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Research Article

OVERVIEW OF LACTATE DEHYDROGENASE (LDH) ENZYME ACTIVITY IN HYPERTENSIVE PATIENTS WITH OBESITY AT TANGERANG DISTRICT HOSPITAL

Maheswari Syifa Puspamurti[1] ✉, Ramadas A[2]

[1]Department of Medical Laboratory Technology, Polytechnic of Health of Banten, Tangerang Indonesia
[2]Jeffrey Cheah School of Medicine and Health Science, Malaysia

KEYWORDS

Lactate Dehydrogenase
Enzyme Activity
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Hypertension
Obesity

ABSTRACT

Hypertension is a condition characterized by abnormally high blood pressure. One of the modifiable risk factors for hypertension is obesity. Increased body mass requires the heart to pump blood more forcefully, resulting in elevated blood pressure. One of the complications experienced by patients with hypertension is endothelial dysfunction, which can serve as a predictor of atherosclerosis. This condition may lead to the release of the lactate dehydrogenase (LDH) enzyme into the bloodstream. This study aimed to describe LDH enzyme activity in hypertensive patients with obesity at Tangerang District Hospital. A descriptive research design was used, and the study was conducted from March to May 2025. Data were collected using purposive sampling, involving 26 respondents. LDH levels were measured using the International Federation of Clinical Chemistry (IFCC) method. The results showed that elevated LDH enzyme activity was found in 8 patients (31%). Based on age, elevated levels were most common in the pre-elderly group (46–60 years), with 5 patients (63%). Based on sex, elevated levels were predominantly observed in female patients, accounting for 7 cases (88%). Based on obesity status, all patients classified as Obesity I (8 patients, 100%) showed elevated LDH levels. Based on antihypertensive medication use, elevated LDH levels were most commonly found in patients taking amlodipine, with 5 cases (63%). Future research is recommended to explore additional factors that were not examined in this study, such as physical activity, dietary patterns, and a history of vitamin C intake or alcohol consumption.

Kata Kunci

Aktivitas enzim laktat dehidrogenase
LDH
Hipertensi
Obesitas

ABSTRAK

Hipertensi adalah suatu kondisi yang ditandai dengan tekanan darah yang meningkat secara abnormal. Salah satu faktor risiko yang dapat dimodifikasi pada hipertensi adalah obesitas. Peningkatan massa tubuh menyebabkan jantung harus memompa darah lebih kuat sehingga mengakibatkan peningkatan tekanan darah. Salah satu kerusakan yang dialami penderita hipertensi adalah disfungsi endotel, yang dapat menjadi prediktor terjadinya aterosklerosis. Kerusakan ini menyebabkan pelepasan enzim laktat dehidrogenase (LDH) ke dalam darah.
Penelitian ini bertujuan untuk mengetahui gambaran aktivitas enzim LDH pada pasien hipertensi dengan obesitas di RSUD Kabupaten Tangerang. Desain penelitian yang digunakan adalah deskriptif dan dilaksanakan pada bulan Maret hingga Mei 2025. Teknik pengambilan data menggunakan purposive sampling dengan jumlah responden sebanyak 26 orang. Metode pemeriksaan yang digunakan adalah metode IFCC (International Federation of Clinical Chemistry). Hasil penelitian menunjukkan bahwa aktivitas enzim LDH pada pasien hipertensi tergolong tinggi pada 8 responden (31%). Berdasarkan usia, hasil tinggi paling banyak ditemukan pada kelompok pra-lansia (46–60 tahun) sebanyak 5 responden (63%). Berdasarkan jenis kelamin, hasil tinggi lebih banyak ditemukan pada perempuan, yaitu 7 responden (88%). Berdasarkan status obesitas, seluruh responden dengan Obesitas I (8 responden, 100%) menunjukkan hasil tinggi. Berdasarkan penggunaan obat antihipertensi, hasil tinggi paling banyak ditemukan pada kelompok yang mengonsumsi amlodipin, yaitu sebanyak 5 responden (63%). Peneliti selanjutnya diharapkan dapat mengeksplorasi faktor lain yang belum diteliti, seperti aktivitas fisik, pola makan, serta riwayat konsumsi vitamin C atau alkohol.

✉ ***Corresponding Author:***

Maheswari Syifa Puspamurti
Department of Medical Laboratory Technology, The Polytechnic of Health of Banten, Tangerang Indonesia
maheswari.syifa28@gmail.com

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INTRODUCTION

Hypertension is defined as a persistent increase in blood pressure, with a systolic value of ≥140 mmHg and/or a diastolic value of ≥90 mmHg. Uncontrolled high blood pressure over a long period may become permanent. Hypertension is often referred to as the "silent killer" because it generally does not present with noticeable symptoms. Complications of hypertension can lead to endothelial damage and the development of atherosclerosis, which may result in stroke or myocardial infarction.

Globally, approximately 1.28 billion adults aged 30–79 years are affected by hypertension. According to data from the Riset Kesehatan Dasar (Riskesdas) 2018, the prevalence of hypertension in Indonesia was 34.11%. In Banten Province, the prevalence reached 29.47%.

One of the modifiable risk factors for hypertension is excess body weight, commonly referred to as obesity. Obesity can contribute to hypertension through both direct and indirect mechanisms. Tissue damage in the body may affect various enzymes, including lactate dehydrogenase (LDH). LDH is an intracellular enzyme that plays a role in converting pyruvate into lactate to maintain glycolysis and adenosine triphosphate (ATP) production under anaerobic conditions by regenerating nicotinamide adenine dinucleotide (NAD^+) from its reduced form (NADH).

A study conducted by Rahmadi (2024) reported that LDH levels were elevated in patients with preeclampsia, a hypertensive disorder of pregnancy detected at ≥20 weeks of gestation and accompanied by proteinuria.

Based on the above background, the research question of this study is: "What is the overview of LDH enzyme activity in hypertensive patients based on age, sex, obesity status, and antihypertensive medication use?"

The aim of this study is to determine and analyze LDH enzyme activity in hypertensive patients. Specifically, this study aims to examine LDH enzyme activity based on age, sex, obesity status, and antihypertensive medication use.

MATERIALS AND METHODS

Instruments, Materials, and Samples

This study employed a descriptive design using observational methods to describe LDH enzyme activity in hypertensive patients with obesity at Tangerang District Hospital. The research was conducted in the hospital laboratory from March to May 2025. The study population consisted of all hypertensive patients at Tangerang District Hospital during this period.

Samples were selected using a purposive sampling technique based on inclusion criteria (willingness to undergo blood pressure, weight, and height measurements; a history of hypertension; BMI ≥25.0; age 36–60 years; and current use of antihypertensive medications) and exclusion criteria (history of hemolytic anemia, lung disease, or current pregnancy). A total of 26 respondents were included, determined using the Lemeshow formula with an additional 10% to account for potential dropout.

Blood samples were collected from respondents and subsequently centrifuged. The separated serum was transferred into a microtube (200 µL). LDH levels were then measured using a Pentra C-400 analyzer with the IFCC method. The results were presented in tables and narrative form.

This study received ethical approval from the Health Research Ethics Committee of Tangerang District Hospital (No. 000.9.2/012 KEP RSUTNG).

RESULT AND DISCUSSION

Table 1. Distribution of Hypertensive Patients

Characteristics	Frequency (F)	Percentage (%)
Hypertension Category		
Stage 1 Hypertension	20	77%
Stage 2 Hypertension	6	23%
Age (Years)		
Adults (36-45)	7	27%
Pre-elderly (46-60)	19	73%
Gender		

Male	10	38%
Female	16	62%
Obesity		
Obesity I (25.0 – 29.9)	21	81%
Obesity II (> 30.0)	5	19%
Antihypertensive Drugs		
Amlodipine	11	42%
Candesartan	8	31%
Captopril	4	15%
Hydrochlorothiazide (HCT)	2	8%
Adalat Oros	1	4%
Total	26	100%

Table 1 shows the distribution of hypertensive patients. Based on hypertension category, 20 patients (77%) had stage 1 hypertension, while 6 patients (23%) had stage 2 hypertension. Based on age, the majority were in the pre-elderly group (46–60 years), comprising 19 patients (73%), while 7 patients (27%) were in the adult group (36–45 years). Based on sex, 16 patients (62%) were female and 10 patients (38%) were male.

Based on obesity status, most patients were classified as Obesity I (BMI 25.0–29.9 kg/m²), accounting for 21 patients (81%), while 5 patients (19%) were classified as Obesity II (BMI >30.0 kg/m²). Based on antihypertensive medication use, 11 patients (42%) were taking amlodipine, 8 patients (31%) candesartan, 4 patients (15%) captopril, 2 patients (8%) hydrochlorothiazide (HCT), and 1 patient (4%) Adalat Oros.

Table 2. Distribution of Questionnaire Results of Hypertensive Patients

Questionnaire	Frequency (F)	Percentage (%)
Types of Food Consumed		
Vegetables	4	15%
Vegetables & Fruits	9	35%
Vegetables & High-fat foods	6	23%
Vegetables, Fruits, High-fat foods & Fast food	7	27%
Total	26	100%

Table 2 shows the distribution of dietary patterns among hypertensive patients based on questionnaire results. Based on the types of food consumed, 4 patients (15%) reported consuming vegetables only, 9 patients (35%) consumed vegetables and fruits, 6 patients (23%) consumed vegetables and high-fat foods, and 7 patients (27%) consumed vegetables, fruits, high-fat foods, and fast food.

Table 3. Results of LDH Enzyme Activity in Hypertensive Patients

Respondent Characteristics	LDH Enzyme Activity: Low (F)	Low (%)	Normal (F)	Normal (%)	High (F)	High (%)
Hypertension Classification						
Stage 1 Hypertension	1	100%	13	76%	6	75%
Stage 2 Hypertension	0	0%	4	24%	2	25%
Age (Years)						
Adults (36-45)	1	100%	3	18%	3	37%
Pre-elderly (46-60)	0	0%	14	82%	5	63%
Gender						
Male	0	0%	9	53%	1	12%
Female	1	100%	8	47%	7	88%
Obesity						
Obesity I (25.0 – 29.9)	0	0%	13	76%	8	100%

Obesity II (> 30.0)	1	100%	4	24%	0	0%
Antihypertensive Drugs						
Amlodipine	0	0%	6	35%	5	63%
Candesartan	0	0%	6	35%	2	25%
Captopril	1	100%	2	12%	1	12%
Hydrochlorothiazide (HCT)	0	0%	2	12%	0	0%
Adalat Oros	0	0%	1	6%	0	0%
Types of Food Consumed						
Vegetables	0	0%	1	5%	3	38%
Vegetables & Fruits	0	0%	8	47%	1	12%
Vegetables & High-fat foods	0	0%	4	24%	2	25%
Vegetables, Fruits, High-fat foods & Fast food	1	100%	4	24%	2	25%
Total	1	100%	17	100%	8	100%

Table 3 presents the results of LDH enzyme activity in hypertensive patients. Based on reference values, LDH levels differ by sex, with normal ranges of 135–225 U/L for males and 135–214 U/L for females. Overall, 8 patients (31%) had elevated LDH levels, 17 patients (65%) had normal levels, and 1 patient (4%) had low levels. Based on age, patients in the adult group (36–45 years) showed 1 low result (100%), 3 normal results (18%), and 3 elevated results (37%). In the pre-elderly group (46–60 years), 14 patients (82%) had normal LDH levels and 5 patients (63%) had elevated levels.

Based on sex, male patients had 9 normal results (53%) and 1 elevated result (12%). In contrast, female patients had 1 low result (100%), 8 normal results (47%), and 7 elevated results (88%). Based on obesity status, patients classified as Obesity I had 13 normal results (76%) and 8 elevated results (100%), while those classified as Obesity II had 1 low result (100%) and 4 normal results (24%). Based on antihypertensive medication use, patients taking amlodipine had 6 normal results (35%) and 5 elevated results (63%). Those taking candesartan had 6 normal results (35%) and 2 elevated results (25%). Patients taking captopril had 1 low result (100%), 2 normal results (12%), and 1 elevated result (12%). Patients taking hydrochlorothiazide (HCT) had 2 normal results (12%), while those taking Adalat Oros had 1 normal result (6%). Based on dietary patterns, patients who consumed vegetables only had 1 normal result (5%) and 3 elevated results (38%). Those who consumed vegetables and fruits had 8 normal results (47%) and 1 elevated result (12%). Patients who consumed vegetables and high-fat foods had 4 normal results (24%) and 2 elevated results (25%). Meanwhile, patients who consumed all types of food had 1 low result (100%), 4 normal results (24%), and 2 elevated results (25%).

Hypertension classification according to JNC VII consists of stage 1 hypertension (140–159 mmHg and/or 90–99 mmHg) and stage 2 hypertension (≥160 mmHg and ≥100 mmHg). Based on Table 1, the results from 26 respondents showed that the most common classification was stage 1 hypertension, with 20 patients (77%). This finding is consistent with a study by Nurhikmawati (2024), which reported that 25 patients (61%) had stage 1 hypertension, while 16 patients (39%) had stage 2 hypertension.

Risk factors for hypertension, according to the Indonesian Ministry of Health P2PTM (2021), are categorized into non-modifiable factors (such as age and sex) and modifiable factors (including smoking, inadequate fruit and vegetable intake, lack of physical activity, and obesity). Obesity is a condition characterized by excessive fat accumulation due to an imbalance between energy intake and expenditure over time. Increased body mass leads to a higher blood volume, forcing the heart to pump more forcefully, which in turn increases blood pressure.

Elevated blood pressure can cause endothelial dysfunction, resulting in the release of lactate dehydrogenase (LDH) into the bloodstream. The greater the tissue damage, the higher the LDH enzyme activity. LDH plays an essential role in anaerobic glycolysis as a catalytic enzyme. In this study, 8 out of 26 respondents (31%) showed elevated LDH enzyme activity. This finding is consistent with Cai (2023), who reported higher LDH levels in hypertensive patients compared to normotensive individuals, likely due to endothelial damage.

Based on age, elevated LDH levels were more common in the pre-elderly group (46–60 years), with 5 patients (63%), compared to the adult group (36–45 years), with 3 patients (37%). According to Nurhayati et al. (2023), individuals entering the pre-elderly stage tend to experience physiological changes in the cardiovascular system, including the heart, blood vessels, and hormonal regulation, which increase the risk of hypertension and related complications.

Based on sex, elevated LDH levels were more frequently observed in female patients, with 7 cases (88%). This finding is consistent with Ostadi (2023), who reported higher LDH levels in women (56%) compared to men (44%). Estrogen plays a protective role in maintaining vascular function through vasodilation. However, after menopause, estrogen levels decline, leading to increased vascular stiffness and a higher risk of hypertension. Although men also produce estrogen, its levels are relatively low and less effective in providing cardiovascular protection (Rochira et al., 2023).

Based on obesity status, elevated LDH levels were predominantly found in the Obesity I group (8 patients, 100%). This finding aligns with Yu (2025), who reported higher LDH levels in patients with metabolic syndrome (MetS), a condition associated with hypertension and obesity. According to Johari (2018), mild disease conditions may not significantly affect LDH levels, but more severe conditions can lead to increased LDH activity.

Regarding antihypertensive medication use, elevated LDH levels were most commonly found in patients taking amlodipine (5 patients, 63%), followed by candesartan (2 patients, 25%) and captopril (1 patient, 12%). A low LDH result was observed in one patient taking captopril. According to Jayanti et al. (2023), antihypertensive drugs may cause side effects ranging from mild (e.g., dizziness, headache, nausea) to severe (e.g., edema and organ dysfunction). However, in this study, reported side effects were generally mild and not associated with significant tissue damage.

Based on dietary patterns, elevated LDH levels were found in patients consuming vegetables only (3 patients, 38%), vegetables and fruits (1 patient, 12%), vegetables and high-fat foods (2 patients, 25%), and all food types (2 patients, 25%). A low LDH level was observed in one patient consuming all food types. According to Bhargavi (2025), diet can influence LDH activity, as inflammatory responses caused by certain foods may lead to cellular damage and increased LDH levels. Anti-inflammatory foods such as green vegetables, citrus fruits, whole grains, and fish may help reduce LDH levels, whereas processed foods, fried foods, refined sugars, and alcoholic or caffeinated beverages may increase LDH activity. However, further research is needed to evaluate the frequency and quantity of food intake.

CONCLUSION

Based on the results of this study involving 26 respondents at Tangerang District Hospital, most hypertensive patients had normal LDH enzyme activity, although a considerable proportion showed elevated levels. Elevated LDH levels were more frequently observed in the pre-elderly group (46–60 years), female patients, and those classified as Obesity I.

Additionally, elevated LDH levels were most commonly found among patients receiving amlodipine therapy. These findings suggest that LDH enzyme activity in hypertensive patients may be influenced by age, sex, obesity status, and antihypertensive medication use.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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