



# Poor Quality of Sleep is Associated with Lower Academic Performance in Undergraduate Dental Students: A Cross-Sectional Study

Mariana da Silva Muñoz<sup>1</sup> · Pedro Paulo de Almeida Dantas<sup>2</sup> · Natália Marcumini Pola<sup>1</sup> · Máisa Casarin<sup>1</sup> · Rafaela Zazyki de Almeida<sup>2</sup> · Francisco Wilker Mustafa Gomes Muniz<sup>1</sup>

Received: 23 July 2022 / Revised: 23 July 2022 / Accepted: 28 December 2022 / Published online: 7 January 2023  
© The Author(s), under exclusive licence to Springer Nature Singapore Pte Ltd. 2023

## Abstract

**Purpose** This study aimed to assess the quality of sleep and associated factors among dental students.

**Methods** All dental students regularly enrolled at the Federal University of Pelotas, Brazil, were invited to participate. A structured online questionnaire was applied to collect the independent variables, including academic performance. Quality of sleep was assessed by the validated version of the Pittsburgh Sleep Quality Index. Sample was dichotomized as good sleep quality (total score:  $\leq 4$ ) and at least poor quality (total score:  $\geq 5$ ). Adjusted analyses were performed using Poisson regression with robust variance to detect the association between sleep quality and independent variables. Independent adjusted models were performed to the whole-sample, only undergraduate and only graduate dental students.

**Results** Poor quality of sleep was detected in 266 (65.2%) dental students, of which 228 (68.9%) and 38 (49.4%) were undergraduate and graduate dental students, respectively. Female students presented a prevalence ratio (PR) 19% higher compared to males (95% confidence interval [CI] 1.01–1.41). When only graduate students were considering, those that reported not being the head of the family presented a PR 4.39 higher for poor quality of sleep (95% CI 1.91–10.09). Poor quality of sleep was associated with lower academic performance among undergraduate students (PR: 0.94; 95% CI 0.89–0.99), but not significantly associated when graduate students are considered (PR: 0.99; 95% CI 0.96–1.03).

**Conclusion** It was concluded that dental students, mainly female ones, have high prevalence of poor quality of sleep, which is associated with undergraduate student's worst academic performance.

**Keywords** Academic performance · Education, dental · Epidemiology · Sleep deprivation

## 1 Introduction

Sleep is a basic biological necessity for good functioning of the organism, and it is critical for memory consolidation, learning, decision making and critical thinking. Regarding the duration of sleep, it is estimated that individuals have to sleep approximately 8 h per night to perform their

---

Presentation at a conference: The abstract of this study was presented at the Congress on Brain, Behavior and Emotions 2021, Brazil.

---

✉ Francisco Wilker Mustafa Gomes Muniz  
wilkermustafa@gmail.com

Mariana da Silva Muñoz  
marianasmunoz@hotmail.com

Pedro Paulo de Almeida Dantas  
pedro15\_paulo@hotmail.com

Natália Marcumini Pola  
nataliampola@gmail.com

Máisa Casarin  
maisa.66@hotmail.com

Rafaela Zazyki de Almeida  
rafaelazazyki@gmail.com

<sup>1</sup> Department of Periodontology, Graduate Program in Dentistry, Federal University of Pelotas, Rua Gonçalves Chaves, 457, Pelotas, RS 96015-560, Brazil

<sup>2</sup> School of Dentistry, Federal University of Pelotas, Pelotas, RS, Brazil

daily activities properly and maintain a good health [1]. In contrast, shorter duration or poor quality of sleep has a strong relationship with some morbidities, including several psychological disorders [2, 3], development of chronic non-communicable diseases, such as type 2 diabetes mellitus [4] and cardiovascular diseases [5]. Literature also reports that lower sleep duration affects the quality of life and may lead to a greater risk of mortality [6].

Adequate quality of sleep is very important for the correct performance of academic activities [7], since poor quality of sleep was associated with lower grades and higher rates of depressive symptoms among students [8]. When a student enters higher education, one of the first and most important changes that may occur is the decline in the frequency and/or quality of sleep, which becomes irregular or insufficient, being able to harm the learning process [1] and general health [9]. Higher stress rates have been detected in individuals with poorer sleep quality [10] and, in this context, dental students experience greater stress than other areas of health, such as medicine for example [11, 12].

Despite this knowledge, no study in the literature has assessed the overall quality of sleep among dental students, especially its association with academic performance and years of academic training. In this sense, the present study aimed to evaluate quality of sleep and associated factors in undergraduate and graduate dental students during the distance learning period.

## 2 Material and Methods

### 2.1 Study Design and Ethical Aspects

All dental students from the Federal University of Pelotas, Brazil were invited to participate in this cross-sectional study. Prior to their participation in the study, all students read and electronically signed an informed consent. The local ethics committee approved the study under protocol #3.910.723.

### 2.2 Inclusion Criteria, Sample and Sampling Strategy

The present study invited all dental students regularly enrolled in the first semester of 2020, including undergraduate and graduate dental students. No exclusion criterion was imposed, but student enrollment was confirmed with the dean of the School of Dentistry after acceptance to participate.

In the first semester of 2020, a total of 474 and 105 undergraduate and graduate dental students were, respectively, enrolled. Invitations to participate in the study were performed by e-mail, social media, and contact

through a class representative. Data collection was carried out between June and August 2020, as the first academic semester of 2020 happened up to September 2020 due to the COVID-19 pandemic. During this period, the school was performing only online activities, as face-to-face activities were not allowed.

### 2.3 Data Collection

Data were collected by an electronic questionnaire composed of both structured and semi-structured questions. The questionnaire included demographical, behavioral, occupational, fear and anxiety related to the COVID-19 pandemic variables and quality of sleep. All questions included and their response options are available in Table 1. Fear and anxiety related to the COVID-19 pandemic were assessed by five questions, which were adapted and translated by a previous study [13]. However, this instrument was not validated for the present study.

Academic performance was assessed only in dental students that allowed access to their academic history. Data collection for this variable was performed only by the principal investigator of the present study. The academic performance of undergraduate dental students ranges from zero to 10. The overall mean of all completed courses was calculated for the present study. For the academic performance of graduate dental students, concepts are attributed, which include A (excellent), B (good), C (adequate), and D (insufficient). Percentages of all concepts were collected.

### 2.4 Outcome Definition

Quality of sleep was assessed by the validated version to Brazil of the Pittsburgh Sleep Quality Index (PSQI) [15]. The questionnaire consists of 19 self-rated questions. These questions are categorized into 7 components, classified in a score ranging from 0 to 3. The components of the PSQI are as follows: subjective sleep quality (C1), sleep latency (C2), sleep duration (C3), habitual sleep efficiency (C4), sleep disorders (C5), use of sleeping medication (C6), and daytime dysfunction (C7). The total of the scores of these 7 items results in a global proportion, which ranges from 0 to 21, in which the highest score indicates worse sleep quality. A global PSQI score of at least 5 indicates major difficulties in at least 2 components or moderate difficulties in more than 3 components. Thus, the data were dichotomized as follows:  $\leq 4$  score, representing “good sleep quality”, and  $\geq 5$  score represents “poor quality of sleep and sleep disorder” [14]. The version used in the present study was the version of

**Table 1** Independent variables and their response options collected during the study

Variables	Response options
Age	In years
Sex	Male Female Other
Skin color	White Brown Black Indigenous Yellow
<i>Physical activity</i> —Do you regularly do physical activities?	Yes No
<i>Sexual orientation</i>	Heterosexual Homosexual Bisexual Other
<i>Head of the family</i> —Are you the head of your family?	Yes No
<i>Current occupation or scholarship</i> —Do you receive any scholarship or are you currently employed?	Yes No
<i>Study level</i> —To undergraduate dental student only: in what semester are you regularly enrolled?	Answers ranged from 1st to 10th
<i>Study level</i> —To graduate dental student only: In what level of study are you regularly enrolled?	Master degree Ph.D
<i>Alcohol exposure</i> —Did you consume alcohol in the last 30 days?	Yes No
<i>Smoking exposure</i> —Did you smoke in the last 30 days?	Yes No
<i>Marijuana exposure</i> —Did you use marijuana in the last 30 days?	Yes No
<i>Use of medication</i> —Do you use any antidepressant or anti-anxiety drug?	Yes No
<i>Fear and anxiety related to the COVID-19 pandemic</i>	For each question, answer:
1) Are you afraid of getting infected with COVID-19 from a patient and co-worker?	<input type="radio"/> Yes
2) Are you anxious when providing treatment to a patient who is coughing or suspected of being infected with COVID-19?	<input type="radio"/> No
3) Do you feel nervous when talking to patients in close vicinity?	<input type="radio"/> Do not know
4) Do you have fear that you could carry the infection from your dental practice back to your family?	
5) Do you feel afraid when you hear that people are dying because of COVID-19?	

the questionnaire translated into Portuguese-BR (PSQI-BR), which was validated in a previous study [15].

## 2.5 Exposures

Age in years was used. Sex was dichotomized into “male” and “female,” as none of the included participants answered “none” to this variable. Skin color was dichotomized into white and non-white, which included those that reported themselves as black, brown, indigenous and yellow. Sexual orientation was dichotomized into “heterosexual” and “other,” which included homosexual, bisexual and others.

Physical activity, being the head of the family, occupation or scholarship, alcohol exposure, smoking exposure, use of marijuana, use of antidepressant or anti-anxiety drugs, and fear and anxiety of COVID-19 pandemic were dichotomized as “yes” and “no” in each variable. For fear and anxiety of COVID-19 pandemic variable, “yes” was attributed when a participant provided this answer to all question. If at least one “no” or “do not know” were replied, the participants was categorized as “no”.

Level of education training among undergraduate dental students was divided into 1st, 2nd, 3rd, 4th and 5th Years. Students in the preclinical stage belonged to the 1st and

2nd Years of dental education, while those in the clinical stage were in the 3rd, 4th, or 5th Years. Graduate dental students were dichotomized into master's degree and Ph.D. student. Mean grades of all completed courses were used to demonstrate academic performance of undergraduate dental students. The percentage of concepts "A" were used among graduate dental students. As some students did not allow access to their academic history, missing data was detected in this variable. No data input was performed.

## 2.6 Statistical Analysis

All analyses were performed using SPSS software (version 21.0) for Windows. Independent models were constructed for whole sample, undergraduate and graduate dental students. Bi- and multivariable analyses were carried out by Poisson regression with robust variance to detect associated factors between quality of sleep and independent variables. All independent variables that presented a  $p$  value  $< 0.25$  in the bivariate analysis were included in the initial multivariable model.

However, three independent variables were included in all models regardless of their  $p$  values. These variables were study level, fear and anxiety of COVID-19 pandemic and academic performance. As different patterns of anxiety, stress and depressive symptoms are expected among the different years of educational training, we decided to adjust all models with study level [16]. This study was conducted during the pandemic of COVID-19, and some interference of the sleep quality may not be ruled out among those individuals in this period. Additionally, academic performance was defined as the main confounder of the present study.

To all analyses a  $p < 0.05$  was established to statistical significance. Regarding multivariate models, analyses of model modification were also considered. The final multivariable model was built using a backward elimination strategy, excluding one independent variable at each time. The independent variable with the highest  $p$  value was excluded until the lowest Bayesian information criterion (BIC) was achieved. The Wald test ascertained the overall fit of the predictors. Therefore, the final multivariate model was formed by a combination of  $p < 0.05$  and changes in goodness of fit. Both significant and non-significant independent variables could be included in the final multivariate model. Multicollinearity analyses were performed using the following cutoff points, but none of the independent variables demonstrated collinearity.

## 3 Results

Participants in this study ( $n = 408$ ) were divided according to the PSQI scores, where scores  $\leq 4$  were considered as good quality of sleep ( $n = 142$ , mean age  $25.09 \pm 6.64$ , mean scores of PSQI:  $2.95 \pm 0.95$ ), and  $\geq 5$  scores were attributed poor quality of sleep or sleep disorder ( $n = 266$ , mean age  $23.65 \pm 4.30$ , mean scores of PSQI:  $8.59 \pm 2.84$ ) (Table 2).

Table 2 demonstrates the bivariate analysis involving the whole sample. The independent variables that were associated with the PSQI were age ( $p = 0.017$ ), sex ( $p = 0.010$ ), skin color ( $p = 0.042$ ), sexual orientation ( $p = 0.009$ ) and use of antidepressant or anxiolytic drugs ( $p < 0.001$ ). For the level of education, graduate students had significantly lower prevalence ratios (PR) for the occurrence of poor quality of sleep or sleep disorder when compared with undergraduate students in the pre-clinical phase ( $p = 0.003$ ). The variables being or not being a householder ( $p = 0.001$ ) and having some remuneration ( $p = 0.022$ ), such as scholarship or working activities, also had a significant association with the PSQI index.

For the bivariate analysis, which involved only undergraduate students ( $n = 331$ ), significant associations were obtained between the PSQI index and sex ( $p = 0.023$ ), in which women had a PR of 1.22 (Confidence interval of 95% [95% CI] 1.03–1.46). Use of antidepressant or anxiolytic drugs ( $p < 0.001$ ) was significantly associated with quality of sleep, as non-users of these drugs had 26% lower PR for poor quality of sleep (PR: 0.74; 95% CI 0.65–0.84). Moreover, academic performance was significantly associated with the PSQI index ( $p = 0.02$ ), with a PR of 0.93 (95% CI 0.88–0.97), demonstrating that for each increase in 1 point in the student's final grade, there is a 7% decrease in the PR of the student having poor quality of sleep or sleep disorder (Table 3).

Table 4 shows the bivariate analysis involved only graduate students ( $n = 77$ ). The independent variables significantly associated with PSQI index were skin color ( $p = 0.016$ ) and being a householder ( $p = 0.001$ ). Non-white individuals have 71% higher PR of having poor sleep or some sleep disorder compared to white ones (PR: 1.71; 95% CI 1.10–2.64), while students who were not householders had 2.69 times higher PR of having a score  $\geq 5$  on the PSQI (PR: 2.69; 95% CI 1.48–4.89).

Three multivariate analyses were performed, considering the whole sample, only undergraduate students and only graduate students (Table 5). Regarding the whole sample analysis, quality of sleep was significantly associated with sex ( $p = 0.040$ ), skin color ( $p = 0.025$ ), being a householder ( $p = 0.009$ ) and use of antidepressant and anxiolytic drugs ( $p < 0.001$ ). Non-white and women dental students had 19% higher PR of having poor quality of sleep or sleep

**Table 2** Demographical and behavioral characteristics associated with PSQI scores, considering both undergraduate and graduate dental students

		PSQI score $\leq 4$ (Good) ( $n = 142$ ; 34.8%)	PSQI score $\geq 5$ (poor or sleep disorder) ( $n = 266$ ; 65.2%)	Bivariate analysis (Poisson regression with robust variance)	<i>P</i> value
PSQI	Mean $\pm$ SD	2.95 $\pm$ 0.95	8.59 $\pm$ 2.84	–	–
Age	Mean $\pm$ SD	25.09 $\pm$ 6.64	23.65 $\pm$ 4.30	0.98 (0.96–0.99)	0.017
Sex	Male— $n$ (%)	57 (40.1)	71 (26.7)	1	0.010
	Female— $n$ (%)	85 (59.9)	195 (73.3)	1.26 (1.06–1.49)	
Skin color	White— $n$ (%)	123 (86.6)	211 (79.3)	1	0.042
	Non-white— $n$ (%)	19 (13.4)	55 (20.7)	1.18 (1.01–1.38)	
Do you regularly do physical activities?	Yes— $n$ (%)	74 (52.1)	129 (48.5)	1	0.487
	No— $n$ (%)	68 (47.9)	137 (51.5)	1.05 (0.91–1.21)	
Sexual orientation	Heterosexual— $n$ (%)	133 (93.7)	231 (86.8)	1	0.009
	Other— $n$ (%)	9 (6.3)	35 (13.2)	1.25 (1.06–1.48)	
Are you the head of your family?	Yes— $n$ (%)	31 (21.8)	17 (6.4)	1	0.001
	No— $n$ (%)	111 (78.2)	249 (93.6)	1.95 (1.33–2.88)	
Do you receive any scholarship or are you currently employed?	Yes— $n$ (%)	63 (44.4)	86 (32.3)	1	0.022
	No— $n$ (%)	79 (55.6)	180 (67.7)	1.20 (1.03–1.41)	
Study level	Undergraduate (preclinical)— $n$ (%)	35 (24.6)	92 (34.6)	1	0.260
	Undergraduate (clinical)— $n$ (%)	68 (47.9)	136 (51.1)	0.92 (0.80–1.06)	
	Graduate (Master and Ph.D)— $n$ (%)	39 (27.5)	38 (14.3)	0.68 (0.53–0.88)	
Did you consume alcohol in the last 30 days?	Yes— $n$ (%)	91 (64.1)	192 (72.2)	1	0.108
	No— $n$ (%)	51 (35.9)	74 (27.8)	0.87 (0.74–1.03)	
Did you smoke in the last 30 days?	Yes— $n$ (%)	8 (5.6)	25 (9.4)	1	0.120
	No— $n$ (%)	134 (94.4)	241 (90.6)	0.85 (0.69–1.04)	
Did you use marijuana in the last 30 days?	Yes— $n$ (%)	16 (11.3)	23 (8.6)	1	0.426
	No— $n$ (%)	126 (88.7)	243 (91.4)	1.12 (0.85–1.47)	
Do you use any antidepressant or antianxiety drug?	Yes— $n$ (%)	20 (14.1)	90 (33.8)	1	<0.001
	No— $n$ (%)	122 (85.9)	176 (66.2)	0.72 (0.63–0.82)	
Answered “yes” to all COVID-19 questions	Yes— $n$ (%)	34 (23.9)	195 (73.3)	1	0.536
	No— $n$ (%)	108 (76.1)	71 (26.7)	0.95 (0.81–1.11)	

disorders (PR: 1.19; 95% CI 1.01–1.41 and PR: 1.19; 95% CI 1.02–1.39, respectively) when compared to men and white individuals. Those who were not households had 69% higher PR of having a poor PSQI score (PR: 1.69; 95% CI 1.14–2.49), and non-users of anxiolytic or antidepressant drugs had 23% lower PR for poor sleep or presence of sleep disorders (PR: 0.77; 95% CI 0.67–0.87).

For undergraduate students, the multivariate analysis showed a significant association for academic performance ( $p = 0.035$ ), with a PR of 0.94 (95% CI 0.89–0.99). In addition, not using anxiolytic or antidepressant drugs showed lower PR for the presence of poor sleep or sleep disorders ( $p = 0.004$ ). For this last variable, non-users had a 20% lower PR and had poor scores related to the index

(PR: 0.80; 95% CI 0.69–0.93) when compared with users. No significant association between years of undergraduate study and sleep quality was identified.

When analyzing only graduate students, there was a statistically significant association for skin color ( $p = 0.009$ ) and being the householder ( $p < 0.001$ ). Non-white individuals had 2.28 times higher PR for poor sleep or sleep disorders (PR: 2.28; 95% CI 1.23–4.21) compared to white ones, and those who were not householder had higher PR compared to head of family (PR: 4.39 95% CI 1.91–10.09).

**Table 3** Demographical and behavioral characteristics associated with PSQI scores, considering only undergraduate dental students

		PSQI score $\leq 4$ (Good) ( $n = 103$ ; 31.1%)	PSQI score $\geq 5$ (Poor or Sleep disorder) ( $n = 228$ ; 68.9%)	Bivariate analysis PR (95%CI)	<i>P</i> -value
PSQI	Mean $\pm$ SD	3.02 $\pm$ 0.90	8.70 $\pm$ 2.87	–	–
Age	Mean $\pm$ SD	22.71 $\pm$ 3.75	22.73 $\pm$ 3.39	1.00 (0.98–1.02)	0.956
Sex	Male— $n$ (%)	43 (41.7)	64 (28.1)	1	0.023
	Female— $n$ (%)	60 (58.3)	164 (71.9)	1.22 (1.03–1.46)	
Skin color	White— $n$ (%)	86 (83.5)	180 (78.9)	1	0.305
	Non-white— $n$ (%)	17 (16.5)	48 (21.1)	1.09 (0.92–1.29)	
Do you regularly do physical activities?	Yes— $n$ (%)	50 (48.5)	109 (47.8)	1	0.901
	No— $n$ (%)	53 (51.5)	119 (52.2)	1.01 (0.87–1.17)	
Sexual orientation	Heterosexual— $n$ (%)	94 (91.3)	197 (86.4)	1	0.152
	Other— $n$ (%)	9 (8.7)	31 (13.6)	1.15 (0.95–1.38)	
Are you the head of your family?	Yes— $n$ (%)	5 (4.9)	8 (3.5)	1	0.599
	No— $n$ (%)	98 (95.1)	220 (96.5)	1.12 (0.73–1.74)	
Do you receive any scholarship or are you currently employed?	Yes— $n$ (%)	26 (25.2)	49 (21.5)	1	0.468
	No— $n$ (%)	77 (74.8)	179 (78.5)	1.07 (0.89–1.29)	
Study level	1st Year— $n$ (%)	17 (16.5)	38 (16.7)	1	
	2nd Year— $n$ (%)	18 (17.5)	54 (23.7)	1.09 (0.87–1.36)	0.468
	3rd Year— $n$ (%)	18 (17.5)	42 (18.4)	1.01 (0.80–1.29)	0.916
	4th Year— $n$ (%)	20 (19.4)	47 (20.6)	1.02 (0.80–1.29)	0.899
	5th Year— $n$ (%)	30 (29.1)	47 (20.6)	0.88 (0.69–1.14)	0.334
Did you consume alcohol in the last 30 days?	Yes— $n$ (%)	65 (63.1)	164 (71.9)	1	0.128
	No— $n$ (%)	38 (26.9)	64 (28.1)	0.88 (0.74–1.04)	
Did you smoke in the last 30 days?	Yes— $n$ (%)	7 (6.8)	21 (9.2)	1	0.421
	No— $n$ (%)	96 (93.2)	207 (90.8)	0.91 (0.73–1.14)	
Did you use marijuana in the last 30 days?	Yes— $n$ (%)	13 (12.6)	21 (9.2)	1	0.389
	No— $n$ (%)	90 (87.4)	207 (90.8)	1.13 (0.86–1.49)	
Do you use any antidepressant or anti-anxiety drug?	Yes— $n$ (%)	14 (13.6)	78 (34.2)	1	<0.001
	No— $n$ (%)	89 (86.4)	150 (65.8)	0.74 (0.65–0.84)	
Academic performance (undergraduate students)	Mean $\pm$ SD	7.88 $\pm$ 0.63	7.58 $\pm$ 1.12	0.93 (0.88–0.97)	0.002
Answered “yes” to all COVID-19 questions	Yes— $n$ (%)	20 (19.4)	56 (24.6)	1	0.276
	No— $n$ (%)	83 (80.6)	172 (75.4)	0.92 (0.78–1.07)	

## 4 Discussion

The present study aimed to assess the quality of sleep among dental students and the associated factors. It was observed a higher prevalence of poor quality of sleep or sleep disorders in this population (65.2% and 34.8% for undergraduate and graduate dental students, respectively), which is higher than the prevalence of sleep disorders found in medical students, ranging from 38.9% [17] to 42.3% [18]. Additionally, it was demonstrated that sex, skin color, use of antidepressants and anxiolytics drugs and whether the individual is a householder were associated with quality of sleep. Among undergraduate dental students, poorer academic performance was also associated with poor quality of sleep.

When the whole-sample was considered, female dental students presented a PR 19% higher of having a poor quality

of sleep. The greater vulnerability detected in females has already been addressed in other studies [19, 20], being related a higher level of stress and anxiety, which may contribute to the problems related to sleep. Moreover, literature shows that female dental students self-reported higher rates of depression [16]. It may be hypothesized that those factors contributed to the worst quality of sleep among female dental students in the present study.

A previous study showed higher levels of anxiety in dental students compared to other courses in the health area [21], which can lead to the use of drugs to reduce the problems caused by this anxiety, including through self-medication [22]. However, in the present study, it was verified that the use of antidepressants or anxiolytic drugs were associated with quality of sleep, as non-users of anxiolytic or antidepressant drugs had 23% lower PR for at

**Table 4** Demographical and behavioral characteristics associated with PSQI scores, considering only graduate dental students

		PSQI score $\leq 4$ (Good) ( $n = 39$ ; 50.6%)	PSQI score $\geq 5$ (Poor or Sleep disorder) ( $n = 38$ ; 49.4%)	Bivariate analysis PR (95%CI)	<i>P</i> -value
PSQI	Mean $\pm$ SD	2.77 $\pm$ 1.09	7.97 $\pm$ 2.53	–	–
Age	Mean $\pm$ SD	31.39 $\pm$ 8.34	29.16 $\pm$ 5.07	0.97 (0.94–1.01)	0.131
Sex	Male— $n$ (%)	14 (35.9)	7 (18.4)	1	0.126
	Female— $n$ (%)	25 (64.1)	31 (81.6)	1.66 (0.87–3.18)	
Skin color	White— $n$ (%)	37 (94.9)	31 (81.6)	1	0.016
	Non-white— $n$ (%)	2 (5.1)	7 (18.4)	1.71 (1.10 – 2.64)	
Do you regularly do physical activities?	Yes— $n$ (%)	24 (61.5)	20 (52.6)	1	0.426
	No— $n$ (%)	15 (38.5)	18 (47.4)	1.20 (0.77–1.88)	
Sexual orientation	Heterosexual— $n$ (%)	39 (100.0)	34 (89.5)	–	–
	Other— $n$ (%)	0 (0.0)	4 (10.5)		
Are you the head of your family?	Yes— $n$ (%)	26 (66.7)	9 (23.7)	1	0.001
	No— $n$ (%)	13 (33.3)	29 (76.3)	2.69 (1.48–4.89)	
Do you receive any scholarship or are you currently employed?	Yes— $n$ (%)	37 (94.9)	37 (97.4)	–	–
	No— $n$ (%)	2 (5.1)	1 (2.6)		
Study level	Master degree— $n$ (%)	14 (35.9)	18 (47.4)	1	0.302
	Ph.D— $n$ (%)	25 (64.1)	20 (52.6)	0.79 (0.51–1.24)	
Did you consume alcohol in the last 30 days?	Yes— $n$ (%)	26 (66.7)	28 (73.7)	0.84 (0.49–1.43)	0.517
	No— $n$ (%)	13 (33.3)	10 (26.3)		
Did you smoke in the last 30 days?	Yes— $n$ (%)	1 (2.6)	34 (89.5)	–	–
	No— $n$ (%)	38 (97.4)	4 (10.5)		
Did you use marijuana in the last 30 days?	Yes— $n$ (%)	3 (7.7)	2 (5.3)	1	0.690
	No— $n$ (%)	36 (92.3)	36 (94.7)	1.25 (0.42–3.75)	
Do you use any antidepressant or anti-anxiety drug?	Yes— $n$ (%)	6 (15.4)	12 (31.6)	0.66 (0.43–1.02)	0.062
	No— $n$ (%)	33 (84.6)	26 (68.4)		
Academic performance (graduate students)	Mean $\pm$ SD	90.17 $\pm$ 9.57	88.73 $\pm$ 8.62	0.99 (0.97–1.02)	0.530
Answered “yes” to all COVID-19 questions	Yes— $n$ (%)	14 (35.9)	15 (39.5)	0.93 (0.59–1.47)	0.744
	No— $n$ (%)	25 (64.1)	23 (60.5)		

least poor quality of sleep. Moreover, midnocturnal insomnia is the most frequent residual symptom of depression. Thus, all antidepressants should normalize sleep. However, at least in short-term treatment, many antidepressants with so-called activating effects (e.g., fluoxetine and venlafaxine) may disrupt sleep, while others with sedative properties (e.g., doxepin, mirtazapine, and trazodone) rapidly improve sleep, but may cause problems in long-term treatment due to oversedation [23, 24].

Regarding academic performance, a significant relationship was found with the PSQI index, with PR of 0.93, thus, the student with poor sleep quality or sleep disorder has a lower academic achievement than the one found in the other group. This corroborates with another study that pointed out that poor sleep quality negatively impacts the academic performance of university students [7]. In addition, fatigue and insufficient sleep are associated with negative physician health outcomes, which may be correlated with those performed by oral health professional

[25]. Individuals with poor quality of sleep may present tiredness during the whole-day, and this factor may reflect of the student’s quality of study and, consequently, in their academic performance.

Although there are studies that report no differences in the sleep profile of non-white individuals [26], the present study demonstrated that non-white individuals had 1.19 and 2.28 higher PR for poor sleep quality or some sleep disorder when compared to white individuals, both in the whole-sample and among graduate dental students, respectively. Short sleep duration and poor quality of sleep are reported among Afro-decent individuals [27]. Some factors may contribute to this data, such as the lower socioeconomic status, the need to constantly juggle work and studies, and live at home with many residents [28].

It was possible to see that non-white women have a 19% higher PR of having poor sleep quality or sleep disorders when compared to the opposite group (white men), crossing two factors that have been shown to be associated with sleep

**Table 5** Multivariate analysis for PSQI score

	Whole-sample PR (95%CI)	<i>P</i> value	Undergraduate students only PR (95%CI)	<i>P</i> value	Graduate students only PR (95%CI)	<i>P</i> value
Academic performance	–	–	0.94 (0.89–0.99)	0.035	0.99 (0.96–1.03)	0.732
Sex						
Male	1	0.040	1	0.106	1	0.473
Female	1.19 (1.01–1.41)		1.17 (0.97–1.42)		0.77 (0.38–1.57)	
Skin color						
White	1	0.025	–	–	1	0.009
Non-white	1.19 (1.02–1.39)				2.28 (1.23–4.21)	
Are you the head of your family?						
Yes	1	0.009	–	–	1	<0.001
No	1.69 (1.14–2.49)				4.39 (1.91–10.09)	
Study level (whole-sample)						
Undergraduate (preclinical)	1		–	–	–	–
Undergraduate (clinical)	0.90 (0.78–1.04)	0.141				
Graduate (Master and Ph.D)	0.81 (0.63–1.03)	0.090				
Study level (undergraduate)						
1st Year	–	–	1		–	–
2nd Year			0.94 (0.71–1.24)	0.638		
3rd Year			0.94 (0.71–1.24)	0.646		
4th Year			0.86 (0.65–1.15)	0.314		
5th Year			0.75 (0.55–1.02)	0.066		
Study level (graduate)						
Master degree	–	–	–	–	1	0.555
Ph.D					0.83 (0.45–1.55)	
Did you consume alcohol in the last 30 days?						
Yes	1	0.092	–	–	–	–
No	0.87 (0.74–1.02)					
Did you smoke in the last 30 days?						
Yes	1	0.074	–	–	–	–
No	0.84 (0.69–1.02)					
Do you use any antidepressant or anti-anxiety drug?						
Yes	1	<0.001	1	0.004	1	0.212
No	0.77 (0.67–0.87)		0.80 (0.69–0.93)		0.68 (0.38–1.24)	
Answered “yes” to all COVID-19 questions						
Yes	1	0.762	1	0.505	1	0.543
No	0.98 (0.84–1.14)		0.95 (0.81–1.11)		1.17 (0.71–1.93)	

disorders, in this and other studies [19, 28] and discussed above. Not being the householder presented a higher PR for poorer quality of sleep among the whole-sample and graduate dental students. It may be hypothesized that the worry to become independent cause impact in the quality of sleep. Further studies must assess this finding.

Among the limitations of this study, one can point out the characteristics of being a cross-sectional study. Therefore, the cause-effect relationship may not be attributed, since data collection is done in a single moment and does not follow the samples to give this response of exposure and outcome [29]. In addition, sleep quality assessed by a questionnaires



and further instruments may validate the sleep patterns in adults individuals. However, PSQI is a largely used tool and its validated version was used in the present study.

In this sense, good quality of sleep is an important factor, both for the individual's general health and for academic success. Being little or not addressed in colleges, this issue tends to extend and harm a significant amount of young people who do not have adequate information and awareness about the problem.

## 5 Conclusion

Mainly, the present study showed the relationship between sleep quality and academic performance among dental students. A significant relationship was found for poorer academic performance and poorer quality of sleep. Based on these results, we recommend actions in dental schools to inform their students about the problems of poor sleep quality, their academic life and general health. In addition, some strategies to decrease stress and anxiety can be incorporated and adapted into undergraduate and graduate programs, such as mindfulness-based intervention, relaxation, and meditation for these students [30]. Additionally, further strategies to improve quality of sleep at the start of classes, which can help prevent poor sleep quality and sleep disturbances in students.

**Supplementary Information** The online version contains supplementary material available at <https://doi.org/10.1007/s41782-022-00223-2>.

**Author Contributions** NMP, MC and FWMGM designed the study. MC, RZA and FWMGM collected the data. FWMGM analyzed the data. NMP and MSM validated the results. MSM, PPAD and FWMGM wrote the manuscript. All authors revised the literature and approved the final version of the manuscript.

**Funding** This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior—Brasil (CAPES)—Finance Code 001. All other funding was self-supported by the authors.

**Data availability statement** Data will be available upon request to the corresponding author.

**Code Availability** Data will be available upon request.

## Declarations

**Conflict of Interest** The authors report no conflict of interest.

**Ethical approval** The local ethics committee approved the study under protocol #3.910.723.

**Informed Consent** An informed consent was signed by all participants.

## References

1. Roehrs T, Shore E, Papineau K, Rosenthal L, Roth T. A two-week sleep extension in sleepy normals. *Sleep*. 1996;19:576–82.
2. Jaussent I, Bouyer J, Ancelin ML, Akbaraly T, Pérès K, Ritchie K, et al. Insomnia and daytime sleepiness are risk factors for depressive symptoms in the elderly. *Sleep*. 2011;34:1103–10.
3. Lucchetti G, Damiano RF, DiLalla LF, Lucchetti ALG, Moutinho ILD, da Silva EO, et al. Cross-cultural differences in mental health, quality of life, empathy, and burnout between US and Brazilian medical students. *Acad Psychiatry*. 2018;42:62–7.
4. Spiegel K, Knutson K, Leproult R, Tasali E, Van Cauter E. Sleep loss: a novel risk factor for insulin resistance and Type 2 diabetes. *J Appl Physiol*. 2005;99:2008–19.
5. Cappuccio FP, Cooper D, D'Elia L, Strazzullo P, Miller MA. Sleep duration predicts cardiovascular outcomes: a systematic review and meta-analysis of prospective studies. *Eur Heart J*. 2011;32:1484–92.
6. Gallicchio L, Kalesan B. Sleep duration and mortality: a systematic review and meta-analysis. *J Sleep Res*. 2009;18:148–58.
7. Gilbert SP, Weaver CC. Sleep quality and academic performance in university students: a wake-up call for college psychologists. *J Coll Stud Psychother*. 2010;24:295–306.
8. Menon B, Karishma H, Mamatha I. Sleep quality and health complaints among nursing students. *Ann Indian Acad Neurol*. 2015;18:363–4.
9. Schneider ML, Vasconcellos DC, Dantas G, Levandovski R, Caumo W, Allebrandt KV, et al. Morningness-eveningness, use of stimulants, and minor psychiatric disorders among undergraduate students. *Int J Psychol*. 2011;46:18–23.
10. Almojali AI, Almalki SA, Allothman AS, Masuadi EM, Alaqeel MK. The prevalence and association of stress with sleep quality among medical students. *J Epidemiol Glob Health*. 2017;7:169–74.
11. Birks Y, McKendree J, Watt I. Emotional intelligence and perceived stress in healthcare students: a multi-institutional, multi-professional survey. *BMC Med Educ*. 2009;9:61.
12. Elani HW, Allison PJ, Kumar RA, Mancini L, Lambrou A, Bedos C. A systematic review of stress in dental students. *J Dent Educ*. 2014;78:226–42.
13. Ahmed MA, Jouhar R, Ahmed N, Adnan S, Aftab M, Zafar MS, et al. Fear and practice modifications among dentists to combat novel coronavirus disease (COVID-19) outbreak. *Int J Environ Res Public Health*. 2020;17(8):2821.
14. Buysse DJ, Reynolds CF 3rd, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh sleep quality index: a new instrument for psychiatric practice and research. *Psychiatry Res*. 1989;28:193–213.
15. Bertolazi AN, Fagundes SC, Hoff LS, Dartora EG, Miozzo IC, de Barba ME, et al. Validation of the Brazilian Portuguese version of the Pittsburgh sleep quality index. *Sleep Med*. 2011;12:70–5.
16. Muniz F, Maurique LS, Toniazzi MP, Silva CF, Casarin M. Self-reported depressive symptoms in dental students: systematic review with meta-analysis. *J Dent Educ*. 2021;85:135–47.
17. Samaranayake CB, Arroll B, Fernando AT 3rd. Sleep disorders, depression, anxiety and satisfaction with life among young adults: a survey of university students in Auckland, New Zealand. *N Z Med J*. 2014;127:13–22.
18. Lima PF, Medeiros ALD, Araujo J. Sleep-wake pattern of medical student: early versus late class starting time. *Braz J Med Biol Res*. 2002;35:1373–7.
19. Brenneisen Mayer F, Souza Santos I, Silveira PSP, Itaquí Lopes MH, de Souza ARND, Campos EP, et al. Factors associated to

- depression and anxiety in medical students: a multicenter study. *BMC Med Educ* [Internet]. 2016;16:282.
20. Chernomas WM, Shapiro C. Stress, depression, and anxiety among undergraduate nursing students. *Int J Nurs Educ Scholarsh*. 2013;10:255.
  21. Sanders AE, Lushington K. Effect of perceived stress on student performance in dental school. *J Dent Educ*. 2002;66:75–81.
  22. Machado AV, Castro CO, Botelho Filho CR, Bruzamonlin CD, Scariot R, Pizzatto E, et al. Anxiety and sleep quality in dental students at a private Brazilian university. *Bull Tokyo Dent Coll*. 2020;61:27–36.
  23. Everitt H, Baldwin DS, Stuart B, Lipinska G, Mayers A, Malizia AL, et al. Antidepressants for insomnia in adults. *Cochrane Database Syst Rev*. 2018;5:CD010753.
  24. Wichniak A, Wierzbicka A, Wałęcka M, Jernajczyk W. Effects of antidepressants on sleep. *Curr Psychiatry Rep*. 2017;19:63.
  25. Gates M, Wingert A, Featherstone R, Samuels C, Simon C, Dyson MP. Impact of fatigue and insufficient sleep on physician and patient outcomes: a systematic review. *BMJ Open*. 2018;8:e021967.
  26. Whinnery J, Jackson N, Rattanaumpawan P, Grandner MA. Short and long sleep duration associated with race/ethnicity, sociodemographics, and socioeconomic position. *Sleep*. 2014;37:601–11.
  27. Cunningham TJ, Wheaton AG, Ford ES, Croft JB. Racial/ethnic disparities in self-reported short sleep duration among US-born and foreign-born adults. *Ethn Health*. 2016;21:628–38.
  28. Johnson DA, Jackson CL, Williams NJ, Alcántara C. Are sleep patterns influenced by race/ethnicity—a marker of relative advantage or disadvantage? Evidence to date. *Nat Sci Sleep*. 2019;11:79–95.
  29. Belbasis L, Bellou V. Introduction to epidemiological studies. *Methods Mol Biol*. 2018;1793:1–6.
  30. McConville J, McAleer R, Hahne A. Mindfulness training for health profession students—the effect of mindfulness training on psychological well-being, learning and clinical performance of health professional students: a systematic review of randomized and non-randomized controlled trials. *Explore (NY)*. 2017;13:26–45.

**Publisher's Note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Springer Nature or its licensor (e.g. a society or other partner) holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.