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Prevalence of depressive symptoms among dental students is influenced by sex, academic performance, smoking exposure, and sexual orientation: cross-sectional study

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Aim: To estimate the prevalence and associated factors of self-reported depressive symptoms in undergraduate and graduate dental students. **Methods:** The Depression, Anxiety and Stress Scale (DASS-21) was applied, and only the depression domain was verified. A structured questionnaire was used to collect sociodemographic, behavioral, and COVID-19 pandemic-related fear variables. Academic performance was assessed based on academic records, ranging from 0 (worst possible grade) to 10 (best possible grade). Respondents included 408 regularly enrolled dental students. Bi- and multivariate analyses were performed using Poisson regression with robust variance to verify the association between at least moderate depressive symptoms and independent variables. **Results:** The prevalence of at least moderate depression was 40.5% among undergraduate students and 26% among graduate students. The prevalence of fear and anxiety due to the COVID-19 pandemic was 96.1% among undergraduate students and 93.5% among graduate students. In the final multivariate analysis, being female (prevalence ratio [PR]:2.01; 95% confidence interval [95%CI]:1.36–2.96) was associated with a higher PR for depression. Conversely, no exposure to smoking (PR:0.54; 95%CI:0.36–0.82) and a final academic performance average ≥7.0 (PR:0.56; 95%CI:0.41–0.76) was associated with a lower PR for depression. Finally, among graduate students, a non-heterosexual orientation was associated with a higher PR for depression (PR:6.70; 95%CI:2.21–20.29). **Conclusion:** Higher rates of depression symptoms were observed in female undergraduates, students with lower academic performance and smoking exposure, and graduate dental students with a non-heterosexual orientation.

Keywords: Academic performance. Students, dental. Depression. Mental health.

Introduction

Depression is part of a group of mental disorders called minor psychiatric disorders[1]. Such disorders are characterized by a combination of thoughts, perceptions, and emotions that may include physical symptoms with no apparent cause. More than 300 million people have been diagnosed with depression worldwide, generating high costs and strong socioeconomic impacts[2].

As a chronic and recurrent mental disorder, depression can significantly impact an individual's personal and professional performance, ability to relate to others, and ability to address and solve everyday problems[3,4]. When evaluating the presence of a depressive disorder, it is necessary to consider not only dimensional characteristics but also factors such as intensity, duration, persistence, physiological and psychological interference, and disproportionate reactions to triggering factors. Other critical considerations include environmental circumstances and an individual's life history, as these can be triggers for depressive symptoms. These factors together determine the limit of normality; based on the disorder's characteristics, depression can vary from normal (when it is considered a human reaction to a difficulty) to severe (when the patient is at risk of suicide and/or psychotic symptoms).

In Brazil, recent data from the Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística [IBGE]) (2020)[5] showed that cases of depression have grown by 34.2%. A high prevalence of mental disorders has also been reported among college-educated students and, reflecting data from various parts of the world, the number of depression cases is even higher among students in the health field. In 2019, one study[6] reported a prevalence of 83% for mild to moderate depression among health science students. In a study performed among final-year undergraduate dentistry students in Colombia, an overall prevalence of 30.3% for common mental disorders was found[7]. Another study showed that depression affects three out of ten dental students at a private university in central-western Brazil[8]. Crucially, the high variability for the prevalence of depression among students, variability which is dependent on the instruments used and the categorizations established.

The beginning of academic life is a period full of changes for undergraduate students, who must adjust their routines and lifestyles to a new environment[9]. New students experience an adaptive physiological response to these changes, generating temporary anxiety and stress, which is expected during this phase[10]. However, when individuals have recurrent feelings of sadness and depression, these feelings may interfere with their professional training[11]. Factors such as moving to another city, reduction or absence of family support, lack of leisure time, deadlines, professional expectations, and personal demands have been associated with mental strain for students[6,12]. The consumption of mind-altering substances (legal or illegal) typically also increases during the period of transition from adolescence to adulthood[13]. In addition, the COVID-19 pandemic—with its attendant lockdowns, online classes, and changes in routine—has significantly affected students, and may have increased symptoms of anxiety[14] and depression[15]. Further-

more, the psycho-pedagogical impact of mental disorders on students has been associated with poor academic performance[16].

Although several studies have evaluated the prevalence of depression among dental students, investigation of the factors associated with depression, especially through adjusted analytical strategies, remains scarce in the literature. Therefore, this study aimed to assess the prevalence and associated factors of self-reported depressive symptoms among undergraduate and graduate dental students during the COVID-19 pandemic.

Material and Methods

Study Design, Location, and Ethical Aspects

A cross-sectional study of undergraduate and graduate dental students at the local university was performed from June 2020 to August 2020. The present study was written following the recommendations of the STROBE reporting checklist. The study protocol was reviewed and approved by the university ethics committee (n° 3.910.723). All participants electronically signed an informed consent form prior to inclusion in the study.

Population, Inclusion and Exclusion Criteria

All regularly enrolled dental students were invited to participate in the study. Exceptions included students who had cancelled the course, those under 18, and graduate students without a degree in dentistry.

Data Collection

Invitations to participate in this study were distributed via email, sent to all class representatives, and made available on the university's digital platform and social networks. Data were collected online through an electronic, self-applied questionnaire available on Google Forms. The questionnaire consisted of both structured and semi-structured questions.

In this questionnaire, participants were asked if they consented to releasing access to their academic records. Authorization to access academic records was electronically obtained. Participants who denied access to their academic records did not have their data included in this study. Participants who authorized access to their academic records were responsible for attaching the relevant academic record document to the final question of the questionnaire; in case of refusal, this field remained blank. All academic records were automatically sent only to the researcher, and remained confidential.

The instrument was divided into several sections, addressing questions about socioeconomic, demographic, behavioral, and health data. No attempt was made at validation for these participant profile questions. The Depression, Anxiety and Stress Scale (DASS-21), validated for Brazil[17], was then applied. In addition, three questions from a prior questionnaire[18] about fear and anxiety related to the COVID-19 pandemic were applied: 1) "Do you want to close your dental practice until the number of COVID-19

cases starts declining?" 2) "Are you afraid of getting quarantined if you get infected?" and 3) "Are you anxious about the cost of treatment if you get infected?"

Outcome Definition

Self-reported depression symptoms were defined as the primary outcome of the present study. The DASS-21 scale, with 21 questions, was used in its translated and validated version for Portuguese[17] to assess symptoms of depression in dentistry students in a context unrelated to their daily dental work routine for the previous week.

The scale includes questions that measure depression, anxiety, and stress, with seven questions corresponding to each of the three domains. For each question, there were four possible answers according to the Likert scale. Score 0: not applied at all; Score 1: applied to some degree, or for a short time; Score 2: applied to a considerable degree, or for a significant amount of time; Score 3: applied to an overwhelming degree, or most of the time.

For the present study, only the seven questions related to the depression domain were considered. Thus, sample data were categorized into the following depression symptom severities: normal (0 to 9 points), mild (10 to 13 points), moderate (14 to 20 points), severe (21 to 27 points), or extremely severe (≥28 points) self-reported depressive symptoms.

Independent Variables

The independent variables included the following: age (in years); sex (female, male, or other); skin color or race according to the IBGE classification (white, brown, black, yellow, or indigenous); monthly family income (average value in Brazilian Reais); physical activity (yes or no); sexual orientation (heterosexual, homosexual, bisexual, or others); dentistry as a first choice of undergraduate course (yes or no); current semester for undergraduate students (1st to 10th semester); program level for graduate students (master's or doctorate); academic performance (final average for undergraduate students, or frequency of the concepts achieved in the curriculum subjects for graduate students); receives salary/scholarship (yes or no); alcohol use (yes or no); cigarette use (yes or no); marijuana use (yes or no); and questions related to fear and anxiety within the context of the COVID-19 pandemic.

For the present analysis, sex was dichotomized into "male" and "female," as no participant answered "other." Regarding skin color, the sample was categorized into "white" and "non-white." Sexual orientation was dichotomized into "heterosexual" and "non-heterosexual." Years of undergraduate study were categorized into 1st year, 2nd year, 3rd year, 4th year, and 5th year.

Academic performance at the university is measured in different ways for undergraduate and graduate students. Undergraduate students receive grades ranging from 0 (worst possible grade) to 10 (best possible grade). Graduate students, on the other hand, receive concepts ranging from A (best possible concept) to E (worst possible concept). Thus, for the academic performance of undergraduate students, the sample was dichotomized into those who presented a final average of ≥7.0 or <7.0. For graduate students, the percentage of "A" grades was calculated.

For the presence of salary/scholarship, participants were categorized as "yes" if they reported being scholarship holders, being self-employed, being civil servants, or having some other type of employment relationship. Regarding the questionnaire related to COVID-19 pandemic fear and anxiety, the sample was divided into two groups: participants who answered "yes" to any question related to the COVID-19 pandemic, and participants who answered "no or do not know" to all questions.

Statistical Analysis

Only the depression domain of the DASS-21 tool was considered in this study. Therefore, mean scores in this domain were compared between sexes for undergraduate and graduate students, and between different years of study (undergraduate) or level of education (graduate). For this variable, normality was tested using the Shapiro-Wilk test, and no symmetric distribution was detected. Therefore, the non-parametric Mann-Whitney and Kruskal-Wallis tests were used.

Bivariate and multivariate analyses using Poisson regression with robust variance were employed to verify the association between self-reported depressive symptoms and exploratory variables. For these analyses, the sample was dichotomized into "normal or mild depressive symptoms" and "moderate, severe, or extremely severe depressive symptoms." Independent analyses were performed for undergraduate and graduate students. Four variables were included in the final multivariate model based on theoretical and biological plausibility, regardless of the observed p-value. These variables were sex, years of education or education level, academic performance, and anxiety and fear related to the COVID-19 pandemic. Academic performance was defined as the main exploratory variable in this study. In addition, data collection was performed during the period of restricted face-to-face activities at the university, prompting the inclusion of the variable related to fear and anxiety in the face of the COVID-19 pandemic.

For all other variables, only those that presented a p-value <0.25 in the bivariate analysis were included in the initial multivariate model. The final multivariate model was built using the "backwards" strategy, i.e., observing the statistical significance and the effect of the modifications on the model. Statistical significance was defined as $p<0.05$. All analyses were performed using SPSS software (version 21.0, Statistics IBM, College Station, TX, USA).

Results

In the first semester of 2020, the School of Dentistry enrolled 570 students, of which nine undergraduate students were excluded from this study for not being regularly enrolled. From the remaining 561, 409 students initially responded, with one respondent refusing to participate further after reading the informed consent form. Thus, 408 students ultimately responded to the survey, including 331 undergraduate (response rate: 71.18%) and 77 graduate (response rate: 74.29%) students. No significant difference was found between participants and non-participants in terms of the overall population sex for undergraduate ($p=0.550$) and graduate ($p=0.273$) students.

The majority of the sample consisted of female students (68.6%) and white students (81.9%). The occurrence of cigarette use was higher among undergraduate students (8.5%) compared to graduate students (6.5%); the same result was observed for marijuana use, with an occurrence higher in undergraduate (10.3%) than in graduate (6.5%) students. The prevalence of fear and anxiety due to the COVID-19 pandemic was 96.1% in undergraduate students and 93.5% in graduate students (Table 1).

Table 1. Descriptive characteristics of the sample regarding sociodemographic and behavioural variables for both undergraduate and graduate dental students (n=408) from the local University, 2020.

Variables	Undergraduate (n=331; 81.1%)	Graduate (n=77; 18.9%)	Total (n=408)
Age			
Mean±SD	22.70±3.56	30.29±6.97	24.13±5.31
Sex			
Male – n (%)	107 (32.3)	21 (27.3)	128 (31.4)
Female – n (%)	224 (67.7)	56 (72.7)	280 (68.6)
Skin colour			
White – n (%)	266 (80.4)	68 (88.3)	334 (81.9)
Non-white – n (%)	65 (19.6)	9 (11.7)	74 (18.1)
Monthly family income (in thousand Brazilian Reais)			
Mean±SD	8.37±30.79	8.50±6.14	8.40±27.68
Absent	26	1	27
Practice of physical activity			
Yes – n (%)	159 (48.0)	44 (57.1)	203 (49.8)
No – n (%)	172 (52.0)	33 (42.9)	205 (50.2)
Sexual orientation			
Heterosexual – n (%)	291 (87.9)	73 (94.8)	364 (89.2)
Non-heterosexual – n (%)	40 (12.1)	4 (5.2)	44 (10.8)
Dentistry as the first choice			
Yes – n (%)	225 (68.0)	57 (74.0)	282 (69.1)
No – n (%)	106 (32.0)	20 (26.0)	126 (30.9)
Year			
1st Year – n (%)	55 (16.6)	-	55 (16.6)
2nd Year – n (%)	72 (21.8)		72 (21.8)
3rd Year – n (%)	60 (18.1)		60 (18.1)
4th Year – n (%)	67 (20.2)		67 (20.2)
5th Year – n (%)	77 (23.3)		77 (23.3)
Mean final grade			
<7.0 – n (%)	46 (18.8)	-	46 (18.8)
≥7.0 – n (%)	199 (81.2)		199 (81.2)
Absent	86		86

Continue

Continuation			
Graduate level			
Master's – n (%)	-	32 (41.6)	32 (41.6)
Doctorate – n (%)		45 (58.4)	45 (58.4)
Percentage of grades A			
Mean±SD	-	89,44±9.05	89.44±9.05
Absent		18	18
Is a scholarship holder or has some paid activity			
Yes – n (%)	75 (22.7)	74 (96.1)	149 (36.5)
No – n (%)	256 (77.3)	3 (3.9)	259 (63.5)
Alcohol use in the last 30 days			
Yes – n (%)	229 (69.2)	54 (70.1)	283 (69.4)
No – n (%)	102 (30.8)	23 (29.9)	125 (30.6)
Cigarette use in the last 30 days			
Yes – n (%)	28 (8.5)	5 (6.5)	33 (8.1)
No – n (%)	303 (91.5)	72 (93.5)	375 (91.9)
Marijuana use in the last 30 days			
Yes – n (%)	34 (10.3)	5 (6.5)	39 (9.6)
No – n (%)	297 (89.7)	72 (93.5)	369 (90.4)
Answer yes to any COVID-19 question?			
Yes – n (%)	318 (96.1)	72 (93.5)	390 (95.6)
No/Do not know – n (%)	13 (3.9)	5 (6.5)	18 (4.4)

COVID-19: Coronavirus disease 2019; SD: Standard deviation.

As shown in Table 2, a comparison of the mean scores on the DASS-21 tool reveals a significantly higher depression score among female undergraduate students when compared to male undergraduate students ($p<0.001$). It was also observed that 40.5% (n=134) of undergraduate students had scores indicating moderate, severe, or extremely severe depression symptoms. However, when considering only graduate students, no significant differences between sexes ($p=0.154$) or education levels ($p=0.481$) were identified for the DASS-21 scores.

Table 2. Description of the Depression, Anxiety and Stress Scale (DASS-21) tool, according to sex, years of study for undergraduation and graduate level (n=408) from the local University, 2020.

Variables	Undergraduate (n=331; 81.1%)	Graduate (n=77;18.9%)	Total (n=408)
Depression domain			
Mean±SD	12.74±10.97	8.16±9.13	11.88±10.79
Depression domain			
Normal	156 (47.1)	48 (62.3)	204 (50.0)
Mild	41 (12.4)	9 (11.7)	50 (12.2)

Continue

Continuation				
Moderate	64 (19.3)		14 (18.2)	78 (19.1)
Severe	26 (7.9)		2 (2.6)	28 (6.9)
Extremely severe	44 (13.3)		4 (5.2)	48 (11.8)
		p-value		**p-value**
Depression domain				
Male	9.48±8.96	0.001*	5.33±7.91	0.154*
Female	14.30±11.51		9.21±9.39	
Depression domain				
1st Year	12.58±10.89	0.786#	-	
2nd Year	13.17±10.87			
3rd Year	12.50±12.24			
4th Year	13.73±11.10			
5th Year	11.79±10.13			
Depression domain				
Master's	-		7.00±7.92	0.481*
Doctorate			8.98±9.90	

*SD: Standard deviation; *Mann-Whitney Test; #Kruskal-Wallis Test.*

The prevalence of at least moderate depression symptoms was 40.5% (n=134) and 26% (n=20) for undergraduate and graduate students, respectively. In the univariate analysis (Table 3), when considering only undergraduate students, the variables of sex (p<0.001) and final course average (p=0.001) were significantly associated with the occurrence of at least moderate depression symptoms. When considering only graduate students, sexual orientation was the only variable significantly associated with the presence of depression symptoms (p=0.001).

Table 3. Bivariate analysis for the presence of self-reported symptoms of at least moderate depression among undergraduate and graduate dental students (n=408) at the local University, 2020.

	Undergraduate PR (95%CI)	**p-value**	**Graduate PR (95%CI)**	**p-value**
Age	1.00 (0.96 – 1.04)	0.973	0.99 (0.94 – 1.04)	0.617
Sex				
Male	1	<0.001	1	0.415
Female	1.89 (1.33 – 2.70)		1.50 (0.57 – 3.97)	
Skin colour				
White	1	0.282	1	0.577
Non-White	1.18 (0.87 – 1.60)		1.33 (0.49 – 3.67)	
Monthly family income	1.00 (0.99 – 1.01)	0.304	0.97 (0.92 – 1.03)	0.307

Continue

Continuation				
Practice of physical activity				
Yes	1	0.231	1	0.079
No	1.18 (0.90 – 1.53)		2.00 (0.92 – 4.33)	
Sexual orientation				
Heterosexual	1	0.072	1	0.001
Non-heterosexual	1.35 (0.97 – 1.88)		3.22 (1.60 – 6.50)	
Dentistry as the first choice				
Yes	1	0.613	1	0.087
No	1.07 (0.82 – 1.41)		1.90 (0.91 – 3.96)	
Year				
1st Year	1		-	-
2nd Year	1.18 (0.79 – 1.77)	0.422		
3rd Year	0.83 (0.51 – 1.35)	0.459		
4th Year	1.05 (0.68 – 1.61)	0.842		
5th Year	0.97 (0.64 – 1.49)	0.904		
Mean final grade				
<7.0	1	0.001	-	-
≥7.0	0.61 (0.45 – 0.83)			
Graduate level				
Master's	-	-	1	0.495
Doctorate			1.321 (0.59 – 2.94)	
Percentage of grades A	-	-	1.01 (0.97 – 1.06)	0.627
Is a scholarship holder or has some paid activity				
Yes	1	0.319	1	0.756
No	1.19 (0.85 – 1.67)		1.30 (0.25 – 6.74)	
Alcohol use in the last 30 days				
Yes	1	0.212	1	0.988
No	0.83 (0.61 – 1.12)		1.01 (0.44 – 2.29)	
Cigarette use in the last 30 days				
Yes	1	0.248	1	0.421
No	0.79 (0.53 – 1.18)		0.63 (0.20 – 1.97)	
Marijuana use in the last 30 days				
Yes	1	0.640	1	0.762
No	0.91 (0.61 – 1.36)		1.32 (0,22 – 7.94)	
Answer yes to any COVID-19 question?				
Yes	1	0.129	1	0.762
No/Do not know	0.37 (0.10 – 1.34)		0.76 (0.13 – 4.56)	

95%CI: 95% confidence interval; COVID-19: Coronavirus disease 2019; PR: prevalence ratio.

In the final multivariate model (Table 4), female undergraduate students showed significantly higher levels of depression symptoms. The prevalence ratio (PR) was approximately twice as high (p<0.001) for the occurrence of at least moderate depression symptoms in female students than in male students. However, in graduate students, no significant association was identified for sex (p=0.099). Non-heterosexual graduate students presented a 6.7 times higher PR (p=0.001) for at least moderate depression symptoms than heterosexual students.

Undergraduate students with a final average ≥7.0 showed a 44% lower PR (p<0.001) for the presence of depression symptoms when compared to students with a final average <7.0. Furthermore, smoking was associated with the occurrence of depression symptoms among undergraduate students; those not having used a cigarette in the last 30 days had a 46% lower PR for at least moderate depression symptoms when compared to those having used one recently (p=0.004) (Table 4).

Table 4. Multivariate analysis for the presence of at least moderate depression among undergraduate and graduate dental students (n=408) from the local University, 2020.

	Undergraduate PR (95% CI)	p-value	Graduate PR (95% CI)	p-value
Sex				
Male	1	<0.001	1	0.099
Female	2.01 (1.36 – 2.96)		3.47 (0.79 – 15.16)	
Sexual orientation				
Heterosexual	-	-	1	0.001
Non-heterosexual			6.70 (2.21 – 20.29)	
Year				
1st Year	1		-	-
2nd Year	0.89 (0.51 – 1.54)	0.677		
3rd Year	0.85 (0.48 – 1.52)	0.580		
4th Year	0.93 (0.54 – 1.59)	0.786		
5th Year	0.65 (0.35 – 1.18)	0.155		
Mean final grade				
<7.0	1	<0.001	0.99 (0.94 – 1.04)	0.675
≥7.0	0.56 (0.41 – 0.76)			
Graduate level				
Master's	-	-	1	0.057
Doctorate			2.99 (0.97 – 9.23)	
Cigarette use in the last 30 days				
Yes	1	0.004	-	-
No	0.54 (0.36 – 0.82)			
Answer yes to any COVID-19 question?				
Yes	1	0.798	1	0.322
No/Do not know	0.87 (0.29 – 2.61)		2.98 (0.34 – 25.95)	

95%CI: 95% confidence interval; COVID-19: Coronavirus disease 2019; PR: prevalence ratio.

Discussion

This study assessed the prevalence of self-reported depressive symptoms among undergraduate and graduate dental students. A significant prevalence of at least moderate depression symptoms was found, mainly in undergraduate dental students. Higher rates of depression symptoms were demonstrated in female undergraduates, undergraduates with lower academic performance, undergraduates with smoking exposure, and graduate dental students with a sexual orientation other than heterosexual.

To understand these findings, it is important to highlight that higher rates of regular exercise and smoking exposure were observed in undergraduate male dental students (57% and 14%, respectively) when compared to female students (43.8% and 5.8%, respectively). However, 83.2% of female undergraduate students had an overall mean ≥7.0, while this rate was 76.9% among male students. Sexual orientations other than heterosexual were reported among 14.3% and 1.8% of male and female graduate students, respectively. Although these rates may partially explain the current results, they also emphasize the necessity of conducting an adjusted analysis to control possible confounders associated with depression symptoms.

Studies involving academics in the health sciences have suggested that higher rates of mental disorders are most strongly related to demanding clinical routines, extensive scheduling, career doubts, and the highly competitive environment. These factors are responsible for creating an exhausting environment that can trigger stress events and psychological illnesses such as burnout syndrome and impostor syndrome[19,20]. Due to the characteristics of the program, dental students are constantly exposed to risky or unhealthy environments, serious and complicated pathological processes, and the fear of making mistakes during educational training, all of which can negatively impact a student's physical and psychological health[19]. One systematic review showed an overall prevalence of 29% (95%CI: 26–34) for depression among dental students[21]. Similarly, 37.8% of the dental students included in this study reported at least moderate depression symptoms.

The higher prevalence of depressive symptoms detected among female undergraduate students highlights the impact of several sociocultural factors in contemporary society. These include the oppression experienced by women throughout their lives, the history of demands on women, and the greater ease women typically have with reporting and admitting feelings and seeking medical treatment, in addition to low self-esteem and biological factors such as sex hormones, endocrine reactivity to stress, and lower levels of vitamin B12[22,23]. Such concerns expose women to risk factors for developing depression, increasing their vulnerability to the illness[24]. All these factors contribute to the higher occurrence of self-reported depression in women, which has already been demonstrated in the dental literature[21].

In addition to sex, tobacco consumption among the participants was significantly associated with the occurrence of depressive symptoms. However, the direction of this relationship is still not well understood, since nicotine acts as a self-medication to relieve feelings of sadness or negative mood[25,26]. Smoking can also momentarily distract the individual from stressful situations and problems[27]. Another hypothesis

for this association is that smoking and depressive symptoms have a bidirectional relationship, wherein smoking is positively reinforced when depressed smokers use tobacco to alleviate their negative feelings, obtaining the desired effect from nicotine[28]. It must also be noted that the present study did not assess the frequency of consumption of cigarettes, alcohol, or illicit drugs. Thus, assuming a dose-response gradient is not possible given the results found.

In the present study, poorer academic performance was associated with a higher occurrence of at least moderate self-reported symptoms of depression. Stress and depression have the potential to impact reasoning, memory, and motivation, which may reflect on the learning process. Furthermore, stress is one of the symptoms of depressive disorder, causing damage to an individual's performance and a further decrease in productivity[29]. Thus, the lower academic performance observed among undergraduate students with depression symptoms can be justified.

The literature indicates that young people who belong to sexual minorities are significantly more likely to present depressive symptoms and face the double stigma of belonging to this marginalized group and experiencing mental health problems[30,31]. This disparity in the prevalence of depressive symptoms among non-heterosexual individuals has been associated with stressors such as discrimination, structural prejudices, concealment of sexual orientation, and isolation among heterosexual individuals[32,33].

In addition to the many stressors discussed above, the interruption of teaching activities due to the COVID-19 pandemic has induced fear of losing manual skills, anxiety related to the consequences for long-term plans, and concerns regarding new dental protocols during the resumption of normal activities[34,35]. For these reasons, all multivariate analyses performed in the present study were adjusted for fear and anxiety specifically related to the COVID-19 pandemic. However, no significant associations were found between this variable and the occurrence of depressive symptoms.

It is critical for health education institutions—which are responsible for training future professionals who will provide assistance to the community—to adopt preventive measures of psychological support for students facing academic and social challenges. Measures that promote awareness and inclusion of stigmatized groups are also necessary in order to reduce requirements for supportive and psychological treatment. Higher education should thus aim to promote total academic success, embracing the individual and their anxieties. Therefore, it is important to highlight that different academic levels and circumstances are related to different factors that might trigger depression in different ways.

The limitations of this study were due primarily to the COVID-19 pandemic, which made it difficult to contact participants and significantly changed their routines and activities. In addition, the aim of this study was restricted to evaluating responses to self-reported symptoms of depression, and was not concerned with any formal diagnosis of this condition. As a result, further studies that include an interview or psychiatric evaluation are needed to provide a more nuanced understanding. Furthermore, the cross-sectional nature of this study did not allow for the establishment of causality between the detected associations. In this context, the reverse causal-

ity hypothesis cannot be ruled out. Although the present study did not find significant associations between depressive symptoms and fear and anxiety regarding the COVID-19 pandemic, it must be noted that the pandemic might have had a serious impact on all students, which may have contributed to the mental health burdens faced by these particular students. Moreover, only one public higher education institution was included in the present study, which could be seen as a limiting factor. However, this also means that a higher internal validity can be expected, and thus that a high external validity may be applied for other public Brazilian institutions with similar socioeconomic characteristics.

This study ultimately concluded that female undergraduate dental students exhibit higher levels of depression symptoms when compared to male students. Poorer academic performance was also associated with the occurrence of depression symptoms in undergraduate students, as was cigarette consumption within the last 30 days. Finally, graduate dental students belonging to sexual minorities reported greater depressive symptoms when compared to heterosexual students.

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Author Contribution

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All authors actively participated in the discussion of the manuscript's findings, revised, and approved the final version of the manuscript.

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