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Stability of Urine Glucose in Active-Smoking Adolescents with Delayed Examination Times

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ABSTRACT

Urine glucose is one of the important parameters in early screening for glucose metabolism disorders. The presence of glucose in urine occurs when blood glucose levels exceed the renal threshold, causing it to be excreted in the urine. Adolescents with long-term smoking habits may develop insulin resistance, which increases the risk of glucosuria. This study aimed to describe the results of urine glucose examinations among active-smoking adolescents with delayed testing at 2, 4, and 6 hours at a storage temperature of 2–8°C in Private College X. This research employed a descriptive observational design. The samples consisted of 30 active-smoking adolescents whose urine specimens were examined using the dipstick method. The results showed that all urine samples were negative for glucose, even after a delay of up to 6 hours. No indicator color changes were observed on the test strips during the storage period. These findings may be related to stable glucose metabolism and an intact renal reabsorption threshold in adolescents.

Keyword: Urine glucose; Adolescents; Active smokers; Delayed testing; Stability

ABSTRAK

Glukosa urine merupakan salah satu parameter penting dalam skrining awal gangguan metabolisme glukosa. Adanya glukosa dalam urine terjadi ketika kadar glukosa darah melebihi ambang ginjal sehingga diekskresikan melalui urine. Remaja dengan kebiasaan merokok jangka panjang dapat mengalami resistensi insulin sehingga meningkatkan risiko terjadinya glukosuria.

Penelitian ini bertujuan untuk mengetahui gambaran hasil pemeriksaan glukosa urine remaja perokok aktif dengan penundaan waktu 2, 4, dan 6 jam pada suhu penyimpanan 2–8°C di Perguruan Tinggi Swasta X. Penelitian ini menggunakan desain deskriptif observasional. Sampel terdiri dari 30 remaja perokok aktif yang diperiksa menggunakan metode dipstick. Hasil penelitian menunjukkan bahwa seluruh sampel urine memberikan hasil negatif terhadap glukosa, meskipun terdapat penundaan hingga 6 jam. Tidak ditemukan perubahan warna indikator pada strip uji selama masa penyimpanan. Temuan ini dapat disebabkan oleh masih stabilnya metabolisme glukosa serta ambang reabsorpsi ginjal yang belum mengalami gangguan pada kelompok usia remaja.

Kata Kunci: glukosa urine; remaja; perokok aktif; penundaan pemeriksaan

INTRODUCTION

Adolescence is a crucial phase in the human life cycle, characterized by rapid physical, emotional, and social development(1). During this period, individuals undergo identity formation and begin exploring social values and lifestyle behaviors, including those that pose health risks(2,3). Significant hormonal changes combined with the desire for social acceptance make adolescents highly vulnerable to deviant behaviors such as smoking(4).

Smoking among adolescents is no longer merely an individual phenomenon but has become a significant public health concern. According to WHO, more than 60 million Indonesians are active smokers, and this number is projected to increase to 90 million by 2025, with the majority coming from the younger population(5). Data from Riskesdas 2018 also indicate an increasing prevalence of smoking among individuals aged 16–19 years, reaching 20.5%, with initiation occurring as early as 10–14 years of age(6).

Long-term exposure to toxic substances in cigarettes, such as nicotine, carbon monoxide, and tar, contributes to an increased risk of non-communicable diseases including coronary heart disease, chronic respiratory diseases, cancer, and diabetes mellitus(7,8). Prolonged smoking may lead to insulin resistance through oxidative stress pathways and chronic inflammation, which play a role in the pathogenesis of hyperglycemia and glucosuria(9).

One consequence of chronic hyperglycemia is glucosuria, which occurs when blood glucose levels exceed the renal reabsorption threshold (approximately 160–180 mg/dL). Urine glucose testing is a commonly used screening tool in clinical laboratories due to its non-invasive, rapid, and cost-effective nature(10). The dipstick method, based on enzymatic reactions involving glucose oxidase and peroxidase, allows semi-quantitative detection of glucose through color changes(11). However, the validity of test results is strongly influenced by the timing and temperature of urine specimen storage(12).

According to the *Clinical and Laboratory Standards Institute* (CLSI), urine specimens should ideally be examined within two hours of collection. When delays are unavoidable, samples must be stored at 2–8°C to prevent degradation of chemical components such as glucose(12). Previous studies have shown that delayed testing without refrigeration can lead to significant decreases in urine glucose levels due to enzymatic activity and microbial growth(13). Even under refrigerated conditions, glucose stability must still be evaluated as storage time increases(14).

On the other hand, laboratory practice often encounters technical challenges such as delayed specimen transport or high patient volume, making postponement of urine testing unavoidable. In this context, it is important to determine the extent to which urine glucose results remain accurate after certain delays, particularly among active-smoking adolescents who may have a higher risk of metabolic disturbances.

Based on this background, this study aims to evaluate the urine glucose examination results of active-smoking adolescents with delayed testing at 2, 4, and 6 hours at a storage temperature of 2–8°C. The findings are expected to provide a scientific basis for urine specimen handling in

laboratories and serve as a reference to overcome technical limitations frequently encountered in daily clinical practice.

METHODS

This study was conducted at STIKES Wira Medika Bali during the period of February to April 2025. The research employed a descriptive observational design, which is a type of study used to describe or obtain factual information regarding specific symptoms or conditions without administering any interventions to the research subjects. The study population consisted of all male students from one of the academic programs at STIKES Wira Medika Bali. A total of 30 samples were included, selected using a non-probability purposive sampling technique based on predetermined inclusion and exclusion criteria. Primary data were collected through questionnaire administration and urine glucose examination using random urine samples obtained from male students at the private college X. The collected data were then processed and presented in tabular form. This study was conducted in accordance with research ethics and was supported by an ethical clearance certificate, Number: 493/E1.STIKESWIK/EC/IV/2025.

RESULTS

The present study included 30 adolescent active smokers who participated in the research conducted at the Clinical Chemistry Laboratory of STIKES Wira Medika Bali. Respondents' demographic and lifestyle characteristics were collected using a structured questionnaire. Regarding age, participants ranged from 19 to 21 years old. The majority were 21 years old (46.7%), followed by 19 years old (30%) and 20 years old (23.3%) (Table 1).

Table 1. Respondent Characteristics Based on Age

Age	Frequency (n)	Percentage (%)
19 years	9	30
20 years	7	23.3
21 years	14	46.7
Total	30	100

All respondents were light smokers, consuming 1–10 cigarettes per day, with no moderate or heavy smokers in the sample (Table 2). The duration of smoking varied, with most participants having smoked for 1–5 years (70%), while the remaining 30% had smoked for 6–10 years (Table 3).

Table 2. Respondents' Characteristics by Daily Cigarette Consumption

Cigarette Consumption	Frequency (n)	Percentage (%)
Light Smoker (1–10 cigarettes/day)	30	100
Moderate Smoker (11–20 cigarettes/day)	0	0
Heavy Smoker (>20 cigarettes/day)	0	0
Total	30	100

Table 3. Respondents' Characteristics by Duration of Smoking

Duration of Smoking	Frequency (n)	Percentage (%)
1–5 years	21	70
6–10 years	9	30
Total	30	100

All participants reported not consuming any medications (Table 4). Regarding alcohol consumption, 26.7% of respondents consumed alcohol, while 73.3% did not (Table 5). A family history of diabetes mellitus was uncommon among respondents, with only 3.3% reporting a positive history and 96.7% reporting no such history (Table 6).

Table 4. Respondents' Characteristics by Medication Consumption

Group	Frequency (n)	Percentage (%)
Consuming medications	0	0
Not consuming medications	30	100
Total	30	100

Table 5. Respondents' Characteristics by Alcohol Consumption

Group	Frequency (n)	Percentage (%)
Consuming alcohol	8	26.7
Not consuming alcohol	22	73.3
Total	30	100

Table 6. Respondents' Characteristics by Family History of Diabetes Mellitus

Group	Frequency (n)	Percentage (%)
Family history of DM present	1	3.3
No family history of DM	29	96.7
Total	30	100

Urine glucose levels were assessed using the dipstick method at four time points: immediately after collection (0 hours), and after 2, 4, and 6 hours. All urine samples tested negative for glucose at each time point, indicating no detectable glucosuria among the adolescent smokers (Table 7).

Table 7. Urine Glucose Examination Results Using Dipstick Method

Examination Time	Sample Size	Positive Result	Negative Result
0 hours (fresh)	30	0	30
2 hours	30	0	30
4 hours	30	0	30
6 hours	30	0	30

These results provide a comprehensive overview of the demographic and lifestyle characteristics of adolescent active smokers in this cohort and establish baseline urine glucose levels in this population.

DISCUSSION

The present study was conducted at STIKES Wira Medika Bali. After completing the questionnaire, potential respondents who met the inclusion criteria were selected and required to complete the informed consent form. They were then interviewed to verify responses related to alcohol and medication consumption to ensure accuracy. Subsequently, respondents were provided with urine collection cups, and the procedures for sample collection were clearly explained by the researchers.

The characteristics of the study subjects were obtained from the questionnaires and interviews. These characteristics included demographic data such as age and behavioral factors related to the study variables, including daily cigarette consumption, duration of smoking, history of medication and alcohol use, and family history of diabetes mellitus (DM). These characteristics were chosen as they are considered potential confounding factors influencing urine glucose examination results.

Based on the study conducted on 30 adolescent active smokers at the private university, all urine glucose tests were negative across all time points, including immediate testing (0 hours) and delayed testing at 2, 4, and 6 hours. This finding indicates that adolescents with a smoking habit did not exhibit glucosuria. Glucosuria generally occurs when blood glucose levels exceed the renal threshold, approximately >180 mg/dL, causing excess glucose to be excreted in urine. One possible explanation for the negative findings is that the participants were light smokers, whose metabolic status may not yet result in significant changes in blood glucose levels.

A study by Maddatu et al. reported that smoking, even at light to moderate intensity, is significantly associated with an increased risk of type 2 diabetes mellitus; however, this effect is more pronounced in long-term or high-exposure smokers(15). In light smokers, especially adolescents, metabolic changes such as insulin resistance or hyperglycemia may not have developed substantially, so blood glucose levels remain within normal limits and below the renal reabsorption threshold, preventing glucosuria. Additionally, adolescents physiologically have relatively optimal organ function and metabolism, allowing them to maintain glucose homeostasis despite early exposure to toxic substances like nicotine(16,17). Therefore, the negative urine glucose results in this group can be attributed to the preserved regulation of blood glucose and kidney function.

Another factor contributing to stable metabolism in adolescents is physical activity. Regular physical activity optimizes metabolism and helps control blood glucose levels, thereby preventing glucosuria. Physical activity enhances insulin sensitivity in body cells(18). This is supported by a study by Sundayana et al., which demonstrated a correlation between physical activity and reduced blood glucose levels(19). Higher levels of physical activity increase carbohydrate utilization as an energy source for working muscles. As physical activity intensifies, energy expenditure rises, leading to a decrease in blood glucose levels(20). Conversely, insufficient physical activity may trigger insulin resistance, resulting in elevated blood glucose levels(21).

In summary, the negative urine glucose results observed in adolescent light smokers can be explained by a combination of factors, including light smoking intensity, preserved physiological function and glucose homeostasis, and the beneficial effects of physical activity, which together maintain blood glucose levels below the threshold for renal glucose excretion.

CONCLUSION

Urine glucose examination in 30 adolescent light smokers showed consistently negative results at all time points, indicating no glucosuria, and future studies are recommended on older or long-term smokers, or individuals with a family history of diabetes mellitus and heavy smoking habits, to further explore the impact of chronic smoking on glucose metabolism.

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