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Mental health and quality of life of Brazilian medical students: Incidence, prevalence, and associated factors within two years of follow-up

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ABSTRACT

Medical students' mental health and quality of life (QoL) cause growing concern worldwide, but, to date, few longitudinal studies have followed these students. Our objective was to evaluate the incidence, prevalence, and factors associated with quality of life and symptoms of depression, anxiety, and stress of Brazilian medical students who were followed for a period of two years. Students' mental health (DASS-21), QoL (WHOQOL-Bref), and religiousness (DUREL) were evaluated in four different waves(four semesters). A total of 312 (54.2%) medical students responded to all four waves. Medical students demonstrated a high prevalence and incidence of emotional disorders. Almost half of the students presented high levels of depression, anxiety, and stress during the two-year follow-up; approximately one out of five students without symptoms at the baseline were considered new cases and these problems have a cyclical nature. Baseline factors such as depression, anxiety, stress, having low income, being female, being in the early stages of medical training and non-white were associated with poorer mental health and quality of life in the follow-up. Our results show that medical students have a high prevalence and incidence of mental health disorders during their medical training. This data may help educators plan preventive strategies.

1. Introduction

The mental health and quality of life (QoL) of university students have been the object of increasing concern worldwide (Dyrbye et al., 2006). Healthcare students seem to be more subject to depression (Alexandrino-Silva et al., 2009) and among them, medical students are one of the groups most affected (AlFaris et al., 2016). In fact, studies show that medical students are vulnerable to disorders like stress, anxiety, depression, and low QoL (Brazeau et al., 2014; Dyrbye et al., 2006; Ludwig et al., 2015; Puthran et al., 2016).

A recent systematic review showed a high prevalence of depression (varying from 6.0%–66.5%), anxiety (7.7%–65.5%), and psychological stress (12.2%–96.7%) in English-speaking medical students outside the United States (Hope and Henderson, 2014). These numbers are similar to other international studies, where there is a prevalence of 27.2% for depression, varying from 9.3% to 55.9%, depending on the country investigated (Rotenstein et al., 2016). However, in spite of the large number of studies published in the area, most are still cross sectional, which hinders understanding of the cause-effect relationships and estimating the incidence of new cases – data essential for greater comprehension and for planning interventions in the area.

Longitudinal studies published to date tend to report increased mental disorders over the course of medical school, as seen in Australian (Dendle et al., 2018), Indian (Goel et al., 2016), American (Ludwig et al., 2015), and Malaysian (Yusoff et al., 2011) students, but not among Dutch students, for whom prevalence was stable (Borst et al., 2016). Nevertheless, more studies are needed to further understand the incidence of these disorders among medical students. A 2016 Dutch study confirmed a 20% incidence of depression and 17% for anxiety during a one-year follow-up (Borst et al., 2016) and an American study conducted in 1988 found an incidence of 24% over six months (Clark et al., 1988).

Several factors have been suggested as being related to medical students' poor mental health, such as being in the early stages of medical training (Dyrbye et al., 2006; Ludwig et al., 2015), being female, the school's location, and whether or not the student has a scholarship (Brenneisen Mayer et al., 2016). Other personal factors and those associated with the learning environment, such as the characteristics of individuals in late adolescence, the lack of free and leisure time, financial restrictions, family stressors, heavy curricular and extracurricular loads, competition for high performance and the quality of professor-student relationships are also among the reasons students

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become ill (AlFaris et al., 2016; Dyrbye et al., 2006; Ohayon and Roberts, 2014). These factors have negative repercussions on academic performance and on their motivation to learn. They further result in reduced empathy which can influence the quality of life and well-being, enhancing suffering and despair (Angkurawaranon et al., 2016; Hwang et al., 2017).

Even though student well-being is an important factor in this context, there are fewer studies, especially longitudinal studies, dealing with this when compared to mental health. The few longitudinal studies have shown a drop in quality of life for Indian (Chandramouleeswaran et al., 2014) and American (Goldin et al., 2007) students during clerkship.

To promote more evidence about medical students' well-being and mental health, we need more longitudinal studies from outside of the US and Europe. Understanding how this process comes about is very important for planning how to care for our future doctors, preventing social distancing, fatigue, and serious outcomes like severe depression and suicide (Hwang et al., 2017).

Thus, this study aims to evaluate the incidence, prevalence, and factors associated with quality of life and symptoms of depression, anxiety, and stress of Brazilian medical students who were followed for a period of two years.

2. Methods

2.1. Study design and place

This was an observational, longitudinal study with medical students at the Federal University of Juiz de Fora (UFJF, acronym in Portuguese), in Brazil. UFJF is a public university, with a curriculum that is still considered traditional, permeated by active activities like team- and problem-based learning, flipped classrooms, and increasing exposure to patients throughout the course. There are 80 to 90 openings for enrollment per semester, of which 50% are reserved for socioeconomic, racial, and handicapped students. The course lasts six years and UFJF's curriculum is basically divided into three phases/stages of training: preclinical (1st and 2nd years – studying most of the basic sciences: anatomy, histology, physiology; using almost exclusively classroom activities and little patient exposure), clinical (3rd and 4th years – studying diseases: cardiology, gastroenterology, surgery, mostly having classroom activities but with an increasing amount of patient exposure), and clerkship (5th and 6th years – mostly inpatient or outpatient care and few classroom activities). The project was approved by the University Teaching Hospital/UFJF's Research Ethics Committee under report no. 790.822. All students participating signed a consent form.

2.2. Participants and eligibility criteria

Medical students officially enrolled in the School of Medicine at UFJF were eligible to participate. Students were followed up on every semester during the two-year period from 2014 to 2016, which corresponds to a total of four waves. Students were included if they could be followed for two years, were present when data was collected, and agreed to participate in the study. Students who did not fill out questionnaires during all four waves (i.e., those who concluded the course before the end of the study, those who entered the university during or after wave 2, and those who did not respond to the questionnaire in at least one of the waves) were excluded.

2.3. Procedures

Students filled out the questionnaires during class time (before or after educational activities), always in the middle of the school term in order to evaluate students at a moment closest to their baseline state, which means being distant from periods closest to vacations (beginning of semester) and summative evaluations (end of semester). Application, taking about 20 min, was done exclusively by researchers, guaranteeing data confidentiality.

2.4. Measures

The following self-reporting, in-person questionnaires were used:

- Socio-demographic data: gender, ethnicity, family income, and age;
- Depression, anxiety, and stress – evaluated using the DASS 21 (*Depression Anxiety Stress Scale*) questionnaire, validated for Portuguese (Vignola and Tucci, 2014). This short, 21-item scale allows simultaneous evaluation of the three emotional states and their symptomology related to depression, anxiety, and stress. It is easily applied in clinical and nonclinical settings (Antony et al., 1998; Henry and Crawford, 2005; Lucchetti et al., 2018) and is adequate for different age groups, including medical students. Higher scores are related to poorer mental health. In our sample, the Cronbach's alpha for this scale was 0.905.
- Quality of Life – evaluated using the *World Health Organization Quality of Life* scale (WHOQOL-Bref), validated for Portuguese. It is a 26-item scale with four domains: physical, psychological, social relations, and environment, as well as a general facet dealing with respondents' "quality of life" and "health" over the previous two weeks. High values are related to better QoL (Cruz et al., 2011). In our sample, the Cronbach's alpha for this scale was 0.864.
- Duke University Religion Index (DUREL), validated for Portuguese (Lucchetti et al., 2012), made up of five Likert scale items that evaluate the following dimensions of religiosity: organizational (religious frequency), non-organizational (frequency of private activities such as prayer, reading religious literature, and religious meditation), and intrinsic (religion as a reason for living). In our sample, the Cronbach's alpha for this scale was 0.907.
- Satisfaction with being a doctor, evaluated with the question: "In general, how satisfied or dissatisfied are you with studying to become a doctor". Answers are on a scale where 1 = very satisfied, 2 = moderately satisfied, 3 = not very satisfied, and 4 = very dissatisfied.

2.5. Statistical analyses

This is a population study since all students in our medical school were eligible to participate. However, the minimum required sample size for this study was 200 students (based on an alpha of 5%, Beta-1 of 90%, population size of 756 and a response distribution of 50%). The sample size calculation was performed using the Yamane formula (Yamane, 1967).

Descriptive analyses were conducted using frequency, percentage, mean, and standard deviation for socio-demographic data and the questionnaires. The incidence (number of new cases occurring within two years) and prevalence (actual number of cases in each wave) of depression (cut-off: 9), anxiety (cut-off: 7) and stress (cut-off: 14) among medical students were calculated (Lovibond and Lovibond, 1995).

Afterwards, inferential analyses were carried out. First, chi-square tests or Mann–Whitney tests at the baseline were used to evaluate the differences between participants who either did (respondents) or did not (non-respondents) complete all 4 waves. Next, DASS and WHOQOL-Bref scores were also examined during the four waves and compared using ANOVA for repeated measures with Bonferroni post-hoc tests. Finally, a stepwise linear regression model was used to evaluate which factors in the baseline could be associated with each dependent variable during follow-up – wave 4 (DASS subscales, WHOQOL subscales and "satisfaction with being a doctor"). The following independent variables (at baseline – wave 1) were included: undergraduate year, gender, age, income, race, organizational religiosity, non-organizational religiosity, intrinsic religiosity, DASS Depression, DASS Anxiety, and DASS Stress. Fit measures and R^2 were evaluated.

The value of $p < 0.05$ and a confidence interval of 95% were adopted for all analyses. In order to avoid missing data imputations, we decided to consider non-respondents those questionnaires did not have

complete responses in the DASS items or those who failed to answer one wave.

3. Results

From a total of 756 eligible students, 575 (76.0%) answered the mental health baseline questionnaire at the beginning (wave 1) and 181 (24%) were not present during data collection. Of these, 458 (79.6%) answered wave 2, 451 (78.4%) answered wave 3, and 420 (73.0%) answered wave 4, totaling 312 (54.2%) students who completely answered all four waves. A total of 263 were considered non-respondents (11 students answered all four waves but failed to fully answer all DASS 21 items and 252 failed to answer at least one wave because they were not present during data collection). No one refused to answer. The sample was composed mostly of white (70.7%) women (64.1%) with low to medium income (53.4%) having a mean age of 21.0 (SD 2.6) years old. Participants responding during all four waves were different from non-respondents in gender (more females), year of medical training (earlier years), and age (younger). No other differences were observed, including no differences in mental health and quality of life scores (Table 1). As for the sample's religious characteristics, 90 students (28.8%) attend religious services once a week or more, 134 (42.9%) pray at least once a day, 246 (78.8%) agree that "they experience the presence of the Divine", 188 (60.2%) agree that "their religious beliefs are what really lie behind their whole approach to life" and 154 (49.3%) agree that they "try hard to carry their religion over into all other dealings in life".

Table 2 shows the prevalence and the incidence of depression, anxiety and stress for each wave. Considering all waves, the prevalence of mental health disorders was 29.8% for depression (varying from 10.5 to 14.7% in each wave), 30.1% for anxiety (varying from 10.5 to 15.3% in each wave), 25.3% for stress (varying from 8.3 to 14.4% in each wave). Likewise, the incidence of mental health disorders considering all waves was 21.5% for depression (varying from 5.6 to 10.7% in each wave), 19.8% for anxiety (varying from 5.6 to 9.2% in each wave) and 16.7% for stress (varying from 3.3 to 9.6% in each wave).

Table 1
Comparison of the Sociodemographic data, quality of life and mental health outcomes between respondents and non respondents.

	Respondents *n*(%)	Non respondents *n*(%)	*p*[a]
Gender			
Male	112 (35.9%)	128 (48.7%)	
Female	200 (64.1%)	135 (51.3%)	**0.002**
Year of medical training			
1	93 (29.8%)	62 (23.6%)	
2	88 (28.2%)	52 (19.8%)	
3	75 (24.0%)	63 (24.0%)	
4	56 (17.9%)	86 (32.7%)	**<0.001**
Race			
White	220 (70.7%)	200 (76.0%)	
Non-white	91 (29.3%)	63 (24.0%)	0.158
Income			
Low/Medium (>9 Minimum wage)	165 (53.4%)	132 (50.6%)	
High (9 MW or more)	144 (46.6%)	129 (49.4%)	0.556
	Respondents Mean (SD)	**Non respondents Mean (SD)**	***p*b**
Age	21.0 (2.6)	21.6 (2.7)	**0.009**
DASS Depression	4.1 (3.8)	4.5 (4.4)	0.744
DASS Anxiety	3.5 (3.3)	3.5 (3.6)	0.513
DASS Stress	8.0 (4.4)	8.0 (4.8)	0.953
WHOQOL Physical	3.5 (0.5)	3.5 (0.5)	0.778
WHOQOL Psychological	3.0 (0.5)	3.0 (0.5)	0.813
WHOQOL Social	3.8 (0.6)	3.6 (0.7)	0.074
WHOQOL Environment	3.5 (0.5)	3.5 (0.5)	0.351
Satisfaction of being a doctor	4.3 (0.7)	4.2 (0.7)	0.149
Number of respondents	312	263	

[a] Chi-square test.
[b] Mann–Whitney test.

The patterns and cyclical nature of students' mental health problems can be visualized better in the alluvial graph (Fig. 1). Fig. 2 presents the overlap among mental health disorders in medical students, considering all waves. Approximately half of the sample (47.1%) had a mental health problem in at least one wave. A total of 12.8% had all three conditions concomitantly (depression, anxiety, stress), 12.4% had two conditions, and 21.7% only had a single condition (Fig. 2).

Stepwise linear regression models (Table 3) showed that: (a) stress at wave 4 was associated with stress at wave 1, anxiety at wave 1, and the early stage of medical training; (b) anxiety at wave 4 was associated with anxiety at wave 1 and the early stage of medical training; (c) depression at wave 4 was associated with anxiety at wave 1, depression at wave 1, and the early stage of medical training; (d) physical quality of life at wave 4 was negatively associated with stress at wave 1, anxiety at wave 1, and being female; (e) psychological quality of life at wave 4 was negatively associated with depression at wave 1, stress at wave 1, and income; (f) social quality of life at wave 4 was negatively associated with depression at wave 1; (g) environmental quality of life at wave 4 was negatively associated with stress at wave 1, depression at wave 1, having low income, and being non-white; (h) "satisfaction with being a doctor" at wave 4 was negatively associated with depression at wave 1.

Changes in relation to mental health and quality of life scores in the follow-up for the four waves can be seen in supplementary figures 1 and 2. We found significantly higher scores of depression and stress in wave 2 and better scores for physical and environmental qualities of life in wave 3. However, in general, most scores were stable over time.

4. Discussion

This study found a high prevalence and incidence of emotional disorders in medical students, in that almost half of the students demonstrated high levels of depression, anxiety, and stress during the two-year follow-up while approximately one out of five students without symptoms at baseline were considered new cases at the end of the study. The levels of quality of life and mental health remained mostly stable through the waves, and students' mental health problems were cyclical in nature. Baseline factors such as depression, anxiety, stress, having low income, and being female, in the early stages of medical training, and non-white were associated with poorer mental health and quality of life in the follow-up.

The prevalence found in this study, in which 30% of students presented depressive symptoms in the follow-up, is greater than a British longitudinal study that found a prevalence of 18.2% of depression at any point during follow-up (Quince et al., 2012). However, it is similar to a recent systematic review which found a 27.2% prevalence of depression compiling all international studies (Rotenstein et al., 2016). In our study, almost half of the students showed high levels of mental problems in at least one wave of data collection over those two years and almost 13% had an overlap of depression, anxiety, and stress. These findings reflect concerns, which reinforce the idea that medical school is not an environment designed to maintain suitable mental health, as it has important repercussions on its students (Dyrbye et al., 2008, 2014).

In spite of most longitudinal studies presenting data that reveals an increase in mental disturbances during medical school (Dendle et al., 2018; Goel et al., 2016; Ludwig et al., 2015; Yusoff et al., 2011), our study tends to show a stability of prevalence, with a slight increase in stress and depression in the second wave and a better quality of life in the third. That stability has also been found in a study of Dutch students (Borst et al., 2016), but not in a Portuguese study that found a decrease in depressive symptomology (Silva et al., 2017). Nevertheless, despite this relative stability, it is noted that mental health problems are far from being static and affecting the same population of students. They present a cyclical nature in which some students have an increase in

Table 2
Prevalence and the incidence of depression, anxiety and stress for each wave.

	Wave 1	Wave 2	Wave 3	Wave 4	In any wave
Depression					
Prevalence					
Yes	33 (10.5%)	46 (14.7%)	39 (12.5%)	36 (11.5%)	93 (29.8%)
No	279 (89.5%)	266 (85.3%)	273 (87.5%)	276 (88.5%)	219 (70.2%)
Incidence[a]	–	30/279 (10.7%)	17/249 (6.8%)	13/232 (5.6%)	60/279 (21.5%)
Returned to a non-depression score[b]	–	17/33 (51.5%)	6/16 (37.5%)	6/10 (60%)	
Recurrent Depression	–	–	12	19	
Anxiety	Wave 1	Wave 2	Wave 3	Wave 4	In any wave
Prevalence					
Yes	40 (12.8%)	40 (12.8%)	33 (10.5%)	48 (15.3%)	94 (30.1%)
No	272 (87.2%)	272 (87.2%)	279 (89.5%)	264 (84.7%)	218 (69.5%)
Incidence[a]	–	25/272 (9.2%)	14/247 (5.6%)	15/233 (6.4%)	54/272 (19.8%)
Returned to a non-anxiety score[b]		25/40 (62.5%)	6/15 (40%)	1/9 (11.1%)	
Recurrent Anxiety	–	–	10	25	
Stress	Wave 1	Wave 2	Wave 3	Wave 4	In any wave
Prevalence					
Yes	32 (10.2%)	45 (14.4%)	26 (8.3%)	29 (9.2%)	79 (25.3%)
No	280 (89.8%)	267 (85.6%)	286 (91.7%)	283 (90.8%)	233 (74.7%)
Incidence[a]		27/280 (9.6%)	12/253 (4.7%)	8/241 (3.3%)	47/280 (16.7%)
Returned to a non-stress score[b]		14/32 (43.7%)	10/18 (55.5%)	2/8 (25%)	
Recurrent Stress		–	6	15	

[a] Incidence: number of new cases occurring in each wave and within two years.
[b] Returned to a non-depression cut-off score: students who were above cutoff in a wave and in the following wave returned to a level below cutoff.

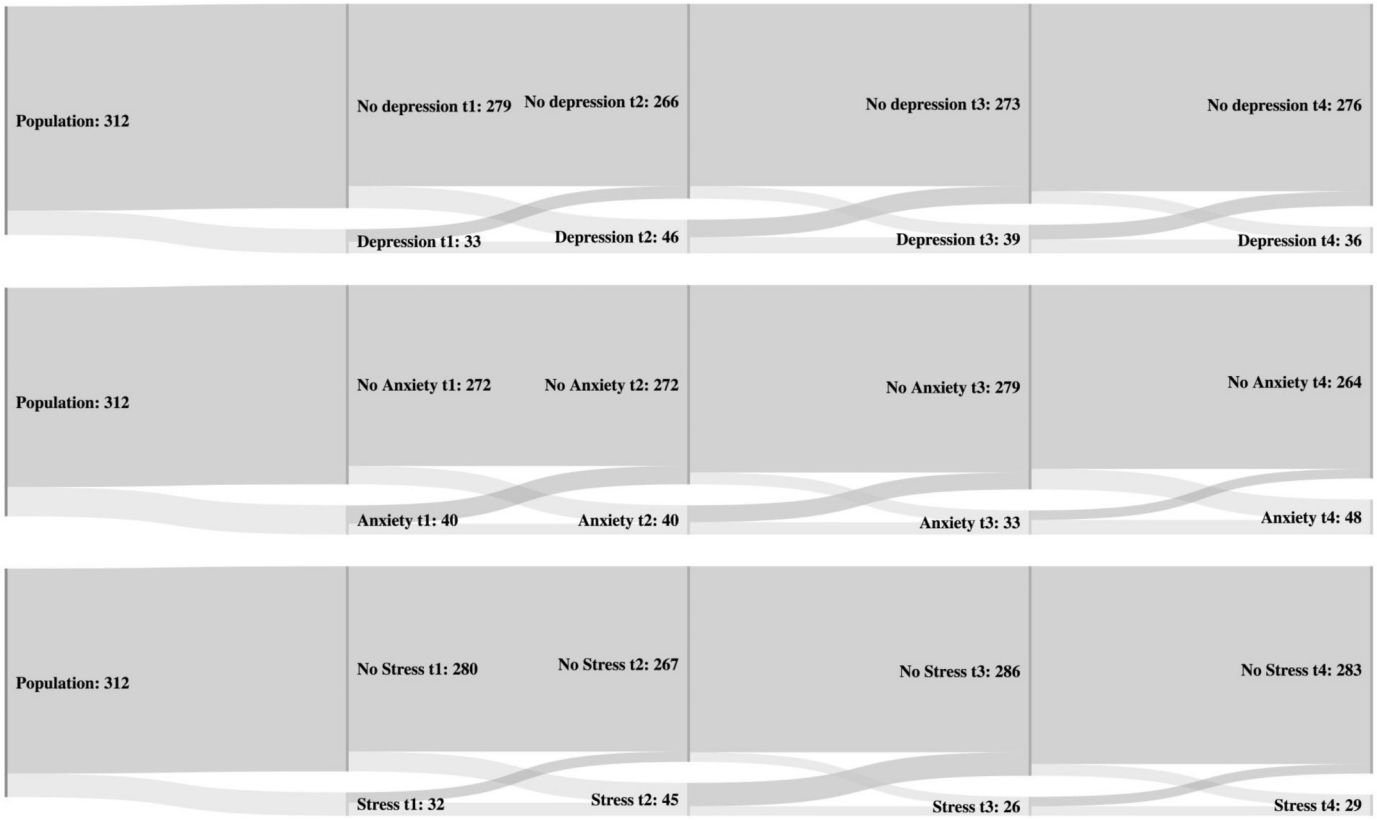

Fig. 1. Alluvial graph showing the patterns and cyclic characteristic of students' mental health problems.

symptomology while others show a decrease, as we can see more clearly in the alluvial graph.

In relation to incidence, it is troubling that more than 150 new cases of mental disturbances were identified over the two years, with our levels of incidence being similar to a previous study conducted in Holland (Borst et al., 2016), even though they were less than in an older American study (Clark et al., 1988). As highlighted in the introduction, there is a dearth of studies that have specifically evaluated incidence. This occurs because it is challenging to follow the same population of students through all waves to obtain incidence, which, in turn, depends on a good response rate. Thus, studies, even longitudinal ones, tend to only describe the prevalence among waves or even define prevalence as

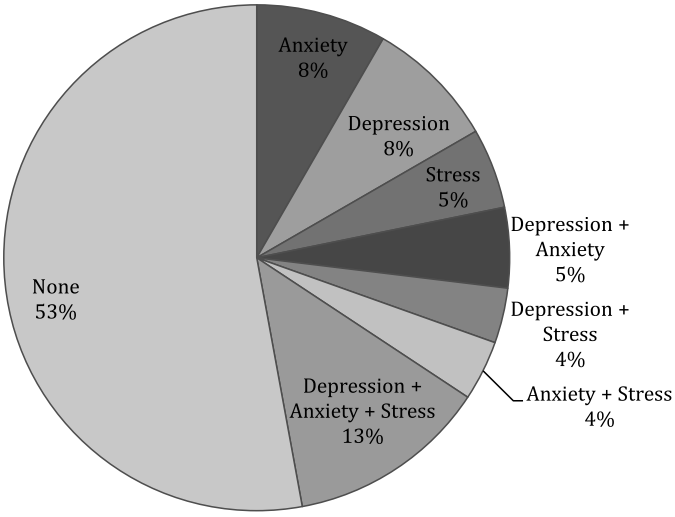

Fig. 2. Overlapping between mental health disorders among medical students considering all waves.

Table 3
Stepwise Linear regression showing the factors associated with mental health, quality of life and "Satisfaction being a doctor" after two years of follow-up.

	Beta	95.0% CI		*p*
DASS Stress at wave 4[a]				
DASS Stress at wave 1	0,36	0,244	0,521	**<0.001**
Year of medical training	−0,122	−0,457	−0,042	**0,018**
DASS Anxiety at wave 1	0,132	0,002	0,366	**0,047**
DASS Anxiety at wave 4[b]				
DASS Stress at wave 1	0,434	0,368	0,591	**<0.001**
Year of medical training	−0,133	−0,378	−0,051	**0,01**
DASS Depression at wave 4[c]				
DASS Anxiety at wave 1	0,256	0,152	0,432	**<0.001**
DASS Depression at wave 1	0,219	0,094	0,339	**0,001**
Year of medical training at wave 1	−0,117	−0,371	−0,02	**0,029**
WHOQOL Physical at wave 4[d]				
DASS Stress at wave 1	−0,168	−0,041	−0,004	**0,018**
DASS Anxiety at wave 1	−0,187	−0,057	−0,009	**0,008**
Female gender	−0,113	−0,275	−0,006	**0,04**
WHOQOL Psychological at wave 4[e]				
DASS Depression at wave 1	−0,24	−0,048	−0,015	**<0.001**
DASS Stress at wave 1	−0,178	−0,035	−0,006	**0,006**
Income at wave 1	0,142	0,018	0,125	**0,008**
WHOQOL Social at wave 4[f]				
DASS Depression at wave 1	−0,236	−0,067	−0,024	**<0.001**
WHOQOL Environment at wave 4[g]				
DASS Stress at wave 1	−0,205	−0,042	−0,01	**0,001**
Income at wave 1	0,268	0,09	0,207	**<0.001**
DASS Depression at wave 1	−0,151	−0,04	−0,004	**0,018**
White ethnicity at wave 1	0,106	0,001	0,26	**0,049**
Satisfaction being a doctor at wave 4[h]				
DASS Depression at wave 1	−0,26	−0,03	−0,075	**<0.001**

[a] $R = 0.470$, R-Square = 0.221, Adjusted R-Square = 0.213.
[b] $R = 0.463$, R-Square = 0.214, Adjusted R-Square = 0.209.
[c] $R = 0.430$, R-Square = 0.185, Adjusted R-Square = 0.176.
[d] $R = 0.352$, R-Square = 0.124, Adjusted R-Square = 0.115.
[e] $R = 0.392$, R-Square = 0.154, Adjusted R-Square = 0.145.
[f] $R = 0.236$, R-Square = 0.056, Adjusted R-Square = 0.052.
[g] $R = 0.432$, R-Square = 0.186, Adjusted R-Square = 0.175.
[h] $R = 0.260$, R-Square = 0.068, Adjusted R-Square = 0.065.

a synonym of incidence (Cuttilan et al., 2016; Macedo et al., 2009). Our study stands out because it has obtained incidence data, seeking to understand how many students without previous symptoms come to have them over the course of medical training, data which can help the development of preventive strategies.

In relation to the predictive factors for mental health after two years, having a mental health problem in the first wave was strongly associated with future outcomes. These findings are supported by scientific literature and are expected, since those having problems tend to maintain their condition or suffer treatment relapses (Goel et al., 2016; Guthrie et al., 1998; Niemi and Vainiomäki, 2006). The lack of social support and having personality traits of low self-control and low emotional resilience tend to foretell the retention of emotional disturbances (Bore et al., 2016). Thus, early identification of mental health problems should be encouraged in medical schools, as the majority of students with depression tend to maintain this symptomology over the two years (Silva et al., 2017).

Another important factor was that being in the earlier stages of medical training was associated with future mental health problems. These results are compatible with previous international studies (Quince et al., 2012; Walkiewicz et al., 2012; Yusoff et al., 2011) and are accounted for by the fact that some students had already demonstrated mental health problems when entering medical school; that other students are far from home and have no social support; and also by great interpersonal competition and heavy course load (Tempski et al., 2012). In this sense, educators should help medical students develop strategies for coping, adapting, administering stressors, and facilitating peer support networks (Yusoff et al., 2011).

In relation to the quality of life, despite the strong predictive risk of having a mental health problem in the first wave, other important factors were associated with poor quality of life in the follow-up, such as income level and being female and non-white. In the case of being female, other studies have shown the relationship between gender and physical quality of life (Aboalshamat et al., 2015; Puthran et al., 2016), which can be accounted for by the fact that women tend to exercise less (Shareef et al., 2015) than men, in spite of there being no consensus for that explanation in scientific literature. Being non-white has been associated with poor environmental quality of life, possibly because minorities are seen as being more negatively affected by medical school, possibly due to racial prejudice and different cultural expectations that can create a feeling of isolation and loss of QoL (Dyrbye et al., 2007).

Income also influenced emotional and environmental quality of life, a result supported by the scientific literature and probably justified by the fact that lower economic status generates more stress and that low income individuals are more commonly members of minorities (Dyrbye et al., 2007). Our school has only had ethnic-racial quotas for fifteen years and there are expectations that inclusion will foster a change in racial minorities' symptoms, which still do not have well-defined causes. These results point to the fact that, in relation to the quality of life, socioeconomic factors can have greater importance than the stage of medical training itself. Educators and educational administrators should dedicate themselves to facilitating integration and support among peers, as well as financial counseling, improving the educational environment to favor these students remaining in medical school.

Finally, higher scores for depression have been associated with satisfaction with being a doctor after two years, showing the repercussion that an emotional problem can have on satisfaction with the medical career. The course's very nature can lead to great frustration due to stress and the loss of quality of life and a "disenchantment" with such a sought-after profession (Pacheco et al., 2017). All of these factors can be taken into consideration and seem to influence the relationship between medical students and well-being.

This study has some limitations that need to be pointed out. It was conducted at a single Brazilian medical school. Thus, more studies should be conducted to increase the data's general applicability. Furthermore, this study used instruments to evaluate symptomology related to mental health problems via cut-off scores. Despite there being great correlation of these instruments with the diagnosis (Vignola and Tucci, 2014), these conditions were not diagnosed by psychiatrists, which could be considered the gold-standard for the diagnosis. Another limitation is the fact that we did not have information concerning the previous history of mental illness among these students, which may potentially have an influence on the results. Finally, our response rate

for all four waves was 54%. A possible criticism would be that students with poor mental health did not respond to the questionnaires because they were absent from classes or did not wish to reveal their problems. Nevertheless, to minimize this potential problem, we compared students who responded to the research in the four waves (312) with those who did not (263) and found no significant differences in terms of mental health and quality of life, results compatible with those of a previous study (Guthrie et al., 1998). Nevertheless, there were differences concerning age, gender, and the grade between groups. Therefore the respondents may not fully represent our medical school's population.

Despite these limitations, a strength this study has is the fact that students were followed for two years (semester by semester), thus allowing us to evaluate the incidence and verify the cyclical nature of mental health problems, aspects rarely evaluated in the scientific literature. This allowed for identification of predictive factors that can serve as the basis for future interventions in this field of research.

In conclusion, our results suggest that medical students have high levels of depressive symptoms, anxiety, and stress during medical school, with an elevated incidence and a cyclical pattern. Factors measured at the baseline, such as mental health, stage of medical training, being female, having low income, and being non-white were associated with poorer scores for mental health and quality of life in the follow-up. Our data calls educators' attention to the need to seek out strategies for improving medical students' mental health and quality of life, as well as methods that can help them face factors which unleash stress, anxiety, and depression, and search for ways to live better during medical school.

Declaration of interest

None.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.psychres.2019.02.041.

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