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ORIGINAL RESEARCH

STRESS LEVELS AMONG UNDERGRADUATE MEDICAL STUDENTS ON EXPOSURE TO ONLINE LEARNING

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ABSTRACT

Background: *Adolescence is a time of significant psychosocial and physiological changes, such as changes in the reactivity of the hypothalamic-pituitary-adrenal (HPA) axis, which causes an increase in stress-induced hormonal responses. Mental health disorders in medical students are often reported. Moreover, during the COVID-19 pandemic, most medical schools have changed the pre-clinical learning curriculum to online learning, hence most of the student's needs cannot be fulfilled. This study aims to determine the overview of the stress level among undergraduate medical students in Indonesia on exposure to online learning.*

Methods: *This research uses a descriptive cross-sectional design. The primary data was taken with Medical Student Stressor Questionnaire, with undergraduate medical students, especially semester III-VII, as the target population. The minimal population was calculated using a stratified random sampling technique. Data were analyzed using the descriptive method.*

Results: *In this study, most of the students experienced moderate stress (49.1%). Based on their age, the highest stress level was found in students aged 20 years (37%). Based on their gender, a higher stress level was found in female students (61.1%), compared to male students (38.9%). Based on the year, the highest stress level was found in the class of 2019 students (35.2%).*

Conclusion: *Most of the students of the Faculty of Medicine in Indonesia experienced moderate stress during online learning. There is no significant difference between the stress levels of undergraduate medical students before and after the implementation of the online learning system.*

Keywords: *Coronavirus Disease 2019 (COVID-19), stress level, online learning system*

PRACTICE POINTS

- The pandemic condition causes the learning activities of medical students to be hindered, such as gathering in lecture rooms, laboratories, or small classrooms, thus having an impact on the medical students' psychology and quality of life.
- Healthcare workers and students experience a higher risk of psychological distress, depression, anxiety, and burnout than other populations.

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INTRODUCTION

Stress is a threat that can produce physiological and behavioural responses. Stress has a significant negative effect on physical and mental health, regardless of gender, race, and age. Stress occurs when mental, emotional, and physical demands increase beyond an individual's regulatory capacity. The impact given to individuals may differ depending on the frequency, magnitude, and duration of stress. While moderate levels of stress can be adaptive, stress that persists for a long time can cause negative consequences on an individual's well-being.[1]

Adolescence is a period of significant psychosocial and physiological changes in individuals. One of these changes is the way individuals respond to stressors. In particular, the adolescence phase is also marked by a remarkable transformation in the reactivity of the hypothalamic-pituitary-adrenal (HPA) axis, leading to an increase in stress-induced hormonal responses.[2] Based on research, adolescents also show significant negative affective and neurobiological responses to social threats compared to children and adults. According to WHO, the age limit for adolescence is 12 to 21 years, with the late adolescence phase being between the age of 18-21 years.[3]

During adolescence, people usually experience increased stress. Pressure from various aspects, such as school, peers, and family, is escalating as we get older. Adolescents also reported having the same or higher levels of psychosocial stress than adults. In addition to increased environmental pressure, hence, increased psychological stress, research also shows that the sensitivity to the environment increase in adolescence. All of these things combined make an adolescent more vulnerable to the negative impacts of psychosocial stress.[3]

Although stress reactivity and regulation are core aspects of the response to stress, the effect of sex differences is also frequently reported. Research by Rahmayani4, on students of the Faculty of Medicine, Andalas University is one of the studies that show differences in stress levels based on gender. The study shows that girls in first-year medical students had higher stress levels than boys. Regarding stress reactivity, women tend to report higher levels of subjective stress, in response to acute stressors. In contrast, men tend to show stronger physiological stress reactivity, as indexed by an elevated amount of glucocorticoid hormones.[5] Basically, women and men differ in their exposure and reactions to stressors. Women experience more chronic stress than men and perceive stress as more threatening.[6]

The health sector, mental health disorders in medical students are often reported. Research shows that healthcare workers and students are at a higher risk of psychological distress, depression, anxiety, and burnout than other populations. These things could be because medical students have the added stress of an overlong academic period and a greater risk of exposure to disease and death from patient-borne pathogens. High prevalence of stress levels has also been found among medical students in various countries, for example, Pakistan (60%), Thailand (61%), Malaysia (42%), and America (57%).[8]

At the end of 2019, the first case of coronavirus disease, or what the World Health Organization called "COVID-19", was found in a patient with symptoms of a lower respiratory tract infection in Wuhan, China. The first 10 cases spread rapidly until March 2020, when World Health Organization designated COVID-19 as a world pandemic case. To slow down the escalating number of cases, people are required to stay at home, maintain a distance, at least 1 meter between individuals, avoid contact with surfaces of objects that may have been contaminated, and use virtual media to carry out social interactions with the community, one of which is by implementing work and distance learning.[11]

In response to COVID-19, most of the medical faculties in the world, including Indonesia, have changed the form of the pre-clinical learning curriculum to online learning. Hence, some of the basic competencies that should be fulfilled by medical students cannot be fully met. The ease of lecturing, provision, and the delivery of materials have proven to work quite well in this learning system, but the stress level experienced by medical students due to these changes still requires further evaluation.[9]

The reason why the researchers chose this topic is that based on the description above, it is known

that high-stress levels are a condition that is generally experienced by adolescents, especially medical students. Moreover, during the COVID-19 pandemic, medical students have to go through an online learning system, which has not been able to meet all the student's demands. Therefore, researchers are interested in examining stress levels in medical students after the exposure of the online learning system during the COVID-19 pandemic, by grouping them based on age, gender, class year, and causes of student's stress.

METHODS

Research design

This research is a descriptive observational study with a cross-sectional approach, which aims to describe the stress levels in the first year to the third-year medical students of the Faculty of Medicine, Universitas Sumatera Utara on exposure to the online learning system. The technique used in this sampling is stratified random sampling, with data is being collected by the MSSQ (Medical Student Stressor Questionnaire) questionnaire, following the inclusion and exclusion criteria. The inclusion criteria in this study were students who were still actively studying at the Faculty of Medicine, University of North Sumatra, students who were willing to fill out questionnaires, and students aged 18-21 years. Then, the exclusion criteria in this study were students who did not fill out the questionnaire completely, students who had a history of mental illness, and students who took anti-depressant, anti-psychotic, and anti-anxiety drugs. The minimum number of samples was calculated using a categorical descriptive formula, which was 96 subjects.

Research Instrument

The instrument used in this study was the Medical Student Stressor Questionnaire (MSSQ). The questionnaire has been translated into Bahasa and then validated by testing it first on respondents with the same characteristics as the actual respondents, namely 35 students from medical faculties in Indonesia. The purpose of this test was to know the validity and reliability level of the tool. In this study,

all questions on the questionnaire are valid and reliable.

The modified MSSQ research questionnaire consists of 46 questions, contains questions related to stress caused by academic factors – 19 questions, intrapersonal and interpersonal relationship factors – 7 questions, teaching and learning factors – 7 questions, social-related factors – 6 questions, the desire-related factors – 3 questions, and the group-learning factors – 4 questions. Respondents were asked to analyze the stress conditions during the implementation of the online learning system by selecting one of the conditions from 5 categories: 'not causing stress at all', 'causes mild stress', 'causes moderate stress', 'causes severe stress', 'causes a very severe stress'.[12]

The assessment was carried out using a Likert scale with a value of 0-4. A 0 point will be given for the 'no stress at all' response and a score of 4 for the 'causes severe stress' response. The average score of the 46 questions will be used as an indicator of stress levels. The results of the questionnaire assessment consist of the categories of mild stress (0.1-1), moderate stress (1.01-2), severe stress (2.01-3), and very severe stress (3.01-4). Mild stress is a condition that does not experience stress, while moderate stress is interpreted as a normal stress condition to be experienced. Severe stress indicates a significant emotional disturbance, although daily activities are not disturbed. Meanwhile, in very severe stress, we can find an emotional disturbance accompanied by disruption of the individual's life.[12]

The MSSQ questionnaire was developed to identify stressors of medical students and measure the intensity of stress caused by these stressors. The six stress domains as measured by the MSSQ were developed based on various studies. Each question on the MSSQ was selected from a literature review related to stress research. All questions are designed according to local culture and values. MSSQ classify stressors into six domains, each based on a common underlying theme[12]:

1. **Academic Related Stressor (ARS)**
   Academic-related stressor refers to any activity in a school, university, college, or educational environment: a bad exam system, grading

methods, academic schedule, student activities related to academic, such as getting bad grades in exams, high self-expectations to succeed in studies, a large amount of material to be studied, having difficulty understanding the material, lack of time to make revisions, competitive learning conditions, and difficulties in answering questions given by the teacher.[12]

2. **Interpersonal & Intrapersonal Related Stressors (IRS)**
Interpersonal and intrapersonal-related stressors refer to any form of relationship between an individual and within the individual that causes stress. Intrapersonal stressors are generally related to relationships within oneself, including poor learning motivation and self-conflict. Interpersonal stressors are commonly related to relationships including verbal, physical, and emotional abuse caused by others, and conflicts with teachers, coworkers, and staff.[12]

3. **Teaching and Learning Related Stressor (TLRs)**
Teaching and learning-related stressors refer to any event related to teaching or learning that causes stress: the suitability of the tasks given by the teacher, how the teacher supervise and teach students, the quality of the feedback provided by the teacher, the recognition and support provided by the teacher to the students, and the clarity of the learning objectives provided by the teacher to the students.[12]

4. **Social Related Stressor (SRS)**
Social related stressor refers to any form of community and social relationship that causes stress. It is generally associated with leisure time with family and friends, cooperation with others, personal time for oneself, work interruptions from others, and problems of the patients.[12]

5. **Desire Related Stressor (DRS)**
Stressors related to drives and desires refer to any form of internal or external force that influences a person's attitudes, emotions, thoughts, and behavior which then causes stress. This type of stress is generally related to reluctance to study medicine for various reasons such as not choosing to study medicine, choosing the wrong major, reduced motivation after knowing medical science, parents' desire to study medicine, and following friends to study medicine.[12]

6. **Group-Activity Related Stressor (GARS)**
Group activity-related stressor refers to any event and group interaction that causes stress. This type of stress is generally related to group discussions, group presentations, and other expectations of doing well.[12]

Stages of research

This research has finished after going through several stages: pre-field, field, data analysis, and report writing. During pre-field, the researcher prepares the design, objectives, sample, and research population. After the research design has compiled, the researchers prepared a research instrument such as informed consent and the MSSQ questionnaire.

In this study, a reliability test was conducted to determine the consistency level of a questionnaire used by the researchers, so that the questionnaire can be used to measure research variables repeatedly with the same questionnaire. The requirement for the questionnaire to be declared reliable or consistent is if the value of Cronbach's alpha is > 0.6. The result of the first validity and reliability test will be used to improve the questions on the research instrument. Then, a second validity and reliability test will be conducted on the research subject in the hope that all questions on the research instrument are valid and reliable. The reliability test of the questionnaire conducted in this study resulted in the Cronbach's alpha value of 0.966, which indicated that the questionnaire was reliable. All questions on the MSSQ questionnaire used in this study were valid and reliable. The pre-field stage ends with the submission of a research permit. In this study, the researcher has obtained a research permit in the form of an ethical feasibility letter from the Ethics Commission of the Universitas Sumatera Utara.

Due to the COVID-19 pandemic, face-to-face data collection is not possible. Therefore, during the field stage, researchers took steps to collect data remotely. First, the researcher prepared and sent a google-

form link containing an informed consent and a questionnaire to prospective respondents through a communication network. Then, respondents who were willing to join the research would fill out the informed consent and questionnaire. After that, the answers from each respondent were going to be arranged in a centralized folder. After the number of research subjects has met the minimum number, the process of collecting data would be stopped.

All data that has been obtained in this study will be processed and analysed using the IBM® SPSS® computer program version 25.0. Statistical analysis used is descriptive statistics. The data is served in the form of frequency tables and diagrams.

RESULTS AND DISCUSSION

In this study, the total respondents were 110 subjects from the class of 2017, 2018, and 2019. The characteristics of the subjects can be seen in tables 1 and 2.

Table 1. Characteristics of the sujects

Characteristics	N=110
Gender, n (%)	
Male	48 (43,6)
Female	62 (56,4)
Age, median (min-max)	20 (18–21)
Class year, n (%)	
2017	34 (30,9)
2018	34 (30,9)
2019	42 (38,2)

Table 2. Frequency Distribution Table of Stress Levels

Stress Levels		Mild	Moderate	Severe	Very Severe	Total
Frequency	n	32	54	21	3	110
Percentage	(%)	29,1	49,1	19,1	2,7	100
Age						
18 years old	n	8	7	2	1	18
	(%)	25,0%	13,0%	9,5%	33,3%	16,4%
19 years old	n	11	14	6	1	32
	(%)	34,4%	25,9%	28,6%	33,3%	29,1%
20 years old	n	8	20	11	0	39
	(%)	25,0%	37,0%	52,4%	0%	35,5%
21 years old	n	5	13	2	1	21
	(%)	15,6%	24,1%	9,5%	33,3%	19,0%
Total	n	32	54	21	3	110
	(%)	100%	100%	100%	100%	100%
Gender						
Female	n	15	33	11	3	62
	(%)	46,9%	61,1%	52,4%	100%	56,4%
Male	n	17	21	10	0	48
	(%)	53,1%	38,9%	47,6%	0%	43,6%
Total	n	32	54	21	3	110
	(%)	100%	100%	100%	100%	100%
Class Year						
2017	n	7	18	9	0	34
	(%)	21,9%	33,3%	42,8%	0%	30,9%
2018	n	9	17	6	2	34
	(%)	28,1%	31,5%	28,6%	66,7%	30,9%
2019	n	16	19	6	1	42
	(%)	50,0%	35,2%	28,6%	33,3%	38,2%
Total	n	32	54	21	3	110
	(%)	100%	100%	100%	100%	100%

In this study, all respondents totaled 110 subjects from the first year, second year, and third year. Based on gender, most of the research subjects were women, namely 62 people (56.4%), while 48 people were men (43, 6%). Based on the class year, the majority of research subjects came from the 2019 class (38.2%), followed by the 2017 class (30.9%), and the 2018 class (30.9%).

In table 2, we can see that students with moderate stress conditions hold the majority of percentage, as much as 49.1% (54 people), mild stress as much as 29.1% (32 people), severe stress as much as 19.1% (21 people), and very severe stress conditions with the smallest percentage, which was 2.7% (3 people). Based on age, most students who experienced mild stress were 19 years old, as many as 11 people (34.4%), most students who experienced moderate stress were 20 years old, as many as 20 people (37.0%), and most students who experience severe stress were 20 years old, as many as 11 people (52.4%).

Mild stress was mostly found in males, as many as 17 people (53.1%). Moderate stress was mostly found in females, as many as 33 people (61.1%), severe stress conditions were most commonly found in females, as many as 11 people (52.4%), and very severe stress conditions, most commonly found in females, as many as 3 people (100%). Then, students who experienced the mildest stress came from the 2019 class, which were 16 people (50%), most students who experienced moderate stress came from the 2019 class, which were 19 people (35.2%), most students who experienced severe stress came from the 2017 class, which was 9 people (42.9%), and most students who experienced very severe stress came from the 2018 class, namely 2 people (66.7%).

When we observed further, the results of the stress level data obtained in this study are in line with research by Kumari[13] on medical students at Shaheed Hasan Khan Mewati, Govt. Medical College India, stated that most students experienced moderate-to-severe stress, with a prevalence of 64%, in the online learning system during the COVID-19 pandemic.

However, on the other hand, research by Adryana[14] on medical students at the University of Lampung showed that before the COVID-19 pandemic, most of the medical students had moderate stress conditions, as much as 72.3%. This research shows a decrease in the prevalence of stress levels experienced by medical students before and during the COVID-19 pandemic.

According to Kumari[13], the decreased levels of stress in medical students during a pandemic COVID-19 can be caused by many things. One of which is the COVID-19 conditions which require all the learning processes to be done through an online learning system. This learning system requires students to carry out the learning process from home, with emotional support and optimal supervision from the family, so that it can indirectly reduce student stress levels.[13]

In this study, the distribution of stress levels based on age was also carried out to see the differences in stress levels in older adolescents. If we analyzed it by age, this study shows a similar result to the research by Pathmanathan[15], on the students of the Faculty of Medicine at Universitas Sumatera Utara in 2013, which states that most of the severe stress conditions were experienced by students aged 19 and 20 years. The theory that has been developing states that older people tend to feel more negative effects due to the increasing causes of everyday stress.[16] However, age can also predict a person's way of solving a problem. The more mature a person is, the better their ability to make changes in attitudes, cognitive, and emotions, to carry out coping strategies. In other words, students with older age can perform better and more diverse problem-solving strategies than people who are younger than them.[17]

Differences in stress levels by gender are also frequently reported. In this study, there was a significant difference between the stress levels in male and female students. Differences in the prevalence of stress levels in male and female students in this study are consistent with research by Rahmayani[4], at Andalas University School of Medicine student, stating that based on gender, first-year medical students with female gender (69.6 %) had a higher stress level than men (30,4%). Then, this is also in line with research by Eva[18] at a private university in Bangladesh, which states that second and third-

year medical students, who are female (64%), have a higher prevalence of stress levels than men (36%).[18]

The difference in stress levels between males and females in the table above can be related to the theory of the different stress responses in men and women. These differences are related to the activity of the HPA axis and the sympathetic nervous system which will provide negative feedback when the body is under stressful conditions. The pituitary-pituitary-adrenal (HPA) axis regulates the production of cortisol, while the sympathetic nervous system regulates heart rate and blood pressure. The HPA and autonomic nervous system responses are higher in men, thus affecting a person's response to coping with stress-causing factors. In addition, sex hormones in women will decrease the HPA sympathoadrenal response which can reduce the cortisol's negative feedback to the brain, so that women tend to be easily stressed.[19]

In medical students, excessive stress due to the pressure from the learning system and lecture environment is also still a problem. Moreover, in this study, medical students had to undergo an online learning system that could not meet all learning needs. Academic pressures are different in each academic year, so it is essential to analyse stress levels by year of class.

During the implementation of the online learning system, the prevalence of first-year students who experienced moderate-severe stress was slightly lower (59.5%) when compared to the first-year students who experienced moderate-severe stress in the Kumari[13] study in India, which is 64%. Research by Patil[20] on medical students at the Topiwala National Medical College India, also explains that the stress levels in medical students are increasing along with the academic year. In this study, it was found that most of the students who experienced severe stress were final year students, and most of the students who experienced mild stress were first-year students.[20]

However, on the other hand, the results of this study contradict the research conducted by Rafique[21] on medical students in Arabia, which showed that along with the increase in the academic year,

namely the first year to the third year, there was a decrease in the prevalence of students experiencing stress. These differences in results can be caused by different curricula and social environments in each countries.[21]

The first-year students were still in the environmental recognition phase and were still full of a proud feeling of being a medical student. In this period, first-year students also have not faced any academic difficulties because they have learned most of the lectures before.[22] This is slightly different when compared to third-year students. In third-year students, stress is strongly influenced by higher academic demands, more difficult materials, and other activities outside classes.[18]

Table 3. Frequency Distribution Table of Stress Levels based on the Stressors

Stressor		Tingkat Stres			
		Mild Stress	Moderate Stress	Severe Stress	Very Severe Stress
ARS	n	24	52	25	9
	%	21,8%	47,3%	22,7%	8,2%
IRS	n	34	42	25	9
	%	30,9%	38,2%	22,7%	8,2%
TLRS	n	34	48	26	2
	%	30,9%	43,6%	23,7%	1,8%
SRS	n	42	46	21	1
	%	38,2%	41,8%	19,1%	0,9%
DRS	n	59	32	13	6
	%	53,6%	29,1%	11,8%	5,5%
GARS	n	44	41	21	4
	%	40,0%	37,3%	19,1%	3,6%

In table 3, we can see that most subjects experienced moderate stress because of academic-related stress, (ARS), as many as 52 people (47.3%), moderate stress because of interpersonal and intrapersonal-related stress, (IRS), as many as 42 people (38.2%), moderate stress because of teaching and learning-related stress, as many as 48 people (43.6%), moderate stress because of social relationship-related stress,, as many as 46 people (41.8%), mild stress because of desire and control-related stress,, as many as 59 people (53.6%), and mild stress because of group activity-related stress, as many as 44 people (41%).

This result is in line with research by Kumari[13] which states that academics are the most stress-causing factor experienced by students who undergo an online learning system during the COVID-19 pandemic. Decreased ability to carry out exams, too many materials to be studied, and a little time to repeat material are the biggest causes of stress for medical students.

Before the era of the COVID-19 pandemic, research by Yussof and Yee[22] on medical students at Universiti Sains Malaysia and Universiteit Maastricht showed that academic-related matters were the most common stressor experienced by medical students. However, when compared with research by Rahmayani4 on first-year students at the Faculty of Medicine, Andalas University, there are differences in the majority of stress levels in each stressor. In research by Rahmayani[4], it is said that most students experienced severe stress because of academic and intrapersonal-interpersonal stressors. Differences in the results of this study can be caused by differences in the systems of each university, personality type, and the environment where the research subjects live.[4]

In this study, the use of the MSSQ (Medical Student Stressor Questionnaire) questionnaire, which has been modified and validated, does not contain specific questions regarding the confirmation of Coronavirus Disease 2019 (COVID-19) infection, which should be added to gain a deeper understanding of the causes of stress in students. Research related to this topic has not been carried out widely. So, not many journals can be discussed and compared to obtain a more fundamental theory regarding stress levels in medical students who undergo an online learning system during the COVID -19 pandemic.

CONCLUSION

Most of the medical students in the Faculty of Medicine, Universitas Sumatera Utara experienced moderate stress when implementing the online learning system during the COVID-19 pandemic. Students who are 20 years old, female, and are in the 2019 batch have higher stress levels than other characteristics. Academics are the most stressful factors experienced by the medical students of the Faculty of Medicine, Universitas Sumatera Utara when implementing the online learning system during the COVID-19 pandemic.

RECOMMENDATION

This study found that the stress level of medical school students before and after the online learning system is not significantly different. However, the increasing stress levels, especially in medical students, should be managed to avoid the bad impact of more severe stress. Hence, for medical faculties in other universities, this research could be used as an evaluation to prevent stress in students, as well as an evaluation for the online learning procedures. Not only as an evaluation material but we also expect each faculty to be open to all forms of change, which can help students in dealing with their problems.

In some cases, students are often not aware of the stressful conditions because of the lack of insight into stressful conditions that may arise in adolescence. Therefore, for students, especially medical students, it is hoped that the results of this study can provide insights regarding stress levels in medical students. A more open insight is expected to help students pay more attention to the stressful conditions they've experienced before and while undergoing the online learning system so that students can be more sensitive to their mental health conditions.

This study did not include questions regarding confirmation of COVID-19 infection in students, or conditions in the student's environment. Therefore, questions related to the confirmation of Coronavirus Disease 2019 (COVID-19) infection, as well as COVID-19 conditions in the student's environment can be added in further research, so that more in-depth and specific results can be obtained. This research is also expected to be a trigger for other researchers to examine a similar problem, or to be even more specific.

COMPETING INTEREST

The authors declare that there is no conflict of interest regarding the studies in this manuscript.

LIST OF ABBREVIATIONS

ARS : *Academic Related Stressor*
COVID-19 : *Coronavirus Disease-2019*
DRS : *Desire Related Stressor*
GARS : *Group Activities Related Stressor*
HPA : *Hypothalamic-Pituitary Adrenal*
IRS : *Interpersonal – Intrapersonal Related Stressor*
MSSQ : *Medical Student Stressor Questionnaire*
SPSS : *Statistical Package for Social Science*
SRS : *Social Related Stressor*
TLRS : *Teaching and Learning Related Stressor*
WHO : *World Health Organization*

AUTHOR'S CONTRIBUTION

Sanian Inama – developing research proposals, collecting data, analysing data, and publishing manuscripts.
Yuke Sarastri – developing research proposals, analysing data.

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