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ORIGINAL RESEARCH

Mental Health of Medical Students Before and During COVID-19 Pandemic: a 3-Year Prospective Study

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Abstract

Background Very few studies prospectively analyzed medical students' mental health before and during the COVID-19 pandemic. This study aimed to prospectively evaluate mental health in medical students in 2018, 2019, and 2020 during the COVID-19 pandemic lockdown.

Methods All students from first to fourth year were invited to participate in 2018. These students were also invited to participate in the same period in 2019 and 2020 (during the peak of the COVID-19 lockdown). The Self-Reporting Questionnaire (SRQ-20), created by the WHO to investigate 20 nonpsychotic psychiatric symptoms, was used to evaluate common mental disorders. The cut-off for relevant symptom severity for mental distress is seven (SRQ-20 ≥ 7).

Results In the years 2018, 2019, and 2020, a total of 860 SRQ-20 questionnaires were completed. Overall, mean SRQ-20 scores were 8.2 ± 4.6, and SRQ-20 ≥ 7 frequency was 60.5%. When comparing the years 2018, 2019, and 2020, no differences were found for either SRQ-20 scores (8.4 ± 4.7, 8.2 ± 4.6, and 7.8 ± 4.4, respectively; $p = 0.351$) or SRQ-20 ≥ 7 frequency (62.2%, 60.9%, and 59.2%, respectively; $p = 0.762$).

Conclusion In contrast to our initial hypothesis, stable results on mental health measures were found even during the 2020 COVID-19 lockdown. Maintenance of daily routines through distance learning and the continuation of adapted clerkship activities with strict safety measures could have contributed to these results. However, this study points to high overall levels of common mental disorders, especially among women. Further studies should be conducted to understand all the factors responsible for such stability, such as social and economic support, resilience, or even previous high levels of common mental disorders.

Keywords Prospective · Medical students · COVID-19 · Distance learning · Mental health

Introduction

Mental health problems are highly prevalent among medical students [1–3]. Due to the COVID-19 pandemic, governments implemented strict measures with social distancing and temporary closure of schools and universities. Several teaching institutions were able to adapt to the new situation, and their content-based classes started to be offered remotely. Medical schools often had to suspend patient-facing activities in the first months of quarantine. However, a few medical schools maintained clerkship activities with enhanced safety measures, such as patient interaction within smaller groups, protective clothing and equipment, and avoidance of direct contact with confirmed positive COVID-19 patients.

So far, very few studies have analyzed medical students' mental health during the COVID-19 pandemic, especially using prospectively collected data, and results differ. For example, one study identified increased mental suffering [4], whereas another found an improvement [5]. Moreover, both studies were conducted comparing data collected over a short period – less than a year.

Few prospective studies compared mental health measures before and during the COVID-19 pandemic lockdown

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with different groups other than medical students. For example, a large survey from the UK Household Longitudinal Study (UKHLS) assessed the mental health of individuals before and during the COVID-19 pandemic lockdown [6]. Mental health in the UK had deteriorated compared with pre-COVID-19 trends, especially among women, young people, and those with preschool-aged children. However, there seemed to be no increase in mental suffering in other groups, for instance, the unemployed or other economically inactive individuals such as full-time students. Another prospective study compared individuals with anxiety, depression, and obsessive–compulsive disorders to individuals without psychiatric disorders through the 16-item Quick Inventory of Depressive Symptoms (QIDS); the 21-item Beck Anxiety Inventory (BAI); the 11-item Penn State Worry Questionnaire (PSWQ); and the six-item De Jong Gierveld Loneliness Scale (DJGLS). People without previous depressive, anxiety, and obsessive–compulsive disorders showed a greater increase in symptoms during the COVID-19 pandemic lockdown. In contrast, individuals with the most significant burden on their mental health tended to show a slight symptom decrease [7].

Medical students are a specific group among undergraduate students because they are in close contact with changes in health care systems, such as those that occurred during the COVID-19 pandemic in 2020, and often have high levels of mental distress [1–3]. Our hypothesis was that mental disorders would worsen during the beginning of the COVID-19 pandemic considering social activities were diminished by that time. This survey aimed to evaluate mental disorders in medical students along college years. As the COVID-19 pandemic got the world by surprise, we saw an opportunity to evaluate mental disorders during strict lockdown. Considering that the COVID-19 pandemic caused several changes in daily routines, it is very likely that study routines and interpersonal relationships suffered due to these changes. In addition, social isolation and loneliness have frequently been associated with depression [8] and, in conjunction with stress and worries caused by the pandemic, could have affected and deteriorated medical students' mental health. Thus, this study aimed to prospectively investigate medical students' mental health in 2018, 2019, and 2020 during the COVID-19 pandemic lockdown.

Methods

Study Design

This is a comparative analysis of 3-year prospective medical student mental health evaluation before and during the COVID-19 pandemic. All students from first to fourth year ($n = 440$) of Jundiai Medical School were invited to participate in 2018 (between August and October). These students were also invited to participate in the same period in 2019 (between August and October) when they were in second to fifth year, respectively, and in 2020 from April to June (during early the COVID-19 pandemic lockdown), when they were in the third to the sixth year, respectively. All SRQ-20 answers from the first- to the fourth-year students in 2018 were compared with their SRQ-20 answers in 2019 and 2020, when they were in the second to fifth year and the third to the sixth year, respectively. Each of the 2018 classes (first-, second-, third-, and fourth-year classes) was also analyzed separately along 2019 and 2020. Therefore, the SRQ-20 answers of the 2018 first-year class were compared with their SRQ-20 answers in 2019 and 2020, when they were in the second and third year, respectively. We also conducted a similar analysis of the SRQ-20 answers of the 2018s-year class, the 2018 third-year class, and the 2018 fourth-year class. These analyses were also repeated stratifying by gender.

During 2018 and 2019, the students were contacted in person and via their mobile numbers. In 2020, they were contacted only via their mobile number due to the COVID-19 pandemic lockdown strict social distancing measures. In Brazil, medical school consists of 6 years, with the last 2 years being the clerkship period, which take place within the same institution. Medical school is a full-time course and most Jundiai Medical School students depend economically on a third part during their course, usually their family. The socio-demographics of the student's family are, on average, middle to high income as most medical schools in Brazil [9]. The students who consented entered the study, which was previously approved by the Ethics Committee. The questionnaire was available online through the Google Forms platform and could be accessed via a link sent to all participants. Student participation was entirely voluntary, and individuals were not identifiable in the research.

Data Collection

The questionnaire contained two different sections: sociodemographic information (regarding gender, age, and current year class) and the Self-Reporting Questionnaire (SRQ-20) questionnaire.

Mental distress was evaluated via the Brazilian validated version of SRQ-20 [10]. The World Health Organization developed the SRQ-20 to investigate nonpsychotic psychiatric disorders [11]. The difference between both versions is that SRQ-20 [10] was translated and validated for Brazilian Portuguese. SRQ-20 aims to evaluate symptoms

and screens for common mental disorders. It comprises twenty items that evaluate depressive/anxious and somatic symptoms, reduced vital energy, and depressive thoughts.

The possible answers are yes/no, with each affirmative answer equivalent to one point in the final score. Different studies were conducted with the purpose of evaluating the best cut-off for the SRQ-20. The proposed cut-off point for SRQ-20 varies according to the population studied [12–15]. The cut-off point for relevant symptom severity for common mental disorders of the present survey was set at a score of seven/eight based on a Brazilian validation study with 960 individuals [10].

Statistical Analysis

The statistical analysis of obtained data was performed on SPSS version 21. Descriptive statistics were used to describe frequencies, gender, and age. Ordinal data was analyzed using the chi-squared test. Continuous variables were analyzed using the Kruskal–Wallis test for gender differences or the ANOVA, and post hoc tests were used to identify differences among the groups. The analysis considered average scores for the entire sample in 2018, 2019, and 2020 as well as average scores for each class year across the 3 years. The adopted significance level was $P < 0.05$. SRQ-20 sub-items were analyzed using multiple comparisons and corrected by Bonferroni test ($P < 0.0025$).

Results

In the year of 2018, a total of 361 (82.0% of the sample) questionnaires were obtained from the first- to fourth-year classes (105, 93, 95, 68, respectively). In the year of 2019, a total of 248 (56.3% of the sample) questionnaires were obtained from the second- to the fifth-year classes (65, 77, 78, 28, respectively). In the year of 2020 (during the beginning of COVID-19 pandemic lockdown), a total of 250 (56.8% of the sample) questionnaires were obtained from the third- to the sixth-year classes (75, 54, 43, 78, respectively).

Regarding the combined results across the 3 years, the mean age was 22.6 ± 3.7 years old, and 64.3% were women. SRQ-20 mean scores were 8.2 ± 4.6, and the proportion of SRQ-20 ≥ 7 (above the cut-off for relevant symptom severity) was 60.5%. Women had higher SRQ-20 scores than men (9.1 ± 4.4 and 6.6 ± 4.6 respectively; $p < 0.001$) and higher SRQ-20 ≥ 7 frequencies than men (69.8% and 45.4% respectively; $p < 0.001$).

When comparing the results of the entire sample collected in 2018, 2019, and 2020, no differences were found for either SRQ-20 scores (8.4 ± 4.7, 8.2 ± 4.6, and 7.8 ± 4.4, respectively; $p = 0.351$) or SRQ-20 ≥ 7 frequencies (62.2%, 60.9%, and 59.2%, respectively; $p = 0.762$). The mean age and gender distribution in each class year in 2018, 2019, and 2020 are presented in Table 1.

The analysis of SRQ-20 sub-items showed no differences along 2018, 2019, and 2020 for almost all subitems as follows: "feel nervous, tense or worried" ($p = 0.985$),

Table 1 – Age and gender distribution of each year class in 2018, 2019, and 2020 during COVID-19 pandemic lockdown

		2018	2019	2020
2018 first-year class	**Age (years), mean ± SD**	19.9 ± 1.5	21.4 ± 1.7	21.7 ± 1.7
	N	105	65	75
	Women, *n* (%)	77 (73.3%)	46 (70.8%)	60 (80.0%)
	Men, *n* (%)	28 (26.6%)	19 (29.2%)	15 (2.0%)
2018s-year class	**Age (years), mean ± SD**	20.3 ± 1.5	22.8 ± 3.5	23.3 ± 2.6
	N	93	77	54
	Women, *n* (%)	55 (59.1%)	45 (58.4%)	36 (66.7%)
	Men, *n* (%)	38 (40.8%)	32 (41.5%)	18 (33.3%)
2018 third-year class	**Age (years), mean ± SD**	22.6 ± 2.1	23.5 ± 2.0	24.1 ± 1.7
	N	95	78	43
	Women, *n* (%)	50 (52.1%)	41 (52.6%)	30 (69.8%)
	Men, *n* (%)	45 (47.3%)	37 (47.4%)	13 (30.2%)
2018 fourth-year class	***N***	68	28	78
	Age (years), mean ± SD	23.4 ± 1.9	25.0 ± 2.3	25.1 ± 2.0
	Women, *n* (%)	43 (63.2%)	18 (64.3%)	52 (66.7%)
	Men, *n* (%)	25 (36.7%)	10 (35.7%)	26 (33.3%)

SD standard deviation, *Age* expressed as mean ± SD, *N* number of responses, *Women* total of women that participated in the study (expressed as total number of participants and percentage), *Men* total of men that participated in the study (expressed as total number of participants and percentage)

"easily frightened" ($p=0.304$), "feel unhappy" ($p=0.773$), "cry more than usual" ($p=0.115$), "often have headaches" ($p=0.916$), "sleep badly" ($p=0.037$), "uncomfortable feelings in the stomach" ($p=0.772$), "poor digestion" ($p=0.740$), "poor appetite" ($p=0.016$), "hands shake" ($p=0.381$), "easily tired" ($p=0.614$), "difficult to make decisions" ($p=0.819$), "difficult to enjoy your daily activities" ($p=0.473$), "daily work suffering" ($p=0.257$), "trouble thinking clearly" ($p=0.114$), "unable to play a useful part" ($p=0.928$), "lost interest in things" ($p=0.083$), "thought of ending your life" ($p=0.046$), and "feel that you are a worthless person"($p=0.934$). Differences were found only for the sub-item "feel tired all the time" ($p<0.001$), which decreased in 2020: 2018 (73.2%), 2019 (73.4%), and 2020 (56.0%).

When stratifying by gender for men, no differences were found among years for either SRQ-20 scores ($p=0.995$) or SRQ-20 ≥ 7 frequencies ($p=0.437$). For women, a difference in SRQ-20 scores was found among years ($p=0.040$), and post hoc analyses identified a decrease from 2018 to 2020 (9.6 ± 4.3 and 8.6 ± 4.3 respectively; $p=0.026$). A decrease in SRQ-20 ≥ 7 frequencies was also found in the female group (75.6%, 70.5%, and 64.4%, respectively; $p=0.029$).

When analyzing each class year across the 3-year data collection period, a few improvements were found in the results and are described below. Table 2 and Fig. 1 show data for both SRQ-20 scores and SRQ-20 ≥ 7 frequencies across 2018, 2019, and 2020.

For the 2018 first-year class, no changes were found in SRQ-20 scores ($p=0.568$) or in SRQ-20 ≥ 7 frequencies ($p=0.502$) when comparing data of 2018 – when they were in the first year, data of 2019 – when they were in the second year, and data of 2020 – when they were in third year. Considering the lower rate of response in 2019, we also compared 2018 with 2020 separately, and no differences were found for SRQ-20 scores ($p=0.504$) or SRQ-20 ≥ 7 frequencies ($p=0.415$). When stratifying by gender, no differences in both SRQ-20 total scores ($p=0.890$) and SRQ-20 ≥ 7 frequencies ($p=0.803$) were found for women. There was a difference for the male group in SRQ-20 scores ($p=0.024$), and post hoc analysis identified a decrease in SRQ-20 scores from 2019 to 2020 ($p=0.013$), but no difference was found for SRQ-20 ≥ 7 frequencies ($p=0.102$).

For the 2018s-year class, no changes were found in SRQ-20 scores ($p=0.620$) or in SRQ-20 ≥ 7 frequencies ($p=0.812$) in 2018, 2019, and 2020. When stratifying by gender, no difference in both SRQ-20 scores ($p=0.425$) and SRQ-20 ≥ 7 frequencies ($p=0.082$) was found for men. For women, no differences were found in SRQ-20 scores ($p=0.083$), but there was a decrease in SRQ-20 ≥ 7 frequencies (80.0%, 66.7%, 55.6%; $p=0.043$).

For the 2018 third-year class, no changes were found in SRQ-20 scores ($p=0.491$) or in SRQ-20 ≥ 7 frequencies ($p=0.782$) in 2018, 2019, and 2020 – during their internship. When stratifying by gender, no differences for both SRQ-20 scores ($p=0.408$) and SRQ-20 ≥ 7 frequencies ($p=0.399$) were found for men. For women, differences were found in SRQ-20 scores (9.7 ± 4.6, 9.5 ± 4.7, 6.8 ± 4.7; $p=0.018$), and post hoc analysis identified a decrease in SRQ-20 scores ($p=0.016$), from 2018 to 2020. Differences were also found for SRQ-20 ≥ 7 frequencies (74.0%, 75.6%, 50.5%; $p=0.040$).

Finally, for the 2018 fourth-year class, no changes were found in SRQ-20 scores ($p=0.318$) or in SRQ-20 ≥ 7 frequencies ($p=0.258$) in 2018, and in 2019 or 2020 – during their internship. Considering the lower response rate in 2019, we also analyzed data from 2018 and 2020 separately and no differences were found for SRQ-20 scores ($p=0.644$) or SRQ-20 ≥ 7 frequencies ($p=0.503$). When stratifying by gender, no differences were found in SRQ-20 scores ($p=0.476$ and $p=0.790$) and in SRQ-20 ≥ 7 frequencies ($p=0.796$ and $p=0.334$) for both men and women.

Table 2 Self-Reporting Questionnaire-20 results in 2018, 2019, and 2020 during COVID-19 pandemic lockdown

		2018 ($n=361$)	2019 ($n=248$)	2020 ($n=250$)	*P*
2018 first-year class	**SRQ-20 total score, mean ± SD**	9.1 ± 1.7	9.5 ± 4.3	8.6 ± 4.5	0.568[a]
	SRQ-20 ≥ 7	66.7%	72.3%	64.0%	0.502[b]
2018s-year class	**SRQ-20 total score, mean ± SD**	8.7 ± 4.7	8.7 ± 4.5	8.1 ± 4.6	0.620[a]
	SRQ-20 ≥ 7	65.6%	66.2%	61.1%	0.812[b]
2018 third-year class	**SRQ-20 total score, mean ± SD**	7.7 ± 5.1	7.2 ± 4.9	6.6 ± 4.7	0.490[a]
	SRQ-20 ≥ 7	55.2%	52.6%	48.8%	0.782[b]
2018 fourth-year class	**SRQ-20 total score, mean ± SD**	8.0 ± 4.3	6.8 ± 4.4	7.7 ± 4.0	0.318[a]
	SRQ-20 ≥ 7	60.3%	42.9%	59.0%	0.258[b]

N number of responses, *SD* standard deviation, *SRQ-20* Self-Reporting Questionnaire expressed as mean ± SD, *SRQ-20 ≥ 7* expressed as a total number of participants and percentage., *P* significance level. For this study $p<0.05$

[a]ANOVA; [b]chi-squared tesT

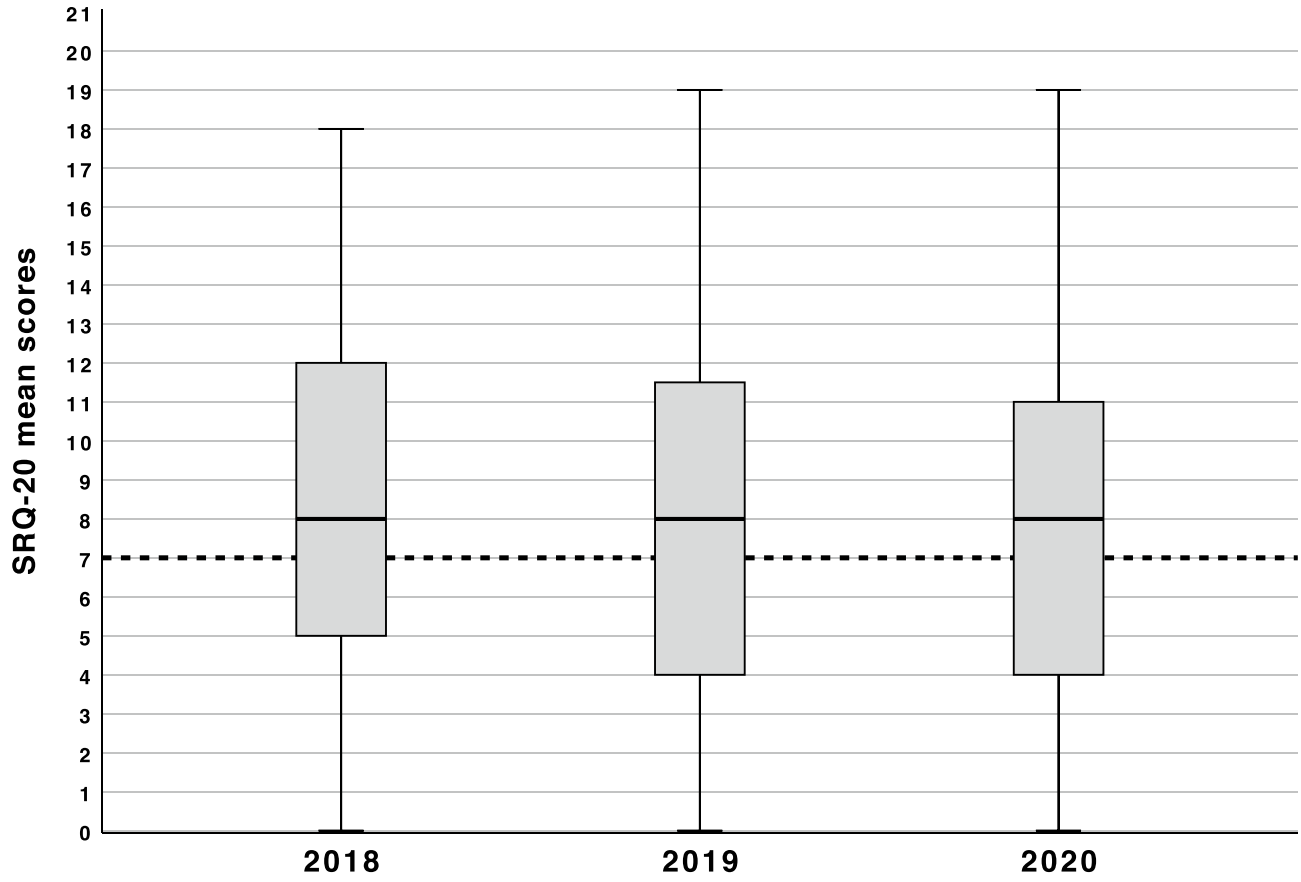

Fig. 1 Self-Reporting Questionnaire-20 mean scores in 2018, 2019, and 2020 cohorts

Discussion

In this 3-year prospective study on the mental health of medical students, we analyzed 860 surveys. Across the years of 2018, 2019, and 2020 during the first months of the COVID-19 pandemic lockdown when strict social distancing measures were implemented, we found stable scores on the SRQ-20. This is a World Health Organization measure of mental health screening tool comprising 20 items. Moreover, we found a slight improvement in subgroups, such as among women. Also, to our knowledge, this is the first 3-year prospective study comparing mental health before and during the COVID-19 pandemic in medical students. However, despite the observed stability or even improvement in symptom severity, when considering data from all surveys, the mean prevalence of SRQ-20 scores above the cut-off point for relevant severity of common mental disorders was high (60.5%). Another survey conducted on the same institution in 2020 compared data from all school years, and SRQ-20 results were similar to our results in 2018, with the worst results in the first-year class [16].

This study was designed to evaluate all students from pre-clinical and clinical years in 2018 and follow their mental health status over the years, including those who started their clerkship, which is usually completed at the same institution in Brazil. Consequently, it was easier to compare results since few respondents were lost in most studied subgroups. Overall, according to the data, the prevalence of common mental disorders among medical students did not change over the years nor during the COVID-19 pandemic lockdown. Few studies prospectively collected data on mental health before and during the COVID-19 pandemic, especially in undergraduate students. The only prospective study with undergraduate medical students published so far analyzed a smaller sample of 217 students in India, where strict lockdown was implemented in March 2020. It assessed depression, anxiety, and stress levels through Depression Anxiety Stress Scale 2 Items, measured 6 months apart, in December 2019 and June 2020, during early the COVID-19

pandemic [4]. In contrast with our findings, an increase in anxiety and stress levels was found; depression levels, however, remained unchanged, in accordance with results from the present study. Even though it is hardly debatable that COVID-19 quarantine can exert a profound impact on mental health, some subgroups seem to cope better with this scenario, and this might explain the lack of significant change in some of the measures used. Similar to our findings, a large survey from the UK Household Longitudinal Study (UKHLS) through a different mental disorders screening measure, the 12-item General Health Questionnaire (GHQ-12) [6], assessed the mental health of individuals before and during early COVID-19 pandemic lockdown [6] and found no increase in mental suffering in certain groups including unemployed or other economically inactive individuals such as full-time students. Stability in mental health measurements was found in both our sample and the full-time students of the UKHLS study, although there might be differences in economic and employment status between the two groups.

However, it is important to mention that in this UK household study [6], some subgroups had an increase in mental suffering, especially women, adolescents, young adults, and families with preschool-aged children. Considering the entire sample, female medical students had stable SRQ-20 scores ($p = 0.083$) in our study. The post hoc analysis demonstrated a slight improvement (a decrease in SRQ-20 scores) from 2018 to 2020 ($p = 0.049$); the same was observed for scores above cut-off (SRQ-20 ≥ 7) in the years 2018, 2019, and 2020 (75.6%, 70.5%, and 64.4%, respectively; $p = 0.029$). Women from our study had higher SRQ-20 scores than men ($p < 0.001$), and both genders had high mean SRQ-20 scores before the COVID-19 pandemic. We hypothesize that the more consistent improvement observed in women can be linked both to higher previous scores – in which proportional differences are more easily measured or, perhaps more importantly, to positive daily life changes, despite the stress brought by the pandemic. For example, during the COVID-19 pandemic, many students were able to maintain online learning and had more free time or were able to study on-demand, at their own pace as many classes were recorded. Other factors could be less social pressure by peers or the possibility to go back to their families' home and study from there. These changes might have had a more positive impact on women; however, further investigation is needed. Finally, another possibility is that the SRQ-20 evaluates symptoms that are more common in women, and therefore their improvement is also more easily measured in this gender. Perhaps if we had used a scale more focused on men's mental health issues more changes in their gender could be observed.

When considering each class separately, there was no worsening in mental health; on the contrary, in some subgroups, improvements were found both for men and women. There is no clear explanation for these results, and they contradict our initial hypothesis. One possible explanation is that our students already had high levels of common mental disorders before the pandemic. These levels were still high during quarantine, consistent with findings from another cross-sectional study of medical students during the COVID-19 quarantine [17]. The high levels of common mental disorders could result in a "ceiling effect," such that statistical analyses could only detect differences for decreases in SRQ-20 scores. All sub-items that compose SRQ-20 had stability among years, except for an improvement in "feel tired all the time," which can be related with social distance measures and less daily activities. Although using another questionnaire, the stability of measures of mental distress for some groups was observed in the UK Household Longitudinal Study [6]. As stated by the authors, they did not find a significant additional independent increase in an individual's change in mental distress because of the COVID-19 pandemic compared to other pre-existing characteristics. These characteristics included being an ethnic minority, living without a partner, being a key worker, being unemployed, living in an urban area, or having a pre-existing health condition that would put a person at greater risk of infection with COVID-19. For these categories, pre-pandemic mental health inequalities were maintained, but these had not significantly increased by the end of the first month of the lockdown period. Moreover, unchanged levels of mental suffering were also observed in the 2011 H1N1 epidemic in China; in this survey using the same SRQ-20 scale as our study, no difference was found for both quarantined and non-quarantined undergraduate students [18].

It is important to analyze different results, especially because the SRQ-20 is a screening tool for common mental disorders. Unlike our results, a 5-month longitudinal survey conducted with 555 college students in China found an increase in anxiety and depressive symptoms during the COVID-19 outbreak through the 10-item Positive and Negative Affect Schedule (PANAS) and the 4-item Patient Health Questionnaire (PHQ-4) [19]. One possible explanation is that a different undergraduate student population was studied, and no medical students were included. Moreover, all students were confined during the quarantine in question. In our sample, students were able to attend remote learning and during clerkships most of the students were able to maintain their activities, despite some limitations due to safety measures. Perhaps this may indicate that students can be more resilient by maintaining some academic activities in an alternative learning schedule. In concordance with our results, a cross-sectional Chinese study with 56,679 participants from different regions during the COVID-19 quarantine found that maintaining work-related activities was associated with lower risks of depression (adjusted OR,

0.85), anxiety (adjusted OR, 0.92), and insomnia (adjusted OR, 0.87) through the Patient Health Questionnaire-9, Generalized Anxiety Disorder-7, Insomnia Severity Index, and Acute Stress Disorder Scale [20]. On the other hand, for individuals with pre-existing mood disorders, less stable daily routines were associated with higher levels of depression in bivariate analyses through the [21]. Perhaps students who can maintain at least part of their routines or have no formal financial obligations to others may not feel a relevant impact on mental health during quarantine periods. This was the case for most students from our study.

Another contributing factor for stability on common mental disorders measures might be that distance learning can favorably affect mental health, at least for some medical students. In one of the few prospective studies available, conducted with 798 first-year through fifth-year medical students in Kazakhstan, online learning due to the COVID-19 pandemic was compared with traditional learning 6 months before through different scales such as the Copenhagen Burnout Inventory (CBI-S), Patient Health Questionnaire-9 (PHQ-9), Generalized Anxiety Disorder, the 7-item (GAD-7), and the Patient Health Questionnaire-15 (PHQ-15) scale [5]. An improvement in mental health was found, with lower rates of depression, anxiety, and burnout. Further examination is needed regarding causative effects, but the authors argue that the ability to combine academic with personal and family life may have had a positive effect in that group. Even so, it is not possible to confirm that distance learning will benefit students' mental health and more studies should be conducted to compare distance learning and mental health.

Even before COVID-19, aspects of medical education had begun to migrate online. Many medical students already watch recorded lectures at home and supplement their learning with online resources [22]. However, many curricula integrate evidence-based strategies to enhance learning, such as team-based exercises, interactive clinical cases, and real-time quizzing. In contrast to lectures, these other forms of pedagogy traditionally required in-person class time. Therefore, distance learning has a lot to improve to have similar benefits as traditional learning. Moreover, some aspects of medical education do not easily translate online, such as learning how to perform a physical exam [22]. Interestingly, as social distancing is pressed to the use of new pedagogical approaches, some may outlast COVID-19 and become a standard part of medical education. With better video conferencing tools, traveling physicians will be able to participate in department grand rounds, residents and fellows at different clinical sites can have conferences together, and students can remediate missed content due to illness. Bringing more formative assessments online will also empower educators to implement more periodic testing than they have been in person. Finally, social distancing may have forced us to rethink and restructure medical education, but we might be generating tools to connect, innovate, and educate that will improve medicine now and in the future [22].

Stability in mental health statistics during the COVID-19 pandemic lockdown was also found in other study populations. The Dutch 2-year longitudinal population-based LISS study measured anxiety and depression in 3983 adults, and no difference was found among years through the 5-item Mental Health Index or Inventory (MHI-5) [23]. Another prospective study assessed psychiatric symptoms through the 9-item short version of the Antonovsky scales and Mini-Symptom Checklist, in February 2020 (before COVID-19) and in March 2020 (after the COVID-19 outbreak) in a German-speaking sample of 1591 participants, and found that most of the sample (82%) remained stable [24]. The elderly population that participated in ELSA-Brasil São Paulo study center, a cohort trial from Brazil that used the Clinical Interview Scheduled-Revised (CIS-R) and the Depression Anxiety Stress Scale-21 (DASS-21), had similar results and showed that psychiatric symptoms decreased in 2020. No correlation was found between the pandemic and worsening physiologic symptoms [25].

There are several studies underway evaluating mental health during the COVID-19 pandemic. Medical students are unique particularly as they have contact with the disease, directly or through colleagues, on top of a very demanding curriculum usually associated with high levels of mental distress. Despite this, there are fewer studies on the mental health of medical students. However, a cross-sectional study done with medical students in China during the COVID-19 pandemic lockdown (in February 2020) through the Patient Generalized Anxiety Disorder-7 and the Health Questionnaire-9 established high levels of anxiety and depressive symptoms, and females were more likely to be depressed than men [17]. Those studies had their data collected during the first semester of 2020 and it is known that the COVID-19 pandemic is still a globally public health problem. A systematic review analyzed the long-term effects of COVID-19 on mental health and the conclusions showed none or mild increase in anxiety and depression rates [26]. Even with these results, it is necessary to evaluate other aspects of mental health and continue to conduct research among different populations once the coronavirus is still causing restrictions all over the world.

Despite its intriguing results, the present study has some limitations that must be taken into account. First, during data collection, a few subgroups could be underrepresented. Another limitation is that our data was collected using a self-reported instrument that relies heavily on each participant's interpretation of the questions and their level of self-knowledge. Nevertheless, self-reported instruments are widely used in research, and our WHO

instrument, the SRQ-20, is validated for use in Brazilian Portuguese [27]. It has been widely used, including in studies on mental health during the COVID-19 quarantine [28]. A very important point is that SRQ-20 is a screening tool for common mental disorders and does not give any diagnostic findings, which makes it difficult to compare with other studies that used other mental health instruments. It comprises twenty items that include anxiety and depression symptoms and that favors the possibility of comparing with different studies, even though they used different scales. It is also crucial to consider that 2020 data was collected during a specific 3-month period (from April until June 2020) at the beginning of the COVID-19 pandemic, and that this may change over time, especially because the COVID-19 pandemic is still going on. It is crucial to emphasize that our results represent only the beginning of the COVID-19 pandemic and that the longer this disease is present in our society, the common mental disorders might change over time and again, we accentuate the need for further mental health prospective studies. The students were going through different school grades, such as the third- and fourth-year classes that were on distance learning and the fifth- and sixth-year classes that were having in-person activities and studying for residency programs exams. For both differences on lockdown, the workload was diminished and this could be impacted on the results, once part of the group was living in social distance and the other part was having contact with other people and even with patients contaminated with the coronavirus. This could have impacted on the results and more studies should be done to be able to draw conclusions. Moreover, our sample might not be representative of the entire academic student population. Unfortunately, because the forms were anonymous, we could not assess socio-demographic and clinical information of those who did not respond to compare it with data from students included in the present study. Few prospective studies on student's mental health were published during the 2020, 2021, and 2022 COVID-19 pandemic with contrasting results. No study was conducted with medical students and, moreover, the majority analyzed data collected at the beginning of the 2020 COVID-19 pandemic. Two of those studies had results different from ours: mental health problems and stress increased during the first months of the COVID-19 pandemic [29, 30]. On the other hand, another study made with university students found no clinically significant changes in mental health symptoms, in line with our study [31]. Interestingly, all studies agree on the need for further studies on the subject. Taking all of this into consideration, we emphasize that further studies and meta-analytical analyses should be done to better examine the impacts of the COVID-19 pandemic on mental health among medical students.

Conclusions

This is the first 3-year prospective study on mental health in medical students that has investigated the effects of the COVID-19 pandemic lockdown. The COVID-19 pandemic lockdown caused substantial changes in medical students' daily routines, with social distancing measures directly affecting academic activities. In contradiction to our initial hypothesis, stability in levels of common mental disorders was found when 2018 and 2019 results were compared with 2020 results (during the pandemic lockdown). This outcome proceeded with an alternative learning schedule in both pre-clinical and clinical periods. Students continued academic activities through distance learning and maintained many practical activities in clerkship, despite implemented safety measures including patient interaction in smaller groups, protective clothing and equipment, and avoidance of direct contact with confirmed positive COVID-19 patients. This study may indicate that medical students can be resilient when living through a pandemic such as COVID-19, at least if some academic activities were maintained in an alternative learning schedule. There are still very few prospective studies, which examined a short time period, but some of their findings are in concordance with ours. Further studies should be conducted to understand factors responsible for such stability, such as social and economic support, resilience, or even high levels of previous common mental distress.

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Data Availability The data that support the findings of this study are available from the corresponding author, MBP, upon reasonable request.

Declarations

Ethics Committee Approval This research was approved by the Ethics Committee.

Conflict of Interest The authors declare no competing interests.

References

1. Pacheco JP, Giacomin HT, Tam WW, Ribeiro TB, Arab C, Bezerra IM, et al. Mental health problems among medical students in Brazil: a systematic review and meta-analysis. Brazilian Journal of Psychiatry. 2017;39(4):369–78.
2. Tian-Ci Quek T, Tam W-S, X Tran B, Zhang M, Zhang Z, Su-Hui Ho C, et al. The global prevalence of anxiety among medical students: a meta-analysis. Int J Envi Res Pub Health. 2019;16(15):2735.

3. Rotenstein LS, Ramos MA, Torre M, Segal JB, Peluso MJ, Guille C, et al. Prevalence of depression, depressive symptoms, and suicidal ideation among medical students: a systematic review and meta-analysis. JAMA. 2016;316(21):2214–36.
4. Saraswathi I, Saikarthik J, Kumar KS, Srinivasan KM, Ardhanaari M, Gunapriya R. Impact of COVID-19 outbreak on the mental health status of undergraduate medical students in a COVID-19 treating medical college: a prospective longitudinal study. PeerJ. 2020;8: e10164.
5. Bolatov AK, Seisembekov TZ, Askarova AZ, Baikanova RK, Smailova DS, Fabbro E. Online-learning due to COVID-19 improved mental health among medical students. Med Sci Educ. 2020:1–10.
6. Pierce M, Hope H, Ford T, Hatch S, Hotopf M, John A, et al. Mental health before and during the COVID-19 pandemic: a longitudinal probability sample survey of the UK population. Lancet Psychiatry. 2020;7(10):883–92.
7. Pan KY, Kok AAL, Eikelenboom M, Horsfall M, Jörg F, Luteijn RA, Rhebergen D, Oppen PV, Giltay EJ, Penninx BWJH. The mental health impact of the COVID-19 pandemic on people with and without depressive, anxiety, or obsessive-compulsive disorders: a longitudinal study of three Dutch case-control cohorts. Lancet Psychiatry. 2021 Feb;8(2):121–129. https://doi.org/10.1016/S2215-0366(20)30491-0. Epub 2020 Dec 8. Erratum in: Lancet Psychiatry. 2021 Mar;8(3):e11. PMID: 33306975; PMCID: PMC7831806
8. Matthews T, Danese A, Wertz J, Odgers CL, Ambler A, Moffitt TE, et al. Social isolation, loneliness and depression in young adulthood: a behavioural genetic analysis. Soc Psychiatry Psychiatr Epidemiol. 2016;51(3):339–48.
9. Scheffer MC, Dal Poz MR. The privatization of medical education in Brazil: trends and challenges. Hum Resour Health. 2015;13:96. Published 2015 Dec 17. https://doi.org/10.1186/s12960-015-0095-2.
10. Santos KO, Araújo TM, Pinho PdS, Silva ACC. Avaliação de um instrumento de mensuração de morbidade psíquica: estudo de validação do Self-Reporting Questionnaire (SRQ-20). Revista Baiana de Saúde Pública. 2010;34(3):544–60.
11. Beusenberg M, Orley JH, World Health Organization. Division of Mental Health. A user's guide to the self reporting questionnaire (SRQ / compiled by M. Beusenberg and J. Orley. World Health Organization. 1994. https://apps.who.int/iris/handle/10665/61113.
12. van der Westhuizen C, Wyatt G, Williams JK, Stein DJ, Sorsdahl K. Validation of the Self Reporting Questionnaire 20-Item (SRQ-20) for use in a low- and middle-income country emergency centre setting. Int J Ment Health Addict. 2016 Feb 1;14(1):37–48. https://doi.org/10.1007/s11469-015-9566-x. Epub 2015 Jun 30. PMID: 26957953; PMCID: PMC4779367.
13. Chen S, Zhao G, Li L, Wang Y, Chiu H, Caine E. Psychometric properties of the Chinese version of the Self-Reporting Questionnaire 20 (SRQ-20) in community settings. Int J Soc Psychiatry. 2009;55(6):538–47. https://doi.org/10.1177/0020764008095116. Epub 2009 Jul 10 PMID: 19592444.
14. Scazufca M, Menezes PR, Vallada H, Araya R. Validity of the self reporting questionnaire-20 in epidemiological studies with older adults: results from the Sao Paulo Ageing & Health Study. Soc Psychiatry Psychiatr Epidemiol. 2009;44(3):247–54. https://doi.org/10.1007/s00127-008-0425-y. Epub 2008 Sep 8 PMID:18777144.
15. Gonçalves DM, Stein AT, Kapczinski F. Avaliação de desempenho do Self-Reporting Questionnaire como instrumento de rastreamento psiquiátrico: um estudo comparativo com o Structured Clinical Interview for DSM-IV-TR [Performance of the Self-Reporting Questionnaire as a psychiatric screening questionnaire: a comparative study with Structured Clinical Interview for DSM-IV-TR]. Cad Saude Publica. 2008 Feb;24(2):380–90. Portuguese. https://doi.org/10.1590/s0102-311x2008000200017. PMID: 18278285.
16. Perissotto T, da Silva TCRP, Miskulin FPC, Pereira MB, Neves BA, et al. Mental health in medical students during COVID-19 quarantine: a comprehensive analysis across year-classes. Clinics. 2021;76: e3007.
17. Xiao H, Shu W, Li M, Li Z, Tao F, Wu X, et al. Social distancing among medical students during the 2019 Coronavirus disease pandemic in China: disease awareness, anxiety disorder, depression, and behavioral activities. Int J Environ Res Public Health. 2020;17(14):5047.
18. Wang Y, Xu B, Zhao G, Cao R, He X, Fu S. Is quarantine related to immediate negative psychological consequences during the 2009 H1N1 epidemic? Gen Hosp Psychiatry. 2011;33(1):75–7.
19. Li HY, Cao H, Leung DYP, Mak YW. The psychological impacts of a COVID-19 outbreak on college students in China: a longitudinal study. Int J Environ Res Public Health. 2020;17(11):3933.
20. Shi L, Lu Z-A, Que J-Y, Huang X-L, Liu L, Ran M-S, et al. Prevalence of and risk factors associated with mental health symptoms among the general population in China during the coronavirus disease 2019 pandemic. JAMA network open. 2020;3(7):e2014053-e.
21. Murray G, Gottlieb J, Swartz HA. Maintaining daily routines to stabilize mood: theory, data, and potential intervention for circadian consequences of COVID-19. The Canadian J Psychiatry. 2020:0706743720957825.
22. Vasavda C, Ho BK, Davison A. Socially distant medical education in the face of COVID-19. Med Sci Educ. 2020:1–3. https://doi.org/10.1007/s40670-020-01127-4.
23. Van der Velden PG, Contino C, Das M, van Loon P, Bosmans MWG. Anxiety and depression symptoms, and lack of emotional support among the general population before and during the COVID-19 pandemic. A prospective national study on prevalence and risk factors. Journal of affective disorders. 2020;277:540–8.
24. Schäfer SK, Sopp MR, Schanz CG, Staginnus M, Göritz AS, Michael T. Impact of COVID-19 on public mental health and the buffering effect of a sense of coherence. Psychother Psychosom. 2020;89(6):386–92.
25. Brunoni AR, Suen PJC, Bacchi PS, Razza LB, Klein I, dos Santos LA, et al. Prevalence and risk factors of psychiatric symptoms and diagnoses before and during the COVID-19 pandemic: findings from the ELSA-Brasil COVID-19 mental health cohort. Psychological medicine. 2021;1–12.
26. Bourmistrova NW, Solomon T, Braude P, Strawbridge R, Carter B. Long-term effects of COVID-19 on mental health: a systematic review. J Affect Disord. 2022 Feb 15;299:118–125. https://doi.org/10.1016/j.jad.2021.11.031. Epub 2021 Nov 16. PMID: 34798148; PMCID: PMC8758130.
27. Mari JJ, Williams P. A validity study of a psychiatric screening questionnaire (SRQ-20) in primary care in the city of Sao Paulo. Br J Psychiatry. 1986;148:23–6.
28. Zhuo K, Gao C, Wang X, Zhang C, Wang Z. Stress and sleep: a survey based on wearable sleep trackers among medical and nursing staff in Wuhan during the COVID-19 pandemic. Gen Psychiatr. 2020;33(3):e100260-e.
29. Koelen JA, Mansueto AC, Finnemann A, de Koning L, van der Heijde CM, Vonk P, Wolters NE, Klein A, Epskamp S, Wiers RW. COVID-19 and mental health among at-risk university students: a prospective study into risk and protective factors. Int J Methods Psychiatr Res. 2022;31(1): e1901. https://doi.org/10.1002/mpr.1901.
30. Ballesio A, Zagaria A, Musetti A, Lenzo V, Palagini L, Quattropani MC, Vegni E, Bonazza F, Filosa M, Manari T, Freda MF, Saita E, Castelnuovo G, Plazzi G, Lombardo C, Franceschini C. Longitudinal associations between stress and sleep disturbances during COVID-19. Stress Health. 2022 Mar 24. https://doi.org/10.1002/smi.3144. Epub ahead of print. PMID: 35332673.
31. Stamatis CA, Broos HC, Hudiburgh SE, Dale SK, Timpano KR. A longitudinal investigation of COVID-19 pandemic experiences and mental health among university students. Br J Clin Psychol. 2022;61(2):385–404. https://doi.org/10.1111/bjc.12351. Epub 2021 Nov 30 PMID: 34850405.