2020) and using risk management in the workplace to control viral and psychological risks with greater intensity than usual (Dennerlein et al., 2020; Gibbs and Nonnenmann, 2020).

In continuity, difficulties were identified in organizing workplaces with a focus on social distance based on WHO, which include the reorganization of tables/benches to respect the 1.5 m spacing, division into more shifts/rotations of work, use of a mandatory mask on company premises, installation of more bathrooms, washbasins and greater availability of water, soap, alcohol gel 70% for hand hygiene (Garzillo et al., 2020; Spinazzé et al., 2020). These measures are very valuable for the Occupational Health and Safety Services in granting and evaluating the set of preventive measures to implement before the workers return to the facilities after the lockdown period in Spain (Gallardo et al., 2020; Parker, 2020).

In addition, some studies indicated difficulties in implementing safety indicators for cash management for employees, considering the control of the rate of employees on leave by COVID-19 and the consequences generated by the disease, which can even be death (Parker, 2020; Oliveira Neto et al., 2021). Thus, it is necessary to develop safety indicators based on OHSAS18001:2007 (Dufour et al., 2020), being essential to develop trust (Dennerlein et al., 2020), which can generate employee awareness (Gallardo et al., 2020).

As a result of what was found in the extant literature, hypothesis 3 can be posed.

H3: Covid-19 outbreak has a negative effect workers health and safety.

This context leads to the need for OHS areas to adapt the criteria defined by WHO to moderate the contamination of COVID-19 in the workplace. Michaels and Wagner (2020), Ndiiaye and Diatta (2020) and O’Neill (2020) concluded that each workplace needs a COVID-19 prevention plan that includes the redesign of the area’s layout to avoid crowding and allow for distance physical, personal protective equipment with the use of masks and respirators, improved ventilation, hand hygiene and facilities suitable for washing and disinfecting potentially contaminated surfaces. Parker (2020) also mentions the need to redesign the structural layout to prevent the transmission of COVID-19, including removing employees from their physical offices to work electronically at home. Sönmez et al. (2020) and Sorensen et al. (2021) reinforce that the COVID-19 pandemic increased the dependence on remote work as an OHS action. Giorgi et al. (2020) concluded that OHS actions, mainly with the use of personal protective equipment, play a crucial role in moderating (reducing the effect) of the risk of contagion in the workplace and in improving the safety of employees, reducing the worsening mental health of people facing the COVID-19 pandemic. Jahangiri et al. (2020) emphasized that the implementation of sufficient bathrooms, with a strict cleaning regime and social distance, are moderating measures of proven effectiveness to minimize contamination, allowing the safe return of employees to work. Therefore, hypothesis 4 consists of:

H4: Covid-19 outbreak effects on the workers health and safety are moderated by the adoption of OHS measures.

From the development of the research hypotheses, the conceptual model presented in Fig. 2 was proposed.

3. Methods

3.1. Research methods and data collection procedures

As part of the literature review, a systematic literature assessment was performed through paper content analysis. This is essential to understand and select the relevant theoretical constructs (Bryman, 2016). Therefore, a two stage-analysis was adopted.

Initially, the titles, abstracts and keywords were analyzed. Then, the selected papers were read in full. The systematic literature
review enabled the selection of 26 articles relevant to define the variables and research hypotheses. The research instrument was developed and validated by OHS specialists, and the structured questionnaires (Appendix) were sent to 320 multinational companies located in Brazil to facilitate the collection of field information.

The questionnaire was divided into five large sections, (i) related to the characteristics of the company and the respondent, then (ii) the impacts of COVID-19 (ICC) were detailed in terms of the extent of the damage caused. Next (iii) addressed the practices to combat COVID-19 (OHS) adopted by the companies, then (iv) the operational, logistical and market performances (OLMP) and, finally, (v) the performances related to health and safety at work (OHSP).

10 specialists validated the questionnaire in the field of OHS from the main sectors researched, such as: automotive, chemistry, auto parts and metal mechanics. The experts selected for questionnaire validation were the managers and supervisors in more than ten years in these companies’ OHS area. It is noteworthy that the analysis of the questionnaire by the experts was very important to calibrate the instrument, mainly because they are managers directly in the area and are currently undergoing several changes in the OHS area due to COVID-19 contamination. Furthermore, experts collaborated by correcting and adding technical terms familiar to Health and Safety professionals. These changes were intended to ensure a perfect understanding of the issues.

It is important to note that the scale used was the Likert type with a score of seven, because it allowed measuring the different intensities regarding the agreement of each item researched, thus ensuring that there was no room for doubts or problems of interpretation (Likert, 1932).

It is noteworthy that during the numerous follow-up steps by email and telephone to encourage participation by answering the questionnaires, positive feedback was obtained regarding the understanding of the questions. Due to the tireless execution of this protocol, it was possible to obtain completed questionnaires from 102 different companies.

This sample size was considered comfortable for performing the statistical analyses, as it almost doubled the result obtained by the minimum sample size calculations, considering the effect size of 0.15 (Hair et al., 2016), the significance level of 0.05, and the test power of 0.80 (Faul et al., 2009). These criteria could be considered since scientific research is more likely to reject the true hypothesis, that is, type I error, than to accept the false hypothesis, also known as type II error.

3.2. Data analysis procedures

The analysis of the collected data was carried out using the structural equation model (SEM) with a partial least squares (PLS) measurement model, also known as PLS-SEM. These procedures were adopted following the guidelines of Hair et al. (2019) to clarify the relationships between constructs and their variables - it is worth mentioning that this model is frequently applied in scientific research as it is a flexible and robust method.

However, before handling the data and carrying out the analyzes with the Smart PLS 2.0 software, the data distribution was tested for normality using the Kolmogorov-Smirnov (KS) test. This is a robust test and does not depend on the accumulated distribution function (Triola, 2008). The distribution of data, in turn, did not respect normality, but this does not prevent the application of the PLS-SEM procedures (Ringle et al., 2015).

According to Hair et al. (2016), the PLS-SEM is similar to the use of multiple regression analysis, the main objective is to maximize explained variance in the dependent constructs and assess data quality based on the characteristics of the measurement model. As a result, using PLS-SEM, researchers rely on measures that indicate the predictive ability of the model to judge its quality. More precisely, the evaluation of the resulting structural and measurement models in PLS-SEM is based on a set of non-parametric evaluation criteria, using procedures such as bootstrapping and blindfolding.

PLS-SEM applied together is more robust than the isolated application. On the other hand, due to its flexibility, the limitations of application and interpretation of results should be done sparingly (Rönkkö et al., 2016). Recent discussions reinforce the need for the correct application of the PLS-SEM model, either through a sequence of test applications (Hair et al., 2019), or through the correct interpretation of the results regarding its capabilities (Vandenb, 2006).

For example, it is not recommended to use this method for undirected correlations, and its use is also not recommended for conceptual and theoretical constructs - in this case, it is recommended to use the Likert scale responses measurement instrument, in the same way, that it is recommended to use large sample sizes (Sarstedt et al., 2016; Ramli et al., 2018; Wong, 2019). Therefore, this work used the PLS-SEM procedures described in Table 2 to test the hypotheses developed.

Therefore, the calculation of the path coefficients of the structured model made it possible to test the hypotheses developed.

4. Results and discussion

The evaluation of the modelling quality was carried out by analyzing the results presented in Table 3. The Average Extracted Variances (AVE), Composite Reliability (CR), Pearson’s determination coefficient (R²) and Cronbach’s Alpha (CA) were calculated.

The analysis of the results of the AVE made it possible to verify that the model has satisfactory quality. The analysis of the results of CR and CA made it possible to verify that the model has reliability, it is worth noting that even with some CR values a little above 0.9, the calculated CA values remained within the range between 0.7 and 0.9, a satisfactory condition to affirm that the data have negligible biases.
The analysis of the $R^2$ values made it possible to verify a moderate effect of the OHSP construct due to the ICC and a high effect of the OLMP construct due to the ICC, that is, the latter relationship is more intense. It is noteworthy that Hair et al. (2019) states that the $R^2$ parameters are interpretive and that constructs directly related to economic gains, such as OLMP, usually present higher values than other constructs, such as OHSP. However, they should not be disregarded solely and exclusively by this criterion.

The calculation of the discriminating validities made it possible, by comparison with the square roots of the AVE, to verify that the values calculated on the main diagonal were higher than those calculated for the other relationships. The bootstrapping process performed the significance of the correlation values and slope of the regression lines and calculated the values of Student’s $t$-tests. It was found that all values were higher than the adopted benchmark ($t > 1.96$), except for OHSS. However, as this was a modifying variable, it does not belong to the nomological or causal model.

The moderating variable directly affects the relationship and the higher its value, the more of a cause construct is related to its effect construct and vice versa. In other words, the moderating variable can be interpreted as a regulating value of causal relationships.

The evaluation of the moderating effect of OHS in the relationship between ICC and OLMP was performed by adding the values presented in the path coefficients, also known as betas of the regression lines. The result of this calculation was 0.491, therefore, the moderation of OHS in the relationship between ICC and OLMP was considered relevant because it represents approximately 50%. In turn, the calculation of OHS moderation in the relationship between ICC and OHSP was 0.018, therefore, this moderation represented 1.8% and was considered negligible.

The final model can be interpreted through Fig. 3, emphasizing that the moderating variable was presented through a mathematical resource, the Smart PLS 2.0 software used the JAVA language to algebraically represent the moderating variable. The following model had its illustration adjusted to facilitate interpretation without any information being changed.

The results of the calculations of effect sizes ($f^2$) and predictive validities ($Q^2$) can be analyzed in Table 5.

Constructs are important to the model because they have met the highest effect size criteria. Additionally, they are accurate for having met the criteria of predictive validity. Therefore, the proposed model proved to be in accordance with the consulted literature since the research in Social and Behavioral Sciences does not have the precision of physical measures. Finally, the path coefficients (Table 6) can be analysed to test the hypotheses developed.

Initially, it was found that H1 was confirmed, considering that the outbreak of COVID-19 has a negative effect (0.631) on the company (ICC-2/0.864) and sector (ICC-1/0.805). However, few factories surveyed have suspended activities (ICC-6/0.554), despite dealing with negative impacts on operational performance in terms of reduced productivity, product quality and increased production costs (OLMP-1/0.920). This finding corroborates the exploratory survey by Garzillo et al. (2020) when considering the restrictions and forced closure of work activities (affecting productivity and costs). It is also in line with the confirmatory survey by Rukuni et al. (2020) carried out in South Africa, which emphasizes that the reduction of COVID-19 transmission has a positive and significant impact on companies’ manufacturing performance. Thus, this study contributes to the theory by presenting the first confirmatory result that, in fact, COVID-19 impairs the operational performance of companies/sectors in terms of reduced productivity, quality, and increased costs due to the installed economic crisis. In addition, it also provides more information to organizational practice by showing a warning signal to shareholders about the need to act systematically to minimize the negative effect on production.

### Table 2
Step by step to test the hypotheses through PLS-SEM.

| Steps | Criteria | Authors |
|-------|----------|---------|
| Minimum sample size | Test Power > 0.8 | Cohen (1988); Faul et al. (2009); Ringle et al. (2015); Hair et al. (2016) |
| Average Variance Extracted (AVE) by convergent validity | Effect Size > 0.15 | Henseler et al. (2009); Ringle et al. (2015); Hair et al. (2019) |
| Cross-loads by discriminant validity | AVE > 0.5 | Chin (1998); Ringle et al. (2015); Sarstedt et al. (2016); Hair et al. (2019) |
| Fornell and Larcker test by discriminant validity | Correlation values are higher than other relations | Fornell and Larcker (1981); Ringle et al. (2015); Hair et al. (2019) |
| Cronbach’s Alpha (AC) and Composite Reliability (CR) | AC > 0.7 | Ringle et al. (2015); Hair et al. (2016); Hair et al. (2019) |
| Evaluation of Pearson’s coefficients of determination ($R^2$) | $R^2$ > 0.25 small | Cohen (1988); Henseler et al. (2009); Ringle et al. (2015); Hair et al. (2019) |
| $R^2$ > 0.5 moderate | Effect size ($f^2$) or Cohen indicator | Ringle et al. (2015); Hair et al. (2016); Hair et al. (2017); Hair et al. (2019) |
| $R^2$ > 0.75 high | Predictive Validity ($Q^2$) or Stone-Geisser Indicator | Ringle et al. (2015); Hair et al. (2016); Hair et al. (2017); Hair et al. (2019) |
| $Q^2$ > 0 small acc. | Student’s $t$ test (bootstrapping) | Ringle et al. (2015); Hair et al. (2016); Hair et al. (2017); Hair et al. (2019) |
| $Q^2$ > 0.25 moderate acc. | $t > 1.96$ (HR: $\lambda = 0$ and $\Gamma = 0$) |

### Table 3
Model quality indicators.

| Constructors | AVE | CR | $R^2$ | CA |
|--------------|-----|----|-------|----|
| ICC          | 0.643 | 0.914 | 0.885 |
| OHSS         | 0.639 | 0.696 | 0.894 |
| OHSP         | 0.871 | 0.931 | 0.855 |
| OLMP         | 0.643 | 0.839 | 0.717 |
| Criteria     | > 0.50 | > 0.70 | > 0.70 |

### Table 4
Evaluation of the discriminant validity of the model.

| ICC | OHSS | OHSP | OLMP |
|-----|------|------|------|
| 0.802 | 0.272 | 0.283 | 0.536 |
| 0.800 | 0.121 | 0.933 | 0.437 |
| 0.802 | | | |
The outbreak of COVID-19 has a negative effect (0.631) on suppliers (ICC-3/0.827), hampering the logistical performance of companies in the purchasing, supply, and distribution process (OLMP-2/0.860). This finding corroborates the exploratory survey by Garzillo et al. (2020), which demonstrates that COVID-19 affected the logistical, purchasing, supply, distribution performance, generating delays in the delivery of suppliers, automakers, and dealerships. Furthermore, this study innovates the state of the art, since it confirms the negative effect of COVID-19 on suppliers and, consequently, on logistical performance, due to the lack of refuelling. In addition, it impels the supply chain managers to improve the relationship with suppliers in this moment of the COVID-19 pandemic crisis.

Another finding was that companies had their sales demand minimized (ICC-5/0.812), affecting market performance, due to increased customer dissatisfaction, reduced sales, and loss of important market share (OLMP-3/0.587). The same happened with the competition (ICC-4/0.912). This finding is in line with the literature review and documentary analysis by Sönmez et al. (2020), which, carried out in the hotel sector, showed that the global travel and tourism industry is among the hardest hit with a large reduction in sales and loss of customers. This is one of the few scientific studies that proves that companies had reduced demand due to COVID-19, suffering from reduced sales and loss of market share. In view of this scenario, a relevant result is presented to organizational managers regarding the signaling that the reduction in sales in this period of crisis is associated with the COVID-19 pandemic.

However, despite COVID-19 having this negative effect on company performance, the adoption of OHS managed to minimize these effects by 50%, confirming H2 (0.491). Thus, the use of the criteria defined by WHO by the OHS area related to the use of water and soap or hand sanitizers with 70% alcohol for hand hygiene, self-declaration of symptoms form, temperature measurement, and use of PFF2 or N95 masks (OHS-1/0.482), organization of the workstation to maintain a safe distance of 1.5 m (OHS-2/0.723), distribution of workforce throughout the day and in more shifts (OHS-3/0.903), disinfection between shifts and ensure the exchange of air and (OHS-4/0.846) and emergency care for suspects from COVID-19 (OHS-5/0.846) minimized the indicated effects by 50%. Research on the subject only indicated the use of the WHO protocol by the OHS area to try to mitigate COVID-19 in the company (Michaels and Wagner, 2020; Ndiaye and Diatta, 2020; O’Neill, 2020; Oliveira Neto et al., 2021), but none assessed the moderating effect of OHS-based WHO actions to mitigate the effects of COVID-19 on the company, being result contributes a lot to the theory. Likewise, it shows a promising and effective path to this important sector of production (SSO), which is no longer a support activity to be an essential activity of the company.

The results also confirmed H3, in which the outbreak of COVID-19 has a negative effect (0.762) in the OHS area of companies (ICC-2/0.864) and sector (ICC-1/0.805), negatively affecting performance related to occupational health indicators for employees, increasing biological risks of contamination, absenteeism and the number of notifications to social security epidemiological control,
in addition to undermining the occupational health medical control program (OHSP-1/0.913). It is noteworthy that the increase in the absenteeism rate due to leave directly affected the fulfillment of customer demand, due to the reduction of operational and management manpower (ICC-5/0.812), some industries even had to suspend activities due to COVID-19 (ICC-6/0.554) for a fixed period to protect employees from contamination, as well as the lack of labor in small and medium-sized Brazilian companies. Other companies were affected by the delay in delivery by suppliers (ICC-3/0.827), making it impossible for customers to deliver orders on time. On the other hand, the problem was global, which also hampered competition (ICC-4/0.912). In this context, non-scientific research has carried out an assessment to confirm whether the outbreak of COVID-19 has a negative effect on the health of employees. Unfortunately, the pandemic of COVID-19 has generated contamination in companies and affected the health of employees, considering the route to and from, especially in small and medium-sized companies, or even employees are contaminated in their personal lives. The problem with all of this is mainly the gradual increase in absenteeism and consequent lack of an Occupational Health Medical Control Program aimed at preventing COVID-19. In addition, there is a gray cloud in the Social Security Epidemiological Nexus information related to the negative indexes generated in employees’ health by COVID-19. This finding innovates the state of the art and encourages WHO guidance on the mandatory lockdown in companies to preserve lives and mitigate contamination in the route or company.

The outbreak of COVID-19 has a negative effect (0.762) on the OHS area of companies and the sector, including suppliers and competition, worsening performance indicators related to employee safety. Even providing an N95 mask, the effectiveness of on-the-job training was impaired and the risk management program and the organization of work safety (OHSP-2/0.953). This affects demand fulfillment (ICC-5/0.812) and has even caused some industries to suspend activities (ICC-6/0.554). As mentioned, existing scientific research has not done a confirmatory test to see if the COVID-19 outbreak has, in fact, a negative effect on employee safety; thus, this study contributes to the theory. The contribution also extends to work safety practice because the COVID-19 pandemic has changed companies’ on-the-job safety training protocols a lot, addicting the care with biological risks.

Another important result related to H4 was that the effects of the COVID-19 outbreak on workers’ health and safety performance were not moderated by the adoption of OHS (only 1.8%). In this context, the OHS area moderates little the relationship between COVID-19’s negative impacts on the company/sector in meeting demand, suppliers and competitors and the occupational health performance of employees (OHSP-1), because even structuring the company with more washbasins and using the criteria that the WHO recommends in terms of: providing water and soap or 70% alcohol, self-reported symptom form, temperature measurement, use of PF2F or N95 masks (OHS-1 and OHS-5), organization of the workstation to maintain a safe distance of 1.5 m (OHS-2), distribute workforce throughout the day in more shifts (OHS-3) and perform disinfection between shifts (OHS-4). Thus, the use of the WHO protocol by the OHS area mitigated only 1.8% of the contamination of employees by COVID-19. In addition, OHSP-2) because even training employees on the job for employee safety by means of WHO protocols was generated COVID-19 contamination, resulting in leave. Thus, this work contributes to theory because it is one of the few scientific studies that assesses the moderating effect of the adoption of WHO actions by OHS and its impacts on the industry and employee safety performance.

5. Conclusion

Finally, this study contributes to the theory because it is one of the few scientific studies that expectedly confirms that the pandemic of COVID-19 has drastically affected the operational performance of companies/sector in terms of reduced productivity, loss of quality and increased costs. Also, it has negatively impacted logistical performance due to problems in supplying suppliers, affecting the purchase, production, and distribution process of products. The market performance was badly altered due to reduced demand, consequently losing market share. Finally, OHS performance was distorted due to problems in worker health because the COVID-19 pandemic is global and contamination occurs in the company and in public transportation and personal life. As a result, the application of occupational medical control to minimize biological risks was not enough - especially when the scenario points out to a lack of financial resources to invest in infrastructure for washbasins, toilets, and changing rooms, resulting in absenteeism.

Despite the worsening of OHS performance due to lack of technical knowledge about combating COVID-19, the companies relied on the WHO criteria to minimize the impact of the pandemic on their overall performance. Therefore, this is one of the few scientific studies that evaluated the moderating effect of OHS actions based on WHO to mitigate the effects of COVID-19 in companies. It was concluded that the use of WHO protocol in the workplace can reduce at least 50% of the effect of the COVID-19 crisis on operational, logistical, and market performance. Concerning the negative effects of health and safety performance in the worker, there was a minimization of only 1.8%, generating a relevant increase in absenteeism due to physical and mental problems of employees.

This study also contributes to the organizational practice by highlighting the factors of attention for managers/shareholders related to the installed economic crisis of COVID-19, suggesting emergency action plans in the production management. Likewise, close monitoring of suppliers and the development of new ones is suggested to balance companies’ logistical capacity. It is noteworthy that there are also negative impacts on the health and safety of workers due to uncertainties in the management of viral biological risks dispersed in the air. In this context, there is a relevant trade-off in the thinking of business decision-makers about COVID-19. On the one hand, the company needs to make money to survive and on the other, it needs to preserve the lives and wellbeing of its employees, and it is not enough just actions from the company’s OHS area to mitigate the effects of the disease at work. Even with this scenario, the OHS area demonstrated an important practical contribution, moving from the support area to the essential field of work in the fight against COVID-19.

This study considered multinational companies operating in Brazil which may lead to conclusions that do not necessarily apply to other countries, denoting a limitation. Furthermore, a limitation for survey-type research is the difficulty to ensure that the respondent has the profile designed. This work carried out many follow-ups to encourage participation and, in this way, emphasized the importance of the respondents being adherent to the designed profile, however, this protocol is tiring and does not guarantee the solution to this problem. Therefore, as a suggestion for future research we recommend replicating our study in other countries or regions to verify whether the results would be the same, mainly in genuinely Brazilian companies according to Paoli et al. (2013).

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.
Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.psep.2022.01.011.

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