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Crystal sediment profile in the urine of public transportation drivers on route 2 in Kupang city

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Abstract

Background: Drivers have a profession that requires prolonged sitting, leading to the release of bone calcium into the bloodstream, which can trigger the formation of urinary stones or nephrolithiasis. Urinary stone (nephrolithiasis) is a condition where stones form in the urinary tract. *Objectives*: The aim of this study was to describe the crystal sediment profile in the urine of public transportation drivers on Route 2 in Kupang City. *Materials and Methods*: This descriptive study involved 16 public transportation drivers on Route 2 in Kupang City as research subjects. Data were collected through interviews. *Results*: The results showed the presence of various crystals in the urine sediment, including Calcium Oxalate crystals (25%), Calcium Carbonate crystals (18.75%), Uric Acid crystals (12.5%), and Amorphous crystals (6.25%). *Conclusions*: Based on the characteristics and habits of the respondents, it was found that frequent urinary retention, drinking less than 1 liter of water per day, and consuming supplemented or carbonated drinks were the three main factors affecting urine sedimentation in public transportation drivers on Route 2 in Kupang City.

Keywords

Driver, Public transportation, Urine sediment crystals.

1. Introduction

Urinary sediment is a solute component in urine originating from blood, kidneys, and the urinary tract. If allowed to accumulate over time, it can lead to the formation of urinary tract stones (UTS). Urinary sediment examination is crucial as it provides essential information to aid in diagnosing and monitoring diseases, especially those affecting the kidneys and urinary tract (Naid et al., 2015).

Urinary tract stones (UTS) are a condition where stones are formed within the urinary tract due to prolonged crystalline sedimentation of urine. The formation of UTS is believed to be related to urinary flow disorders, metabolic disorders, urinary tract infections, dehydration, and other yet-to-be-uncovered conditions (Marlini, 2018). UTS generally

contain elements such as Calcium Oxalate, Calcium Phosphate, Uric Acid, Magnesium-Ammonium-Phosphate (MAP), Xanthine, and Cystine. Various types of kidney stones include Calcium, Struvite, and Cystine stones. The most commonly found crystals are Calcium Oxalate and Uric Acid crystals, while other types of crystals are rarely encountered (Hasanah, 2016).

In a study by (Mulsim, 2007), titled UTS - a lifestyle and dietary problem and its economic analysis in treatment, conducted in Semarang, it was stated that people with sedentary jobs like drivers are more prone to UTS compared to those with physically active jobs. Drivers have a profession that requires them to sit for extended periods, increasing the risk of UTS.

In their daily routine, drivers have long working hours due to considerable travel distances, with minimal rest time during work, leading them to sit even longer to withhold the urge to urinate while on the road. Repeatedly withholding urination can have adverse effects on the body, especially on the bladder. Frequent urination withholding can lead to urinary bladder diseases known as urolithiasis, which is urinary tract infections (Ardianzah, 2016). Drivers are divided into two groups: private drivers who operate private vehicles and company drivers who work for public transportation companies such as taxis, buses, public transportation (angkot), or cargo transportation (Erfiani, 2017).

Public transportation is still one of the transportation choices for the people of Kupang City, although not as much as two decades ago. Public transportation is often used because it is fast, cheap, easily accessible, besides reducing the use of private vehicles and alleviating traffic congestion. The most popular public transportation routes in Kupang City are Routes 1 and 2 (Manu, 2016). These routes are quite busy compared to others, with drivers of various ages. Age backgrounds can depict drivers' behavioral patterns and habits in carrying out their duties, including habits of drinking water, withholding urination, and consuming supplements or soda drinks.

The aim of this study is to determine the profile of urinary sediment crystals in public transportation drivers on Route 2 in Kupang City based on drivers' characteristics, inorganic urinary sediment crystals found, and drivers' habits.

2. Materials and Methods

This study is descriptive research, aiming primarily to observe or describe the profile of urinary sediment crystals in public transportation drivers on Route 2 in Kupang City. Sampling was conducted on Route 2 of public transportation, and subsequently, the samples were examined at the Clinical Chemistry Laboratory of the Medical Laboratory Technology Department, Poltekkes Kemenkes Kupang, carried out in March-April 2022. The sample in this study comprised 16 public transportation drivers on Route 2 in Kupang City. The sampling technique used in this research is Total sampling, which is a sampling technique where the sample size equals the population size.

Data were collected descriptively, and the research findings will be discussed by comparing the obtained results with existing theories regarding the characteristics of public transportation drivers, such as age and duration of employment, habits of public transportation drivers, including urination withholding, drinking habits of water, and duration of sitting during work, as well as the results of microscopic examination of urinary sediment.

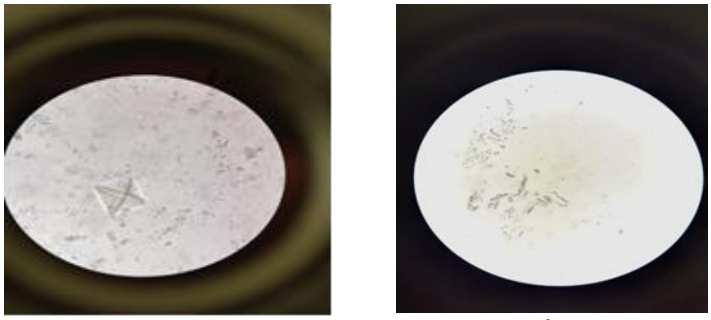
3. Results and Discussion

A study on the Profile of Urinary Sediment Crystals in Public Transportation Drivers on Route 2 in Kupang City in 2022 has been conducted at the Clinical Chemistry Laboratory of the Medical Laboratory Technology Department, Poltekkes Kemenkes Kupang, with a sample size of 16 samples who were previously informed and consented to participate in the study by signing an informed consent form. This study has been approved by the Health Research Ethics Commission (KEPK) of Poltekkes Kemenkes Kupang with the approval number LB.02.03/1/0046/2022. After conducting the research, the following results were obtained.

Table 1. Distribution of frequency of urinary sediment crystals in public transportation drivers on route 2 in Kupang City in 2022

No.	Category	Frequency (n)	Percentage (%)
1	Positive uric acid crystals (+$C_5H_4N_4O_3$)	2	12,5
2	Positive calcium oxalate crystals (+CaC_2O_4)	4	25
3	Positive calcium carbonate crystals(+$CaCO_3$)	3	18,75
4	Positive amorphous crystal (+Amr)	1	6,25
5	Negative (-)	6	37,5
	Total	16	100

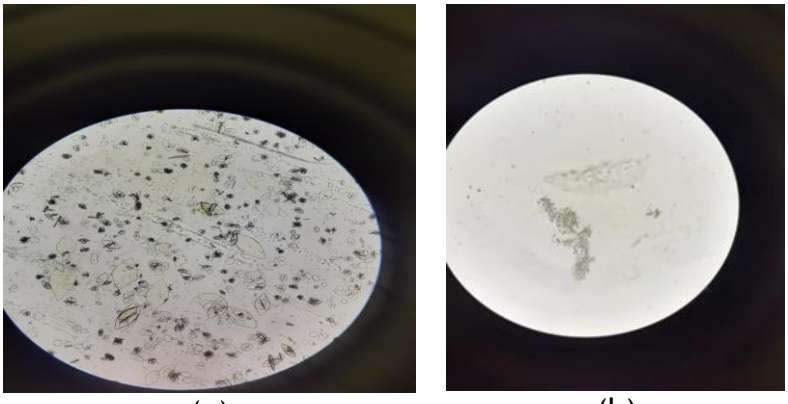
The research findings indicate that the most commonly found urinary sediment crystal in this study is calcium oxalate crystal (Figure 1a).



(a) (b)

Figure 1. (a) Calcium Oxalate Crystals one of the respondents.
(b) Calcium Carbonate Crystals one of the respondents

Calcium oxalate crystals were found most frequently because, based on the data obtained through the questionnaire, many respondents reported drinking insufficient water, frequently holding urine, sitting for prolonged periods during work, and consuming vitamin C/supplements. The next crystal is calcium carbonate crystal (Figure 1b), which forms due to drinking water with a high content of lime. Then, there are uric acid crystals (Figure 2a), which are actually a normal component of blood and urine, meaning the human body naturally always has limited amounts of uric acid. Lastly, the least commonly found crystals are amorphous crystals (Figure 2b).



(a) (b)

Figure 2. (a) Uric Acid Crystal from one of the respondents.
(b)Amorphous Crystal from one of the respondents

These crystals are often found in normal urine. If found in urine with a basic pH, they are called amorphous phosphate, and if found in acidic pH, they are called amorphous urate. Table 2 shows the frequency distribution of urine sediment crystal based on age.

Table 2. The frequency distribution of urine sediment crystal based on age

No.	Age (Year)	Examination Results					Total	
		Neg.	$+C_5H_4N_4O_3$	$+CaC_2O_4$	$+CaCO_3$	+Amr		
		n	n	n	n	n	N	%
1	17-25	2	0	1	0	0	3	18,75
2	26-35	2	0	2	3	1	8	50
3	36-45	2	0	1	0	0	3	18,75
4	46-55	0	2	0	0	0	2	12,5
	Total	6	2	4	3	1	16	100

The research results indicate that most of the positive findings were observed in respondents aged ≥30 years. Based on the table above, out of 16 respondents, 10 of them experienced urine sedimentation, with the highest number of positive results found in the age group of 26-35 years, comprising 8 respondents (50%). These findings were obtained through interviews followed by urine sample examination in the laboratory. The youngest respondent who experienced urine sedimentation was 24 years old, while the oldest was 54 years old.

Table 3. Frequency distribution of urine sediment crystal based on age group and daily water drinking habit

No.	Age (year)	Daily Water Drinking Habit/day				Total	
		≤1 liter		>1 liter			
		Pos.	Neg.	Pos.	Neg.	N	%
1	17-25	0	1	1	1	3	18,75
2	26-35	5	2	1	0	8	50
3	36-45	0	1	1	1	3	18,75
4	46-55	2	0	0	0	2	12,5
	Total	7	4	3	2	16	100

Based on Table 3, it is known that respondents who drink less water (≤1 liter/day) are at risk of urine sediment formation, as seen in the examination results where 7 out of 10 respondents with positive findings of urine sediment crystals consume ≤1 liter/day of water.

Table 4. Frequency distribution of urine sediment crystal based on age group and frequency of holding Urination

No.	Age	Frequency of Holding Urination						Total	
		Often		Sometimes		Never			
		Pos.	Neg.	Pos.	Neg.	Pos.	Neg.	N	%
1	17-25	1	0	0	2	0	0	3	18,75
2	26-35	4	2	2	0	0	0	8	50
3	36-45	0	2	1	0	0	0	3	18,75
4	46-55	2	0	0	0	0	0	2	12,5
	Total	7	4	3	2	0	0	16	100

Tabel 4 shows that out of 16 respondents, 10 of them experienced urine sedimentation, with 7 respondents often holding urination and 3 respondents occasionally holding urination. The results of this study are consistent with the theory that the habit of drivers holding urination also contributes to urine sedimentation. The habit of frequently holding urination can lead to urinary stasis. Urinary stasis can cause hyper saturation and crystal aggregation, leading to the formation of urine sediment, which is the initial stage of urinary tract stones (UTS)(Susiwati et al., 2020).

Table 5. Distribution of Frequency of Urine Sediment Crystal Based on Sitting Duration While Working and Years of Working as a Driver

No.	Sitting Duration	Years of Working as a Driver						Total	
		<5 years		6-10 years		>10 years			
		Pos.	Neg.	Pos.	Neg.	Pos.	Neg.	N	%
1	<10 hours/day	3	2	1	2	1	0	9	56,25
2	>10 hours/day	3	1	0	1	2	0	7	43,75
	Total	6	3	1	3	3	0	16	100

Based on Table 5, it can be observed that out of the 10 respondents with positive results, 6 respondents, who had been working for less than 5 years and were considered new drivers, tested positive. Additionally, 4 respondents had been working for 6 to ≥10 years. Theoretically, drivers who sit for >10 hours/day and have been working for 6-10 years or even >10 years could be factors contributing to urinary sedimentation. However, the field examination revealed contrasting results. Through interviews with the 6 respondents who had been working for <5 years, it was found that 3 respondents had a sitting duration of <10 hours/day. It was discovered that other factors influenced urinary sedimentation, such as habits of drinking water, frequent urine retention, and consumption of supplements/soda drinks. These factors could lead to urinary sedimentation among public transportation drivers in Route 2 of Kupang City, despite their varying lengths of employment.

Table 6. Distribution of frequency of urinary sediment crystal based on age and habit of consuming supplements/soda drinks

No.	Age	Consuming Supplements/Soda Drinks						Total	
		Often		Sometimes		Never			
		Pos.	Neg.	Pos.	Neg.	Pos.	Neg.	N	%
1	17-25	0	0	1	2	0	0	3	18,75
2	26-35	2	2	4	0	0	0	8	50
3	36-45	1	0	0	2	0	0	3	18,75
4	46-55	1	0	1	0	0	0	2	12,5
	Total	4	2	6	4	0	0	16	100

Based on Table 6, it can be observed that out of 16 respondents, 10 experienced urinary sedimentation, with 4 respondents having a habit of frequently consuming supplements/soda drinks and 6 respondents occasionally consuming supplements/soda drinks. This indicates that consuming supplements or soda drinks may lead to urinary sedimentation. It appears that regardless of how often supplements/soda drinks are consumed, there is still a positive result in the urinary sediment examination. Frequent consumption of supplements/soda drinks (soft drinks) can lead to acidification with phosphoric acid, which can increase the risk of urinary tract stone disease. (Alfianti, 2018).

Table 7. Distribution of frequency of urinary sediment crystal based on frequent urinary retention and consumption of soda/supplements drinks

No.	Consumption of Soda/Supplements	Holding urination habit						Total	
		Often		Sometimes		Never			
		Pos.	Neg.	Pos.	Neg.	Pos.	Neg.	N	%
1	Often	2	2	2	0	0	0	6	37,5
2	Sometimes	5	2	1	2	0	0	10	62,5
3	Never	0	0	0	0	0	0	0	0
	Total	7	4	3	2	0	0	16	100

Based on Table 7, it can be observed that out of 16 respondents, 10 of them experienced urinary sedimentation. The highest number of positive results, totaling 2 respondents, was among those who frequently consumed supplements/soda and frequently held back urination. Additionally, there were 5 respondents who occasionally consumed supplements/soda and frequently held back urination, 2 respondents who frequently consumed supplements/soda and occasionally held back urination, and 1 respondent who occasionally consumed supplements/soda and occasionally held back urination.

Based on the results presented in Table 1, this study aligns with the research conducted by Clarita Reko on the Description of Urinary Sediment Crystal in Bus Drivers at Oebobo Bus Terminal, Kupang City, in 2019. Out of 17 bus drivers, amorphous crystals were found in 88.2% of cases, calcium oxalate crystals in 35.2%, sodium urate crystals in 23.5%, calcium carbonate crystals in 11.7%, and uric acid crystals in 5.8% (Reko, 2019). Another study by Shania Girsang on the Description of Calcium Oxalate Crystals in Urinary Sediment of Security Guards at PT. Bintang Sigra Anugerah Security Services, Palembang, in 2021, revealed that 66.7% of respondents were negative for calcium oxalate crystals, while 33.3% were positive (Girsang, 2021).

The findings from Table 2 are consistent with the study conducted by Ni Made Ratih Dwi

Marlini on Urine Sediment Characteristics in Bus Drivers at Mengwi Bus Terminal, Badung Regency, in 2018. The study explained that the increase in urinary sediment formation corresponds with age and reaches its peak in adulthood. This occurs because the kidneys develop from infancy to adulthood along with an increase in renal concentration capacity, resulting in increased crystallization in the loop of Henle I. Nephrons in children are underdeveloped, characterized by shortening and reduced volume of the proximal tubules and the Henle loop. This shorter size reduces the opportunity for crystal formation, leading to urinary sedimentation (Marlini, 2018). Another study by Susiwati, Jon Farizal, and Leni Marlina on the Relationship between Risk Factors for Urinary Sediment Formation in Drivers in Bengkulu City in 2019 found positive respondents ranging from the youngest at 35 years old to the oldest at 69 years old, indicating that age influences urinary sediment formation in individuals (Susiwati et al., 2020).

The positive and negative results in this study may be influenced by several factors, including internal factors originating from within the individual, such as age and gender (Purnomo, 2015). External factors, such as environmental factors surrounding the individual, like drinking habits, duration of work, duration of sitting while working, and habit of holding back urination, also play a significant role (Faila, 2018).

It is noted that three respondents who consumed more than 1 liter of water per day still experienced urinary sedimentation (positive), as indicated in Table 3. This positive result may be due to the high calcium content in the water consumed, leading to urinary sedimentation with continuous consumption. Another factor that may affect positive results is gender; all respondents in this study were male. This aligns with the theory that males are at four times higher risk than females. Males are more prone to kidney stones because their urinary tract is longer than that of females, and factors such as activity intensity, physical influence, and hormones also play a role. Testosterone hormone significantly influences the increase in endogenous oxalate production in the liver (Purnomo, 2015). These findings are consistent with a study by Nur Lina on Risk Factors for Urinary Tract Stones in Men in 2008, which identified insufficient water intake as a risk factor for urinary tract stones, recommending the consumption of 2-2.5 liters (approximately 8 glasses) of water daily and emphasizing the importance of drinking 250 ml of water before bed (Lina, 2008). The behavior of drivers reducing their daily water intake can increase urinary water concentration in the body. Increased urinary water

production causes drivers to urinate more frequently, but sometimes irregularly while working and often holding back urination during travel, leading to health problems such as back pain suspected to be due to the kidneys working harder to concentrate urine to meet the body's fluid needs, which can trigger the formation of kidney stones (Wahyuni, 2013).

This study also aligns with Marlini's research on Urine Sediment Characteristics in Bus Drivers at Mengwi Bus Terminal, Badung Regency, which found the highest percentage of calcium oxalate crystals in the group with the habit of frequently holding back urination, as seen in Table 4.

The results in Table 5 are consistent with previous research by Anggun Setiowati on Preventive Measures for Recurrent Urinary Stones in the Redisari Village, Rowokele Sub-District, Kebumen Regency, in 2016, which stated that one of the risky behaviors causing urinary tract stones is prolonged sitting, advising against prolonged sitting and recommending changing positions every hour to reduce the risk of urinary tract stones (Setiowati, 2016). Prolonged sitting during work disrupts body metabolism. When working in a prolonged sitting position, bone calcium is released into the blood, leading to hypercalcemia, which in turn triggers urinary tract stones due to electrolyte/crystal supersaturation in the urine. Supersaturated (thick/concentrated) urine begins to form solid crystals that can eventually become stones (Lina, 2008). This aligns with Marlini's findings in her study, stating that a lack of movement significantly increases the risk of urinary sediment formation, which can lead to kidney stones if daily activities involve mostly sitting(Marlini, 2018).

The average positive result of urinary sediment examination, as shown in Table 6, was in respondents aged 26-35 years, which is still considered young adulthood. Factors that may affect positive results include gender; all respondents in this study were male. This aligns with the theory that males are at four times higher risk than females, and factors such as activity intensity, physical influence, and hormones also play a role. Testosterone hormone significantly influences the increase in endogenous oxalate production in the liver (Purnomo, 2015). Another factor that may affect positive urinary sediment results in respondents categorized as young adults is the habit of frequently holding back urination, as revealed during interviews.

The highest number of positive results was found in respondents who occasionally consumed supplements/soda but frequently held back urination, as seen in Table 7. This indicates that certain habits, such as consuming supplements/soda and holding back urination, significantly influence urinary sediment formation in individuals, specifically in respondents working as public transportation drivers on Route 2 in Kupang City.

4. Conclusions

From this study, it can be concluded that the characteristics of public transportation drivers on Route 2 in Kupang City in 2022 are as follows: 50% of them are aged 26-35 years old, with less than 5 years of experience as public transportation drivers (37.5%), drivers who sit for less than 10 hours per day (31.25%), and drivers who sit for more than 10 hours per day (31.25%). Four types of inorganic urinary sediment crystals were obtained, namely Calcium Oxalate crystals (25%), Calcium Carbonate crystals (18.75%), Uric Acid crystals (12.5%), and Amorphous crystals (6.25%). The habits of public transportation drivers on Route 2 in Kupang City in 2022 include drinking less than 1 liter of water per day (25%), frequently holding back urination (43.75%), and occasionally consuming supplements/soda (37.5%).

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