MUKHTABAR
JOURNAL OF MEDICAL LABORATORY TECHNOLOGY

VOLUME 2 (2), 2024, 39-45 | RESEARCH ARTICLE

The Effect of Stress Levels on Blood Glucose Levels in Medical Laboratory Technology Final-Year Students

Perdina Nursidika [1*], Risti Maulani Astari[1], Ayi Furqon[1]

[1] Applied Undergraduate Program Medical Laboratory Technology, Faculty of Health Sciences and Technology, Jenderal Achmad Yani University Cimahi, West Java, Indonesia
*Corresponding author : perdinanursidika@lecture.unjani.ac.id

SUBMITTED 5 September 2024 **REVISED** 1 October 2024 **ACCEPTED** 10 October 2024

ABSTRACT

Background & Objective: Final-year students are a group that experiences stress due to academic life, responsibilities, and demands from the academic world, such as completing theses, fieldwork, and other academic burden. In addition, the current pandemic may cause stress related to communication and daily life changes. Stress increases the release of epinephrine, catecholamine, glucagon, glucocorticoids, beta-endorphin, and growth hormone, which causes excessive cortisol production, increasing blood sugar levels. This study aimed to determine the relationship between stress levels and blood sugar levels in undergraduate students in medical laboratory technology.
Method: This research method used a cross-sectional approach, with 35 samples that fit the inclusion criteria. The stress measuring tool used was the Depression Anxiety Stress Scale (DASS) questionnaire. Blood glucose examination using the Glucose Oxidase Peroxidase Aminoantypirin method. The analysis used in this study is the correlation test using the Chi-square test
Result: Stress levels in students show normal stress at as much as 11% mild stress at 26% moderate stress at 46%, and severe stress at as much as 17%. The results of bivariate analysis between stress levels and blood glucose levels were $p=0.012$ ($p<0.05$).
Conclusion: there is a significant relationship between stress levels and blood glucose levels in final-year students of D4 Medical Laboratory Technology at Jenderal Achmad Yani University, Cimahi. The results of this study became one of the prediabetes screening data. The need for stress management in students can be one of the factors to avoid the risk of diabetes.

Keywords: blood glucose level; stress; student.

Introduction

Stress is a psychological and physiological response to external or internal pressures, characterized by feelings of tension, anxiety, or strain. It occurs when individuals perceive that the demands placed upon them exceed their ability to cope, impacting both mental and physical health.

The demands and duties of academic life on students might contribute to the stress that students typically face, making them a group that is susceptible to developing homeostatic imbalance (Reddy et al., 2018). In addition, Indonesia and the world are facing a new type of coronavirus called SARS-CoV-2 (COVID-19), so a physical distancing policy has been implemented, impacting academic activities (Naully et al., 2022).

Learning process activities are diverted to online methods, which are carried out at their respective homes (study from home); this activity is an alternative so that learning continues. Due to modifications in the lecture method and daily life, this pandemic condition may produce stress and anxiety for students (Fauziyyah et al., 2021). Students studying medical laboratory technology (MLT) are needed to understand the material through practical application.

Online learning does not help MLT students' abilities because they need lab and intellectual skills. In particular, final-year students research and compile final projects. Now, the students are under more pressure. MLT students experience increased stress. Stress is a reaction that a person shows, psychologically and emotionally, if there is a change in the environment to which the person needs to adapt. Stress occurs throughout life (Chu et al., 2024).

The effects of stress affect people's physical and mental well-being (Yaribeygi et al., 2017). When under stress, energy is stimulated, and anti-regulatory hormones are released, often increasing blood sugar levels and improving the risk of diabetes (Surwit et al., 2002). In stressful situations, the body increases catecholamines, glucagon, glucocorticoids, beta-endorphin, prolactin, and growth hormone (Pilozzi et al., 2020; Ranabir & Reetu, 2011).

The hormone cortisol, which counteracts the effects of insulin and increases blood sugar levels, is produced more in stress response. Since cortisol and insulin work in opposition to each other, this disease causes increased levels of glucagon and decreased levels of insulin in the body, resulting in increased blood sugar levels (Beaupere et al., 2021).

High blood sugar levels increase the risk of diabetes. Psychological stress is associated with the risk of diabetes mellitus (Sahu et al., 2021). Previous studies have shown that academic stress is a significant problem for middle and high school students. The severity of school stress affects students' academic performance, academic achievement and employment, the amount and quality of sleep, and related outcomes. They are related to physical health, mental health, and substance use (Pascoe et al., 2020; Wang & Fan, 2023).

Objective

This study aimed to determine the relationship between blood glucose levels and stress related to online learning in medical laboratory technology students. This study focuses on professional students because online courses burden them more academically. The findings of this study can be used to estimate the risk of diabetes in MLT students**,** highlighting the urgent need to address the health implications of online learning.

Method

Participants and Study Design This study was conducted using a cross-sectional survey of 35 MLT final year students, according to the inclusion criteria. The data collection was done using the Depression Anxiety Stress Subscale Questionnaire (DASS), a carefully selected tool that was distributed and completed individually by each subject. Blood samples were then taken for laboratory tests. The study used the Depression Anxiety Stress Scale (DASS-42) to measure individual stress levels, a questionnaire consisting of 42 items that measure general psychological distress, such as depression, anxiety, and stress.

The researchers chose the DASS stress under the questionnaire because it was consistent with the research objectives (Marsidi, 2021). Respondents were asked to answer the DASS test, which consists of 4 items in the form of a Likert scale. After the respondent answers the statement, the points obtained are combined and grouped into a stress level, a classification of stress levels. The careful selection of research tools assures the study's validity.

Determination of glucose level samples was taken in a non-anticoagulant tube. The serum was obtained by centrifugation (PRC) of the sample at 3000 RPM for 15 minutes. Collected serum is examined using the glucose oxidase peroxidase aminoantipyrine method and read with a Mindray BA-880 imager. Quality control was conducted before testing using normal and pathological serum level controls. Data analysisThe analysis used in this study is the correlation test using the chi-square test; this test was chosen because the data obtained is ordinal, so it can be used to filter data that is closely related to the data string.

This research was approved with ethics number 15/KEPK/FITKES-UNJANI/III/2022.

Results

This research was conducted on 35 research subjects who fit the inclusion criteria. Determination of stress levels using the Depression Anxiety Stress Scale (DASS) questionnaire, the stress subscale, which consists of 14 question items and the results are in table 1.

TABLE 1. Results of Stress and Glucosel level

Stress level	Frequency (N)	Glucose level mean (mg/dL)
Severe	6	102,0
Moderate	16	89,4
Mild	9	82,0
Normal	4	76,5

As shown in table 1, the higher the stress level, the higher the blood glucose level. The statistical test was continued with the Chi Square test and the results obtained can be seen in table 3.

TABLE 2. Results of Stress and Glucosel level

Fasting blood glucose level			
Stress Level	< 100 mg/dL	>100 mg/dL	p-value
	N	N	
Severe	3	3	
Moderate	15	1	0,012
Mild	9	0	
Normal	1	0	

The results of the Chi-Square test obtained a p-value of 0.012 ($p < 0.05$) which means there is a significant relationship between the two variables. This means, there is an increase in blood glucose levels in the stress group.

Discussion

This study found that final-year students who studied during the Covid period experienced stress due to academic pressure. The results of the research by Ambarwati (2019) showed that most of the stress experienced by final-year students was moderate. Final year students were more dominant with early adulthood, at this time, students experienced stress due to internal factors, such as being unable to properly address and understand problems, and external factors, such as the demands of the lecture process. The results of Norma (2021) also show that most students experienced moderate levels of stress during the Covid-19 pandemic due to the online learning process.

According to the questionnaire data, the individuals in this study experienced stress due to heavy academic loads and crowded online learning environments. Final-year students tend to experience a period of boredom or burnout; this period is a period of physical, emotional, and mental exhaustion that can occur as a result of being in a demanding situation for a long time. For final year students, these requirements may be writing a thesis or KTI, passing an exam on time, doing homework and lectures, etc.

Students get bored due to living alone, problems understanding study material, being lonely at home, and not meeting friends face to face, which can cause depression and anxiety in students (Mukaromah & Kassymova, 2022). This underscores the urgent need for support for students' mental well-being.

The results of the Chi-Square test confirmed a significant relationship between stress and blood glucose levels, with a p-value of 0.012 ($p < 0.05$). This finding indicates an increase in blood glucose levels in the stress group. Specifically, it points to a correlation between stress levels and fasting blood glucose levels in final-year MLT students. In essence, the higher the stress level, the higher the blood sugar level, as demonstrated by Yitshak-Sade et al. (2020). This relationship has also been observed in college students (Ahmed et al., 2023; Jena et al., 2016).

This happens because when the body is stressed, the activity of the sympathetic nerve increases and the energy increases because the activity in the body increases, cortisol levels increase, blood sugar levels rise. This effect occurs due to the situation and stress, the brain activates the HPA axis. In the HPA axis, the hypothalamus secretes corticotropin-releasing hormone (CRH), and CRH stimulates the pituitary gland to secrete adrenocorticotropic hormone (ACTH). ACTH causes the adrenal cortex to release the hormone cortisol. When cortisol levels are high, cortisol responds by suppressing the production of CRH in the hypothalamus and ACTH in the pituitary gland. However, when faced with stress, it can suppress negative responses or regulate them, thus increasing cortisol levels and increasing blood sugar levels (Sherwood, 2012).

Stress can stimulate endocrine organs to release epinephrine, which has a powerful effect in causing the process of gluconeogenesis in the liver so that it will release large amounts of glucose in the blood in a few minutes, causing an increase in glucose levels. When stress occurs in the form of physical, psychological stress, or both and occurs over a long period it can cause the pancreas, a gland located behind the stomach, to be unable to control the process of insulin secretion. The pancreas plays a crucial role in the regulation of blood glucose levels by producing and releasing insulin in response to increased blood glucose levels (R et al., 2018). If the blood glucose level is excessive, it will stimulate insulin secretion, but insulin secretion will decrease if the glucose level is average or low. However, if pancreatic dysfunction in

producing insulin and insulin deficiency occurs, then this can cause glucose to be retained outside the cells, leading to diabetes mellitus (Nakrani et al., 2024).

Stress can affect serum cortisol levels because cortisol is released in a stress response, increasing serum sugar levels through gluconeogenesis, depressing the immune system, and helping metabolize fats, proteins, and carbohydrates. Due to stress, Cortisol secretion can increase up to nine times (Cay et al., 2018). When stress manifests physically, psychologically, or both over an extended period, the pancreas may be unable to control insulin secretion because blood glucose levels regulate insulin secretion. Insulin production will increase in response to high blood glucose levels but decline in response to normal or low blood glucose levels. However, if the pancreas cannot produce enough insulin and an insulin shortage develops, this can result in glucose retention outside of cells and diabetes mellitus (Sharma et al., 2022).

The number of students experiencing stress in this study was 88%. The high incidence of childhood diabetes is of great concern. Data from the World Health Organization show an increase in diabetes in children and adolescents (WHO, 2022). Adolescents and young adults worldwide are increasingly at risk of developing type 2 diabetes, especially in countries with high socioeconomic status and language. High body mass index is the most important sociodemographic risk factor for early-onset type 2 diabetes in all regions. In addition to lifestyle and environmental factors, the current review is mainly epidemiological, looking at the links between various emotional stressors and the onset of diabetes. type 2 (Kyrou et al., 2020).

Conclusion

This study found a significant relationship between stress levels and blood sugar levels for final year medical laboratory technology students at General Achmad Yani Simahi University. The results of this study are one of the data from the pre-diabetes screening. The need to control stress in students is one reason to prevent diabetes.

Acknowledgement

The authors would like to give credit to the Faculty of Health Sciences and Technology Jenderal Achmad Yani University for the facility during the research.

Conflict of Interest

No potential conflict of interest was reported by the authors.

References

1. Ahmed, F., Dubey, D. K., Garg, R., & Srivastava, R. (2023). Effects of examination-induced stress on memory and blood pressure. *Journal of Family Medicine and Primary Care*, *12*(11), 2757–2762. https://doi.org/10.4103/jfmpc.jfmpc_925_23
2. Ambarwati, P. D., Pinilih, S. S., & Astuti, R. T. (2019). Gambaran Tingkat Stres Mahasiswa. *Jurnal Keperawatan Jiwa*, *5*(1), Article 1. https://doi.org/10.26714/jkj.5.1.2017.40-47
3. Beaupere, C., Liboz, A., Fève, B., Blondeau, B., & Guillemain, G. (2021). Molecular Mechanisms of Glucocorticoid-Induced Insulin Resistance. *International Journal of Molecular Sciences*, *22*(2), Article 2. https://doi.org/10.3390/ijms22020623
4. Cay, M., Ucar, C., Senol, D., Cevirgen, F., Ozbag, D., Altay, Z., & Yildiz, S. (2018). Effect of increase in cortisol level due to stress in healthy young individuals on dynamic and static balance scores.

Northern Clinics of Istanbul, *5*(4), 295–301. https://doi.org/10.14744/nci.2017.42103

5. Chu, B., Marwaha, K., Sanvictores, T., Awosika, A. O., & Ayers, D. (2024). Physiology, Stress Reaction. In *StatPearls*. StatPearls Publishing. http://www.ncbi.nlm.nih.gov/books/NBK541120/
6. Fauziyyah, R., Awinda, R. C., & Besral, B. (2021). Dampak Pembelajaran Jarak Jauh terhadap Tingkat Stres dan Kecemasan Mahasiswa selama Pandemi COVID-19. *Jurnal Biostatistik, Kependudukan, dan Informatika Kesehatan*, *1*(2), Article 2. https://doi.org/10.51181/bikfokes.v1i2.4656
7. Jena, S. K., Misra, A. K., & Mohanty, A. (2016). Effect of examination stress on blood sugar in medical students. *CHRISMED Journal of Health and Research*, *3*(4), 268. https://doi.org/10.4103/2348-3334.190573
8. Kyrou, I., Tsigos, C., Mavrogianni, C., Cardon, G., Van Stappen, V., Latomme, J., Kivelä, J., Wikström, K., Tsochev, K., Nanasi, A., Semanova, C., Mateo-Gallego, R., Lamiquiz-Moneo, I., Dafoulas, G., Timpel, P., Schwarz, P. E. H., Iotova, V., Tankova, T., Makrilakis, K., & Manios, Y. (2020). Sociodemographic and lifestyle-related risk factors for identifying vulnerable groups for type 2 diabetes: A narrative review with emphasis on data from Europe. *BMC Endocrine Disorders*, *20*(Suppl 1), 134. https://doi.org/10.1186/s12902-019-0463-3
9. Marsidi, S. R. (2021). Identification of Stress, Anxiety, and Depression Levels of Students in Preparation for the Exit Exam Competency Test. *Journal of Vocational Health Studies*, *5*(2), Article 2. https://doi.org/10.20473/jvhs.V5.I2.2021.87-93
10. Mukaromah, L., & Kassymova, G. K. (2022). Students' burnout and psychological distress in undergoing online learning during the Covid-19 pandemic. *Insight: Jurnal Ilmiah Psikologi*, *24*(1), Article 1. https://doi.org/10.26486/psikologi.v24i1.1842
11. Nakrani, M. N., Wineland, R. H., & Anjum, F. (2024). Physiology, Glucose Metabolism. In *StatPearls*. StatPearls Publishing. http://www.ncbi.nlm.nih.gov/books/NBK560599/
12. Naully, P. G., Nursidika, P., Kania, P. P., & Rachmawati, F. (2022). Upaya Pencegahan Penyebaran Covid-19 di Lingkungan Stikes Jenderal Achmad Yani Cimahi dengan Pemeriksaan Antibodi SARS-COV-2. *Aksiologiya: Jurnal Pengabdian Kepada Masyarakat*, *6*(3), Article 3. https://doi.org/10.30651/aks.v6i3.6781
13. Norma, N., Widianti, E., & Hartiningsih, S. S. (2021). Faktor Penyebab, Tingkat Stres dan Dampak Stres Akademik pada Mahasiswa dalam Sistem Pembelajaran Online di Masa Pandemi Covid-19. *Jurnal Ilmiah Permas: Jurnal Ilmiah STIKES Kendal*, *11*(4), Article 4. https://doi.org/10.32583/pskm.v11i4.1656
14. Pascoe, M. C., Hetrick, S. E., & Parker, A. G. (2020). The impact of stress on students in secondary school and higher education. *International Journal of Adolescence and Youth*, *25*(1), 104–112. https://doi.org/10.1080/02673843.2019.1596823
15. Pilozzi, A., Carro, C., & Huang, X. (2020). Roles of β-Endorphin in Stress, Behavior, Neuroinflammation, and Brain Energy

Metabolism. *International Journal of Molecular Sciences*, *22*(1), 338. https://doi.org/10.3390/ijms22010338

16. R, N., Rajaraman, B., Hn, Y., R, N., Rajaraman, B., & Hn, Y. (2018). Stress and Glucose metabolism: A Review. *Imaging Journal of Clinical and Medical Sciences*, *5*(1), 008–012. https://www.peertechzpublications.com/articles/IJCMS-5-137.php
17. Ranabir, S., & Reetu, K. (2011). Stress and hormones. *Indian Journal of Endocrinology and Metabolism*, *15*(1), 18–22. https://doi.org/10.4103/2230-8210.77573
18. Reddy, K. J., Menon, K. R., & Thattil, A. (2018). Academic Stress and its Sources Among University Students. *Biomedical and Pharmacology Journal*, *11*(1), 531–537. https://biomedpharmajournal.org/vol11no1/academic-stress-and-its-sources-among-university-students/
19. Sahu, S., John, J., Augusty, A., & Jawalekar, S. L. (2021). Psychological distress and risk of diabetes among medical students: A cross sectional study. *Medical Journal Armed Forces India*. https://doi.org/10.1016/j.mjafi.2021.09.003
20. Sharma, K., Akre, S., Chakole, S., & Wanjari, M. B. (2022). Stress-Induced Diabetes: A Review. *Cureus*, *14*(9), e29142. https://doi.org/10.7759/cureus.29142
21. Sherwood, L. (2012). *Introduction to Human Physiology*. Brooks/Cole.
22. Surwit, R. S., van Tilburg, M. A. L., Zucker, N., McCaskill, C. C., Parekh, P., Feinglos, M. N., Edwards, C. L., Williams, P., & Lane, J. D. (2002). Stress Management Improves Long-Term Glycemic Control in Type 2 Diabetes. *Diabetes Care*, *25*(1), 30–34. https://doi.org/10.2337/diacare.25.1.30
23. Wang, H., & Fan, X. (2023). Academic Stress and Sleep Quality among Chinese Adolescents: Chain Mediating Effects of Anxiety and School Burnout. *International Journal of Environmental Research and Public Health*, *20*(3), 2219. https://doi.org/10.3390/ijerph20032219
24. WHO. (2022). *Diabetes*. https://www.who.int/news-room/fact-sheets/detail/diabetes
25. Yaribeygi, H., Panahi, Y., Sahraei, H., Johnston, T. P., & Sahebkar, A. (2017). The impact of stress on body function: A review. *EXCLI Journal*, *16*, 1057–1072. https://doi.org/10.17179/excli2017-480
26. Yitshak-Sade, M., Mendelson, N., Novack, V., Codish, S., & Liberty, I. F. (2020). The association between an increase in glucose levels and armed conflict-related stress: A population-based study. *Scientific Reports*, *10*, 1710. https://doi.org/10.1038/s41598-020-58679-z