



## Perception of personal protective equipment availability and mental health outcomes in workers from two national hospitals during the COVID-19 pandemic

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### ABSTRACT

**Background:** During the first wave of the pandemic, a constant concern of healthcare workers, who are more vulnerable to contagion, is their personal safety. This is directly related to the availability of adequate PPE, which led to a perception of dissatisfaction and inequality with government responses. We aim to determine whether perception of adequate PPE availability is associated with depressive, anxiety, and stress symptoms in different types of healthcare workers. **Methods:** Analytical cross-sectional study surveyed clinical and non-clinical healthcare workers in two third-level hospitals in Lima, Peru. An online self-survey assessed the perception of adequate PPE availability, using a Likert scale question, which was then dichotomized for the analysis. In addition, we assessed the depressive, anxiety, and stress symptoms using validated questionnaires.

**Results:** 563 participants were included. In general, there is no association between perception of PPE availability and three mental health outcomes. However, in the subgroup analysis, physicians with better perception of PPE availability had less moderate-severe outcomes in mental health; in contrast, nurses had higher moderate-severe outcomes. The type of profession in healthcare workers may modify the effect of this association.

**Conclusion:** The association between perception of PPE availability and mental health outcomes is complex in healthcare workers from two third-level hospitals. This association can vary according to the type of work.

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## 1. Introduction

On December 29th, 2019, the new strain of coronavirus appeared in Wuhan, China [1]. The new coronavirus disease 2019 (COVID-19), is characterized by being highly contagious, causing a pandemic since March 11th, 2020 [2]. In the beginning of the pandemic, most research was focused on the epidemiology, prevention, diagnosis, and treatment of this virus [3]. However, the context caused by COVID-19 reflects a set of stressors for everyone, based on the perception of a global human disaster [4]. This is reflected in the increased prevalence of depressive symptoms, anxiety traits, acute stress, post-traumatic symptoms, insomnia and exhaustion [5].

Based on the experience of previous pandemics (SARS in 2002 and Ebola in 2014), healthcare workers emerge as a highly vulnerable group in terms of their mental health [6]. This is because they, like general population, deal with social changes. Moreover, they have the highest level of exposure, being directly responsible for diagnosing, treating, and taking care of COVID-19 patients. Added to the fact that during the crisis health personnel had to deal with stressful shifts, little rest, fear of contracting the disease, transmitting it to family members and being continuous witnesses of the suffering and death of patients [7–9]. In Peru, one of the most affected countries in the world by the pandemic, the first case was confirmed on March 6th, 2020 [10], and despite the health measures imposed by the government, the number of cases increased exponentially. The increase in the number of suspected and confirmed cases of COVID-19, together with the high workload, contribute not only to a physical demand, but to intense psychological burden of healthcare workers [11].

During the actual pandemic, several studies showed an association between mental health disorders in healthcare workers with the inefficiency of infection control systems, lack of medicines or specific equipment, lack of personal protective equipment (PPE), aggressive attitude towards healthcare staff, contact with infected patients, constant concern about their own health, and fear of spreading the virus [7,12–14]. A constant concern of healthcare workers, who are more vulnerable to contagion, is their personal safety, and this is directly related to the availability of adequate PPE, which led to a perception of dissatisfaction and inequality with government responses [15,16]. In addition, when healthcare workers are without their ‘tools to do the job’, a key infection prevention resource during a pandemic, their demands are not met, and therefore, they might experience stress, and if it is chronic, in consequence might affect their mental health [17]. A study in Canada showed that the perception of adequate provision of PPE was related to lower symptoms of anxiety and depression among respondents who had their PPE needs met [18]. Another study in the Netherlands showed that the availability of sufficient PPE was negatively related to self-reported psychological distress and symptoms of depression [19].

However, ensuring global access to PPE remains a challenge due to factors such as PPE shortages, probably driven by increased demand, an unreliable supply chain due to limited healthcare system resources, and situations like hoarding and misuse. These challenges can be particularly severe in Low Middle Income Countries (LMICs) where panic related to a lack of understanding of this disease can exacerbate the situation [20,21]. This may be particularly severe in LMIC [22]. In Peru, the lack of PPE is one of the main occupational problems for healthcare workers. This led to the fact that during the COVID-19 pandemic at least 40 % of health personnel did not receive proper PPE for the treatment of COVID-19 patients; despite the Peruvian Government’s recommendation to use N95 respirators (one for every two shifts of 12 h in a COVID-area and one for every five shifts of 6 h in the non-COVID area) ([23–25] [26]). This situation increases the hazard to all healthcare, clinical and non-clinical, workers from hospitals, whose safety depended on the availability and adequate quality of PPE to protect themselves, their colleagues, and patients in general [20]. Based in previous studies, budgets are limited in LMIC, in contrast to High income countries. Lack of local producers and inefficient supply chains aggravate the lack of PPE and its consequences. In addition, there is a hole of knowledge in LMIC, especially in mental health impact associated with the PPE shortage [17]. Therefore, the present article sought to determine whether the perception of adequate PPE availability is related to depressive, anxiety, and perceived stress symptoms in clinical and non-clinical workers from two national hospitals from Peru during the COVID-19 pandemic.

## 2. Methods

### 2.1. Study design

Cross-sectional study that surveyed healthcare and non-health workers in two third-level hospitals in Lima, Peru. We used an online self-survey, which mainly assessed the relationship between perception of adequate PPE availability and three mental health outcomes: depressive, perceived stress, and anxious symptoms. The outcomes were assessed with Spanish versions of validated tools. Data collection was during August and September 2020.

### 2.2. Setting

The Social Security Health Insurance (EsSalud) is the second most important healthcare system in Peru. The Ministry of Labor finances EsSalud and gives healthcare to formal workers, former formal workers, and their relatives [27]. The National Hospital Edgardo Rebagliati Martins and the National Hospital Guillermo Almenara Irigoyen are third-level hospitals from EsSalud and are the biggest health centers in Peru [28,29]. During the COVID-19 pandemic, both hospitals receive a large amount of moderate-to-severe COVID-19 patients.

All workers inside the hospital, especially during the current pandemic, are considered as essential healthcare workers [30].

Clinical healthcare workers are involved, directly or indirectly, in the attention and caring of patients' health, whose most of them had COVID-19 during the recollection data period. While non-clinical healthcare workers are security personnel, cleaning staff, and administrative workers. Security personnel keep the order outside and inside the hospital facility, and they usually are the first contact of patients and their relatives in the hospital. In comparison, the cleaning staff works in all hospital areas and is in charge of common and medical waste management. Non-clinical healthcare also had close contact with patients and their fluids. Both security and cleaning staff are hired by a third-party company that provides services to the hospital. Administrative workers are mainly not in contact with patients or relatives.

### 2.3. Participants

We surveyed a non-probabilistic sample of clinical (physicians, nurses, nurse technicians, nutritionists, psychologists, and midwives) and non-clinical healthcare workers (security and cleaning staff) from National Hospital Edgardo Rebagliati Martins and National Hospital Guillermo Almenara Irigoyen. Participants were included if they physically went to the hospital to work during the data collection period (from July 27th, 2020 to September 06th, 2020) and have worked during the last three months in the hospital. We excluded those who didn't fill any of the three primary outcomes (depression, perceived stress, and anxiety symptoms), their profession, or the variable about perception of PPE availability. Additionally, administrative workers also were excluded since the sample size was too small to be part of the analysis. Healthcare workers that didn't want to take the survey were excluded. The minimal sample size was calculated into 490 participants, considering a 95 % confidence interval (95%CI) and statistical power of 80 %.

### 2.4. Procedures

We used the SurveyMonkey © platform to create an online survey and informed consent. The webpage link directing to the online survey was distributed with workers from both hospitals using a snowball method. Also, one worker by each hospital area (emergency department, inpatients, intensive care units, security, and cleaning staff) from both hospitals distributed the webpage link with their pairs. The survey was self-administered and it took 15 min to answer it. The participant could answer the online survey by him/herself any time that he/she wants.

### 2.5. Instruments

Briefly, the full survey collects personal contact information, sociodemographic variables such as age, sex (female or male), marital status (single, married or living together, divorced, or widower), religion (yes or no), history of a diagnosed mental health problem (yes or no), living alone (yes or no), and living with a person at risk of COVID-19 (yes or no). The survey also collects employment information such as profession (the type of clinical or non-clinical healthcare worker) and the independent variable.

### 2.6. Perception of PPE availability

This variable was asked using the following question in Spanish: "*In the last two weeks, when you started daywork, how often has the institution where you work provided you, according to your level of exposure, the appropriate quantity, and quality of personal protective equipment (masks, alcohol gel, glasses, etc.)?*". This question had a 4-Likert scale option as possible answers: No day, several days (between 1 and 6 days), more than half of the days (between 7 and 11 days), and almost every day (12 or more days). Based on the criteria established by the Peruvian Ministry of Health during the pandemic (RM 193–2020/MINSA), it was recommended that health workers should receive at least one PPE every two working days (i.e. every two shifts). Accordingly, we dichotomized responses into adequate access (7 days or more) and inadequate access (6 days or less). We estimated that over a two-week period, health professionals should have received at least 6 masks, equivalent to 12 working days (one shift per day). Thus, if professionals had access to at least the minimum plus one PPE, it would be considered adequate; conversely, if they had access to the minimum or less, it would be considered inadequate.

The mental health outcomes were perceived stress, depressive symptoms, and anxiety symptoms.

### 2.7. Perceived stress

We used the Spanish version of the Perceived Stress Scale-10 (PSS-10) to measure the perceived stress during the last two weeks [31]. This scale has ten items assessed with a Likert-type scale from 0 ("Never") to 4 ("Very often"). This scale is categorized into three levels of perceived stress: Mild (0–13 points), Moderate (14–26 points), and Severe (27–40 points) [32].

### 2.8. Depressive symptoms

Depressive outcome was assessed with the Patients Health Questionnaire-9 (PHQ-9) for Peru [33]. This tool has nine items rated with a Likert-type scale that ranges from 0 ("never") to 3 ("almost every day"). Depressive symptoms are categorized into five categories: Normal (0–4 points), Mild (5–9 points), Moderate (10–14 points), Moderate - severe (15–19 points), and Severe (20–27 points) [34,35].

## 2.9. Anxious symptoms

Finally, we used the Spanish version of the Generalized Anxiety Disorder-7 (GAD-7) to assess anxiety symptoms [36]. This tool had seven items categorized on a Likert-type scale, ranging from 0 (“never”) to 3 (“almost every day”). Anxiety symptoms are categorized into four categories: Normal (0–4 points), Mild (5–9 points), Moderate (10–14 points), and Severe (15–21 points) [37].

## 2.10. Analysis plan

Before data analysis, the oldest duplicated registries in the database were excluded. Also, we excluded answers without any response, those without profession reported, and those who didn’t accomplish selection criteria. Each participant was assigned an identification number in order to anonymize the database.

For descriptive analysis, we reported absolute and relative frequencies for all categorical variables, and for numerical variables we reported median and interquartile range (IQR). We dichotomized the three mental health outcomes: Perceived stress into mild (0–13 points) and moderate to severe (14–40 points), depression symptoms into normal to mild (0–9 points) and moderate to severe (10–27 points), and anxiety symptoms into normal to mild (0–9 points) and moderate to severe (10–21 points). Later, for bivariable analysis between perception of PPE availability with each dichotomized mental health outcome we used the chi-2 test.

We performed a bivariate and multivariate linear regression to calculate raw and adjusted beta coefficients and their 95 % confidence intervals (95%CI), between the perception of PPE availability with each of the three mental health outcome’s punctuation. For multivariate analysis, we only consider the variable profession (clinical or non-clinical healthcare worker) as a confounding variable. Later, we performed a sensitivity analysis using generalized linear models with Poisson family, link log function, and clustered by hospital, to calculate raw (rPR) and adjusted prevalence ratios (aPR) and their 95%CI between the perception of PPE availability with the three dichotomized mental health outcomes.

Finally, following the same regression analysis with Poisson family, we performed a subgroup analysis in nurses, nurses-technicians, physicians, security, and cleaning staff. Also, in order to assess possible effect modifiers, we calculated the p-values of interactions with each subgroup. In all analyzes, each outcome was independently assessed, and a p-value <0.05 will be considered statistically significant to reject the null hypothesis. Data analysis was performed using Stata software version 16.0 (STATA Corporation, College Station, Texas, USA).

## 3. Ethics

All participants were voluntary and were agreed with a virtual informed consent before their participation. This informed consent specified that there is any coercion or consequence in their jobs for their participation in the study. Also, we offer psychiatric help in case any participant thinks it’s convenient. No economical reward was offered. The research protocol was approved by the COVID-19-specific Institutional Review Board from EsSalud, and by the Institutional Review Board of Universidad Científica del Sur (N° 300-CIEI-CIENTÍFICA-2020).

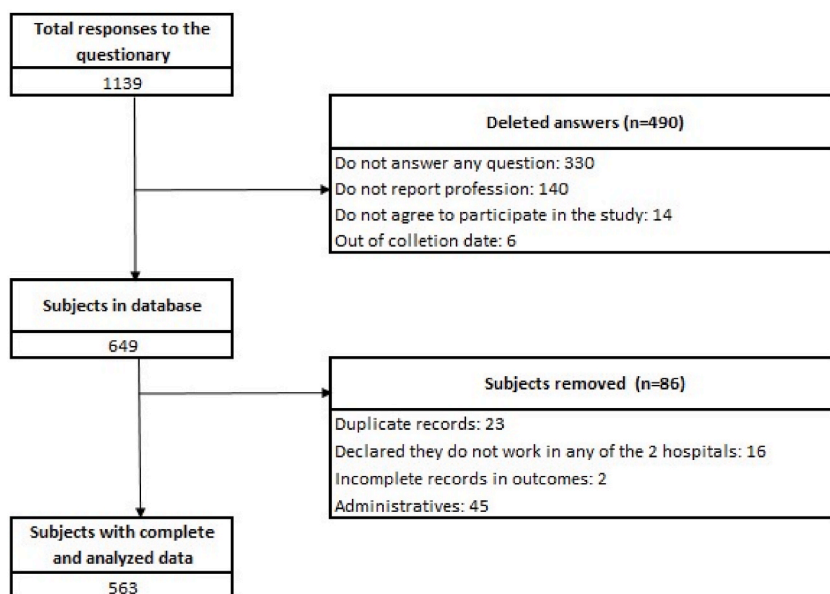


Fig. 1. Flowchart.

## 4. Results

### 4.1. Participants

In total, 1139 records were collected; however, 490 records were eliminated mainly due to lack of answers or because they do not report their profession or work area. Then, of the 649 records in the database, 86 records were eliminated for being duplicates or for not satisfying selection criteria. Finally, the 563 remaining records of the two hospitals workers were used to perform the present analysis (Fig. 1).

The main characteristics of the participants are shown in Table 1. Most of them were women (62.4 %), who professed a religion (68.5 %) and lived accompanied (82.5 %). Almost the half of the respondents were non-clinical healthcare workers (cleaning staff and security personnel). The median score for anxiety symptoms was 2 (IQR: 0 to 5), that for perceived stress was 19 (IQR: 15 to 22), and for depressive symptoms it was 2 (IQR: 0 to 5). Perception of adequate PPE availability varies among types of healthcare worker: 71.2 % in nurse technicians, 59.7 % in nurses, 58.0 % in physicians, 29.6 % in cleaning staff, and 24.6 % in security personnel.

## 5. Bivariate association

In the bivariate analysis the perception of PPE availability is not associated with any of the dichotomized mental health outcomes ( $p > 0.05$ ). In the raw linear regression model, the perception of PPE availability is not associated with the average score for stress, anxiety, and depression, even adjusted for the confounding variable "type of profession". On the other hand, health professionals have,

**Table 1**  
Characteristics of workers from two EsSalud hospitals in Lima (n = 563).

Characteristics	N (%)
<b>Sex<sup>a</sup></b>	
Female	338 (62.4)
Male	204 (37.6)
<b>Age (years)**<sup>a</sup></b>	39 [32–49]
<b>Marital status<sup>a</sup></b>	
Single	269 (49.6)
Married or cohabiting	239 (44.1)
Divorced	25 (4.6)
Widower	9 (1.7)
<b>Hospital</b>	
H. Nacional Guillermo Almenara Irigoyen	349 (62.0)
H. Nacional Edgardo Rebagliati Martins	214 (38.0)
<b>Profession</b>	
Physicians	88 (15.6)
Nurses	124 (22.0)
Nurses technicians	73 (13.0)
Other clinical workers	10 (1.8)
Security personnel	126 (22.4)
Cleaning staff	142 (25.2)
<b>Access to PPE</b>	
Adequate	259 (54.0)
Inadequate	304 (46.0)
<b>Profess religion<sup>a</sup></b>	371 (68.5)
<b>Live alone<sup>a</sup></b>	73 (13.5)
<b>Live with a risk person<sup>a</sup></b>	229 (42.3)
<b>Mint health history<sup>a</sup></b>	37 (6.8)
<b>Adequate PPE</b>	259 (46.0)
<b>Anxiety</b>	
Normal	409 (72.7)
Mild	111 (19.7)
Moderate	32 (5.7)
Severe	11 (2.0)
<b>Depression</b>	
Normal	401 (71.2)
Mild	114 (20.3)
Moderate	26 (4.6)
Severe	19 (3.4)
Very severe	3 (0.5)
<b>Stress</b>	
Mild	116 (20.6)
Moderate	430 (76.4)
Severe	17 (3.0)

<sup>a</sup> Variables total less than 563 for missing data (No more than 5 %); \* Median and interquartile range; PPE: Personal Protective Equipment.

on average, a higher score for stress (2.87 more points) and anxiety (1.43 more points), compared to those who are not health professionals (Table 2).

### 5.1. Sensitivity analysis

In the sensitivity analysis, the three mental health outcomes were dichotomized. Workers who perceived that they had adequate PPE availability had a higher frequency of moderate-severe depression, compared to those who perceived that they had inadequate PPE. However, this association was not maintained in the analysis adjusted for the confounding variable “type of profession”. By contrast, clinical workers had a higher frequency of moderate-severe stress, anxiety, and depression, compared to non-clinical workers (Table 3).

### 5.2. Regression model

Finally, a subgroup and interaction analysis with dichotomized mental health outcomes was performed. In the subgroup of nurses, those who perceived that they had adequate PPE had a higher frequency of moderate-severe stress, moderate-severe depression, and moderate-severe anxiety. In the subgroup of nurse technicians, those who perceived that they had adequate PPE had a lower frequency of having moderate-severe depression and moderate-severe anxiety. Similar results are present in the physician’s subgroup, but these last results were not statistically significant. However, physicians, nurses, technicians-nurses, and cleaning staff categories were presented as a potential effect modifier of at least one outcome in mental health (Table 4).

## 6. Discussion

### 6.1. Main findings and significance of the results

This study shows that, in general, there’s no association between perception of PPE availability and the three mental health outcomes, in clinical and non-clinical workers from two third-level hospitals in an upper middle-income country. However, there’s evidence that the type of profession may be an effect modifier of this association. Physicians with perception of adequate access to PPE had less moderate-severe outcomes in mental health, in comparison with nurses, who those with perception of better PPE availability had higher moderate-severe outcomes in mental health.

Although we found no evidence of the association between perception of PPE availability and mental health outcomes, A recent study in Texas that included nearly 1000 essential health care workers from 2 health systems found that those with statistically significant associations between the availability of PPE and depression, anxiety, and burnout [38]. Additionally, another study from the United States shows that nurses who reported not being provided with PPE had higher symptoms of depression, anxiety, and traumatic-stress disorder. Even, there was an inversely proportional relationship between PPE provision and the severity of the three mental health outcomes [39]. Our results may be explained by the different conditions of PPE availability between high-income and LMIC. The lack of a secure supply chain remains evident as a result of low budgets assigned to health systems in LMIC. This presents an opposed scenario to the high-income countries. If there’s a significant shortage of PPE in high-income countries, it’s reasonable to expect even fewer supplies to be distributed to countries with fewer resources [40,41]. Furthermore, the poor quality of PPE is also a constant big concern of health workers and managers [42]. It’s important to stand out that the present analysis includes all types of workers inside both hospitals, and perhaps this approach is not the most appropriate since PPE needs vary between professions and healthcare centers. According to a Peruvian study realized in the first peak of the pandemic, there was inequality in the PPE distribution, healthcare professionals who did not have a contract (temporary without employment relationship) received adequate PPE less often than those who had a permanent employment relationship. In addition, young workers received incomplete PPE versus workers aged over 56 years; however, the delivery of incomplete PPE or the fact of not receiving a 95 respirator per work shift had no

**Table 2**  
Association between availability of PPE and mental health outcomes.

Variable	Perceived stress (PSS-10)		Anxiety symptoms (GAD-7)		Depression symptoms (PHQ-9)	
	Coef. r $\beta$ (95%CI)	Coef. a $\beta$ (95%CI)	Coef. r $\beta$ (95%CI)	Coef. a $\beta$ (95%CI)	Coef. r $\beta$ (95%CI)	Coef. a $\beta$ (95%CI)
Type of profession						
Non-clinical workers	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Clinical workers	2.87 (0.81–4.92)	2.87 (1.44–4.29)	1.36 (0.59–2.12)	1.43 (0.29–2.56)	1.97 (–4.70 to 8.64)	1.03 (–5.09 to 9.14)
Availability of PPE						
Non-adequate	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Adequate	1.03 (–1.74 to 3.81)	0.00 (–1.77 to 1.78)	0.31 (–0.59 to 1.22)	–0.20 (–1.27 to 0.86)	0.56 (–0.37 to 1.50)	–0.17 (–1.44 to 1.11)

Notes: Coef. r $\beta$ : Raw  $\beta$  coefficient; Coef. a $\beta$ : Adjusted  $\beta$  coefficient by health professional and availability of PPE; 95%CI: 95 % confidence interval; GAD-7: Generalized Anxiety Disorder-7; PHQ-9: Patients Health Questionnaire-9; PPE: Personal Protective Equipment; PSS-10: Perceived Stress Scale-10.

**Table 3**

Sensitivity analysis of the association between availability of PPE and mental health outcomes.

Variables	Stress moderate-severe		Anxiety moderate-severe		Depression moderate-severe	
	rPR (95%CI)	aPR (95%CI)	rPR (95%CI)	aPR (95%CI)	rPR (95%CI)	aPR (95%CI)
Type of profession						
Non-clinical workers	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Clinical workers	1.23 (1.17–1.29)	1.23 (1.13–1.35)	1.53 (1.44–1.63)	1.56 (1.39–1.74)	1.82 (1.42–2.32)	1.79 (1.45–2.21)
Availability of PPE						
Non-adequate	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Adequate	1.07 (0.99–1.15)	0.99 (0.88–1.12)	1.12 (0.99–1.27)	0.96 (0.84–1.10)	1.28 (1.13–1.44)	1.04 (0.95–1.15)

Notes: 95%CI: 95 % confidence interval; rPR: Raw prevalence ratio; aPR: Adjusted prevalence ratio adjusted by health professional and availability of PPE; PPE: Personal Protective Equipment.

**Table 4**

Association between availability of PPE and mental health outcomes categorized by type of professional.

Analysis by type of profession	Stress moderate-severe		p-value*	Anxiety moderate-severe		p-value*	Depression moderate-severe		p-value*
	rPR (95%CI)			rPR (95%CI)			rPR (95%CI)		
<b>Nurses (n = 124)</b>			<0.001			0.368			0.154
PPE non-adequate	Ref.			Ref.			Ref.		
PPE adequate	1.07 (1.03–1.11)			1.13 (1.06–1.20)			2.70 (1.28–5.71)		
<b>Nurse Technicians (n = 73)</b>			<0.001			<0.001			0.371
PPE non-adequate	Ref.			Ref.			Ref.		
PPE adequate	0.94 (0.80–1.11)			0.61 (0.58–0.63)			0.40 (0.20–0.81)		
<b>Physicians (n = 88)</b>			<0.001			<0.001			<0.001
PPE non-adequate	Ref.			Ref.			Ref.		
PPE adequate	1.02 (0.97–1.08)			0.97 (0.54–1.72)			0.73 (0.35–1.52)		
<b>Security personnel (n = 126)</b>			0.551			0.179			0.405
PPE non-adequate	Ref.			Ref.			Ref.		
PPE adequate	1.17 (0.70–1.96)			3.06 (0.60–15.68)			2.30 (0.32–16.31)		
<b>Cleaning staff (n = 142)</b>			0.001			<0.001			0.560
PPE non-adequate	Ref.			Ref.			Ref.		
PPE adequate	0.81 (0.79–0.84)			0.60 (0.16–2.19)			1.19 (0.32–4.42)		

Notes: 95%CI: 95 % confidence interval; rPR; Raw prevalence ratio; PPE: Personal protective equipment; \* P-value of interaction analysis in Poisson regression between availability of PPE with type of professional.

association with the level of the work center, occupation, work hours per shift and years of work in the position. The type of contract is a variable that must be considered in further investigations. Another Peruvian study explained that the lack of adequate PPE among health workers showed that 69.2 % of personnel tend to decontaminate their PPE in order to reuse it. This high percentage demonstrates the logistical stress to which our country's health centers were subjected in the face of the COVID-19 pandemic. Quite the opposite were the percentages of PPE decontaminative presented in England, EEUU and Australia, probably due to the greater socio-economic and/or purchasing power of these high-income countries [17]. Profession type is a confounding and effect-modifying variable in the relationship between perception of PPE availability and mental health in our study. The work schedule, the responsibilities, and the level of exposure to COVID-19 patients vary enormously according to the type of profession inside of a single hospital. Physicians play a vital role against COVID-19, because they are not only in charge of treating patients, but also of opportunistically diagnosing cases in order to avoid complications and contain the spreading [43]. Nurses during different pandemics, including COVID-19, play a fundamental role in preparing health services for the management of patients and the prevention of infectious diseases' spreading. They integrate all the interdisciplinary team and ensure accurate communication between them. Also, inside the hospital, nurses and nurse technicians are the ones who are in greater contact with patients as they stay next to the patients during all hospitalization time [39,44]. The role of security staff during COVID-19 is important inside and outside hospitals, because they deal with the admission of workers and, most important, patients infected with COVID-19. Also, they are present during patients and healthcare workers relocation to and from isolated zones. Besides that, they are placed in the elevators, provide access to routes in and around the hospital, and are constantly giving directions to promote accurate movement inside the hospital [45]. During the pandemic, cleaning staff have an important role because within the hospital environment they are in charge of the prevention of infection's spread associated with healthcare, especially in the context of COVID-19 pandemic, where cleaning and disinfection are the primary and most effective elements to prevent a source of contagion [46]. According to the type of profession there are different levels of exposure to patients and/or people, causing different needs for PPE. Studies that attempt to analyze this association should consider the importance of the type of profession variable and work area in the study design.

In nurses, a perception of adequate PPE availability increases the frequency of moderate-severe anxiety, stress, and depression symptoms. This finding differs from other studies executed in Canada and the United States that showed that perception of access to adequate PPE is associated with lower symptoms of depression, anxiety, and post-traumatic stress disorder [18,39]. Additionally, to the lack of PPE availability, this inverse association could be explained due to the inherent functions of their profession. In general,

nurses are more likely to report more severe symptoms of depression, anxiety, insomnia, and distress as they have a longer time of exposure because they spend more time in contact with COVID-19 patients, therefore they are at higher risk of contagion among healthcare workers [12,39,47]. It should be noted that, nurses avoid drinking water or going to the bathroom during long working hours beside bed patients, in order to safeguard their PPE, because they only may have one PPE per day, which makes their work even more difficult [48].

Among the physicians, having adequate perception of PPE available may decrease the frequency of moderate-severe anxiety, stress, and depression symptoms. This finding is similar to a previous meta-analysis based on different virus outbreaks, including COVID-19, where adequate availability of EPP is a protective factor for mental health, since it is related to better psychological outcomes [49]. Physicians may perceive the same lack of PPE availability as the nurses, but they may have more availability of PPE changes during the day, which was not assessed in the survey. This could suggest an unequal distribution of PPE among healthcare workers or working areas, but more studies are needed in order to make that affirmation [50]. A study of health workers in Spain showed that while nurses reported poorer mental health, doctors improved over time [51]. So, it is important to consider keeping updated the availability of PPE supply and changes to all healthcare workers as a wellbeing criterion, independently of their function [15].

In non-clinical healthcare workers, their perception of the availability of PPE is generally poor. According to our results, this perception may not be associated with a higher level of moderate-severe anxiety, stress and depressive symptoms. However, despite lack of statistical significance in these results, we cannot exclude a true association. According to previous studies which associated PPE and mental health outcomes there's no difference in subgroups since their analysis does not include this categorization or their population study doesn't include different professional as we did. This subgroup of healthcare workers also had fear that they may be infected by COVID-19, and, additionally may have reduced training on the correct use of PPE and infection control procedures, and less knowledge about the COVID-19 [52,53]. Furthermore, our results may reflect the different contexts between LMIC and high-income countries, suggesting that the restrictive and permanent scarcity of resources in LMIC (equipment, human sources and PPE) forces health workers to adapt and endure to this permanent crisis. Finally, almost the half of the respondents were non-clinical healthcare workers (cleaning staff and security personnel), in comparison with the previous studies presented, this is a particular variation in the population and could have influenced in the results due to the fact that non clinicals workers are not directly in contact with patients diagnosed with COVID-19.

## 6.2. Clinical relevance

Our study highlights the importance of adequate PPE availability in healthcare workers, indistinctly if they are clinical or non-clinical, should be kept constant, regardless of their profession or work area. Since the presence or absence of adequate perception of PPE availability could influence some workers to develop or worsen mental health disorders and, in consequence, affect their quality of work and having more probability of making mistakes. Some interventions may be necessary to implement a resource to improve this aspect, as "PPE helpers" or a team inside hospitals, who is in charge of providing information and promoting the best clinical practices on PPE use to all healthcare workers [53]. Finally, it's important to preserve the health of all workers inside of a hospital because everyone plays a fundamental role against the COVID-19 pandemic.

## 6.3. Limitations and strengths

The interpretation of the results had to consider some limitations. The study population is biased since only workers who wanted to respond were included. So, extrapolation to all healthcare workers is not possible. Additionally, mental health outcomes may be underestimated, because those workers with mental health disorders did not participate due to fearing to be fired or were not available to answer the survey. But we assured all participants that there is any coercion or consequence in their jobs for their participation. Besides that, we used self-reported scales to measure the outcome of mental health, not supervised by a health professional specialist such as a psychologist or psychiatrist, therefore it could be misclassifications. However, we used validated tools in Peruvian contexts with sufficient reliability. On the other hand, the perception of PPE availability was measured with a single question, so their response depends on the perception and interpretation of each individual, but this is a common method used by all studies to assess this variable [18,39,41,49,54]. Finally, the subgroup analysis is exploratory, so non-significant results do not necessarily rule out the association in each subgroup.

However, our results had strengths because we included different types of clinical and non-clinical healthcare workers (which not often are included in studies), independently of their rank. Also, we present the association between perception of PPE availability and mental health outcomes, separately between different types of healthcare workers. Also, we used an adequate sample size for the general analysis.

## 7. Conclusion and recommendations

Despite the absence of any association between perception of PPE availability and mental health outcomes in clinical and non-clinical healthcare workers, the perception of PPE availability may be directly or inversely associated with mental health outcomes according to the type of healthcare worker. Furthermore, our results may reflect the differences between LMIC and High income countries; and the shortage of information related to mental health in healthcare workers in Peru. It is essential to provide adequate PPE availability to healthcare workers regardless of the profession or work area they perform, since the physical and mental health of all workers, who play a fundamental role against the COVID-19 pandemic, must be protected.



## Data availability statement

The database is available in open access from Figshare (<https://doi.org/10.6084/m9.figshare.24412636.v1>).

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## Ethics

The research protocol was approved by the COVID-19-specific Institutional Review Board from EsSalud, and by the Institutional Review Board of Universidad Científica del Sur (N° 300-CIEI-CIENTÍFICA-2020). We used a virtual informed consent for all participants.

## CRediT authorship contribution statement

**Alejandra B. Romero-Cabrera:** Writing - original draft, Formal analysis. **Ana Lindo-Cavero:** Writing - original draft, Formal analysis, Conceptualization. **David Villarreal-Zegarra:** Writing - review & editing, Validation, Supervision, Project administration, Investigation, Funding acquisition, Data curation. **Vilma Rodriguez:** Writing - review & editing, Supervision, Resources, Project administration, Investigation. **Matilde L. Luna-Matos:** Writing - review & editing, Investigation, Funding acquisition. **Wendoline N. Rojas-Mendoza:** Writing - review & editing, Investigation, Conceptualization. **Jeff Huarcaya-Victoria:** Writing - review & editing, Visualization, Supervision, Methodology, Data curation. **K. Vanesa Cuzcano-Gonzales:** Writing - review & editing, Validation, Resources, Methodology, Investigation. **Christian Gonzales-Gavancho:** Writing - review & editing, Investigation. **Christopher A. Alarcon-Ruiz:** Writing - review & editing, Visualization, Supervision, Project administration, Methodology, Investigation, Formal analysis, Conceptualization.

## Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Jeff Huarcaya reports financial support was provided by EsSalud - Seguro Social de Salud de Peru.

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