The impact of the fourth wave of the COVID-19 pandemic on depression, anxiety and stress and related factors among medical students at Hue University of Medicine and Pharmacy

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Abstract

Background: Several studies have shown that the rates of mental health problems increased during the Coronavirus Disease 2019 (COVID-19) pandemic. Our research aimed to identify the prevalence and risk factors for depression, anxiety and stress among medical students at Hue University of Medicine and Pharmacy (HueUMP), Vietnam. **Methods:** A cross - sectional study included 2,350 medical students from the first year to the sixth year, in the 2021-2022 school year. We used the DASS-21 (Depression, Anxiety, Stress Scale-21 iterms) to assess depression, anxiety and stress in the participants; and to identify risk factors we used a self–designed questionnaire. Logistic regression was used to analyze factors associated with depression, anxiety and stress in medical students at Hue UMP. **Results:** The prevalence of depression, anxiety and stress among medical students during the 4th wave of the COVID-19 pandemic, as measured by the DASS-21 scale was 38%, 33.2% and 17%, respectively. In multivariate regression analysis, stress-related factors included frequently feeling trapped during the period of social distancing/isolation, relationships affected or not maintained during the pandemic, parents and other family members getting unemployed. Factors associated with anxiety among participants included being female, having oneself or a family member(s) infected with Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), constant worries about missing important scholarships or exams, frequent worries about online exams, feeling trapped due to social distancing/isolation, daily routines and relationships affected by the pandemic, and using beer, stimulants to relax. The factors related to depression in the study subjects included being female; being a 2nd, 3rd, or 6th-year student; having a family member(s) infected with SARS-CoV-2; feeling trapped due to social distancing/isolation; having relationships affected by the Covid pandemic; not exercising regularly; and using alcohol/beer/stimulants to relax. **Conclusion**: The rates of anxiety, depression, and stress among medical students ranged from 17% to 38%. Factors associated with these mental health problems included being female; being a 2nd, 3rd, or 6th-year student; pandemic-related factors and the students' coping mechanisms.

Key words: *COVID-19 Pandemic, medical students, DASS-21, Risk factors, Hue university of Medicine and Pharmacy.*

1. INTRODUCTION

The COVID-19 pandemic broke out at the end of 2019 and quickly spread worldwide, including Vietnam, with the pathogen known as SARS-CoV-2. From then until April 2023, according to a report by the World Health Organization, there had been more than 765 million infected people globally and nearly 7 million deaths [1]. In Vietnam, according to the Ministry of Health's report, there had been over 11 million cases of COVID-19, with over 43 thousand deaths, accounting for 0.4% of infected cases [2]. Particularly, the fourth wave of the COVID-19 pandemic, starting from April 2021, was extremely complicated in Ho Chi Minh City, the southern provinces, and many provinces nationwide with a high number of infected people and deaths. April 27 marked the beginning of the fourth wave of the pandemic in Vietnam, when the first patient appeared in Yen Bai province. From here, the epidemic began to spread to Da Nang, Hanoi, Vinh Phuc, broke out in Bac Ninh, Bac Giang, attacking industrial zones. On June 12, just over a month after the first day of the fourth wave outbreak, Vietnam reached 10000 cases of Covid-19 infection, while all three previous waves only recorded 3000 cases. More than a month later, on July 26, Vietnam exceeded 100000 Covid-19 patients. In the fourth pandemic wave in Vietnam alone (from April 27 to the midle of December 2021), nearly 30000 deaths due to COVID-19 were recorded. Cases of

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DOI: 10.34071/jmp.2025.4.11
Received: 04/12/2024; Accepted: 25/07/2025; Published: 30/08/2025

covid 19 infection in Vietnam, in the 4th wave are mainly caused by the delta strain (B.1.617.2 variant) of the SAR-CoV-2 virus [3]. This is a variant with high virulence and the ability to spread faster than previous alpha strain [4]. Twohig K.A et al studied on 43338 COVID-19 positive patients including 8682 with the delta variant and 34656 with the delta variant in United Kingdom (UK). The results showed that a higher hospital admission or emergency care attendance risk for patients with COVID-19 infected with the delta variant compared with the alpha variant [5]. Faced with the rapid spread of SARS-CoV-2, governments and health systems worldwide introduced many methods to prevent the pandemic's spread. One of these methods, applied by many countries, was quarantine and social distancing. In addition to economic decline and physical health effects, the COVID-19 pandemic also significantly impacted people's mental health, including students in general and medical students in particular.

The mental health of medical students, in particular, warrants urgent attention due to their unique position as future healthcare providers facing unprecedented challenges during the COVID-19 pandemic. The intense academic demands, coupled with the transition to online learning and limited clinical exposure, disrupted their training and heightened psychological distress. Social distancing measures and the fear of infection further exacerbated feelings of isolation, anxiety, and stress, while the high mortality rates and societal impact of the pandemic amplified emotional burdens. Investigating mental health issues in this population is critical not only to understand the immediate effects of the pandemic but also to inform targeted interventions that support medical students' well-being, ensuring their resilience and capacity to serve effectively in future healthcare systems.

Coping mechanisms play a pivotal role in mitigating or exacerbating mental health issues among medical students during the COVID-19 pandemic. Previous studies have shown that adaptive coping strategies, such as regular physical exercise and mindfulness practices, are associated with reduced levels of depression, anxiety, and stress, while maladaptive coping, such as substance use or avoidance, can increase these risks [6, 7]. For instance, Abdulghani et al. found that medical students who engaged in regular physical activity reported lower stress levels, whereas those relying on negative coping mechanisms, like excessive screen time, experienced heightened psychological distress [6]. Understanding these coping strategies is essential for developing effective mental health interventions tailored to medical students facing pandemic-related stressors.

Abdulghani surveyed 243 out of 352 medical students from year 1 to year 5 using the Kessler 10 Psychological Distress scale (K10) and found that the overall stress rate was significantly higher in female students than in male students, and the level of stress was severe in the group. Students aged 18 - 21 are 3 times more likely than students of other ages. Also in this study, students who view online learning as a burden will also experience more severe stress [6] Additionally, as future health workers, medical students have been one of the core forces supporting pandemic prevention and going to the front lines, may leading to psychological pressure that affects their mental health. During the 4th wave of the COVID-19 pandemic in Vietnam, the Ministry of Health mobilized human resources including 19,787 medical staff (3,183 doctors, 6,340 nurses, 227 medical technicians, 847 lecturers, 7,841 students and 1,349 other medical staff) [3]. Previous studies in other countries showed that the rate of medical students suffering from mental health problems increased during the COVID-19 pandemic. Xiao H et al studied on 933 medical students (public health specialty) from 4 -12 February, 2020, using Generalized Anxiety Disorder-7 (GAD-7) and Health Questionnaire-9 (PHQ-9) to measure anxiety disorders and depression revealed that prevalence of anxiety was 17.1% and depression was 25.3%. Associated factors with anxiety were graduate student status (adjusted odds ratio (aOR) = 2.0; 95% confidence interval (CI): 1.2 - 3.5), negative thoughts or actions (aOR = 1.6; 95% CI: 1.4 - 1.7), and feeling depressed (aOR = 6.8; 95% CI: 4.0 - 11.7), depression was associated with female students (aOR = 2.0; 95% CI: 1.2 - 3.3), negative thoughts or actions (aOR = 1.7; 95% CI: 1.5 - 1.9), and anxiety disorder (aOR = 5.8; 95% CI: 3.4 - 9.9) [7]. Adhikari A. conducted a sectional cross study on 223 medical students in Nepal using PHQ-9, results found that the prevalence of depression was 23.3%. Associated factors with depression were preclinical year (1st, 2nd and 3rd year students) [8]. Seetan K et al. surveyed 553 medical students in Jordan and found that about 50% of students had severe mental disorders, with only 13.2% of students being healthy [9]. Harries A.J et al. conducted a multicenter study of US (United State) medical students through an online survey via emails and found that 84.1% of students reported

experiencing stress and anxiety during the pandemic [10]. In Vietnam, Thai Thanh Truc et al. studied 563 Public Health and Preventive Medicine students of the Faculty of Public Health, Ho Chi Minh City University of Medicine and Pharmacy, and found that more than 80% of students suffered from stress to some degree [11]. There were studies on the mental health among medical students during the COVID-19 pandemic reported in countries around the world. However, during the period we conducted this research (from February to April 2022), in Vietnam, there was only one study by Thai Thanh Truc on the impact of the COVID- 19 pandemic on mental health among preventive medicine students. Jia Q. et al conducted a meta- analysis and systemic review with 41eligible articles based on 36608 medical students, the findings showed that the pooled depression prevalence was 37.9% (95% CI: 30.7 - 45.4%), and pooled anxiety prevalence was 33.7% (95% CI: 26.8 - 41.1%). The prevalence of depression and anxiety among medical students varied by gender, country, and continent. The articles selected in this meta-analysis, mostly were from China, other countries including Nepal, America, Germany, Turkey, France, Bangladesh, Iran, India, Japan, Pakistan, Spain, Albania, Greek, Brazil and there was no article from Vietnam [12]. Most studies studied one mental health problem such as depression or anxiety or stress, some studies studied anxiety and depression, few studies mentioned all three problems including stress anxiety and depression in medical students as in our study. Furthermore, we emphasize to impact of the 4th wave of the COVID-19 pandemic on mental health among research subjects. This is the most intense and serious period of the pandemic in terms of both the scale of the number of infected people and the number of deaths, not for the entire pandemic. In addition, other studies have studied among medical students with other specialties including nursing, public health, pharmacy, medicine and preventive medicine students [11-14]. Our study focused on medical students with medicine specialty from the first to the sixth year. We would like to have data in Vietnam to compare with other studies over the world about the impact of the covid pandemic on medical students, and also provide evidences for school administrators to develop policies for supporting to students. Moreover, other studies mainly study the rate and factors related to depression and anxiety. Our study, in addition to assessing rates and related factors, also examined how students' coping methods affected rates of anxiety, depression and stress. Given this gap, this study aimed to determine the prevalence and associated factors especially coping methods of depression, anxiety, and stress among medical students (medicine specialty) at Hue University of Medicine and Pharmacy (HueUMP), Vietnam during the 4th wave of COVID-19 pandemic.

2. METHODS

2.1. Participants

Medical students from year 1 to year 6 of the 2021 - 2022 school year, HueUMP were eligible for this study.

2.2. Sample size and sampling technique

2,350 of the total number of medical students from year 1 to year 6 of the 2021-2022 school year, which is 2,580 students, with a response rate of 91.1%.

We used the total sampling method. All students were invited to participate in the survey, and those who fully answered the questionnaire were selected.

2.3. Study Design

An online-based cross-sectional study was conducted among medical students from year 1 to year 6 of the 2021 - 2022 school year from February to April 2022. The 2021 - 2022 school year was from August, 2021 to the end of July, 2022. During this period, the fourth wave of the COVID-19 pandemic broke out strongly in Vietnam, especially from July - October 2021, during this period, COVID-19 vaccines were not available or were still scarce in Vietnam. All students in Hue University and Pharmacy shifted to online learning. Clinical Practice was cancelled until the end of March, 2022, but about 500 students volunteered go to fronlines of pandemic areas with task of collecting samples for COVID-19 testing.

2.4. Data collection tools and measurement

- The Depression Anxiety and Stress Scale 21 (DASS-21) is an abbreviated scale of DASS-42 used to identify depression, anxiety, and stress in medical students. This scale, adapted in Vietnam, has been widely used in studies on mental health problems in the general population and students in particular, showing good reliability and sensitivity. Nguyen Van Hung et al. adapted the scale for students of Hue University of Medicine and Pharmacy, showing that the scale is reliable with Cronbach's alpha coefficients ranging from 0.75 to 0.81 [15]. This scale consists of 21 items divided into three subscales: depression, anxiety, and stress, each including seven items. Each item is rated on a 4-point Likert type scale ranging from 0 (not at all), 1 (sometimes), 2 (often) and 3 (very often). The score of each subscale is the total score of its seven items. The results of the DASS-21 are as follows:

Severity	Depression	Anxiety	Stress
Normal	0 - 9	0 - 7	0 - 14
Mild	10 - 13	8 - 9	15 - 18
Moderate	14 - 20	10 - 14	19 - 25
Severe	21 - 27	15 - 19	26 - 33
Extremly severe	≥ 28	≥ 20	≥ 34

- Self-designed questionnaire to explore factors related to mental health problems among medical students including 3 parts: demographic factors, coping mechanisms, and factors related to psychological stress due to the pandemic.

- For social - demographic factors, we gathered information including gender, age, year of study, number of siblings of school age in the family, stable job before the pandemic.

- For coping methods, we collected information including doing excercise at home carrying out favorite activities in appropriate conditions (drawing, reading, listening to music, cooking, helping others); practicing gratitude/writting diary; Practicing meditation, relaxation, praying...; Maintaining contact with friends and relatives via videocall, social networks, chat applications...; Using alcohol/beer or other stimulant substances.

- For pandemic related factors, we collected information as follows: worried about yourself or a family member getting covid, participating in the front line of the epidemic, yourself or a family member having been infected with COVID, witnessing severe cases or death from COVID, daily habits or relationships being afected, worries about online learning/exams, quarantine/social distancing, unemployed family members.

- The questionnaires were distributed to all medical students from year 1 to year 6 via an online platform (Google Forms) through the university's official communication channels, including all student's emails managed by the Student Affairs Office, ensuring comprehensive reach and voluntary participation.

Data processing and analysis

- Data were collected using Google Forms over internet. The participants filled out the consent forms and completed the questionaire. Students' response were collected in the same measure.

- All statistical analysis were performed using SPSS version 20.0. Prevalence of depression, anxiety, stress and their severity level were assessed using descriptive statistics and frequencies. All variables used in this study were categorical variables. With this kind of variables were expressed as frequencies and percentages. The odds ratio (OR) and its 95% confidence intervals (CIs) were estimated. Factors related to depression, anxiety, and stress were analyzed through the Chi-square test for bivariate analysis. A p-value < 0.05 was considered statistically significant. Relevant factors were included in the multivariate analysis using the logistic regression method.

2.5. Ethical Consideration

- Students were encouraged to respond to the survey. Those who did not agree to respond were not subjected to any discrimination. Medical students experiencing problems after the survey were instructed to contact the Student Affairs Office or the teaching staff of the Department of Psychiatry for psychological consultation or medical treatment, as necessary. The consultation process is carried out online or in person when needed, and all information collected from the participants was kept confidential under the researcher's custody.

- Informed consent was obtained from all subjects

- All study procedures were approved by the Research Ethics Committee at Hue University of Medicine and Pharmacy, and this study has been conducted in accordance with the Helsinki Declaration.

3. RESULTS

Social – demographic characteristics of participants

A total of 2,350 medical students participated in the study. Females accounted for 54.5%. The distribution of students was relatively even across year 1, year 2, year 3, and year 5, with the number of sixth-year students being the smallest (12.1%). 72.6% of students have siblings who are still of school age, and only 10% of students had a job with a stable income before the pandemic (Table 1).

Table 1. Social - demographic characteristics of participants

Social – demographic characteristics of students		n (2,350)	Percent (%)
Gender	Male	1069	45.5
	Female	1281	54.5
Year of study	Year 1	452	19.2
	Year 2	423	18.0
	Year 3	436	18.6
	Year 4	330	14.0
	Year 5	424	18.0
	Year 6	285	12.1
Number of siblings in the family of school age (from elementary to university)	0	644	27.4
	1	822	35.0
	2	568	24.2
	≥ 3	316	13.4
Having a job with stable income before pandemic	Yes	236	10.0
	No	2114	90.0

Prevalence of Depression, anxiety and stress among medical students

38% of medical students showed signs of depression, of which 3.4% were at a severe level and 3.2% at a very severe level. Additionally, 33.2% of the population suffered from anxiety, including 4.4% with severe anxiety and 4.5% with very severe anxiety. Furthermore, 17% of participants showed signs of stress, with the majority being at mild and moderate levels (Table 2).

Table 2. Prevalence of Depression, anxiety and stress among medical students

	Frequency	Percent (%)
Depression		
No	1458	62.0
Yes	892	38.0
Mild	317	13.5
Moderate	419	17.8
Severe	80	3.4
Extreme	76	3.2
Anxiety		
No	1570	66.8
Yes	780	33.2
Mild	169	7.2
Moderate	403	17.1
Severe	103	4.4
Extreme	105	4.5
Stress		
No	1951	83.0
Yes	399	17.0
Mild	192	8.2
Moderate	104	4.4
Severe	72	3.1
Extreme	31	1.3

Social – demographic characteristics associated with depression, anxiety and stress

The research results in Table 3 showed that female gender is a common risk factor for depression, anxiety, and stress. Second- and third-year students are a risk factor for both depression and anxiety. Having two or more siblings in the family is a specific risk factor for anxiety. Having a stable job before the pandemic showed no significant association with any of the mental health outcomes (p > 0.05)

Table 3. Social – demographic characteristics associated with depression, anxiety and stress (n=2350)

Social – demographic characteristics		Depression (n = 892)	p	Anxiety (n = 780)	p	Stress (n = 399)	p
Gender	Male	360 (33.7)	< 0.05	321 (30.0)	< 0.05	157 (14.7)	< 0.05
	Female	532 (41.5)		459 (35.8)		242 (18.9)	
Year of study	Year 1	147 (32.5)	< 0.05	150 (33.2)	< 0.05	75 (16.6)	> 0.05
	Year 2	193 (45.6)		171 (40.4)		82 (19.4)	
	Year 3	192 (44.0)		157 (36.0)		79 (18.1)	
	Year 4	125 (37.9)		117 (35.5)		59 (17.9)	
	Year 5	134 (31.6)		108 (25.5)		59 (13.9)	
	Year 6	101 (35.4)		77 (27.0)		45 (15.8)	
Number of siblings in the family of school age (from elementary to university)	0	231 (35.9)	> 0.05	205 (31.8)	< 0.05	101 (15.7)	> 0.05
	1	314 (38.2)		251 (30.5)		130 (15.8)	
	≥ 2	347 (39.3)		324 (36.7)		168 (19.0)	
Having a job with stable income before pandemic	Yes	83 (35.2)	> 0.05	81 (34.3)	> 0.05	35 (14.8)	> 0.05
	No	809 (38.3)		669 (33.1)		364 (17.2)	

Factors related to pandemic associated with depression, anxiety and stress in Medical students

Common risk factors across depression, anxiety, and stress included frequent worries about personal or family infection with SARS-CoV-2 (p < 0.05), concerns about accessing medical facilities for non-COVID conditions (p < 0.05), and disruptions to daily habits and relationships due to social distancing (p < 0.05). Specifically, feeling trapped during social distancing/ isolation was strongly associated with all three outcomes (depression: 48.0% vs. 24.1%, p < 0.05; anxiety: 42.8% vs. 20.0%, p < 0.05; stress: 22.7% vs. 9.1%, p < 0.05). Anxiety was further linked to personal or family infection with SARS-CoV-2 (p < 0.05) and witnessing severe cases or deaths (p < 0.05). Academic concerns, such as worries about missing scholarships, online exams, or delayed graduation, significantly increased the risk of depression, anxiety and stress (p < 0.05). Participation in frontline activities showed no significant association with any outcome (p > 0.05) (Table 4).

Table 4. Pandemic-related factors associated with depression, anxiety and stress in medical students (n=2350)

Factors		Depression (n=892)	p	Anxiety (n=780)	p	Stress (n=339)	p
Often worried about yourself being infected with COVID	Yes	690 (42.7)	< 0.05	623 (38.5)	< 0.05	326 (20.2)	< 0.05
	No	202 (27.6)		157 (21.4)		73 (10.0)	
Often worried about your relatives being infected with COVID	Yes	835 (39.8)	< 0.05	738 (35.1)	< 0.05	382 (18.2)	< 0.05
	No	57 (22.8)		42 (16.8)		17 (6.8)	
Frequently worried about yourself/relatives not being able to go to medical facilities for diseases other than COVID	Yes	690 (43.0)	< 0.05	616 (38.4)	< 0.05	317 (19.8)	< 0.05
	No	202 (27.1)		164 (22.0)		82 (11.0)	
Have you ever been a student on the frontline during the COVID-19 pandemic?	Yes	192 (40.1)	>0.05	157 (32.8)	> 0.05	87 (18.2)	> 0.05
	No	700 (37.4)		623 (33.3)		312 (16.7)	

Have you ever been infected with SAR-CoV-2?	Yes No	197 (39.6) 695 (37.5)	> 0.05	186 (37.4) 594 (32.1)	< 0.05	89 (17.9) 310 (17.7)	> 0.05
Has anyone in your family been infected with SAR-CoV-2?	Yes No	346 (40.9) 546 (36.3)	> 0.05	309 (36.5) 471 (31.3)	< 0.05	157 (18.6) 242 (16.1)	> 0.05
Have you ever witnessed severe cases of or death from COVID?	Yes No	164 (41.2) 728 (37.3)	> 0.05	162 (40.7) 618 (31.7)	< 0.05	82 (20.6) 317 (16.2)	< 0.05
Constantly worried about not being able to practice at hospitals, communities or labs?	Yes No	652 (42.2) 240 (29.8)	< 0.05	570 (36.9) 210 (26.1)	< 0.05	303 (19.6) 96 (11.9)	< 0.05
Frequently worried about not being able to complete the program or graduate on time	Yes No	720 (42.1) 172 (26.9)	< 0.05	623 (36.4) 157 (24.5)	< 0.05	332 (19.4) 67 (10.5)	< 0.05
Constantly worried about missing out on scholarship programs and important exams due to the pandemic	Yes No	429 (44.2) 463 (33.6)	< 0.05	414 (42.6) 366 (26.5)	< 0.05	213 (21.9) 186 (13.5)	< 0.05
Frequently worried about online learning because of difficulties accessing Wifi, unstable network quality, or difficulties accessing the internet	Yes No	614 (44.6) 278 (28.6)	< 0.05	551 (40.0) 229 (23.6)	< 0.05	280 (20.3) 119 (12.2)	< 0.05
Frequently worried because there is no means of online learning (smartphone, laptop...)	Yes No	436 (49.9) 456 (30.9)	< 0.05	396 (45.4) 384 (26.0)	< 0.05	200 (22.9) 199 (13.5)	< 0.05
Frequently worried because of not being familiar with taking online exams	Yes No	496 (45.0) 396 (31.7)	< 0.05	474 (43.1) 306 (24.5)	< 0.05	240 (21.8) 159 (12.7)	< 0.05
Often feel trapped during the periods of social distancing/isolation due to the pandemic	Yes No	653 (48.0) 239 (24.1)	< 0.05	582 (42.8) 198 (20.0)	< 0.05	309 (22.7) 90 (9.1)	< 0.05
During the pandemic, daily habits were affected such as: running/walking/cycling/ going to the gym, yoga...	Yes No	621 (41.3) 271 (32.0)	< 0.05	540 (35.9) 240 (28.4)	< 0.05	280 (18.6) 119 (14.1)	<0.05
During the pandemic, were your relationships affected and not maintained like before?	Yes No	544 (46.5) 348 (29.5)	< 0.05	500 (42.7) 280 (23.7)	< 0.05	265 (22.6) 134 (11.4)	< 0.05
During the pandemic, were your parents or family members unemployed?	No Father/ mother Others	481 (33.4) 162 (43.7) 249 (46.4)	< 0.05	412 (28.6) 148 (39.9) 220 (41.0)	< 0.05	198 (13.7) 80 (21.6) 121 (22.5)	< 0.05

Coping mechanisms related to depression, anxiety and stress in medical students

Adaptive coping strategies, such as regular exercise (at least 30 minutes a day, 5 days/week), were associated with lower prevalence of depression (31.6% vs. 46.3%, p < 0.05), anxiety (31.7% vs. 37.0%, p < 0.05), and stress (13.5% vs. 21.4%, p < 0.05) compared to those who did not exercise. Engaging in favorite activities (e.g., drawing, reading, cooking) most or all of the time was linked to reduced depression (32.0% vs. 43.9%, p < 0.05) and anxiety (29.2% vs. 37.8%, p < 0.05). Similarly, maintaining contact with friends and relatives via digital platforms most or all of the time was associated with lower depression (33.9% vs. 43.2%, p < 0.05) and anxiety (30.7% vs. 36.5%, p < 0.05). Conversely, maladaptive coping, such as frequent use of alcohol or stimulants, significantly increased the risk of depression (78.0% vs. 34.4%, p < 0.05) and stress (53.7% vs. 14.9%, p < 0.05). (Table 5)

Table 5. Coping mechanisms related to depression, anxiety and stress in medical students (n=2350)

Coping mechanisms		Depression (n = 892)	p	Anxiety (n = 780)	p	Stress (n = 339)	p
Doing exercise at home	Absolutely not	313 (46.3)	< 0.05	250 (37.0)	< 0.05	145 (21.4)	< 0.05
	Exercise for at least 30 minutes a day and at least 5 days/week	177 (31.6)		178 (31.7)		76 (13.5)	
	Exercise less than 5 days/week or less than 30 minutes a day	402 (36.1)		352 (31.6)		178 (16.0)	
Carrying out favorite activities in appropriate conditions (drawing, reading, listening to music, cooking, helping others)	No	108 (43.9)	< 0.05	93 (37.8)	< 0.05	51 (20.7)	< 0.05
	Sometimes	510 (40.9)		437 (35.0)		226 (18.1)	
	Most of the time/ always	274 (32.0)		250 (29.2)		122 (14.2)	
Practicing meditation, relaxation, praying...	No	460 (36.2)	< 0.05	373 (29.3)	< 0.05	211 (16.6)	> 0.05
	Sometimes	398 (40.9)		363 (37.4)		165 (17.0)	
	Most of the time/ always	34 (32.1)		43 (40.6)		23 (21.7)	
Writing down things you are grateful for, writing a diary	No	614 (35.4)	< 0.05	521 (30.0)	< 0.05	271 (15.6)	< 0.05
	Sometimes	248 (45.5)		231 (42.4)		108 (19.8)	
	Most of the time/ always	30 (43.5)		28 (40.6)		20 (29.0)	
Maintaining contact with friends and relatives via videocall, social networks, chat applications...	No	42 (35.6)	< 0.05	37 (31.4)	< 0.05	23 (19.5)	> 0.05
	Sometimes	437 (43.2)		369 (36.5)		189 (18.7)	
	Most of the time/ always	413 (33.9)		374 (30.7)		187 (15.3)	
Using alcohol/ beer or other stimulant substances to feel better	No	695 (34.4)	< 0.05	250 (37.0)	< 0.05	301 (14.9)	< 0.05
	Sometimes	165 (57.1)		178 (31.7)		76 (26.3)	
	Most of the time/ always	32 (78.0)		352 (31.6)		22 (53.7)	

Multivariate logistic regression model predicting depression by socio-demographic, pandemic-related factors and coping mechanisms among medical students

Table 6 presents the multivariate logistic regression analysis identifying significant predictors of depression among medical students. Female gender (OR = 1.38, 95% CI: 1.08–1.75, p < 0.05), being a second-year (OR = 1.71, 95% CI: 1.19 - 2.46, p < 0.05), third-year (OR = 1.83, 95% CI: 1.26 - 2.66, p < 0.05), or sixth-year student (OR = 1.63, 95% CI: 1.06 - 2.50, p < 0.05), and having a family member infected with SARS-CoV-2 (OR = 1.32, 95% CI: 1.06 - 1.66, p < 0.05) were significant risk factors. Pandemic-related stressors, such as feeling trapped during social distancing (OR = 1.65, 95% CI: 1.29 - 2.11, p < 0.05) and disrupted relationships (OR = 1.31, 95% CI: 1.04 - 1.65, p < 0.05), also increased the odds of depression. Maladaptive coping, specifically frequent use of alcohol or stimulants (OR = 2.93, 95% CI: 1.11 - 7.73, p < 0.05), was a strong predictor, while regular exercise (OR = 0.61, 95% CI: 0.44 - 0.84, p < 0.05) and occasional exercise (OR = 0.71, 95% CI: 0.55 - 0.93, p < 0.05) were protective against depression.

Table 6. Multivariate logistic regression model predicting depression by socio-demographic, pandemic-related factors and coping mechanisms among medical students (Only variables that are significantly different after analysis are listed in this table)

Characteristics		OR	95% CI	p
Gender	Male	1		
	Female	1.38	1.08 - 1.75	< 0.05
Year of study	Year 1	1		
	Year 2	1.71	1.19 - 2.46	< 0.05
	Year 3	1.83	1.26 - 2.66	< 0.05
	Year 4	1.22	0.82 - 1.82	> 0.05
	Year 5	1.08	0.74 - 1.58	> 0.05
	Year 6	1.63	1.06 - 2.50	< 0.05
Has anyone in your family been infected with SARS-CoV-2?	Yes	1.32	1.06 - 1.66	< 0.05
	No	1		
Often feel trapped during the periods of social distancing/isolation due to the pandemic	Yes	1.65	1.29 - 2.11	< 0.05
	No	1		
During the pandemic, were your relationships affected and not maintained as before?	Yes	1.31	1.04 - 1.65	< 0.05
	No	1		
Doing exercise at home	Absolutely not			
	Exercise for at least 30 minutes a day and at least 5 days/week	1 0.61	0.44 - 0.84	< 0.05
	Exercise less than 5 days/week or less than 30 minutes a day	0.71	0.55 - 0.93	< 0.05
Using alcohol/beer or other stimulant substances to feel better	No	1		
	Sometimes	1.20	0.85 - 1.70	> 0.05
	Most of the time/always	2.93	1.11 - 7.73	< 0.05

Multivariate logistic regression model predicting anxiety by socio-demographic, pandemic factors and coping mechanism among medical students

Table 7 summarizes the multivariate logistic regression analysis for anxiety. Significant risk factors included female gender (OR = 1.33, 95% CI: 1.04 - 1.71, p < 0.05), personal infection with SARS-CoV-2 (OR = 1.52, 95% CI: 1.16 - 1.98, p < 0.05), and family member infection (OR = 1.27, 95% CI: 1.01 - 1.60, p < 0.05). Academic stressors, such as constant worries about missing scholarships or exams (OR = 1.32, 95% CI: 1.03 - 1.68, p < 0.05) and unfamiliarity with online exams (OR = 1.34, 95% CI: 1.04 - 1.73, p < 0.05), were also associated with higher anxiety. Social distancing-related factors, including feeling trapped (OR = 1.49, 95% CI: 1.16 - 1.92, p < 0.05) and disrupted relationships (OR = 1.52, 95% CI: 1.20 - 1.92, p < 0.05), significantly increased anxiety risk. Maladaptive coping through frequent alcohol or stimulant use (OR = 4.28, 95% CI: 1.61 - 11.37, p < 0.05) was a strong predictor, while regular physical activity (OR = 0.69, 95% CI: 0.54 - 0.89, p < 0.05) was protective.

Table 7. Multivariate logistic regression model predicting anxiety by socio-demographic, pandemic factors and coping mechanism among medical students
(Only variables that are significantly different after analysis are listed in this table)

Characteristics		OR	95%CI	p
Gender	Male	1		
	female	1.33	1.04 - 1.71	< 0.05
Have you ever been infected with SAR-CoV-2 ?	Yes	1.52	1.16 - 1.98	< 0.05
	No	1		
Has anyone in your family been infected with SAR-CoV-2?	Yes	1.27	1.01 - 1.60	< 0.05
	No	1		
Constantly worried about missing out on scholarship programs and important exams due to the Pandemic	Yes	1.32	1.03 - 1.68	< 0.05
	No	1		
Frequently worried because of not being familiar with taking online exams	Yes	1.34	1.04 - 1.73	< 0.05
	No	1		
often feel trapped during the period of social distancing/isolation due to the pandemic	Yes	1.49	1.16 - 1.92	< 0.05
	No	1		
During the pandemic, daily habits are affected such as: running/ walking/ cycling/ going to the gym, yoga...	Yes	0.69	0.54 - 0.89	< 0.05
	No	1		
During the pandemic, are your relationships affected and not maintained like before?	Yes	1.52	1.20 - 1.92	< 0.05
	No	1		
Using alcohol/beer or other stimulant substances to feel better	No	1		
	Sometimes	1.67	1.19 - 2.35	< 0.05
	Most of the time/always	4.28	1.61 - 11.37	< 0.05

Multivariate logistic regression model predicting stress by socio-demographic, pandemic factors and coping mechanism among medical students

Table 8 outlines the multivariate logistic regression analysis for stress. Key predictors included feeling trapped during social distancing (OR = 1.69, 95% CI: 1.21 - 2.36, p < 0.05) and disrupted relationships due to the pandemic (OR = 1.44, 95% CI: 1.06 - 1.93, p < 0.05). Unemployment of family members, particularly other household members (OR = 1.38, 95% CI: 1.01 - 1.89, p < 0.05), was a significant risk factor. Regular exercise (at least 30 minutes a day, 5 days/week) was protective (OR = 0.64, 95% CI: 0.43 - 0.97, p < 0.05). Unlike depression and anxiety, demographic factors like gender and year of study were not significant in the multivariate model for stress.

Table 8. Multivariate logistic regression model predicting stress by socio-demographic, pandemic factors and coping mechanism among medical students (Only variables that are significantly different after bivariate analysis are listed in this table)

Characteristics		OR	95% CI	p
Often feel trapped during the periods of social distancing/isolation due to the pandemic	Yes	1.69	1.21 - 2.36	< 0.05
	No	1		
During the pandemic, were your relationships affected and not maintained like before?	Yes	1.44	1.06 - 1.93	< 0.05
	No	1		
During the pandemic, were your parents or family members unemployed?	No	1		
	Father/mother	1.22	0.85 - 1.75	> 0.05
	Other members	1.38	1.01 - 1.89	< 0.05

Doing exercise at home	Absolutely not			
	Exercise for at least 30 minutes a day and at least 5 days/week	1 0.64	 0.43 - 0.97	 < 0.05
	Exercise less than 5 days/week or less than 30 minutes a day	0.79	0.57 - 1.09	> 0.05

4. DISCUSSION

Results in Table 2 showed that 38% of medical students suffered from depression, of which 3.4% were at a severe level and 3.2% were at a very severe level. Additionally, 33.2% of the students showed signs of anxiety, including 4.4% with severe anxiety and 4.5% with very severe anxiety. The percentage of students showing signs of stress was 17%, of which 3.1% were at a severe level and 1.3% were at a very severe level. Other studies on the mental health status among medical students or medical staff in Vietnam during the COVID- 19 pandemic but not during the 4th wave found that the rates of depression, anxiety, and stress were lower than in our study.

Research by Bui Thi Thanh Van et al on the rate of depression, anxiety, and stress in medical staff participating in pandemic prevention in Hanoi hospitals in 2020, before the 4th wave broke out, showed that the rate of anxiety, depression and stress are much lower than in our study. The rates of anxiety, depression and stress are 19.5%, 5.7% and 8% respectively [16].

Nguyen Hoang Thuy Linh et al conducted a cross-sectional descriptive study on 877 students at some health sciences universities in Hue, Da Nang, and Ho Chi Minh City during the first wave of the COVID-19 pandemic using an online survey on a convenient sample size. The study found that 12.7% of students showed signs of depression as assessed by the WHO - 5 wellbeing scale with the threshold score for depression being 50 points or less [17].

The time we studied was the 4th wave of the COVID- 19 pandemic in Vietnam. At this time, the number of infected patients and deaths reached the highest rate compared to previous pandemic periods in Vietnam. As we mentioned in the introduction session, during the fourth wave of the COVID-19 pandemic, nearly 30,000 deaths were recorded compared to 43,000 deaths in the entire pandemic. High mortality rates due to COVID-19 in this period might contribute to increased rates of depression among medical students. Our observation is also consistent with the research results of Tian T. et al. in China. 845 frontline health professionals in Beijing Xiaotangshan Hospital participated in Tian T.'s study [18]. The prevalence of moderate to severe stress level was 60.8%; whereas the prevalence of depression, anxiety was 45.6%, 20.7%, respectively. Tian T. et al. used The Perceived Stress Scale (PSS-10), Patient Health Questionnaire (PHQ-9), and Generalized Anxiety Disorder (GAD-7) scale to assess the perceived stress levels and the symptoms of depression and anxiety, respectively. The high rate of stress in Tian's study is because these medical staff were the ones directly treating patients with Covid - 19. In addition to worrying about themselves getting infected, they were also responsible for the lives of their patients. In addition, many medical staff had not had experience in treating Covid-19 patients [18]. All of these factors make the rate of stress among frontline medical staff in Tian's study high.

Research results by Natalia D and Syakurah RA on 1,027 medical students in Indonesia using the DASS - 21 showed that the rate of anxiety, depression and stress was 47.8%, 18.6% and 44.6%, respectively [19]. Jupina. M et al. surveyed on 960 US medical students from December 14, 2020 to January 10, 2021 using the PHQ-2 for depression and GAD-2 for anxiety, finding that 241 students, corresponding to 25.5% of students, suffering from depression and 338 students (corresponding to 40.4% of students) suffering from anxiety [20]. The rates of depression in Natalia's study and Jupina M's were lower than in our study, while the rates of anxiety and stress, especially the figure for stress in Natalia's study were higher than in our study [19, 20]. This can be explained by the different time and location of our research and that of Natalia D. and Jupina M. Each country has different strategies and policies for preventing the spread of COVID-19, and the peak of the pandemic in each country also occured at different times, and the impact of COVID-19 on mental health is also different in each country. That's why the rates of anxiety, depression and stress in our study are different from that of other authors around the world.

Tables 6, 7 and 8 demonstrate that shared factors for risk of anxiety, stress and depression were: feeling of being trapped during the periods of isolation and social distancing; daily habits and relationships disrupted by the pandemic. During the COVID-19 pandemic, to avoid the spread of the pandemic, social distancing and quarantine were

chosen by many countries as methods to prevent the pandemic, including Vietnam. Quarantine and social distancing affects people's daily living habits, such as not being able to go to shopping centers, offices, schools, and physical training centers as usual. Besides, relationships were also affected, friends and relatives couldn't meet or visit together like before. All of these factors would lead to stress, anxiety and even depression for the population in general and students in particular. Students are young, active people with high needs for communication and social relationships, but due to pandemic conditions, these needs were not met, which could make these mental health more likely to occur. Meo S.A studied on 625 medical students at King Saud University, Saudi Arabia by email and found that 530 students (accounting for 84.8%) participated in the survey and among the survey respondents, 44.1% reported having emotional problems while isolated from family due to social distancing policies [21]. Estives C.S et al. studied on 208 students of the Federal Institute of Science and Technology of Rio Grande do Sul, Brazil and found that social distancing or isolation was one of the factors causing anxiety, stress and depression. The rate of anxiety, stress and depression in research subjects during period of social distancing or isolation in this study was 33%, 49% and 39%, respectively [22]. Also in this study, it was shown that social distancing affected significantly the daily living habits of students with only 27% of students still maintaining physical activity with more than 30 minutes of exercise per day. 6% of students did not maintain relationships with family or friends. Brooks S.K. et al. analyzing and synthesizing 5 studies, found that social distancing and isolation had a clear impact on mental health issues in research subjects. This study showed that health workers after a 9-day quarantine due to the SARS virus had a higher rate of acute stress disorder than medical workers who were not quarantined [23]. The study also found that during an influenza pandemic in Australia, quarantined farriers suffered mental health problems 34% compared to a rate of 12% for non-quarantined Australians [23]. Huang et al also agreed that social distance and self-isolation might make students feel more vulnerable and lonelier, increasing depression and anxiety symptoms [24]. Chi et al investigated 2038 university students in China also found that students being isolated with higher level of anxiety [25] Hammoudi Halat also recognised that severe depression, anxiety, and stress were associated with feeling isolated due to COVID-19 [14].

Table 6 and Table 7 showed that shared factors related to anxiety and depression were: being female, having members in family infected with SARS-CoV-2, and frequent use of alcohol. Being female is almost certainly a factor related to anxiety and depression. Through many studies, psychologists have found that women often interpret adverse or even normal events happening around them in a negative and pessimistic way. Because of this cognitive factor, women often suffer from depression and anxiety more often than men. This observation has not only occured during the COVID-19 pandemic but even during normal periods. Research by Park Jinwoo et al. on 600 Korean people found that women are at higher risk of anxiety and other mental health problems than men [26]. A KFF survey on depression and anxiety in Americans during the Covid 19 period found that the rate of anxiety and depression in women was 36% compared to a rate of 28.3% in men. This survey used the PHQ-2 for depression and the GAD-2 for anxiety [27]. Alyoubi A. et al studied on 582 university students in Saudi Arabia using the PHQ-9 scale to assess depression and GAD-7 to assess anxiety and found that female students had higher levels of depression and anxiety than male student [28].

During the 4th wave of the COVID-19 pandemic in Vietnam, the rate of people infected with SAR-CoV -2 and dying from COVID-19 during the crisis period increased greatly compared to previous pandemic periods. When a family members infected with SAR-CoV-2 had to be quarantined, their health and lives would be in dangerous situation. Furthermore, at this stage, the media regularly updates the number of infected and deaths due to the Covid-19 pandemic. For these reasons, when someone in the family was infected with SAR-CoV-2, it could cause anxiety and depression for other members. On the other hand, medical students are those who major in health-related fields, so when a family member is infected, the pressure and responsibility put even more heavily on the shoulders of medical students. Therefore, having a relative infected with SAR-CoV-2 was one of the risk factors for anxiety and depression in our study. Cui S et al. studied on 481 Chinese nurses and found that having a family member infected with SAR-CoV-2 was also a factor related to anxiety in the study subjects [29]. Ying et al., Jiang R also shared this observation[30, 31].

Some studies have also found that alcohol use is a risk factor for depression and anxiety. However, when suffering from depression and anxiety, patients often tend to use alcohol as a coping method to

alleviate anxiety and depression [32, 33, 34]. This coping method only has a temporary effect, but will later make depression and anxiety in these people worse. The relationship between alcohol use and anxiety is a two-way relationship, so it is necessary to have health education programs to guide people with anxiety and depression in positive ways to cope. Other than that, using alcohol makes anxiety and depression more complicated.

Tables 6 and Table 8 indicated that not engaging in regular exercise at home was a significant risk factor for both depression and stress, highlighting the protective effect of physical activity. One of the therapies to help reduce stress, anxiety and depression is regular exercise [35, 36]. Science has proven that physical activity or exercise stimulate nerve cells in the brain to produce chemical neurotransmitters such as dopamine and serotonin. Dopamine is considered a reward hormone. When secreted in the brain, it helps a person feel excited, increased motivation and energy. Serotonin is known as the happy hormone. When serotonin is secreted, it will make a person feel happier and more comfortable. In depressed patients, the amount of serotonin is often reduced. Besides, regular exercise will help a person focus on exercise and reduce time spent on things that cause anxiety and stress [37]. Monfare A.'s study also showed that There was also a significant relationship between the level of psychological distress of the participants and the use of coping strategies including 'exercising' (P = 0.002) [38]. In our study in Tables 6 and Table 8, people who exercise regularly have a lower risk of stress and depression than the group who do not exercise (stress: OR = 0.64, p < 0.05); depression: OR= 0.61, 0.71, p < 0.05).

The demographic risk factors for depression in our study in table 6 were 2nd (OR = 1.71, 95% CI: 1.19 -2.46, p < 0.05), 3rd (OR = 1.83, 95% CI: 1.26 -2.86, p<0.05), and 6th year students (OR = 1.63, 95% CI: 1.06 - 2.50, p < 0.05). Second and third year are the years when students begin to get acquainted with the hospital environment and clinical practice. The pandemic could hinder the hospital internship process, so they are worried that they would not have sufficient skills to practice in the following years or after graduating. As for 6th year students, they were worried that their future plans would be delayed (graduation time, missing important exams...), and at the same time Year 6 students also participated in pandemic prevention work, so they might be under more pressure and had a higher risk of depression. Our research results were different from the research results of Seetan K et al. These authors studied 553 medical students in Jordan during the COVID-19 period and found that 1st year students had the highest stress scores and 6th year students had the lowest stress scores [9]. This difference is probably due to the different learning plans and pandemic prevention programs in each country.

Our study results in table 7 demonstrated that factors increased the risk of anxiety were being infected with SAR-CoV-2 (OR = 1.52, 95% CI: 1.16 -1.98, p < 0.05); constantly worried about missing out on scholarship programs and important exams (OR = 1.32, 95% CI: 1.03 - 1.68, p < 0.05); and frequently worried because of not being familiar with taking online exams (OR =1.34, 95% CI: 1.04 - 1.73, p < 0.05). The COVID-19 pandemic had greatly affected students' study plans such as missing exams and scholarship programs. These factors could contribute to causing anxiety for students. Yadav R.K's study also showed that association between postpone of final exam with depression [39]. Besides, during the pandemic, it is impossible to study and take exams in person, to ensure that students do not have to prolong their study time, online studying and taking exams is necessary. However, some students who live in remote areas where the internet connection is unstable, so taking online exams could lead to anxiety for these students. Therefore, in our study in Table 8, students who felt anxious about online exams had a higher risk of anxiety (OR = 1.34, 95% CI: 1.04 - 1.73, p < 0.05). Cancelling clinical practice, online teaching, learning were also challenges to medical students. These new methods in medical learing and teaching also negative impacted on mental health of the students [13, 40]. Study by Abdulghni reported that most of the students (58.4%) had anxiety before online learning sessions. Likewise, students who refused or did not believe in online learning also experience more severe stress [6]. Abbasi's study on 1255 health science students from 11 countries showed that 34% of the students did not feel confident enough to take exit exams after E-learning sessions, 60% considered that clinical and practical skills are best learned in clinics and laboratories, 41% reported interference of E-learning due to network problems [41]

Table 8 showed one of the factors increased the risk to stress in participants including parents and/ or other family members unemployed. When the COVID pandemic occurred, in order to avoid the spread of the disease, social distancing/quarantine was applied. This caused many workers and employees in non-essential fields to be unemployed. This situation

affects many parents of students, unemployment is related to poor economic conditions, and worries about family living expenses and tuition fees. This makes students tense and stressed. The relationship between unemployment and stress has been proven through many studies [42].

This study had several notable strengths. Firstly, it achieved a remarkably high response rate of 91.1%, with a large sample, 2,350 out of 2,580 medical students participating, enhancing the generalizability and reliability of the findings. The inclusion of a substantial number of medical students from different years of study allowed for a thorough analysis of the mental health impacts across various stages of medical education. The study's comprehensive approach in gathering data on demographic factors, coping mechanisms, and pandemic-related stressors provided a nuanced understanding of the factors influencing mental health outcomes.

There were limitations to our study. First, this was a descriptive cross - sectional study not a longitudinal follow up study so it is difficult to investigate causal relationship. Second, we used the DASS-21 to survey depression, anxiety and stress in medical students during the COVID-19 pandemic, while other studies used screening tests including the PHQ-9, PHQ-2 for depression, GAD-7, GAD-2 for anxiety and PSS-10 for stress, so the comparison of prevalence of mentalhealth problems between our study and other authors is not consistent.

5. CONCLUSION

The prevalence of depression, anxiety and stress among medical students during the 4th wave of the COVID-19 pandemic, as measured by the DASS-21 scale was 38%, 33.2% and 17%, respectively. Key risk factors included female gender, social distancing-related stressors, and family members' infection with SARS-CoV-2, while regular exercise was protective. These findings underscore the need for targeted mental health support and positive coping strategies for medical students. In addition, our study results provide evidence for University's Rector board to have policies to support for the students.

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