Original Article

Depression, Anxiety and Stress Associated With Fear of COVID-19 in Peruvian Dental Students: A Multivariate Analysis With 12 Sociodemographic Factors

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ABSTRACT

Aims and Objectives: Excessive fear of coronavirus disease 2019 (COVID-19) in dental students could cause mood disorders, especially if there are factors in the environment that generate feelings of anxiety or uncertainty. The aim of this study was to evaluate the fear of COVID-19 and its association with depression, anxiety, and stress in Peruvian dental students according to their sociodemographic factors. **Materials and Methods:** This analytical, observational, and cross-sectional study was conducted in 398 dental students of a public university in the Peruvian capital during April 2021 to July 2021. The Depression, Anxiety and Stress Scale—21 items was used to diagnose depression, anxiety, and stress. The Fear of COVID-19 Scale was used to detect fear of COVID-19. The Pearson's chi-square test was used for statistical analysis. In addition, a logit model using odds ratio (OR) was performed to evaluate depression, anxiety, and stress of students with the associated factors: fear of COVID-19 and 12 sociodemographic variables (gender, age group, marital status, year of study, origin, companion, living with vulnerable people, history of mental illness, history of COVID-19, loss of close relatives due to COVID-19, occupation, and area of residence). A significance level of $P < .05$ was considered. In addition, predictive models were developed for the variables depression, anxiety, and stress, considering all possible significant causes. **Results:** The prevalence of fear of COVID-19, depression, anxiety, and stress was 19.6%, 36.2%, 40.7%, and 19.6%, respectively. According to the adjusted logit model, students who had fear of COVID-19 had OR = 2.74 (95% confidence interval [CI]: 1.62–4.64), OR = 5.59 (95% CI: 3.14–9.97), and OR = 3.31 (95% CI: 1.88–5.83) for developing depression, anxiety, and stress, respectively. In addition, those who reported history of mental illness were four times more likely to develop depression (OR = 4.02, 95% CI: 1.96–8.25) and anxiety (OR = 4.50, 95% CI: 2.06–9.82), whereas those living with people vulnerable to COVID-19 were twice as likely to develop stress (OR = 2.06, 95% CI: 1.16–3.66). **Conclusion:** The highest prevalence of mood disorders among dental students was anxiety. In addition, those who were afraid of COVID-19 had three times the probability of developing depression and stress, and

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five times the probability of developing anxiety. On the other hand, the most influential factor in the development of depression and anxiety was history of mental illness, whereas the factor of living with vulnerable people was the most influential factor in the development of stress.

Keywords: *Anxiety, dentistry, depression, fear of COVID-19, Peru, sociodemographic factors, stress, university students*

Introduction

Coronavirus disease 2019 (COVID-19), first identified in Wuhan, China, in December 2019, was declared a public health emergency of international concern by the World Health Organization in January 2020.[1] In Peru, after confirmation of the first case of COVID-19 on March 6, 2020, a state of national emergency with mandatory social isolation was established in order to avoid an exponential increase in the number of infections.[2] However, in May 2021, Peru reported 5540 deaths per million Peruvians, the highest number of deaths per million inhabitants worldwide.[3] Owing to this crisis generated by the COVID-19 pandemic, the entire population was affected in different aspects of their lives. Some examples were interruption of academic activities, loss of work, hasty adaptation to virtuality, as well as deaths of close relatives. As a result, fear of COVID-19 has increased the appearance of several conditions that affect mental health in different age groups, motivated by the constant worry of suffering from this disease and subsequently affecting close relatives.[4-8]

It is known that young people can often be asymptomatic carriers of the coronavirus that causes COVID-19. Being aware of this situation, they may develop undue concern about exposing vulnerable family members to serious complications from COVID-19.[9] In addition, confinement measures have caused young people to break their active social routine, which may increase the risk of developing high levels of anxiety, even to the point of depression.[10] On the other hand, it is possible that factors such as infodemics may further increase the feeling of fear in young people.[11]

Excessive fear of COVID-19 among young people can lead them to anxiety reactions (irritability, insomnia, and anger), increase in harmful habits (alcohol and tobacco consumption), and the appearance of mood disorders such as depression, anxiety, and stress.[12] In this sense, anxiety has been defined as a physiological response of the organism to counteract or cancel out an imminent threat or danger,[13] stress has been defined as the set of neuroendocrine, immunological, emotional, and behavioral responses to situations that require a greater than usual demand for adaptation,[14] and depression has been considered as a state of emotional pain, unhappiness, or sadness that manifests itself as a reaction to an unpleasant event or situation.[15] These mood disorders are now considered one of the leading causes of disability, making them a public health priority.[16] It has also been reported that there are some sociodemographic factors that could be associated with mood disorders among university students, in the context of COVID-19 pandemic and confinement, such as age, sex, presence of chronic diseases, marital status, occupation (student or student/worker), place of origin, academic year, number of household members, and economic difficulties, among others.[7,17-21]

There are several instruments to measure mood disorders in a reliable way, including the Depression, Anxiety and Stress Scale—21 items (DASS-21), which has been used by numerous researchers in behavioral sciences to measure depression, anxiety, and stress with an acceptable psychometric performance in university populations.[22-24] In addition, an instrument that specifically measures fear of COVID-19 (Fear of COVID-19 Scale [FCV-19S]) has recently been developed and validated, demonstrating very good psychometric properties in countries such as Peru and Iran.[4,10]

As it has been reported that health science students are very prone to suffer from anxious symptoms,[6-8] it is of great importance and interest to assess whether the fear of COVID-19 presented by dental students, either because they begin to have contact with patients or perhaps because of confinement, could be generating mood disorders. Early diagnosis of these pathologies could alert university authorities and develop preventive strategies to reduce this psychological impact on university dental students.

Therefore, this study aimed to assess fear of COVID-19 and its association with depression, anxiety, and stress in Peruvian dental students according to their sociodemographic factors. This manuscript was written according to the STrengthening the Reporting of

OBservational studies in Epidemiology guidelines for observational studies.[25]

Materials and Methods

Type of study

An analytical, observational, and cross-sectional study was conducted.

Population and selection of participants

The study was conducted between April and July 2021. The initial population consisted of 427 Peruvian dental students from the Universidad Nacional Federico Villarreal (UNFV) in Lima, Peru. However, after considering inclusion and exclusion criteria, the final population was 398 students, so no sample size calculation was required because the entire final population was included in the study.

Inclusion criteria

1. Students of both genders over 18 years of age (legal age)
2. Students of dentistry professional career
3. Students enrolled from the 2nd to 6th year in the first semester of 2021 (There were no students enrolled in the 1st year.)
4. Students who accepted the virtual informed consent.
5. Dental students attending virtual classes during COVID-19 pandemic

Exclusion criteria

1. Enrolled students who withdrew before the end of academic year
2. Students with variable area of residence in the last 6 months

Associated factors

The factors considered in this study that were associated with the development of depression, anxiety, and stress were fear of COVID-19, gender, age group, marital status, year of study, origin, companion, living with vulnerable people, history of mental illness, history of COVID-19, loss of close relatives due to COVID-19, occupation, and area of residence. It should be clarified, with respect to history of mental illness, that only students who reported having been previously diagnosed by a specialist were taken into account.

Application of instrument

The instrument used was DASS-21. This questionnaire consisted of 21 items distributed in three dimensions: depression, anxiety, and stress. Each dimension was composed of seven questions randomly distributed in the questionnaire. In addition, each item had four ordinal (Likert-type) response alternatives: "Never" (0 points), "Sometimes" (1 point), "Frequently" (2 points), and "Almost always" (3 points). Scores obtained from the students in each dimension were summed, which made it possible to diagnose depression, anxiety, and stress. Finally, those who scored 5–21 points were diagnosed with depression, those who scored 4–21 points were diagnosed with anxiety, and those who scored 8–21 points were diagnosed with stress.[26,27]

Regarding detection of fear of COVID-19, the FCV-19S was used, which consisted of seven items. All items were scored on a 5-point Likert scale, from 1 point (strongly disagree) to 5 points (strongly agree). The total scores ranged from 7 to 35. Those who obtained 17–35 points were diagnosed with fear of COVID-19.[4]

The FCV-19S items were as follows:

1. I am very afraid of COVID-19.
2. It makes me uncomfortable to think about COVID-19.
3. My hands get wet when I think about COVID-19.
4. I am afraid of losing my life because of COVID-19.
5. When I see news and stories about COVID-19, I become nervous or anxious.
6. I can't sleep because I'm worried about getting COVID-19.
7. My heart races or palpitates when I think about getting COVID-19.

To evaluate the reliability of both instruments, Cronbach's alpha was applied and significantly acceptable values were obtained for both DASS-21 (0.91, 95% confidence interval [CI]: 0.87–0.95) and FCV-19S (0.86, 95% CI: 0.79–0.93). In addition, both questionnaires were taken at two different times within 7 days to evaluate the analysis of concordance in responses, altering the order of questions to avoid recall bias (test–retest). The concordance, according to Cohen's kappa index, was significantly good for both DASS-21 (k = 0.83, 95% CI: 0.74–0.92) and FCV-19S (k = 0.89, 95% CI: 0.82–0.96).

Procedure

Scales were elaborated in Google Classroom® and distributed in a hetero-administered way to each student in their virtual classroom through the Microsoft Teams® platform. The link was sent to their emails or through the chat on the same platform, with prior permission from the professor. Informed consent to participate in the study was written at the beginning of each scale, as were the indications. The students were free to refuse the evaluation if they did not wish to complete it during its development. Only researchers had access to data and no personal details (name, address, telephone number, etc.) were required. Only one submission per student

was considered, and the results were sent to their emails after completion of entire study.

Data analysis

Data analysis was performed with the Statistical Package for the Social Sciences (SPSS) version 24.0. Descriptive statistics were applied to obtain percentages of categorical variables. The Pearson's chi-square test was used for bivariate analysis with Yates correction for expected values less than 5. Risk factors were examined with the logistic regression model (logit model) using odds ratio (OR). All analyses were performed, considering *P* value <.05 as significant. In addition, predictive models were developed for the variables depression, anxiety, and stress, considering all possible significant causes.

Bioethical considerations

All participants gave informed consent. In addition, this research respected the bioethical principles for medical research on human beings of the Declaration of Helsinki[28] related to confidentiality, freedom, respect, and nonmaleficence, and was approved by the Ethics Committee of the Postgraduate School of the Universidad Nacional Federico Villarreal (act no. 001-2021-UIIE-EUPG-UNFV).

Results

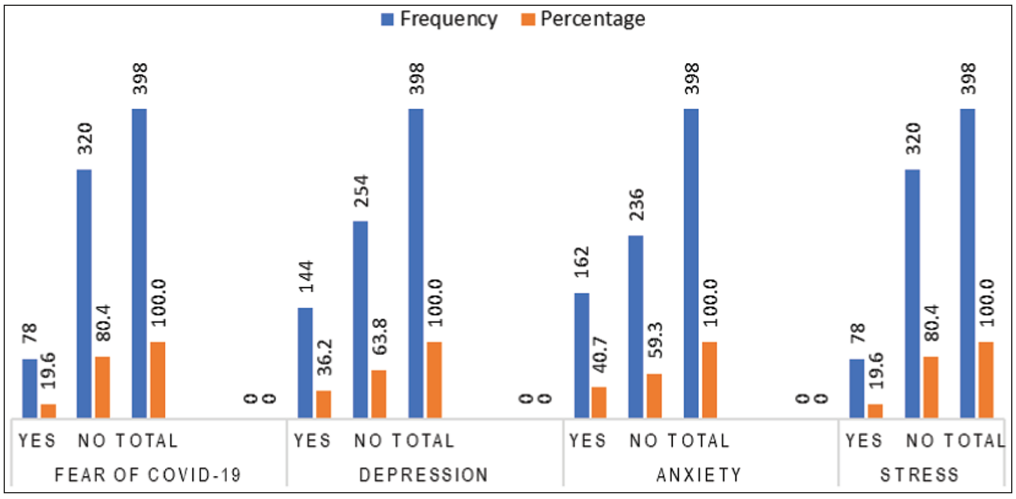
The mean age of the 398 students was 23.64 ± 3.31 years, and the prevalence of fear of COVID-19, depression, anxiety, and stress were 19.6%, 36.2%, 40.7%, and 19.6%, respectively [Graph 1]. The highest prevalence of fear of COVID-19 by category occurred in females (23.2%), students ≤ 23 years (21.9%), those with married marital status (37.5%), 3rd year students (28.1%), those from capital city (20.6%), those living accompanied (19.9%), those living with vulnerable people (21. 2%), those with history of mental illness (27.5%), those with no history of COVID-19 (19.9%), those who lost close relatives to COVID-19 (25.7%), those who worked and studied during the COVID-19 pandemic (19.9%), and those living in rural areas (26.7%) [Table 1].

Depression was significantly associated with fear of COVID-19 in at least one category of the 12 sociodemographic factors considered in this study (*P* < .05). It was not associated in those married or cohabiting (*P* = 1.000), 2nd year students (*P* = .970), 3rd year students (*P* = .269), those from province (*P* = 1.000), those living alone (*P* = .546), those with history of mental illness (*P* = 1.000), and those with history of COVID-19 (*P* = .286) [Table 2].

On the other hand, anxiety was significantly associated with fear of COVID-19 in at least one category of the 12 sociodemographic factors considered in this study (*P* < .05). It was not associated in those married or cohabiting (*P* = .121), 2nd year students (*P* = .745), those living alone (*P* = .712), and those who had history of COVID-19 (*P* = .899) [Table 2].

Finally, stress was significantly associated with fear of COVID-19 in at least one category of the 12 sociodemographic factors considered in this study (*P* < .05). It was not associated in those married or cohabiting (*P* = .620), 2nd year students (*P* = .947), 5th year students (*P* = .545), those from province (*P* = .196), those living alone (*P* = .350), those with history of mental illness (*P* = .146), and those with history of COVID-19 (*P* = .152) [Table 2].

After including the 12 sociodemographic factors and fear of COVID-19 in the crude logistic regression model, it could be observed that depression was significantly associated (*P* < .05) with fear of COVID-19, origin,



Graph 1: Prevalence of fear of coronavirus disease 2019, depression, anxiety, and stress in dental students

Table 1: Descriptive characteristics of sociodemographic variables and prevalence of fear of COVID-19 in dental students

Sociodemographic variable	Categories	*n*	%	Fear of COVID-19	
				Yes	No
Gender	Male	122	30.7	14 (11.5)	108 (88.5)
	Female	276	69.3	64 (23.2)	212 (76.8)
Age group (years)	≤23	224	56.3	49 (21.9)	175 (78.1)
	>23	174	43.7	29 (16.7)	145 (83.3)
Marital status	Married or cohabiting	16	4.0	6 (37.5)	10 (62.5)
	Unmarried	382	96.0	72 (18.8)	310 (81.2)
Year of study	2nd year	51	12.8	8 (15.7)	43 (84.3)
	3rd year	57	14.3	16 (28.1)	41 (71.9)
	4th year	97	24.4	21 (21.6)	76 (78.4)
	5th year	103	25.9	16 (15.5)	87 (84.5)
	Internship	90	22.6	17 (18.9)	73 (81.1)
Origin	Capital city	359	90.2	74 (20.6)	285 (79.4)
	Province	39	9.8	4 (10.3)	35 (89.7)
Companion	Alone	12	3.0	1 (8.3)	11 (91.7)
	Accompanied	386	97.0	77 (19.9)	309 (80.1)
Living with people vulnerable to COVID-19	Yes	240	60.3	51 (21.2)	189 (78.8)
	No	158	39.7	27 (17.1)	131 (82.9)
History of mental illness	Yes	40	10.1	11 (27.5)	29 (72.5)
	No	358	89.9	67 (18.7)	291 (81.3)
History of COVID-19	Yes	52	13.1	9 (17.3)	43 (82.7)
	No	346	86.9	69 (19.9)	277 (80.1)
Loss of close relatives due to COVID-19	Yes	101	25.4	26 (25.7)	75 (74.3)
	No	297	74.6	52 (17.5)	245 (82.5)
Occupation	Studying	197	49.5	38 (19.3)	159 (80.7)
	Studying and working	201	50.5	40 (19.9)	161 (80.1)
Area of residence	Urban	368	92.5	70 (19.0)	298 (81.0)
	Rural	30	7.5	8 (26.7)	22 (73.3)

COVID-19 = coronavirus disease 2019

history of mental illness, and loss of close relative due to COVID-19. Regarding anxiety, it was significantly associated ($P < .05$) with fear of COVID-19, year of study, provenance, and history of mental illness. Finally, stress was significantly associated ($P < .05$) with fear of COVID-19, age group, living with vulnerable people, and history of mental illness [Table 3].

In the adjusted multivariate logistic regression model (logit model), it could be observed that students with fear of COVID-19 presented almost three times the probability of developing depression (OR = 2.74, 95% CI: 1.62–4.64), five times the probability of developing anxiety (OR = 5.59, 95% CI: 3.14–9.97), and three times the probability of developing stress (OR = 3.31, 95% CI: 1.88–5.83). In addition, the most influential sociodemographic factor in the development of depression (OR = 4.02, 95% CI: 1.96–8.25) and anxiety (OR = 4.50, 95% CI: 2.06–9.82) was history of mental illness, whereas the most influential sociodemographic factor in the development of stress (OR = 2.06, 95% CI: 1.16–3.66) was living with people vulnerable to COVID-19. However, studying in the 1st year of dental career represented a protective factor against anxiety. For example, those studying in the 2nd year of dental school were 67% less likely to develop anxiety (OR = 0.33, 95% CI: 0.15–0.72) compared to those studying internship (OR = 0.33, 95% CI: 0.15–0.72) [Table 4].

According to binary logistic regression analysis, three predictive models were developed, being variables of effect: depression, anxiety, and stress. The main cause was the variable fear of COVID-19. The influential intermediate variables for depression were origin, history of mental illness, and loss of close relatives due to COVID-19; for anxiety were 2nd, 3rd, and 4th year of studies, and origin and history of mental illness; and for stress were age ≤ 23 years, living with people vulnerable to COVID-19, and history of mental illness [Table 5].

Discussion

Mood disorders could be due to permanent feeling of insecurity or excessive fear of COVID-19. Students know that at some point, they could be in contact with patients infected by SARS-CoV-2 and be at risk of becoming infected and infecting close relatives, because saliva is the main biological vector of infection.[29-31] In

Table 2: Association of fear of COVID-19 with the prevalence of anxiety, depression, and stress in dental students, according to sociodemographic factors

Sociodemographic factors	Categories	Fear of COVID-19	Depression		*P	Anxiety		*P	Stress		*P
			Yes	No		Yes	No		Yes	No	
			f (%)	*f* (%)		*f* (%)	*f* (%)		*f* (%)	*f* (%)	
Gender	Male	Yes	8 (57.1)	6 (42.9)	.023	10 (71.4)	4 (28.6)	.007	7 (50.0)	7 (50.0)	.001
		No	26 (24.1)	82 (75.9)		37 (34.3)	71 (65.7)		13 (12.0)	95 (88.0)	
	Female	Yes	37 (57.8)	27 (42.2)	.001	47 (73.4)	17 (26.6)	<.001	23 (35.9)	41 (64.1)	.001
		No	73 (34.4)	139 (65.6)		68 (32.1)	144 (67.9)		35 (16.5)	177 (83.5)	
Age group	≤23 years	Yes	29 (59.2)	20 (40.8)	.004	35 (71.4)	14 (28.6)	<.001	21 (42.9)	28 (57.1)	.001
		No	63 (36.0)	112 (64.0)		67 (38.3)	108 (61.7)		33 (18.9)	142 (81.1)	
	>23 years	Yes	16 (55.2)	13 (44.8)	.001	22 (75.9)	7 (24.1)	<.001	9 (31.0)	20 (69.0)	.008
		No	36 (24.8)	109 (75.2)		38 (26.2)	107 (73.8)		15 (10.3)	130 (89.7)	
Marital status	Married or cohabiting	Yes	2 (33.2)	4 (66.7)	1.000	5 (83.3)	1 (16.7)	.121	2 (33.3)	4 (66.7)	.620
		No	2 (20.0)	8 (80.0)		3 (30.0)	7 (70.0)		1 (10.0)	9 (90.0)	
	Unmarried	Yes	43 (59.7)	29 (40.3)	<.001	52 (72.2)	20 (27.8)	<.001	28 (38.9)	44 (61.1)	<.001
		No	97 (31.3)	213 (68.7)		102 (32.9)	208 (67.1)		47 (15.2)	263 (84.8)	
Year of study	2nd year	Yes	4 (50.0)	4 (50.0)	.970	5 (62.5)	3 (37.5)	.745	1 (12.5)	7 (87.5)	.947
		No	18 (41.9)	25 (58.1)		21 (48.8)	22 (51.2)		9 (20.9)	34 (79.1)	
	3rd year	Yes	8 (50.0)	8 (50.0)	.269	12 (75.0)	4 (25.0)	.035	6 (37.5)	10 (62.5)	.016
		No	14 (34.1)	27 (65.9)		18 (43.9)	23 (56.1)		3 (7.3)	38 (92.7)	
	4th year	Yes	12 (57.1)	9 (42.9)	.017	18 (85.7)	3 (14.3)	<.001	9 (42.9)	12 (57.1)	.028
		No	22 (28.9)	54 (71.1)		25 (32.9)	51 (67.1)		13 (17.1)	63 (82.9)	
	5th year	Yes	10 (62.5)	6 (37.5)	.012	11 (68.8)	5 (31.3)	.003	5 (31.3)	11 (68.8)	.545
		No	26 (29.9)	61 (70.1)		26 (29.9)	61 (70.1)		18 (20.7)	69 (79.3)	
	Internship	Yes	11 (64.7)	6 (35.3)	.002	11 (64.7)	6 (35.3)	.001	9 (52.9)	8 (47.1)	<.001
		No	19 (26.0)	54 (74.0)		15 (20.5)	58 (79.5)		5 (6.8)	68 (93.2)	
Origin	Capital	Yes	44 (59.5)	30 (40.5)	<.001	54 (73.0)	20 (27.0)	<.001	28 (37.8)	46 (62.2)	<.001
		No	93 (32.6)	192 (67.4)		99 (34.7)	186 (65.3)		44 (15.4)	241 (84.6)	
	Province	Yes	1 (25.0)	3 (75.0)	1.000	3 (75.0)	1 (25.0)	.048	2 (50.0)	2 (50.0)	.196
		No	6 (17.1)	29 (82.9)		6 (17.1)	29 (82.9)		4 (11.4)	31 (88.6)	
Companion	Alone	Yes	1 (100.0)	0 (0.0)	.546	1 (100.0)	0 (0.0)	.712	1 (100.0)	0 (0.0)	.350
		No	2 (18.2)	9 (81.8)		3 (27.3)	8 (72.7)		1 (9.1)	10 (90.9)	
	Accompanied	Yes	44 (57.1)	33 (42.9)	<.001	56 (72.7)	21 (27.3)	<.001	29 (37.7)	48 (62.3)	<.001
		No	97 (31.4)	212 (68.6)		102 (33.0)	207 (67.0)		47 (15.2)	262 (84.8)	
Living with people vulnerable to COVID-19	Yes	Yes	29 (56.9)	22 (43.1)	.003	38 (74.5)	13 (25.5)	<.001	22 (43.1)	29 (56.9)	<.001
		No	64 (33.9)	125 (66.1)		69 (36.5)	120 (63.5)		36 (19.0)	153 (81.0)	
	No	Yes	16 (59.3)	11 (40.7)	.001	19 (70.4)	8 (29.6)	<.001	8 (29.6)	19 (70.4)	.009
		No	35 (26.7)	96 (73.3)		36 (27.5)	95 (72.5)		12 (9.2)	119 (90.8)	
History of mental illness	Yes	Yes	7 (63.9)	4 (36.4)	1.000	11 (100.0)	0 (0.0)	.045	6 (54.5)	5 (45.5)	.146
		No	19 (65.5)	10 (34.5)		18 (62.1)	11 (37.9)		7 (24.1)	22 (75.9)	
	No	Yes	38 (56.7)	29 (43.3)	<.001	46 (68.7)	21 (31.3)	<.001	24 (35.8)	43 (64.2)	<.001
		No	80 (27.5)	211 (72.5)		87 (29.9)	204 (70.1)		41 (14.1)	250 (85.9)	

Table 2: Continued

Sociodemographic factors	Categories	Fear of COVID-19	Depression		*P	Anxiety		*P	Stress		*P
			Yes	No		Yes	No		Yes	No	
			f (%)	*f* (%)		*f* (%)	*f* (%)		*f* (%)	*f* (%)	
History of COVID-19	Yes	Yes	5 (55.6)	4 (44.4)	.286	5 (55.6)	4 (44.4)	.899	4 (44.4)	5 (55.6)	.152
		No	13 (30.2)	30 (69.8)		20 (46.5)	23 (53.5)		7 (16.3)	36 (83.7)	
	No	Yes	40 (58.0)	29 (42.0)	<.001	52 (75.4)	17 (24.6)	<.001	26 (37.7)	43 (62.3)	<.001
		No	86 (31.0)	191 (69.0)		85 (30.7)	192 (69.3)		41 (14.8)	236 (85.2)	
Loss of close relatives due to COVID-19	Yes	Yes	18 (69.2)	8 (30.8)	.010	17 (65.4)	9 (34.6)	.046	12 (46.2)	14 (53.8)	.015
		No	30 (40.0)	45 (60.0)		32 (42.7)	43 (57.3)		16 (21.3)	59 (78.7)	
	No	Yes	27 (51.9)	25 (48.1)	.001	40 (76.9)	12 (23.1)	<.001	18 (34.6)	34 (65.4)	<.001
		No	69 (28.2)	176 (71.8)		73 (29.8)	172 (70.2)		32 (13.1)	213 (86.9)	
Occupation	Studying	Yes	21 (55.3)	17 (44.7)	.010	27 (71.1)	11 (28.9)	<.001	15 (39.5)	23 (60.5)	.001
		No	52 (32.7)	107 (67.3)		55 (34.6)	104 (65.4)		24 (15.1)	135 (84.9)	
	Studying and working	Yes	24 (60.0)	16 (40.0)	<.001	30 (75.0)	10 (25.0)	<.001	15 (37.5)	25 (62.5)	.001
		No	47 (29.2)	114 (70.8)		50 (31.1)	111 (68.9)		24 (14.9)	137 (85.1)	
Area of residence	Urban	Yes	40 (57.1)	30 (42.9)	<.001	50 (71.4)	20 (28.6)	<.001	26 (37.1)	44 (62.9)	<.001
		No	92 (30.9)	206 (69.1)		98 (32.9)	200 (67.1)		44 (14.8)	254 (85.2)	
	Rural	Yes	5 (62.5)	3 (37.5)	.273	7 (87.5)	1 (12.5)	.022	4 (50.0)	4 (50.0)	.202
		No	7 (31.8)	15 (68.2)		7 (31.8)	15 (68.2)		4 (18.2)	18 (81.8)	

f = frequency, COVID-19 = coronavirus disease 2019

*Based on Pearson's chi-square and, in expected values less than 5, Yates's correction was applied, $P < .05$ (significant association)

Table 3: Crude multivariate logistic regression model of presence of depression, anxiety, and stress in dental students according to associated factors

Associated factors	Categories	Depression				Anxiety				Stress			
		OR	95% CI		*P* value	OR	95% CI		*P* value	OR	95% CI		*P* value
Fear of COVID-19	Yes	2.75	1.59	4.77	<.001	5.64	3.11	10.23	<.001	3.46	1.90	6.29	<.001
	No	1.00				1.00				1.00			
Gender	Male	0.75	0.46	1.24	.270	1.30	0.79	2.13	.297	1.00	0.54	1.83	.995
	Female	1.00				1.00				1.00			
Age group (years)	≤23	1.43	0.85	2.44	.181	1.07	0.63	1.83	.802	2.23	1.17	4.27	.015
	>23	1.00				1.00				1.00			
Marital status	Married or cohabiting	0.26	0.06	1.10	.067	0.88	0.25	3.13	.845	0.64	0.14	3.00	.571
	Unmarried	1.00				1.00				1.00			
Year of study	2nd year	0.87	0.37	2.03	.751	0.36	0.15	0.86	.021	1.24	0.44	3.49	.680
	3rd year	1.03	0.46	2.30	.944	0.38	0.17	0.87	.022	1.71	0.62	4.75	.302
	4th year	1.16	0.58	2.35	.670	0.49	0.24	1.00	.050	0.96	0.41	2.23	.920
	5th year	0.81	0.42	1.57	.539	0.59	0.30	1.16	.125	0.60	0.27	1.34	.215
	Internship	1.00				1.00				1.00			
Origin	Capital	2.98	1.16	7.65	.023	2.65	1.09	6.41	.031	1.28	0.47	3.54	.630
	Province	1.00				1.00				1.00			
Companion	Alone	0.83	0.19	3.56	.802	1.02	0.25	4.11	.974	1.66	0.28	9.92	.576
	Accompanied	1.00				1.00				1.00			
Living with people vulnerable to COVID-19	Yes	1.18	0.74	1.89	.488	1.37	0.85	2.20	.194	2.08	1.14	3.79	.017
	No	1.00				1.00				1.00			
History of mental illness	Yes	4.39	2.06	9.35	<.001	4.74	2.13	10.55	<.001	2.36	1.06	5.25	.036
	No	1.00				1.00				1.00			
History of COVID-19	Yes	0.77	0.39	1.52	.454	1.31	0.68	2.52	.427	0.96	0.44	2.08	.915
	No	1.00				1.00				1.00			
Loss of close relatives due to COVID-19	Yes	1.88	1.14	3.09	.014	1.39	0.83	2.32	.213	1.66	0.94	2.95	.083
	No	1.00				1.00				1.00			
Occupation	Studying	0.95	0.59	1.51	.818	0.98	0.61	1.57	.938	0.88	0.50	1.55	.662
	Studying and working	1.00				1.00				1.00			
Area of residence	Urban	0.68	0.27	1.69	.401	0.69	0.27	1.75	.439	0.66	0.25	1.74	.396
	Rural	1.00				1.00				1.00			

OR= odds ratio, 95% CI= 95% confidence interval, COVID-19 = coronavirus disease 2019

Logit model: Independent variable together with intervening variables were entered in the crude model of multivariate statistical analysis

addition, the virtual classes developed in this pandemic context represent a challenge for them to acquire the appropriate clinical skills to practice their profession correctly.[32] To all the abovementioned, we can add the infodemic regarding the coronavirus that circulates in social networks, which can increase their levels of fear toward COVID-19.[33] Therefore, this study aimed to evaluate the fear of COVID-19 as a possible influential factor in the development of depression, anxiety, and stress, taking into consideration the sociodemographic factors of dental students in the context of pandemic.

In this study, it could be observed that dental students presented anxiety as the most prevalent mood disorder, agreeing with the studies conducted by Islam *et al.*[34] and Pérez-Cano *et al.*,[35] but not with the results of Ochnik *et al.*,[36] probably because the latter worked with a very varied sample of young people, including university and non-university students, and students from different cultures and different geographical areas in a very varied social and/or economic context, and considering European and Latin American young people,[36] unlike this study where the sample was more homogeneous as they were all dental students under the same social and economic contexts as they were from the same country.

On the other hand, in this study, those who were afraid of COVID-19 were almost three times more likely to develop depression, five times more likely to develop

Table 4: Adjusted multivariate logistic regression model of presence of depression, anxiety, and stress in dental students according to associated factors

Associated factors	Categories	OR	95% CI	*P* value	Variables
Fear of COVID-19	Yes	2.74	1.62–4.64	<.001	Depression
	No	1.00			
Origin	Capital city	2.60	1.09–6.19	.031	
	Province	1.00			
History of mental illness	Yes	4.02	1.96–8.25	<.001	
	No	1.00			
Loss of close relatives due to COVID-19	Yes	1.97	1.21–3.21	.006	
	No	1.00			
Fear of COVID-19	Yes	5.59	3.14–9.97	<.001	Anxiety
	No	1.00			
Year of study	2nd year	0.33	0.15–0.72	.005	
	3rd year	0.37	0.17–0.78	.009	
	4th year	0.45	0.23–0.87	.018	
	5th year	0.58	0.30–1.12	.105	
	Internship	1.00			
Origin	Capital	2.36	1.04–5.38	.041	
	Province	1.00			
History of mental illness	Yes	4.50	2.06–9.82	<.001	
	No	1.00			
Fear of COVID-19	Yes	3.31	1.88–5.83	<.001	Stress
	No	1.00			
Age group (years)	≤23	1.90	1.10–3.31	.022	
	>23	1.00			
Living with people vulnerable to COVID-19	Yes	2.06	1.16–3.66	.013	
	No	1.00			
History of mental illness	Yes	1.98	0.93–4.22	.077	
	No	1.00			

OR= odds ratio, 95% CI= 95% confidence interval, COVID-19 = coronavirus disease 2019

Logit model: Variables significantly associated ($P < .05$) in the crude model were entered in the statistical analysis of adjusted multivariate model

anxiety, and three times more likely to develop stress, which is consistent with that reported by Kassim *et al.*[37] who reported that fear of COVID-19 was associated with symptoms of depression, anxiety, and stress. These findings provide novel information regarding the magnitude of effect that fear of COVID-19 had on students in development of depression, anxiety, or stress, especially considering that data collection process covered part of the period of second wave of COVID-19 pandemic in Peru, becoming the country with the highest case fatality rate worldwide in April 2021.[38,39]

Regarding sociodemographic factors, the most influential factor for the development of depression and anxiety was the history of mental illness, corroborating the findings of Wathelet *et al.*[40] and Woon *et al.*[41] who reported psychiatric history as a risk factor for developing mood disorders. This result helps to appreciate the need and importance of performing periodic psychological evaluations of dental students to identify any alteration in their mental health and also take immediate actions to provide timely professional support in order to prevent them from developing depression and anxiety due to fear of COVID-19, especially in countries where the case fatality rate of this disease is high. In addition, the most influential sociodemographic factor in development of stress was living with people vulnerable to COVID-19. This can be explained by the fact that COVID-19 has caused thousands of deaths in vulnerable people. For this reason, in order to avoid infecting their vulnerable family members, young people have avoided many social activities, which implies a radical change in their daily habits.[14]

Regarding levels of fear of COVID-19, a significant association was observed with gender, marital status, and occupation, agreeing with findings reported by Kassim *et al.* who used the same instruments as those in this study.[37] In relation to history of mental illness, it has been reported to be significantly associated with mood disorders,[40,41] coinciding with the findings of this study. On the other hand, some researchers have

Table 5: Development of predictive models for depression, anxiety, and stress

Predictive models	Probability of occurrence (y^*)
$\frac{1}{1+e^{-f(\beta_0+\beta_1x_1+\beta_2x_2+\cdots\beta_nx_n)}}$	Effect
$\frac{1}{1+e^{-6.075+1.007\text{ (Fear of COVID-19)}+0.955\text{ (Origin)}+1.390\text{ (History of mental illness)}+0.678\text{ (Loss of close relatives due to COVID-19)}}}$	Depression
$\frac{1}{1+e^{-5.882+1.721\text{ (Fear of COVID-19)}-1.112\text{ (2nd year of studies)}-0.995\text{ (3rd year of studies)}-0.805\text{ (4th year of studies)}+0.858\text{ (Origin)}+1.504\text{ (History of mental illness)}}}$	Anxiety
$\frac{1}{1+e^{-3.825+1.198\text{ (Fear of COVID-19)}+0.644\text{ (age}\leq 23\text{ years)}+0.724\text{ (Living with people vulnerable to COVID-19)}+0.684\text{ (History of mental illness)}}}$	Stress

y^* = dependent variable (depression, anxiety, or stress), e = exponential function, $f(x)$ = function of probable cause (x), β_0 = coefficient of model constant, β_n = coefficient of independent variable according to model

reported that students who began their university education had a higher risk of severe depression,[36,40] which is discordant with the findings obtained in this study, because for students, attending the 1st year of university was a protective factor against depression. These discrepancies may be due to the fact that dental students, by taking basic training courses in the 1st year, are not constantly concerned about coming into contact with patients potentially infected with COVID-19, nor are they concerned about acquiring manual skills.

Regarding area of origin, it has been reported that students who come from rural areas are less likely to develop severe depression,[40] being corroborated by results obtained in this study. Perhaps, the fact that students are located in rural areas gives them peace of mind, because being in an area with smaller population makes it easier to maintain social distance, and therefore, they may feel less risk of becoming infected with coronavirus.[42] On the other hand, in this study, anxiety was not significantly associated with marital status, which is consistent with the results obtained by Cayo-Rojas *et al.* in dental students of the same nationality.[2]

It has been reported that women and students living alone were more likely to experience depression, anxiety, and stress during the COVID-19 pandemic,[43] which is discordant with the findings of this study. This difference is possibly due to the fact that, in both studies, very few students surveyed lived alone. Therefore, the authors acknowledge that these results may be questionable. Regarding women, the differences obtained could be due to the fact that Hakami *et al.*[43] included only four sociodemographic factors in the logistic regression analysis, whereas this investigation took into consideration 12 factors, in addition to fear of COVID-19, which could explain differences in the multivariate analysis.

Regarding marital status, this was not significantly associated with anxiety in dental students, which is in agreement with the findings obtained by Cayo-Rojas *et al.*, who conducted their study in students of same profession and nationality as this study.[2]

This study is important because it has been reported that health sciences students are more prone to develop anxiety, which can affect their mental health, causing mood disorders.[6-8] Therefore, due to the results obtained and taking into account that a large number of students were included, in addition to covering a large number of sociodemographic factors relevant to the pandemic context, it would be advisable that university

authorities take the initiative in care of students' mental health. To achieve this goal, they should not only focus on monitoring the development of curriculum in virtual education, but they must also manage technical, economic, pedagogical, and psychological assistance in a timely manner, because many have lost close relatives due to the pandemic, live with vulnerable people, have become ill with COVID-19, or already had a history of mental illness, among other situations. In this sense, it is necessary to manage timely actions to prevent students from developing mood disorders that could seriously affect their academic performance and mental health.

In contrast to a study conducted in Ecuador at the beginning of pandemic, in which the effect of fear of COVID-19 on stress and depression levels was assessed, taking anxiety as the mediating variable and considering gender as the only intervening sociodemographic factor,[44] in this present study, 12 possible influencing factors were considered. Therefore, another novel finding was obtained, because the results showed that origin, history of mental illness, and loss of close relatives due to COVID-19 were mediating variables for fear of COVID-19 to cause depression. Also, origin and history of mental illness were mediating variables for fear of COVID-19 to cause anxiety, except for studying in the 1st year of degree, as this was a protective factor. Finally, the variables age group (≤23 years), living with people vulnerable to COVID-19, and history of mental illness were mediating variables for fear of COVID-19 to cause stress. In view of the above, it is important to include various sociodemographic factors in construction of predictive models that could more accurately explain the development of depression, anxiety, and stress in dental students in the pandemic context. This would allow to better guide university authorities in the timely follow-up of students on the aspects considered influential.

This study had some limitations, such as not being able to evaluate students in person, because during the time that survey was conducted, the country was in national emergency and mandatory social isolation. It was also not possible to consider students from all academic years, because university where the study was conducted did not have an admission exam in 2020, nor in the first semester of 2021. Additionally, it was not possible to evaluate the association of virtual education with anxiety, stress, and depression, because at the time this study was carried out, all students only attended this learning modality.

It is recommended to assess levels of depression, anxiety, and stress in dental students from different parts of the world, considering their sociodemographic factors. In addition, it is recommended that the three predictive models developed in this study be tested in other social realities to verify if they are applicable to the pandemic context, especially in countries with high case fatality rate in the last 6 months. Likewise, longitudinal studies are needed to evaluate the impact of fear of COVID-19 on the development of mood disorders in young university students over the long term. In the same way, it is highly recommended that university authorities take into account the organization of plans and strategies for mental health care of their students due to the context of pandemic and, in this way, avoid the increase in anxiety and stress levels, identifying them early and taking immediate and timely action.

Conclusions

In summary, the highest prevalence of mood disorders in dental students was anxiety. In addition, those who were afraid of COVID-19 presented about three times the probability of developing depression and stress, and five times the probability of developing anxiety. On the other hand, of 12 sociodemographic factors evaluated, the most influential factor for the development of depression and anxiety was history of mental illness, whereas living with vulnerable people was the most influential factor for developing stress. This emphasizes the need to implement psychological empowerment strategies involving professional assistance managed by the authorities.

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Conflicts of interest

None to declare.

Authors contributions

ACPV conceived the research idea; ACPV, CFCR, NECL, and MJCM elaborated the manuscript; CFCR and JCP collected and tabulated the information; CLG, MJCM, and LHEJ carried out the bibliographic search; CFCR and JCP interpreted the statistical results; ACPV, NECL, and CLG helped in the development from the discussion; and ACPV, CFCR, NECL, JCP, and LHEJ performed the critical revision of the manuscript. All authors approved the final version of the manuscript.

Ethical policy and institutional review board statement

This research respected the bioethical principles for medical research on human beings of the Declaration of Helsinki related to confidentiality, freedom, respect, and nonmaleficence, and was approved by the Ethics Committee of the Postgraduate School of the Universidad Nacional Federico Villarreal (act no. 001-2021-UIIE-EUPG-UNFV).

Patient declaration of consent

Not applicable.

Data availability statement

The data that support the study results are available from the author (Prof. Antonieta Castro-Pérez Vargas, email: acastro@unfv.edu.pe) on request.

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