



# Psychological Stress is Not Related to Lactic Acid Level in Students

Herdianty K. Handari <sup>1</sup>, Mei Kusumaningtyas <sup>1</sup>, Haikal R. Pradipta <sup>2</sup>, and Edenia C. Nagari <sup>2</sup>

<sup>1</sup>Department of physiotherapy, Poltekkes Kemenkes Surakarta

<sup>2</sup>Department of Applied and Professional Bachelors, Poltekkes Kemenkes Surakarta  
*herdianty.kusuma@poltekkes-solo.ac.id*

**Abstract.** Background: In everyday life the human body experiences physical and psychological stress. Physical stress is related to the body carrying out physical activity, while psychological stress is related to a person's condition in interpreting situations in life. In teenagers at college level, stress can occur due to busy lecture activities, causing fatigue. Fatigue is associated with increased levels of lactic acid in the blood. The aim of this research was to determine the relationship between lactic acid levels and psychological stress levels. Method: This research was a cross sectional study conducted on 27 6th semester students. Lactic acid levels were measured using the Roche brand Accutrend and General Health Questionnaire -12 (GHQ-12) to measure psychological stress levels. Results: From the results of the analysis using Pearson Correlation, the p value = 0.268 ( $p > 0.05$ ), correlation coefficient ( $r$ ) = 0.221, and the direction of the relationship is +. Discussion: Psychological stress is not in harmony with high levels of lactic acid in the blood. Conclusion: There is no relationship between lactic acid levels and psychological stress.

**Keywords:** psychological stress, fatigue, lactic acid

## 1. Introduction

In everyday life the human body experiences stress physically and psychologically. Physical stress is related to the body carrying out physical activity, while psychological stress is related to a person's condition in interpreting situations in life [1]. So far, many people understand that stress is only related to psychological pressure or the mind, even though physically the body can also experience stress due to activities, causing fatigue.

Generally, fatigue occurs due to increased levels of lactic acid in the blood which then causes soreness or pain in the muscles.

Lactic acid occurs in anaerobic activities that do not require oxygen availability. The more dominant the anaerobic energy system is in the body; the more lactic acid will accumulate [2].

Psychological stress can be experienced by children, teenagers, adults and even the elderly, which can affect a person's physical condition. In teenagers at college level, stress can occur due to busy lecture activities, causing fatigue. Fatigue can result in decreased academic abilities, worsening health, sleep disturbances and even depression [3].

Physiotherapy students at Poltekkes Kemenkes Surakarta carry out lecture activities for 6 hours or more per day, both theoretical lectures in class and practice in the laboratory with different levels of lecture seriousness. This does not include other activities related to lecture assignments or the process of preparing a thesis for final year students. Apart from that, another stressor is that students are required to complete a thesis proposal before starting clinical practice in the practice area. These things can certainly affect the level of stress, both physical and psychological, in students.

Based on research that has been conducted, it shows that lactic acid can increase when psychological stress occurs [4]. In addition, research that has been conducted regarding stress levels in medical students shows that there is a relationship between fatigue and stress levels in medical students [5]. Other research also shows that there is a relationship between work stress and work fatigue in sugar factory employees [6]. Although lactic acid can increase in psychological stress, the relationship between the two is not yet known with certainty. Based on this, this research aims to determine the relationship between psychological stress and lactic acid levels.

## **2. Method**

This research has received ethical approval number 4837/B.2/KEPK-FKUMS/V/2023. This research is a cross sectional study by measuring lactic acid levels after lecture activities and stress levels with a questionnaire. The research was conducted in April 2023 at the Physiotherapy Department of the Health Polytechnic, Ministry of Health, Surakarta, with one day chosen as the busiest lecture activity. Determination of subjects was carried out using purposive sampling and 27 subjects were obtained. Inclusion criteria include 6th semester students with a lecture schedule of 6 hours/day or more, currently working on a thesis proposal, and willing to be research subjects. Exclusion criteria include doing heavy activities in the morning that cannot be abandoned. Criteria for dropping out are if you do not take the lactic acid measurement and do not fill out the GHQ-12 questionnaire. The research was carried out by measuring lactic acid levels using Roche brand Accutrend Plus and General Health Questionnaire (GHQ-12) to measure psychological stress

levels. The GHQ-12 used is the Indonesian version which has been proven feasible for use in measuring stress levels [7] In this study, the scoring used on the GHQ-12 was the Likert scoring method (0-1-2-3-4).

All research subjects had their lactic acid levels measured at 3 pm after lecture activities and continued with measuring psychological stress levels. Normal levels of lactic acid are between 1-2 mmol/l [8], while the normal range for psychological stress levels is if the GHQ-12 score is below 12 [9]. Next, the data obtained was subjected to non-parametric statistical analysis.

### 3. Results and Discussion

The results of research on 27 subjects obtained data on subject characteristics based on age and gender. Beside that there are characteristics of lactic acid levels and GHQ-12 scores.

**Table 1.** Characteristics of research subjects

Characteristics	N	Percentage (%)
Jenis kelamin		
Male	11	40,7
Female	16	59,3
Total	27	100%
Ages (years)		
20	6	22,2
21	20	74,1
22	1	3,7
Total	27	100%

**Table 2.** Characteristics of Lactic Acid Levels and GHQ-12 scores

Characteristics	Mean+SD
Kadar asam laktat	2,38±1,44
GHQ-12	14,3±3,68

Based on this data, it was found that the average lactic acid level exceeded the normal limit after lecture activities and the level of psychological stress was found to be higher than the normal limit, which means the subject experienced psychological stress.

Statistical analysis was carried out by carrying out a normality test using Shapiro Wilk and it was found that one of the data distributions was not normal ( $p < 0.05$ ), so the hypothesis test was carried out non-parametrically. The results of hypothesis testing using Pearson obtained a p value  $> 0.05$ .

**Table 3.** Analisis statistic

Statistical test	p value
Normality	
• Lactic acid	0,000
• GHQ-12	0,142
Correlation	
Pearson	0,268
Coefficient correlation (r)	0,221

The aim of this research is to determine the relationship between lactic acid levels and psychological stress. Based on the results of this study, it shows that there is no relationship between lactic acid levels in the blood and psychological stress. In previous research, it was stated that apart from exercise, lactic acid can increase when psychological stress occurs [4]. Lactate provides 60% of total energy for the brain directly or after being metabolized into glucose by the liver and kidneys [10]. To meet energy needs during stress, glucose is circulated towards the blood brain barrier via GLUT-1 and peripheral glucose metabolism via GLUT-4 decreases [11]. Even though lactic acid levels both increase due to physical and psychological stress, physical stress increases lactate levels more than psychosocial stress, which means that the mechanisms for increasing the two are different [12]. Increased lactate levels which trigger psychosocial stress depend on cognitive activity rather than muscle activity, whereas those that trigger physical stress depend on muscle activity rather than cognitive activity [12].

Based on the results of the GHQ-12 score, students' stress levels are in the stress category. During lecture activities, the energy metabolism that occurs is not always anaerobic which can produce lactic acid, in fact it tends to be predominantly aerobic, so that the lactic acid formed does not accumulate more than 2 mmol/l. Lactic acid arises due to the unavailability of oxygen (hypoxia), so when oxygen becomes available again in the body through the respiratory process, the oxygen is used for aerobic processes. With the availability of oxygen, lactic acid will be processed back into glucose to be stored in the liver or used directly to produce energy. The time required for recovery of lactic acid is after 60 minutes [13].

Apart from that, when someone experiences psychological stress, it can be handled in various ways, for example by controlling their breath (breathing exercise) which acts as the first treatment when experiencing stress, anxiety, depression, and some emotional disorders [14].

There are variables that can influence stress levels in students, such as gender, nutritional status, health status and activity, but not all of these variables can be controlled by researchers, thus showing that there is no relationship between psychological stress and increased lactic acid.

## 4. Conclusion

Based on the research objective to determine the relationship between lactic acid levels and psychological stress, it was concluded that there was no relationship between lactic acid levels in the blood and psychological stress. As for further research, the subjects should be more heterogeneous with a larger number of subjects. This research was conducted on 6th semester students only, so the results of this research cannot yet be generalized, therefore it is necessary to measure stress levels at all semester levels.

## 5. Acknowledgements

The author expresses his gratitude to the Surakarta Ministry of Health Polytechnic for giving permission to conduct research. The author also states that there is no conflict of interest in this research.

## References

- [1] B. L. Seaward, *Managing Stress Principle and Strategies for Health and Well Being 6th Edition*, 6th ed., no. 5. Sudbury, Massachusetts: Jones and Bartlett Publisher, 2009.
- [2] M. Rashidi, M. Sedaghat, and M. Shahvaranian, "The effects of the different frequencies of whole-body vibration after a strenuous activity on blood lactic acid," *Ann Appl Sport Sci*, vol. 5, no. 1, 2017, doi: 10.18869/acadpub.aassjournal.5.1.39.
- [3] N. T. L. Gaol, "Teori Stres: Stimulus, Respons, dan Transaksional," *Buletin Psikologi*, vol. 24, no. 1, p. 1, 2016, doi: 10.22146/bpsi.11224.
- [4] B. Kubera *et al.*, "Rise in plasma lactate concentrations with psychosocial stress: A possible sign of cerebral energy demand," *Obes Facts*, vol. 5, no. 3, pp. 384–392, 2012, doi: 10.1159/000339958.
- [5] A. Nathania, I. M. Krisna Dinata, and I. P. Adiartha Griadhi, "Hubungan stres terhadap kelelahan pada mahasiswa Fakultas Kedokteran Universitas Udayana," *Intisari Sains Medis*, vol. 10, no. 1, pp. 134–138, 2019, doi: 10.15562/ism.v10i1.400.
- [6] N. Latif, "Hubungan Stres Kerja Dengan Kelelahan Kerja Pada Karyawan Ptpn Xiv (Persero) Pabrik Gula Takalar," UIN Alauddin makassar, Makassar, 2022.
- [7] S. G. Anjara, C. Bonetto, T. Van Bortel, and C. Brayne, "Using the GHQ-12 to screen for mental health problems among primary care patients: Psychometrics and practical considerations," *Int J Ment Health Syst*, vol. 14, no. 1, Aug. 2020, doi: 10.1186/s13033-020-00397-0.

- [8] S. K. Power and E. T. Howley, *Exercise Physiology Theory and Application to Fitness and Performance*, 10th ed. New York: McGraw-Hill Education, 2015. doi: 10.1177/036354659001800223.
- [9] A. Fattori, F. Greselin, L. Bordini, P. Brambilla, and M. Bonzini, “The potential of the GHQ-12 questionnaire in assessing psychological impairment on a health-care workers population facing Covid-19: an item response theory-based analysis Anna Comotti Foundation IRCCS Ca’ Granda Ospedale Maggiore Policlinico,” 2022, doi: 10.21203/rs.3.rs-1699132/v1.
- [10] F. Boumezbeur *et al.*, “The Contribution of Blood Lactate to Brain Energy Metabolism in Humans Measured by Dynamic <sup>13</sup>C Nuclear Magnetic Resonance Spectroscopy,” *Journal of Neuroscience*, vol. 30, no. 42, pp. 13983–13991, Oct. 2010, doi: 10.1523/JNEUROSCI.2040-10.2010.
- [11] A. Peters, “The selfish brain: Competition for energy resources,” *American Journal of Human Biology*, vol. 23, no. 1. pp. 29–34, Jan. 2011. doi: 10.1002/ajhb.21106.
- [12] R. Hermann, D. Lay, P. Wahl, W. T. Roth, and K. Petrowski, “Effects of psychosocial and physical stress on lactate and anxiety levels,” *Stress*, vol. 22, no. 6, pp. 664–669, 2019, doi: 10.1080/10253890.2019.1610743.
- [13] X. Li *et al.*, “Lactate metabolism in human health and disease,” *Signal Transduction and Targeted Therapy*, vol. 7, no. 1. Springer Nature, Dec. 01, 2022. doi: 10.1038/s41392-022-01151-3.
- [14] R. Jerath, M. W. Crawford, V. A. Barnes, and K. Harden, “Self-Regulation of Breathing as a Primary Treatment for Anxiety,” *Applied Psychophysiology Biofeedback*, vol. 40, no. 2. Springer New York LLC, pp. 107–115, Jun. 18, 2015. doi: 10.1007/s10484-015-9279-8.

**Open Access** This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

