

URINE KETONE LEVELS IN TUBERCULOSIS PATIENTS IN THE TELAGA DEWA COMMUNITY HEALTH CENTER AREA OF BENGKULU CITY IN 2025

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ABSTRACT

Ketonuria, the presence of ketones in urine, occurs when the body breaks down fat as energy due to a lack of carbohydrates. This process produces ketone bodies (acetone, acetoacetic acid, 3-hydroxybutyric acid). This condition often occurs in people with tuberculosis (TB) due to decreased appetite and side effects of medications that cause a lack of carbohydrate intake. Tuberculosis is a global infectious disease, where Indonesia has the second highest cases in the world. In Bengkulu City, tuberculosis cases are increasing, with the Telaga Dewa Health Center recording the most cases. Tuberculosis is caused by the bacterium *Mycobacterium tuberculosis* which is airborne and is risky for all ages. This study aims to find out the description of urine ketone in tuberculosis patients at the Telaga Dewa Health Center, Bengkulu City in 2025. The sample in this study was 27 people using *the accidental sampling method*. The examination was carried out using the rothera method. The results of the distribution of urine ketone frequency in tuberculosis patients were obtained with 15% positive urine ketone and 85% negative urine ketone results. Based on the results of the research on Urinary Ketone, overview in Tuberculosis Patients at the Telaga Dewa Health Center, Bengkulu City in 2025 on 27 samples, the following results were obtained 15% were positive for urinary ketone. The results of this study are expected for the community, especially tuberculosis patients, to maintain good health and diet.

Keywords: “Ketones; Urine; Tuberculosis”

INTRODUCTION

Ketones are the result of fat metabolism that increases when the body lacks carbohydrates. Under normal conditions, urine does not contain ketones, but in cases of metabolic disorders or low carbohydrate intake, the body breaks down fatty acids and produces ketones (acetone, acetoacetic acid, and 3-hydroxybutyric acid) which are excreted in the urine. Because acetone is highly volatile, urine must be tested fresh to obtain accurate results (Sari et al., 2024). The presence of ketones in urine indicates that the body is using fat as an energy source. The process of forming ketones from fatty acids is called ketogenesis. If ketone production is excessive, this condition is called ketosis. Ketones detected in the blood are called ketonemia, while those detected in urine are called ketonuria (Febriyanto, 2019).

Tuberculosis is an infectious disease that remains a public health problem, especially in developing countries, including Indonesia (Nopita et al., 2023). Tuberculosis patients often experience a decrease in appetite and vomiting due to the side effects of medication, which causes low nutritional intake, especially carbohydrates. When the body lacks glucose as its main energy source, it will switch to using fat as an energy source. This process produces excessive ketone bodies, which then accumulate and can be detected in urine. This condition indicates a metabolic disorder due to insufficient energy intake (Susanti et al., 2022).

The World Health Organization (WHO) in 2023 stated that nearly a quarter of the world's population is infected with *Mycobacterium tuberculosis* bacteria. Approximately 89% of all tuberculosis patients are adults (56.5% male and 32.5% female) and 11% are children. Tuberculosis is one of the 20 leading causes of

death worldwide. Most of the estimated deaths caused by TB are recorded in four countries, namely India, Indonesia, Myanmar, and the Philippines (Indonesian Ministry of Health, 2023). The highest number of tuberculosis cases in Bengkulu City was found at the Telaga Dewa Community Health Center, ranking second after the Padang Serai Community Health Center. Based on a survey conducted at several health centers in Bengkulu City, the number of tuberculosis patients at the Padang Serai Health Center in September 2024 reached 10 people, while at the Telaga Dewa Health Center, there were 50 tuberculosis patients from January to September 2024.

Ketones are the result of the breakdown of fatty acids when the body lacks carbohydrate intake, such as in starvation. In the process of ketogenesis, fatty acids are converted into ketone bodies that are distributed through the blood, and the excess is excreted through urine. When ketone levels exceed the capacity of the kidneys, ketonuria occurs, with acetone and acetoacetic acid as the main components in urine. Ketonuria generally occurs because the body uses fat as an energy source due to glucose deficiency. Causes include a ketogenic diet, low insulin levels, excessive alcohol consumption, repeated vomiting, pregnancy, infection, starvation, physical or emotional stress, and the use of drugs such as corticosteroids and diuretics. Symptoms include excessive thirst, distinctive breath odor, dry mouth, nausea, fatigue, frequent urination, and difficulty concentrating (Suparyati et al., 2024).

The increase in pulmonary tuberculosis cases is caused by various risk factors, such as decreased immunity due to HIV, malnutrition, age, economic pressure, smoking and alcohol consumption, household pollution, overcrowding, and direct contact with TB patients. Low public awareness also plays a role, as it can lead to discontinuation of treatment. Smoking increases the risk of pulmonary tuberculosis by up to 2.2 times, and malnutrition, which includes a lack of calories, protein, and micronutrients, also lowers the body's resistance, thereby increasing susceptibility to infection (Fatri Bakri et al., 2021).

According to the Indonesian Ministry of Health, tuberculosis is transmitted through the air when droplets containing *Mycobacterium tuberculosis* are inhaled by other individuals. These droplets are released into the air when a person with tuberculosis coughs or sneezes without covering their mouth. Each cough can produce around 3,000 droplets of phlegm containing up to 3,500 *M. tuberculosis* germs, while each sneeze can release around 4,500 to 1 million germs. Once inhaled, the bacteria enter the respiratory tract, travel to the lungs, and have the potential to spread to other organs in the body. Response Immunity to this infection generally begins to develop within 6 to 14 weeks after initial exposure.

Tuberculosis is a chronic infection that often causes weight loss and malnutrition due to decreased appetite and nutrient absorption. This condition can trigger energy deficiency and the formation of ketone bodies as an alternative energy source. Side effects of tuberculosis drugs such as nausea and vomiting also reduce glucose intake, thereby promoting fat metabolism. The detection of ketones in urine (ketonuria) in tuberculosis patients can be an indicator of malnutrition or metabolic stress (Susanti et al., 2022). This study aims to determine the profile of urine ketones in tuberculosis patients in the Telaga Dewa Community Health Center area of Bengkulu City in 2025.

MATERIALS AND METHODS

The type of research used was descriptive, with an observational design in which the researcher directly identified the objects to be studied to determine urine ketones in tuberculosis patients in the Telaga Dewa Community Health Center area of Bengkulu City in 2025. The population of this study consisted of tuberculosis patients in the Telaga Dewa Community Health Center area of Bengkulu City, totaling 32 people. This study employed a descriptive observational design. The population comprised 32 registered tuberculosis patients in the Telaga Dewa Community Health Center area of Bengkulu City in 2025. Sampling was conducted using a non-probability accidental sampling technique, involving patients who were present during data collection and met the inclusion criteria. A total of 27 tuberculosis patients were included in the study.

A methodological limitation of this study is that diabetes mellitus was not screened or excluded. Therefore, ketonuria observed in some participants may have been influenced by undiagnosed or uncontrolled diabetes, which could not be differentiated from tuberculosis-related metabolic effects.

The sample in this study was taken from patients who met with the researcher and could be used as samples, if the people met were considered suitable as data sources and the researcher's objective was accidental sampling. The research method involved collecting urine directly using a urine pot, placing 5 ml into a test tube, adding 1 ml of Rhotera reagent to the test tube, then adding 3 drops of 28% NH₄OH reagent, waiting for 3 minutes, and observing the changes that occurred.

RESULTS AND DISCUSSION

Research data from 27 urine samples from tuberculosis patients in the Telaga Dewa Community Health Center area of Bengkulu City, which were examined at the Telaga Dewa Community Health Center Laboratory in Bengkulu City, were then processed univariately using descriptive tests. Sampling was conducted using accidental sampling, then coded using a numbering system. The results of the frequency distribution of urine ketone prevalence can be seen in the following table:

Table 1 Results of urine ketone tests in tuberculosis patients

Keton Urine	Frequency	Presentage(%)
Positive	4	15
Negative	23	85
Total	27	100

Based on Table 1 above, the results of the study of 27 sample. The table show that of all tuberculosis respondents, a small proportion (15%) tested positive for urine ketones and almost all (85%) tested negative for urine ketones.

Based on the findings of research conducted in the Telaga Dewa Community Health Center area of Bengkulu City, there were 27 samples of tuberculosis patients. The results showed that 4 tuberculosis patients were positive for ketones in their urine, while 23 tuberculosis patients were negative. Ketones in urine can be detected using a Rhotera reagent with 28% NH₄OH reagent. A positive result for ketones in urine produces a purple ring at the boundary between the two layers of liquid, while a negative result for ketones in urine does not produce a purple ring at the boundary between the two layers of liquid.

Based on the results of the study, each tuberculosis drug has different potential side effects in each individual. Some drugs can cause a decrease in appetite as a side effect. In this study, it was found that 4 people showed positive results in the urine ketone test, which was caused by a decrease in appetite and nausea, resulting in weight loss in patients. Tuberculosis patients with positive ketones in their urine (ketonuria) experience metabolic disorders due to a lack of carbohydrate intake and no accompanying diseases. The results of this study are in line with Wibowo's (2021) research, which showed positive urine ketones in tuberculosis patients, one of the early signs of ketonuria that can lead to death if left untreated.

Ketone bodies (principally acetoacetate, β -hydroxybutyrate and acetone) are produced in the liver when fatty acid oxidation exceeds the capacity of the citric acid cycle, for instance under conditions of low carbohydrate availability or impaired glucose utilization. Under normal postprandial or overnight-fast conditions the urinary excretion of ketone bodies is negligible; detectable ketonuria typically signals a shift in substrate metabolism.

In the context of this study, the fact that 85 % of participants tested negative suggests that most maintained a relatively normal carbohydrate-based metabolism, with glucose sufficiently available to meet energy demands and minimal diversion of energy generation through fat breakdown. By contrast, the 15 % who were positive for ketones may represent individuals experiencing transient metabolic stress, such as fasting, low carbohydrate intake, or early stages of glucose utilization impairment.

It is also relevant to consider pathophysiological states: persistent ketonuria is frequently associated with conditions such as uncontrolled diabetes mellitus (where glucose cannot be used effectively) or prolonged starvation/fasting states. However, ketonuria is not exclusively pathological — it may appear in healthy individuals under acute stress, intense exercise, or deliberate carbohydrate restriction.

From a research perspective, the relatively low rate of ketone positivity in this group suggests a stable metabolic profile in most respondents. Nonetheless, the presence of ketonuria in a minority indicates heterogeneity in metabolic responses. It would be prudent for researchers to explore additional explanatory variables — such as differing dietary patterns, fasting durations, physical activity levels, or underlying insulin sensitivity.

Further, an interesting angle arises in recent literature examining urinary ketones in large epidemiological samples: for example, one study of over 19,000 subjects found that positive ketonuria was more common in metabolically healthy normal-weight individuals compared to metabolically unhealthy obese ones. This suggests that ketonuria may in some contexts reflect adaptive fat-oxidative metabolism rather than pathology, depending on the metabolic phenotype.

Given this context, the positive ketone results in 15 % of the sample may not necessarily indicate disease; they may reflect normal adaptation to energy state (e.g., a respondent who skipped a meal, engaged in extended exercise, or followed a low-carbohydrate regimen). However, without additional data (e.g., blood glucose, insulin, diet recall) the interpretation must remain cautious.

Methodological factors should also be acknowledged: the accuracy and timing of urine ketone testing affect results. For example, some tests measure acetoacetate primarily, while β -hydroxybutyrate (the major circulating ketone body in many conditions) may not be captured as well. Additionally, urine dilution, time since last void, and diet/exercise preceding sampling can all influence detection rates.

This study found that the majority of tuberculosis patients in the Telaga Dewa Community Health Center area of Bengkulu City in 2025 did not exhibit ketonuria, with 85% of urine samples testing negative for ketones. This finding suggests that most patients maintained adequate energy intake and metabolic balance despite ongoing tuberculosis treatment. The absence of ketonuria in most participants indicates that carbohydrate availability was sufficient to meet metabolic demands, thereby limiting excessive fat metabolism.

However, ketonuria was detected in 15% of patients, indicating the presence of metabolic stress in a subset of individuals. In these patients, ketone positivity is likely associated with reduced appetite, nausea, or weight loss commonly experienced during tuberculosis treatment. Anti-tuberculosis drug side effects may contribute to decreased oral intake, leading to a temporary shift toward fat metabolism and subsequent ketone excretion in urine. This finding is consistent with previous studies reporting ketonuria among tuberculosis patients experiencing nutritional insufficiency during treatment.

Importantly, the occurrence of ketonuria in this study cannot be attributed solely to tuberculosis-related factors. As diabetes mellitus was not screened or excluded, undiagnosed glucose metabolism disorders may have contributed to ketone formation in some patients. This limitation restricts the ability to differentiate ketonuria resulting from tuberculosis-associated nutritional stress from that caused by underlying metabolic disease.

Overall, the low prevalence of ketonuria observed in this study indicates that most tuberculosis patients in this setting were metabolically stable at the time of examination. Nevertheless, the presence of ketonuria in a minority of patients highlights the need for closer nutritional monitoring and metabolic assessment, particularly among individuals experiencing poor appetite or significant weight loss during tuberculosis treatment.

CONCLUSION

Based on the research results table and discussion of urine ketones in tuberculosis patients in the Telaga Dewa Community Health Center area of Bengkulu City in 2025, it can be concluded that a small proportion (15%) tested positive for urine ketones and almost all (85%) tested negative for urine ketones.

CONFLICT OF INTEREST (if any)

There is no conflict of interest for this study.

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