



## Research article

# Factors associated with post-traumatic stress disorder symptoms in the post-quarantine context of the COVID-19 pandemic in Peruvian medical students



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## ABSTRACT

**Background:** In March 2020, the Peruvian state introduced quarantine as a measure to control the spread of SARS-CoV-2. It has been suggested that being in quarantine is associated with the development of symptoms of Post-traumatic Stress Disorder (PTSD). The present study aims to explore the factors associated with the development of PTSD in a post-quarantine context due to COVID-19 in medical students.

**Objectives:** To evaluate the factors associated with the development of post-quarantine PTSD symptoms in medical students from a Peruvian university.

**Methods:** Analytical cross-sectional study. The objective will be developed after the lifting of the quarantine in Peru. Medical students enrolled during the 2020-01 academic cycle of the Peruvian University of Applied Sciences will be included. To collect the outcome variable (PTSD), the Impact of Event Scale - Revised (IES-R) will be used. The associated factors will be collected through a form that will be validated by experts and piloted in the field. The crude and adjusted coefficients will be calculated, using bivariate and multivariate linear regression models, respectively. We will use the “manual forward selection” technique to obtain a final model with minimally sufficient fit. After each model comparison and decision, multicollinearity will be evaluated with the variance inflation factor and matrix of independent variables.

**Results:** Not having health insurance, having relatives or close friends who contracted the disease and having a lower family income are factors associated with PTSD in the post-quarantine context of the COVID-19 pandemic in medical students at a Peruvian university.

**Conclusions:** Clinical evaluation is important for medical students with a high probability of having PTSD symptoms. We recommend conducting a longitudinal study to identify causality and other unstudied factors related to PTSD.

## 1. Introduction

In March 2020, the Peruvian state introduced quarantine as a measure to control the spread of coronavirus. This health emergency required different means to contain this disease. The primary restrictions for the pandemic in the country were a national curfew, quarantine, and hospital isolation for those who had symptoms consistent with SARS-COV-2 [1].

Quarantine is the separation and restriction of movement of people who have potentially been exposed to a contagious disease to ensure that, if they were sick, they would have a lesser chance to infect others [2]. It

has also been used over the years to prevent the spread of various diseases such as cholera. However, might lead to the development of fear, discrimination, economic difficulties and disturbance in the population [3]. This measure can mitigate the spread; however, it has the unintended consequence of limiting family customs and activities of daily living [4].

Different studies have been carried out in populations and groups exposed to disasters, showing high levels of Post-Traumatic Stress Disorder (PTSD) [5, 6]. A study conducted in China indicated that being in quarantine was a predictor of PTSD symptoms in hospital employees up to 3 years later [7]. Likewise, research conducted in Canada indicated

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that people under quarantine were distressed and showed symptoms of PTSD and depression [3].

PTSD is an anxiety disorder characterized by avoiding stimuli associated with a traumatic event, re-experiencing the trauma and hyperactivity, such as increased alertness [8]. Unlike the general population, medical students are exposed to a greater number of mental disorders due to the demands of their careers [9, 10, 11]. The most frequent disorders are anxiety and major depression, both with a higher prevalence than reported in the general population [12, 13]. This is a cause for concern, since it favors the deterioration of the student behavior and could reduce the learning capacity [14].

In 2019, the Peruvian Ministry of Health declared mental health research as one of the research priorities in public health [15]. In addition, PTSD has been linked to poor clinical outcomes, especially suicidal behavior, which is the second most frequent cause of death among the 15–29-year-old young adults globally, having a greater impact in the low- and middle-income countries representing 78% of cases [16, 17]. This context, added to the fact of not finding related studies on post-quarantine PTSD in our population of interest, motivated the decision to study and describe the factors associated with post-traumatic stress disorder in the context of the COVID-19 pandemic among medical students from a Peruvian university located in Lima, Peru.

Scientific evidence shows that national emergency situations, such as quarantine, can cause psychological stress and mental disorders such as PTSD [18, 19]. Post-quarantine conditions conceived can seriously affect mental health [7] and, as mentioned above, medical students are more vulnerable to suffering from mental disorders [20]. Therefore, the objective of this study is to reflect the importance of knowing the factors associated with PTSD symptoms in the post-quarantine context of the COVID-19 pandemic.

## 2. Materials & methods

### 2.1. Design and context

Analytical cross-sectional study conducted in medical students from a Peruvian university located in Lima, Peru. The study was carried out between June–October, 2020.

### 2.2. Study population

We tried to reach all the medical students that met the selection criteria. The participants were invited via official social networks of the university. The sampling was by convenience and we recruited the participants via snowball sampling.

### 2.3. Selection criteria

All students enrolled in medical courses during the 2020-1 academic year were included in the study. As selection criteria, all those students who did not have a history of diagnosis of a mental disorder were considered. Underage participants and those who were quarantined outside of Peru were excluded.

### 2.4. Variables

The dependent variable (outcome) was PTSD. It was evaluated with the Impact of Event Scale - Revised (IES-R) [21]. The IES-R is a 22-item self-administered questionnaire that uses a Likert scale, ranging from 0 to 4 ("Not at all" to "Extremely"). In addition, it includes three subscales that measure avoidance, intrusion and hyperarousal, with a total score that can range from 0 to 88. The IES-R has been used in recent publications in countries under the context of COVID-19 [22, 23, 24, 25] and has been adapted and validated for the Spanish-speaking population [26], including the Peruvian university population [27]. In this population, Cronbach's alpha for all the IES-R subscales was greater than 0.8.

Other variables considered were the academic year, living in a different place during the quarantine, the parent's level of education, being in contact with a person with COVID-19 symptoms, being in contact with a person with a COVID-19 diagnosis, cohabiting with a person with COVID-19 symptoms, cohabiting with a person diagnosed with COVID-19, having a family member who passed away from COVID-19, the number of people with whom you cohabit with during quarantine, been sick with a disease different than COVID-19 during quarantine, the decrease of family income per month, among others, were considered as covariates. These variables were collected through a self-elaborated questionnaire in Google Forms, made up of open and multiple-choice questions. This questionnaire went through the approval of an expert judgment following the Delphi methodology and was pilot-tested in a similar population.

### 2.5. Data collection

The survey was conducted in the form of an online questionnaire that was prepared on Google Forms (Google Inc, USA) and it was sent through the official social networks of the university together with informed consent, in which the objectives of the study and the confidentiality rights of the participants were included. The survey was voluntary and self-administered.

### 2.6. Data analysis

We exported into a Microsoft Excel spreadsheet the data obtained from Google Forms. We carried out a coding process by two people independently. After this, we crossed the databases in order to detect coding errors and possible non-plausible data. When a coding error was detected, the entire questionnaire was revised again. We found no implausible data in any case. After this quality control, the database was entered into the statistical package STATA v15.0 (StataCorp, TX, USA) for its analysis.

In the univariate analysis, the numerical variables were presented with the corresponding central tendency and dispersion measures, after assessing their normality with the Shapiro Wilk test. Categorical variables were summarized by absolute and relative frequencies.

For the comparison of the study variables with the outcome (numerical variable), all the necessary independent variables were previously categorized. Subsequently, the Student's T-test or Mann Whitney U test was used. For any of the cases, a prior assessment of the corresponding assumptions was made, highlighting normality and homoscedasticity. The first was evaluated according to the procedures initially described. The second, using the Levene test.

To evaluate the factors associated with the IES-R score, crude ( $\beta_c$ ) and adjusted ( $\beta_a$ ) coefficients were calculated, using bivariate and multi-variable linear regression models, respectively, using the backward selection technique. We assessed the  $R^2$  variation, as well as the Akaike information criterion. The final decision was made using the log-likelihood ratio test. Likewise, after each model decision, the presence of multicollinearity was assessed with the variance inflation factor (VIF) and the matrix of independent variables with the *coldiag2* command. In addition, the assumptions of linearity, normality and homoscedasticity were assessed using the studentized residuals. Since all the independent variables were categorical, the assumption of linearity was met; however, we found the presence of heteroscedasticity according to the Breusch-Pagan/Cook-Weisberg test, so we used robust variances in the regression models.

All statistical tests were performed considering a confidence level of 95% and a statistically significant p-value of less than 0.05.

### 2.7. Ethics

The study protocol was approved by the Ethics Committee of the Universidad Peruana de Ciencias Aplicadas (FCS/CEI 083-05-20). Each

**Table 1.** Baseline characteristics of the study population.

Characteristics	N (%)	IES-R	
		Mean ± SD/ Median [IQR]	p
<b>Sociodemographic</b>			
Sex			0.933 <sup>a</sup>
Male	85 (30.3%)	20.58 ± 20.58	
Female	196 (69.7%)	20.79 ± 18.46	
Age			0.733 <sup>b</sup>
18 to 24	258 (91.8%)	14 [6–34]	
>25	23 (8.2%)	14 [6–33]	
Career years <sup>c</sup>			0.038 <sup>c</sup>
Basics	105 (37.4%)	18 [7–38]	
Clinicals	165 (58.7%)	13 [5–29]	
Internship	11 (3.9%)	11 [2–33]	
Regular student <sup>f</sup>			0.080 <sup>a</sup>
No	82 (29.2%)	23.82 ± 20.08	
Yes	199 (70.8%)	19.44 ± 18.56	
Monthly income (in minimum wages/month) <sup>g</sup>			0.129 <sup>c</sup>
≥9	158 (56.2%)	18.79 ± 18.88	
5 to 8	69 (24.6%)	22.23 ± 18.84	
1 to 4	54 (19.2%)	24.4 ± 19.64	
Father's level of education			0.367 <sup>c</sup>
Postsecondary	262 (93.2%)	20.39 ± 18.88	
Secondary	15 (5.4%)	27.4 ± 22.48	
At least primary	4 (1.4%)	17.75 ± 20.21	
Mother's level of education			0.008 <sup>d</sup>
Postsecondary	252 (89.7%)	13 [5–31.5]	
Secondary	29 (10.3%)	22 [13–52]	
<b>Health-related</b>			
Risk comorbidities			0.659 <sup>b</sup>
No	260 (92.5%)	13.5 [6–34]	
Yes	21 (7.5%)	18 [7–30]	
Health insurance			0.658 <sup>a</sup>
No	72 (25.6%)	21.58 ± 20.95	
Yes	209 (74.4%)	20.43 ± 18.45	
<b>Related to Covid-19</b>			
Had Severity symptoms <sup>h</sup>			0.001 <sup>b</sup>
No	239 (85.1%)	13 [5–30]	
Yes	42 (15.0%)	30 [11–44]	
Had COVID-19 diagnosis			0.134 <sup>b</sup>
No	259 (92.2%)	13 [6–33]	
Yes	22 (7.8%)	22.5 [7–39]	
Relative with a COVID-19 diagnosis			0.189 <sup>a</sup>
No	188 (66.9%)	19.67 ± 18.13	
Yes	93 (33.1%)	22.85 ± 20.83	
Known friend with a COVID-19 diagnosis			0.203 <sup>b</sup>
No	58 (20.6%)	11.5 [5–28]	
Yes	223 (79.6%)	15 [6–35]	
Contact with a person with a COVID-19 diagnosis			0.007 <sup>b</sup>
No	231 (82.2%)	13 [5–30]	
Yes	50 (17.8%)	17 [8–43]	
Cohabitant with a COVID-19 diagnosis			0.007 <sup>b</sup>
No	245 (87.2%)	13 [5–31]	
Yes	36 (12.8%)	23.5 [8.5–41]	

**Table 1 (continued)**

Characteristics	N (%)	IES-R	
		Mean ± SD/ Median [IQR]	p
Relative deceased by COVID-19			0.007 <sup>b</sup>
No	237 (84.3%)	13 [5–31]	
Yes	44 (15.7%)	24 [10.5–38]	
Known friend deceased by COVID-19			0.339 <sup>a</sup>
No	125 (44.5%)	19.5 ± 18.65	
Yes	156 (55.5%)	21.7 ± 19.44	
Number of Cohabitants			0.018 <sup>b</sup>
≤5	239 (85.1%)	13 [5–31]	
>5	42 (14.9%)	21.5 [7–47]	
Cohabitants			0.324 <sup>b</sup>
Family members	9 (3.2%)	12 [2–2]	
Alone or with friends	272 (96.8%)	14 [6–34.5]	
<b>Related to quarantine</b>			
Lack of food or water			0.632 <sup>b</sup>
No	258 (91.8%)	13.5 [6–33]	
Yes	23 (8.2%)	16 [8–41]	
Quarantined with a person with a disease other than COVID-19			0.024 <sup>b</sup>
No	203 (72.2%)	13 [5–29]	
Yes	78 (27.8%)	18 [8–38]	
Person who financially supports you work during quarantine			0.756 <sup>b</sup>
No	67 (23.8%)	15 [6–3]	
Yes	214 (76.2%)	12 [6–35]	
Decrease in family monthly income per month or dismissal during quarantine			0.016 <sup>a</sup>
No	89 (31.7%)	16.70 ± 17.91	
Yes	192 (68.3%)	22.59 ± 19.37 <sup>h</sup>	

<sup>a</sup> T Student.

<sup>b</sup> U Mann Whitney.

<sup>c</sup> ANOVA.

<sup>d</sup> Kruskal Wallis.

<sup>e</sup> Basics (1st to 3rd year of career), Clinicals (4th to 6th year of career), Internship (7th year of career).

<sup>f</sup> University student who at the time of completing the survey takes all the courses corresponding to their academic cycle (according to the university's curricula).

<sup>g</sup> Minimum wage/month in Peru S/. 930 (USD 226, approximately).

<sup>h</sup> Symptoms of Severity (dyspnea or angina pectoris).

participant gave their consent before answering the survey, and the anonymity and confidentiality of the respondents were respected. After finishing and submitting the survey, each participant had access to mental health related resources such as websites and phone numbers to call if they needed help or guidance. All the procedures were conducted according to established ethical guidelines.

### 3. Results

We surveyed a total of 281 medical students. Most of them were female (69.8%) and had an age between 18-24 years (91.8%). We found higher medians of IES-R score among students from basic sciences (p = 0.038), with a mother with only secondary education (p = 0.008), who developed severe symptoms of COVID-19 (dyspnea or angina pectoris) (p = 0.001), who had contact with a person diagnosed with COVID-19 (p = 0.007), who cohabited with a person with COVID-19 (p = 0.007), who had a relative who died from COVID-19 (p = 0.007), who cohabited with

**Table 2.** Characteristics of the study population according to each subscale of IES-R.

Characteristics	Intrusion		Hyperarousal		Avoidance	
	Mean ± SD/ Median [IQR]	p	Mean ± SD/ Median [IQR]	p	Mean ± SD/ Median [IQR]	p
<b>Sociodemographic</b>						
Sex		0.800 <sup>a</sup>		0.949 <sup>a</sup>		0.715 <sup>a</sup>
Male	6.08 ± 6.47		7.15 ± 6.56		7.34 ± 8.23	
Female	5.88 ± 6.11		7.20 ± 5.99		7.7 ± 7.38	
Age		0.838 <sup>b</sup>		0.661 <sup>b</sup>		0.527 <sup>b</sup>
18 to 24	4 [1–9]		5 [2–11]		5 [1–13]	
>25	4 [1–8]		6 [2–14]		5 [1–17]	
Career years <sup>c</sup>		0.099 <sup>d</sup>		0.178 <sup>c</sup>		0.020 <sup>c</sup>
Basics	5 [2–12]		8.07 ± 6.78		9.24 ± 8.31	
Clinicals	3 [1–8]		6.69 ± 5.78		6.64 ± 7.07	
Internship	4 [0–12]		6.3 ± 4.67		6.27 ± 6.99	
Regular student <sup>f</sup>		0.199 <sup>a</sup>		0.017 <sup>a</sup>		0.158 <sup>a</sup>
No	6.68 ± 6.71		8.55 ± 6.48		8.60 ± 8.04	
Yes	5.63 ± 5.99		6.63 ± 5.94		7.18 ± 7.44	
Monthly income (in minimum wages/month) <sup>g</sup>		0.229 <sup>c</sup>		0.208 <sup>c</sup>		0.077 <sup>c</sup>
≥9	5.41 ± 6.08		6.68 ± 6.09		6.71 ± 7.61	
5 to 8	6.36 ± 6.44		7.45 ± 6.05		8.42 ± 7.19	
1 to 4	6.96 ± 6.27		8.35 ± 6.39		9.13 ± 8.00	
Father's level of education		0.395 <sup>c</sup>		0.156 <sup>c</sup>		0.664 <sup>c</sup>
Postsecondary	5.83 ± 6.13		7.05 ± 6.05		7.50 ± 7.60	
Secondary	8 ± 7.44		10.07 ± 7.62		9.33 ± 8.67	
At least primary	4.75 ± 7.54		5.5 ± 5.92		7.5 ± 7.05	
Mother's level of education		0.045 <sup>b</sup>		0.004 <sup>b</sup>		0.014 <sup>b</sup>
Postsecondary	4 [1–8]		5 [2–11]		4.5 [1–12]	
Secondary	5 [2–16]		9 [5–16]		10 [4–18]	
<b>Health</b>						
Risk Comorbidity		0.366 <sup>b</sup>		0.502 <sup>b</sup>		0.982 <sup>b</sup>
No	4 [1–9]		5 [2–11]		5 [1–13]	
Yes	7 [2–8]		6 [4–14]		5 [1–15]	
Health Insurance		0.833 <sup>a</sup>		0.446 <sup>a</sup>		0.506 <sup>a</sup>
No	5.81 ± 6.50		7.67 ± 6.95		8.11 ± 8.32	
Yes	5.99 ± 6.13		7.02 ± 5.86		7.41 ± 7.39	
<b>COVID-19</b>						
Had severity symptoms <sup>h</sup>		0.004 <sup>b</sup>		0.001 <sup>b</sup>		0.004 <sup>b</sup>
No	3 [1–8]		5 [2–10]		4 [1–12]	
Yes	7 [2–12]		10 [4–15]		10.5 [4–18]	
Had COVID-19 diagnosis		0.113 <sup>b</sup>		0.081 <sup>b</sup>		0.297 <sup>a</sup>
No	3 [1–9]		5 [2–11]		5 [1–12]	
Yes	7 [2–11]		7 [4–14]		7.5 [2–13]	
Relative with a COVID-19 diagnosis		0.092 <sup>a</sup>		0.281 <sup>a</sup>		0.298 <sup>a</sup>
No	5.5 ± 5.86		6.91 ± 5.88		7.26 ± 7.41	
Yes	6.83 ± 6.81		7.75 ± 6.68		8.27 ± 8.06	
Known friend with a COVID-19 diagnosis		0.283 <sup>b</sup>		0.246 <sup>b</sup>		0.151 <sup>b</sup>
No	2.5 [1–8]		5 [2–9]		4 [0–9]	
Yes	4 [1–9]		5 [2–11]		5 [1–13]	
Contact with a person with a COVID-19 diagnosis		0.003 <sup>b</sup>		0.028 <sup>b</sup>		0.011 <sup>b</sup>
No	3 [1–8]		5 [2–11]		5 [0–12]	
Yes	6.5 [3–12]		6.5 [3–15]		7 [3–18]	
Cohabitant with a COVID-19 diagnosis		0.016 <sup>b</sup>		0.008 <sup>b</sup>		0.016 <sup>b</sup>
No	3 [1–8]		5 [2–11]		5 [1–12]	
Yes	7.5 [2.5–12]		7 [4–15]		7.5 [3.5–15]	
Relative deceased by COVID-19		0.006 <sup>b</sup>		0.049 <sup>b</sup>		0.011 <sup>b</sup>
No	3 [1–8]		5 [2–11]		4 [1–12]	
Yes	5 [3–12.5]		7 [3.5–12]		8.5 [3.5–16.5]	
Known friend deceased by COVID-19		0.312 <sup>a</sup>		0.441 <sup>a</sup>		0.344 <sup>a</sup>
No	5.52 ± 6.09		6.87 ± 5.95		7.11 ± 7.51	

(continued on next page)

Table 2 (continued)

Characteristics	Intrusion		Hyperarousal		Avoidance	
	Mean $\pm$ SD/ Median [IQR]	<i>p</i>	Mean $\pm$ SD/ Median [IQR]	<i>p</i>	Mean $\pm$ SD/ Median [IQR]	<i>p</i>
Yes	6.28 $\pm$ 6.31		7.44 $\pm$ 6.32		7.98 $\pm$ 7.73	
Number of cohabitants		0.048 <sup>b</sup>		0.005 <sup>b</sup>		0.057 <sup>b</sup>
≤5	3 [1–8]		5 [2–10]		5 [1–12]	
>5	6 [1–15]		8 [3–15]		8.5 [1–17]	
Cohabitants		0.283 <sup>b</sup>		0.475 <sup>b</sup>		0.474 <sup>a</sup>
Alone or with friends	2 [0–5]		3 [2–7]		3 [1–8]	
Relatives	4 [1–9]		5 [2–11]		5 [1–13]	
<b>Quarantine</b>						
Lack of food and water		0.372 <sup>b</sup>		0.800 <sup>b</sup>		0.727 <sup>b</sup>
No	4 [1–9]		5 [2–11]		5 [1–13]	
Yes	5 [2–11]		5 [3–12]		6 [1–14]	
Quarantined with a person with a disease other than COVID-19		0.031 <sup>b</sup>		0.006 <sup>b</sup>		0.113 <sup>b</sup>
No	3 [1–8]		5 [2–9]		4 [1–12]	
Yes	5 [1–12]		6.5 [4–14]		7.5 [1–15]	
Person who financially supports you work during quarantine		0.891 <sup>b</sup>		0.696 <sup>b</sup>		0.650 <sup>b</sup>
No	4 [1–9]		5 [3–11]		6 [1–13]	
Yes	3 [1–9]		5 [2–12]		4 [1–13]	
Decrease in family monthly income per month or dismissal during quarantine		0.026 <sup>a</sup>		0.023 <sup>a</sup>		0.017 <sup>a</sup>
No	4.73 $\pm$ 5.66		5.97 $\pm$ 5.69		6 $\pm$ 7.48	
Yes	6.5 $\pm$ 6.39		7.76 $\pm$ 6.29		8.33 $\pm$ 7.61	

<sup>a</sup> T Student.<sup>b</sup> U Mann Whitney.<sup>c</sup> ANOVA.<sup>d</sup> Kruskal Wallis.<sup>e</sup> Basics (1st to 3rd year of career), Clinicals (4th to 6th year of career), Internship (7th year of career).<sup>f</sup> University student who at the time of completing the survey takes all the courses corresponding to their academic cycle (according to the university).<sup>g</sup> Minimum wage/month in Peru S/. 930 (USD 226, approximately).<sup>h</sup> Symptoms of Severity (dyspnea or angina pectoris).

more than five persons ( $p = 0.018$ ), who had been diagnosed with disease other than COVID-19 ( $p = 0.024$ ) and whose household income declined during the pandemic ( $p = 0.016$ ) (Table 1).

In Table 2 we present the characteristics of the study population according to the score of IES-R subscales: intrusion, hyperactivation and avoidance symptoms. We found that medical students whose mother only had secondary education ( $p = 0.045$ ,  $p = 0.004$ ,  $p = 0.014$ ), who developed severe symptoms of COVID-19 ( $p = 0.004$ ,  $p = 0.001$ ,  $p = 0.004$ ), who had contact with a person diagnosed with COVID-19 ( $p = 0.003$ ,  $p = 0.028$ ,  $p = 0.011$ ), who cohabited with a person diagnosed with COVID-19 ( $p = 0.016$ ,  $p = 0.008$ ,  $p = 0.016$ ), who had a relative who died from COVID-19 ( $p = 0.006$ ,  $p = 0.049$ ,  $p = 0.011$ ) and whose household income declined during pandemic ( $p = 0.026$ ,  $p = 0.023$ ,  $p = 0.017$ ), had higher means in the scores of three subscales respectively. Also, students who had been diagnosed with a disease other than COVID-19 ( $p = 0.031$ ,  $p = 0.006$ ) and who's cohabited with a person with COVID-19 ( $p = 0.048$ ,  $p = 0.005$ ) had higher medians in the scores of intrusion and hyperactivation subscales respectively.

In the multivariable analysis, we found that factors associated with a higher overall score of the IES-R were having had severe COVID-19 symptoms ( $\beta = 8.57$ ; 95%CI = 1.94 to 15.21;  $p = 0.011$ ), more than five cohabitants ( $\beta = 7.05$ ; 95%CI = 0.09 to 14.02;  $p = 0.047$ ), being quarantined with a person diagnosed with a disease other than COVID-19 ( $\beta = 5.65$ ; 95%CI = 0.37 to 10.93;  $p = 0.036$ ) and a decrease in household income during the pandemic ( $\beta = 4.72$ ; 95%CI = 0.06 to 9.38;  $p = 0.047$ ). The factors associated with the scores for each subscale of the IES-R are presented in Table 3.

#### 4. Discussion

The present study identified that being quarantined with a person diagnosed with a disease other than COVID-19, having severe COVID-19 symptoms, more than five cohabitants and a decrease in household income during the pandemic are factors associated with PTSD in the post-quarantine context of the COVID-19 pandemic in medical students.

The fact that being quarantined with a person diagnosed with a disease other than COVID-19 was an associated factor could be explained by the fear of infecting a family member with a disease that could put them at serious risk. Experiencing a decrease in family income was also associated with a higher score on the IES-R and with symptoms of intrusion and avoidance. The lower economic income can be a source of additional frustration due to not being able to cover the adequate need for supplies, medical attention or maintaining the previous lifestyle, as indicated in several studies on the consequences of quarantine [28, 29, 30]. We must remember that the Peruvian state spent 107 days in mandatory social isolation, with the longest duration of quarantine being associated with the presence of symptoms of post-traumatic stress disorder and a greater impact on family finances. Our findings are related to another study that indicates that COVID-19 increased the unemployment rate, had a greater negative impact on the labor market for men, increasing inequalities in the labor market in the short term [31]. During the mandatory social isolation, those families with lower income may have required additional support.

The presence of severe COVID-19 symptoms (such as respiratory distress, pain or pressure in the chest) was associated with hyperarousal symptoms characterized by physiological reactivity, hypervigilance,

**Table 3.** Multivariable regression and parsimonious models for factors associated with PTSD.

Variables	IES-R			Intrusion			Hyperarousal			Avoidance		
	a $\beta$	IC95%	p	a $\beta$	IC95%	p	a $\beta$	IC95%	p	a $\beta$	IC95%	p
<b>Sociodemographic</b>												
Career year <sup>a</sup>	Not included			Ref			Ref			Ref		
Basics	Not included			Ref			Ref			Ref		
Clinicals				-2.10	-3.75 to -0.43	0.014	-0.45	-1.99 to 1.10	0.570	-2.79	-4.76 to -0.83	0.005
Internship				-2.86	-8.00 to 2.27	0.273	-1.83	-6.34 to 2.68	0.424	-4.88	-10.98 to 1.22	0.116
<b>COVID-19</b>												
Had Severity Symptoms <sup>b</sup>	Not included			Ref			Not included			Ref		
No	Ref			Ref			Ref			Ref		
Yes	8.57	1.94 to 15.21	0.011				3.60	1.29 to 5.91	0.002			
Number of Cohabitants												
≤5	Ref			Ref			Ref			Ref		
>5	7.05	0.09 to 14.02	0.047	2.54	-0.02 to 5.10	0.052	2.37	0.28 to 4.47	0.026	2.30	-0.54 to 5.14	0.113
Cohabitants												
Alone or with friends	Not included			Ref			Ref			Ref		
Relative				1.09	-2.93 to 5.11	0.595	0.23	-3.74 to 4.20	0.908	1.38	-3.42 to 6.17	0.573
<b>Quarantine</b>												
Quarantined with a person with a disease other than COVID-19												
No	Ref			Ref			Ref			Ref		
Yes	5.65	0.37 to 10.93	0.036	2.37	0.57 to 4.18	0.010	2.06	0.34 to 3.79	0.019	2.41	0.21 to 4.61	0.032
Decrease in family monthly income per month or dismissal during quarantine												
No	Ref			Ref			Ref			Ref		
Yes	4.72	0.06 to 9.38	0.047	1.62	0.07 to 3.17	0.040	1.51	-0.01 to 3.03	0.051	2.04	0.07 to 4.01	0.042

<sup>a</sup> Basics (1st to 3rd year of career), Clinicals (4th to 6th year of career), Internship (7th year of career).

<sup>b</sup> Symptoms of Severity (dyspnea or angina pectoris).

concentration problems and irritability. This may be due to the fact that people facing the infection develop fear, anguish and concern for the recovery of their health [32]. Likewise, the presence of this variable was associated with having a higher score in the IES-R compared to people who did not have symptoms of severity. It is mainly fear which triggers the autonomic arousal mechanisms of the “fight” or “flight response”, processing thoughts of immediate danger and escape behaviors prior to the development of anxiety associated with muscular tension and hypervigilance in preparation for a real or unreal danger in the future [33].

Living with more than five people during quarantine was associated with symptoms of hyperarousal, criterion E of the DSM-5, which is the presence of involuntary distressing memories, dreams or thoughts, dissociative distancing reactions from the event, or intense psychological distress. This variable was also associated with having a higher score on the IES-R compared to people who cohabit with five people or less. The fear of getting infected from someone who you cohabit with is equivalent to having a traumatic event [34].

Medical students from clinical years had significant lower levels of intrusion and avoidance symptoms than medical students from basic science years. Students from clinical years could not carry out their face-to-face practices due to quarantine, having to adapt the practices to online sessions that do not allow replicating the clinical exposure with as much ease as in person [35]. Our results might be explained by a greater academic and age maturity on the part of clinical science students, making them have a greater commitment to the pandemic situation and express less rejection of the situation. Likewise, clinical science students who are in the last years, may have a more solid life plan, this generates resilience and can act as a protective factor in the face of the pandemic situation.

Since medical students were already at risk for developing psychological symptoms, even prior to the pandemic, after the mandatory social isolation and the “new normality”, it is imperative to establish recovery measures and early detection of serious and chronic disorders that could endanger their well-being and, therefore, public health care. A study

developed in the US by Lee et al (2021), found that over 25% of medical students screened positive for PTSD risk symptoms. The authors recommended that medical schools should consider a broader support system for their students [36]. Another study in Ireland highlights the importance of including pandemic/crisis specific content in medicine school's curriculum, in that way, students can have the necessary resources to face the current or future pandemic situations [35].

Some limitations should be highlighted. First, because of the cross-sectional design, it was not possible to assess causality. Second, our findings are limited to medical students from a private university in Lima and cannot be extrapolated to students from public universities or universities outside Lima; however, we believe that could give an overview of what might be happening in other regions of the country. Third, because of the pandemic and the restrictions in our country (i.e. quarantine), the students enrolled did not respond to the instruments in a face-to-face way. This modality does not guarantee that the survey respondents have paid enough attention to fill it out properly. Fourth, while the study included an extensive number of associated factors, it is possible that other factors remained unidentified. Finally, high IES-R measures may indicate the probability that an enrolled student has PTSD, but this clinical tool does not make the psychiatric diagnosis of PTSD. The diagnosis is made through the psychiatric medical interview.

## 5. Conclusions

We found that having COVID 19 symptoms, cohabiting with more than five people, being quarantined with a person diagnosed with a disease other than COVID-19 and having a decrease in household income during the pandemic are factors associated with PTSD symptoms in medical students. Clinical evaluation is important for medical students with a high probability of having PTSD. We recommend conducting a longitudinal study to identify causality and other unstudied factors related to PTSD.

## Declarations

### Author contribution statement

Rodrigo Alejandro-Salinas; Alexandra C. Rojas-Cueva; Fabriccio J. Visconti-Lopez: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

Miriam L. Osorio-Martinez: Analyzed and interpreted the data; Wrote the paper.

Carlos J. Toro-Huamanchumo: Contributed reagents, materials, analysis tools or data; Wrote the paper.

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### Data availability statement

Data will be made available on request.

### Declaration of interests statement

The authors declare no conflict of interest.

### Additional information

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