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Perception of Possible SARS-CoV-2 Infection and Associated Complications in Seven Labor Sectors in Peru

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ARTICLE INFO	ABSTRACT
	Objective: To determine the perception of possible infection caused by the severe acute respiratory syndrome coronavirus (SARS-CoV-2) and associated complications according to the labor sector in Peru. **Methods:** We performed an observational, cross sectional, and secondary data analysis. The study had three dependent variables that were obtained from a locally validated questionnaire, in which it is asked whether the professionals had the perception that they could be infected with SARS-CoV-2 at work, or could transmit the virus to their family/friends, and regarding the possibility of complications related to the infection. **Results:** Of the 2843 workers participating in the study, those in the health sector perceived that they were more likely to be infected at work. In the multivariate analysis, adjusted for four variables, health sector workers also perceived that they could be infected more frequently at work (adjusted prevalence ratio (aPR): 1.74; 95% confidence interval (CI): 1.40-2.15; p <0.001). These professionals, moreover, perceived that they could transmit the virus to their family/friends (aPR: 0.76; 95% CI: 0.63-0.92; p = 0.005) or that there would be complications resulting from the infection (aPR: 0.59; 95% CI: 0.48-0.73; p <0.001). On the other hand, engineering sector workers were the ones who had a greater perception that they could infect their family/friends (aPR: 1.95; 95% CI: 1.20-3.20; p = 0.007), while workers from other sectors perceived that they could have more chances of complications from the infection (aPR: 1.17; 95% CI: 1.05-1.30; p = 0.006). **Conclusion:** The health sector may be the most vulnerable in this context, which is why occupational health teams should develop and implement specific surveillance plans to prevent and reduce the number of coronavirus disease 2019 (COVID-19) cases among healthcare workers. **Keywords:** occupational health, Coronavirus, workers, perception, Peru

INTRODUCTION

Currently, we are experiencing a serious pandemic due to infection caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) that causes coronavirus disease 2019 (COVID-19) [1-2]. This pandemic, in turn, has affected almost all continents, spreading to more than 180 countries and territories, as well as to Latin America, with more than 45 million confirmed cases [3,4]. The situation is more critical in some countries, as in Peru, where there are currently more than 900,000 confirmed cases of the disease and 34,000 deaths [3].

In consequence of this, major negative impacts have been observed (both related to social and economic aspects, including the work sector), which may have large effects on the global economy in the short term [5]. In this connection, COVID-19 should be recognized in many countries as an occupational disease, since mainly healthcare workers can be infected with COVID-19 at work by contact with infected patients [6].

Given the current scenario, health authorities and governments of several countries have implemented several restrictive measures, such as social distancing, quarantine, and

curfew, which have affected jobs in all sectors [7]. It is worth remembering that, before the pandemic, many people circulated in several workplaces a day, as for example in cinemas and other entertainment venues, air and land transport companies, education, and health institutions, among others [8-11]. Notwithstanding, similar restrictions have also been imposed on jobs of an administrative nature or even in those that do not require contact with so many people, which has implied the need to adopt new work methodologies, including remote teleworking [12].

However, so far, there are few studies in Latin American countries that demonstrate how workers perceive the impact of this pandemic according to the work/function performed in each profession/occupation. Previous research on this theme involving other diseases has shown that this impact should be related to the type of work activity performed. In the case of tuberculosis, different impacts were verified among workers from different sectors [13,14]. Thus, here we determine the perception of possible infection by SARS-CoV-2 and associated complications according to the labor sector in Peru.

METHODS

Study Design and Sample Size Calculations

This is an analytical cross-sectional study of secondary data, based on two previous studies related to the variables of mortality and type of profession/occupation in Peru in the face of the COVID-19 pandemic [15,16].

The study population was composed of people from different professions in Peru (from the 24 departments and the constitutional province). People without COVID-19 and that, at the time of the interview (through the application of a questionnaire), occupied a job or exercised a profession, and gave their consent to participate in the research were included in the study. We excluded from the study 919 people that did not inform their profession or occupation, as well as students, retirees or housewives, and 12 people who did not answer the questions accurately.

A convenience sampling was conducted using data collected from two previous studies [15,16]. The need for a total of 2305 workers was calculated for an analytical cross-sectional design (single sample), with 80% power, 95% confidence level, for a difference of minimum proportions of 75% versus 77.5% (calculated based on the sample of available data).

Study Procedures and Variables

First, the selection criteria were applied, and a first filtration/quality control of the information was also carried out to obtain the number of valid questionnaires. In this step of the study, the main variable (field of activity or sector where they worked) was established. According to the frequency of responses, the variable was categorized into seven sectors of work as follows: health professionals (at any level of care), workers in the field of education (at any level of education), professionals in areas related to engineering or architecture (construction, electricity), technical or operational workers (in different fields), trade workers (formal or informal), professionals from companies that provide administrative services (in office), and workers from other sectors (work in unusual positions).

The dependent variables were obtained from a locally validated questionnaire [16], in which it is asked whether the professionals had the perception that they could be infected with SARS-CoV-2 at work (this was also investigated in university centers, however the students were not included), the perception that they could transmit the virus to their family/friends; as well as, regarding the possibility of severe complications (with need for hospitalization). Furthermore, the variables sex (male or female), age (in full years), education level (none, primary, secondary, technical, university, and postgraduate studies), and number of years worked in total were extracted in addition to the city of residence.

Statistical Analysis and Ethical

The obtained data were tabulated in an Excel 2010 spreadsheet (Microsoft Corp., USA) and statistical analysis was performed using the STATA version 11.1 statistical program (StataCorp LP, College Station, TX, USA). Quantitative variables were described by medians and interquartile range (after normality assessment, through the Shapiro-Wilk test). Frequencies and percentages were used to describe qualitative variables.

For analytical statistics of the variables, we considered the level of statistical significance $p < 0.05$. The bivariate analysis was performed using the Chi-square test, as the data had normality. P-values, adjusted prevalence ratio (aPR) and their respective 95% confidence intervals (CI) were obtained using generalized linear models, with the Poisson distribution and a logarithmic link function, and models for robust variance adjusted for sex, age, number of years worked, and city of residence.

At all times, the research ethics was strictly followed, by guaranteeing anonymity to the respondents, given that personal data, such as the name of the interviewees, were never made available for consultation.

RESULTS

Of the 2843 respondents with a profession or occupation, 54.0% reported working in administrative functions or in an office. In addition, according to the characteristics of the population studied, a higher percentage of women occupying an administrative position was observed (56%, $p = 0.028$), while workers with higher education or postgraduate degrees were the ones who did more administrative work (60%, $p < 0.001$). The median age ($p = 0.003$) and the number of years worked in the profession or occupation ($p < 0.001$) were different according to the type of performed work (**Table 1**).

When asked if the respondents perceived that they could be infected with SARS-CoV-2 at work, healthcare workers reported having this perception ($p = 0.001$). On the other hand, this was not perceived by workers in the areas of education ($p = 0.654$), engineering ($p = 0.702$), by technicians ($p = 0.226$), workers in the trade sector ($p = 0.953$), workers from other sectors ($p = 0.067$), or by those exercising an administrative function ($p = 0.749$) (**Table 2**).

In the multivariate analysis adjusted for sex, age, number of years worked, and city of residence, it was found that health workers perceived that they could be infected more frequently at work (aPR: 1.74; 95% CI: 1.40-2.15; $p < 0.001$). These professionals, moreover, perceived that they could transmit the virus to their family/friends (aPR: 0.76; 95% CI: 0.63-0.92; p

Table 1. Socio-labor characteristics of respondents, in all regions of Peru

Variables	Occupation or profession n (%)		p-value
	Operators/Operational work	Administrative/Office work	
Sex			
Male	641 (48.1%)	692 (51.9%)	0.028
Female	566 (43.8%)	726 (56.2%)	
Age (years)	26 (22-36)	25 (22-31)	0.003
Education level			
None	12 (70.6%)	5 (29.4%)	<0.001
Primary (6 years)	28 (87.5%)	4 (12.5%)	
Secondary (5 years)	202 (64.7%)	110 (35.3%)	
Technical	186 (57.6%)	137 (42.4%)	
University	643 (40.1%)	962 (59.9%)	
Postgraduate studies	132 (40.1%)	197 (59.9%)	
Years of work	4 (2-10)	3 (1-8)	<0.001

The p-values for sex and education level were obtained with the Chi-square test, while for age and years of work with the sum of the intervals

Table 2. Perception of SARS-CoV-2 infection at work, in all regions of Peru

Work area or field	Possibility of SARS-CoV-2 infection at work		p-value
	No	Yes	
Health			
Workers from other sectors	573 (24.4%)	1772 (75.6%)	
From the health sector	80 (17.2%)	385 (82.5%)	0.001
Education			
Workers from other sectors	580 (23.4%)	1902 (76.6%)	0.654
From the education sector	73 (22.3)	255 (77.7%)	
Engineering			
Workers from other sectors	630 (23.3%)	2074 (76.7%)	0.702
From the engineering sector	23 (21.7%)	83 (78.3%)	
Technical			
Workers from other sectors	611 (23.0%)	2043 (77.0%)	0.262
From the technical sector	42 (26.9%)	114 (73.1%)	
Trade			
Workers from other sectors	627 (23.3%)	2070 (76.7%)	0.953
From the trade sector	26 (23.0%)	87 (77.0%)	
Other sectors			
No	392 (22.1%)	1380 (77.9%)	0.067
From other sectors	261 (25.1%)	777 (74.9%)	
Administrative workers			
Operators or operational work	275 (23.0%)	919 (77.0%)	0.779
Administrative or office work	329 (23.5%)	1071 (76.5%)	

The p-values were obtained with the Chi-square test

= 0.005) or that there would be complications resulting from the infection (aPR: 0.59; 95% CI: 0.48-0.73; p <0.001). On the other hand, engineering sector workers were the ones who had a greater perception that they could infect their family/friends (aPR: 1.95; 95% CI: 1.20-3.20; p = 0.007), while workers from other sectors perceived that they could have more chances of complications from the infection (aPR: 1.17; 95% CI: 1.05-1.30; p = 0.006) (**Table 3**).

DISCUSSION

According to the findings of the present study, health sector workers perceived that they were more likely to be infected with SARS-CoV-2 in the exercise of their job title. This may be due to the existing exposure to workers in this area, in which there is contact with people, contaminated material, local unhealthiness, and other several factors that predispose to a greater risk of infection. Results of recent studies showed that about 40% of the COVID-19 cases in Wuhan, China, resulted from hospital transmission (that is, involving the health system), which put this group of workers at a high risk

for the disease. Corroborating this, other researches show a percentage of 14-64% of health sector workers infected with the Coronavirus that causes the Middle East Respiratory Syndrome (MERS-CoV) and a greater perception for the acquisition of Severe Acute Respiratory Syndrome (SARS) [3,17-20].

In the current scenario, the additional risks for transmission of the virus in health care settings are mainly related to inadequate and/or insufficient measures for infection control, as well as due to an increase in the number of hospitalized patients, a greater burden of work and assistance to asymptomatic patients, who give a false perception of safety during consultations [21,22]. In view of this, it is expected that health authorities provide logistical support and adequate human resources for this sector, given that the COVID-19 pandemic has exposed deficiencies in the health systems of most countries with confirmed cases, even in the more developed ones that, a priori, they would be better prepared to face this issue [23].

Another important point in our study was that health sector workers perceived that they were able to transmit SARS-CoV-2 to their family/friends, but on a smaller scale compared to

Table 3. Multivariate analysis of perception of SARS-CoV-2 infection and associated complications by workers according to three different situations, in all regions of Peru

Work area or field	According to the possibility of SARS-CoV-2 infection		
	Being infected	Transmitting the virus	Develop disease complications
Health			
aPR (95% CI)	1.74 (1.40-2.15)	0.76 (0.63-0.92)	0.59 (0.48-0.73)
p-value	<0.001	0.005	<0.001
Education			
aPR (95% CI)	0.91 (0.66-1.25)	1.09 (0.81-1.48)	1.23 (0.96-1.56)
p-value	0.560	0.562	0.100
Engineering			
aPR (95% CI)	1.01 (0.54-1.88)	1.95 (1.20-3.20)	0.70 (0.49-1.00)
p-value	0.983	0.007	0.052
Technical			
aPR (95% CI)	0.84 (0.55-1.28)	1.24 (0.88-1.75)	1.30 (0.90-1.90)
p-value	0.411	0.226	0.166
Trade			
aPR (95% CI)	1.01 (0.65-1.55)	1.02 (0.54-1.95)	0.69 (0.40-1.19)
p-value	0.981	0.947	0.183
Other sectors			
aPR (95% CI)	0.89 (0.78-1.02)	1.01 (0.89-1.15)	1.17 (1.05-1.30)
p-value	0.094	0.837	0.006
Administrative workers			
aPR (95% CI)	0.96 (0.88-1.06)	1.08 (0.98-1.20)	0.97 (0.89-1.06)
p-value	0.475	0.133	0.178

The values of aPR (adjusted prevalence ratio), 95% CI (confidence interval) and p were obtained with generalized linear models (from the Poisson family with a log link function and robust variance models adjusted for sex, age, years of work, and city of residence)

engineering sector workers. This may be related to adequate knowledge of most of the health sector workers about the symptoms and signs of COVID-19 as well the fact that they hold positions with higher risks for infection, leading them to adopt additional preventive measures for individual protection [24]. Although there is great concern on the part of this group of workers about the current pandemic, it is also imminent the possibility for them to take the virus to their homes, especially if they are infected and show no symptoms of the disease [25]. Because of this, some internationally approved protocols have been implemented, such as the 17 steps for the use of personal protective equipment and the 11 steps to safely remove them [26].

Previous studies have also shown that health workers have in general a good knowledge on related topics, especially on viral transmission and identification of patients with typical symptoms, and measures for prevention disease. However, information on this subject matter are quite often obtained from unreliable sources, which reinforces the need for further clarification through official media channels, for both the specialized public and the general public, on false and misleading information [27,28]. Also, taking into account that a considerable percentage of these workers may not have access to all the necessary information or even adequate knowledge about COVID-19, as well as with regard to infection prevention and control strategies [29]; it is essential that agencies of the Peruvian government assess the level of general and specific knowledge of their health workers (from the Ministry of Health and Social Security), in order to plan strategies for improving the qualification of the labor force.

Regarding engineering sector workers, we found that these professionals perceived that they had a greater chance of transmitting the virus to their family/friends. This, in turn, may be due to their perception regarding the work environment, including exposure to confined spaces (with little ventilation and dust), extreme conditions during work, among others; which makes them more prone to unconventional forms of work [30]. However, these adversities can be mitigated through sanitation rules in the workplaces and assessment of mobility policies to promote remote work, using new risk measurement tools (in addition to the Hazards Identification and Risk Assessment approaches already known), together with more targeted training sessions, adoption of safety measures at all levels, and purchase of personal protective equipment [31]. In this sense, it is recommended that the Ministry of Labor of Peru, supported by Peruvian societies of occupational medicine, as well as by other entities involved, develop specific management protocols and guides for each labor area /sector and the positions that present the greatest risks of infection.

We also observed here that healthcare workers perceived that they could have complications due to COVID-19; however, with lower chances in comparison with workers of other sectors (who also had this perception), which may be related to the fact that people more likely to have complications are in general elderly or those with comorbidities. In this regard, it is also important to remember that, knowledge on this subject varies according to the type of professional [32]; moreover, a greater perception of risks leads to greater adherence to the correct use of personal protective equipment, as well as the improvements in the practice of strategies to mitigate them and to specific behaviors in relation to vaccines and other immunizations strategies [33,34]. Thus, all of these variables should be investigated by health agencies from Peru, with the support of the occupational health offices of each hospital, in order to develop specific training and interventions that protect this group of workers as much as possible.

Complementary to this, our study revealed that workers from other sectors perceived that they could have more complications due to COVID-19. Therefore, it is important to conduct training on this disease in a broader way, since the risks inherent to it can be underestimated or exaggerated in certain jobs. Evidence of this has been published in the literature, as in an Italian study, in which construction and agricultural workers reported that there was an

underestimation of biological risks related to their functions, despite being highly exposed to biological agents. This, in turn, reinforces the need for more information and training programs on the exposure of workers to risks in their jobs [35]. It is, moreover, common that the perception of risks is based more on subjective interpretation than on science or official information, so that this should be verified in each sector of work activity as well as given the necessary importance to this subject without maximizing or minimizing its impact [36].

Regarding limitations, the present study had the limitation of not being able to be extrapolated to all labor sectors, due to the fact that we use secondary data, which did not include sectors such as agriculture, transport, aviation, entertainment, or others that are also important to be studied. It is recommended that future studies include data from a larger population (with a greater number of variables to explain the phenomenon studied).

CONCLUSION

In short, we concluded that health sector workers perceived that they were more likely to SARS-CoV-2 infection in the work environment, however with less chance of transmitting the virus to their family/friends and to develop complications resulting from the infection (in both cases compared to the other groups of workers who had such perceptions). On the other hand, according to our findings, engineering sector workers had a greater perception that they could transmit the virus to their family/friends, while workers from other sectors perceived that they could have more chances of complications related to COVID-19.

Furthermore, although healthcare workers may have more knowledge about the means of transmission of the virus [24], it is hard to detect asymptomatic patients with COVID-19, which poses a great risk for these workers and the population in general [37].

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