

# Risk Factors Related to the Crystalluria Case among Workers at Welding Department Of Automotive Industry X Jakarta

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**Abstract.** : The case of crystalluria occurs in almost all types of work. However, its prevalence has not been recorded since crystalluria is the early indicator for urolithiasis and urinary tract disorder. Crystalluria found either in person in normal condition or disorder. In normal people, the crystalluria will disappear within a few days if the person is controlling and avoiding the risk factors. This study aims to look at the relationship between job factors and individual factors with crystalluria cases in welding workers. The study's sample was 220 workers out of 1,253 population at the Welding Department Industry Automotive X Jakarta. Primary data collection was done through a questionnaire, interviewed, measured body weight before and after work, measured of wet and bulb globe temperature (WBGT) in the workspace. Then, secondary data collection was done through employees' medical checkup records (MCU). Univariate and bivariate analyses were used by chi-square and independent T-test. The research found that the significant risk factors to the occurrence of crystalluria were body weight (OR = 1,38; 95% CI = 1,09 to 1,92), the balance of body fluids (OR = 5,77; 95% CI = 2,79 to 11,33), and high purine foods consumption (P-value of 0,04; SD: 237,1). So, the recommendation for controlling risk factors of crystalluria is increasing physical activity, hydration, and dietary adjustments.

**Keywords:** crystalluria; urine crystallization; body weight; body fluids; purine

## 1 Introduction

Urinary crystals, or in medical known as crystalluria was the discovery of the crystals in the urine as sediment. This condition can be seen from the urine analysis in the clinical laboratory. Urine crystals are found both in people under normal conditions and in the presence of interference. For a normal person, crystals in the urine may disappear within a few days if the person has been avoiding the main cause of crystal appearance. Then, crystals of urine are one of the biomarkers that urine has too saturated (supersaturation) due to the metabolic system abnormalities. The presence of a disease, especially in the excretory system kidney and urinary tract (e.g., urinary tract infections and kidney stones); consumption of a particular food; or effect of excessive long-term consumption of drugs [1].

The exact number case of crystalluria was unrecorded due to urine crystals is an early indicator before the advent of stones in the urinary tract (urolithiasis). So, it was often neglected. In the United States in 2014, cases of urinary tract stones were reported around 36 cases per 100,000 population per year. In Indonesia, the incidence of urinary tract stones has

not been recorded with certainty but was estimated 170,000 cases per year. Moreover, in Indonesia, the most common cause of kidney failure was due to urinary tract infections and stones in the urinary tract where both can be prevented when the first indicator (urine crystals) has been detected [2].

According to the Medical Check-Up (MCU) which is routinely done every 2 years In the automotive industry X Jakarta, the result from last three times checked (the year 2011, 2013, 2015) was found that the case numbers of urine crystals are always in the second position (after caries gangrene Radix). Then, from all departments in the industry, the welding department has the highest prevalence cases for crystalluria, which amounted to 27.5%, or about 345 people out of 1,253 workers. □

## **2 Method**

The study design used mixed methods (mixed methods) with sequential exploratory strategy. The sequential exploratory strategy is the method of research that combines the qualitative research method in the first stage and quantitatively in the next stage. Qualitative methods used to discover the hypothesis on the specific cases or limited sample and quantitative methods used to test the hypothesis found from qualitative research on the wider population. The study was conducted at the same time, collected by the observation momentary or within a certain period and only one time observations during the study research. The sample research respondent is 220 workers from the 1.253 population at the welding department automotive industry X Jakarta.

## **3 Results**

Respondents who state as positive crystalluria is having positive (+) calcium oxalate and/or uric acid in the urine. It was known from the urinalysis result at MCU 2015 reports. The urinalysis results have been distributed to each worker. The respondents should have known that he was crystalluria positive or not.

Based on the MCU 2015 report, 86 respondents (39.1%) crystalluria positive, but only 37 respondents (16.8%) were aware that he was suffering from crystalluria. So, 49 people did not realize that he had crystalluria. It means, most of the respondents did not understand the terms contained in their MCU report. For example, the term of crystalluria in an MCU report was positive (+) Ca oxalate and/or uric acid. In addition, there are also other urine parameters on the results of urinalysis MCU, for example, amorphous (+), protein (+) to protein (+++). For that reason, to increase the worker's awareness about crystalluria, the corporate should be given a more detailed explanation to workers.

**Table 1.** Overview Crystalluria Cases Comparison between Respondent's Questionnaire Answers and MCU 2015 Report

Crystalluria	MCU 2015 Report		Respondent's Questionnaire Answers	
	Freq (n)	%	Freq (n)	%
Yes	86	39,1	37	16,8
No	134	60,9	183	83,2
Total	220	100	220	100

### Factors Related to Crystalluria

To see the relation between the independent variables (job factors and individual factors) with the dependent variable (crystalluria) was analyzed with bivariate analysis using the chi-square test and independent T-test. Data distribution is normally based on normality test results.

### Individual Factors Related to Crystalluria

The variables of individual factor are age; the history of another abnormality urine sediment (exclude crystalluria); the history of drug consumption that contains antimicrobial, antiviral agent & diuretic; heredity; physical activity; body mass index; mineral water consumption; body fluid balance; urination frequency; and food consumption.

From 10 variables of individual factor, 3 variables have a statistically significant related to crystalluria case, there are body mass index (P-value = 0.031 and OR = 1.38); body fluid balance (P-value = 0.041 and OR = 5.77); and foods consumption with high purine (P-value of 0.040). (Table 6)

The balanced weight is influenced by a healthy diet, sufficient physical activity, heredity (genetics), and the amount of sleep [21]. The research found for physical activity and heredity didn't have a meaningful relationship with the case of crystalluria. So, workers need to adjustment their healthy diet and improve their total rest. For workers, meals during work hours need to be considered and managed well by the company because the company provides facilities for lunch and overtime meals and dinner for night shift workers.

The research found that crystalluria related to an imbalance body fluid variable. Measurement of body fluid balance is done by calculating the difference in weight when the workers before work and after work. The results are many workers had lost weight. It ranged from 0.5 kg - 2.2 kg. (Tabel 6). Moreover, imbalanced body fluid can be associated with an insufficient number of drinking water per day (Table 2). The research found that respondents with crystalluria (+) are 40,6% lack of mineral water consumption amount, and interval of drinking time was bad also because of its takeover than 2 hours. Most respondents' reasons are the distance of the working area and dispenser is too far and drinking water in the weird workplace taste (Table 3).

**Table 2.** Respondents Mineral Water Drinking Habits a Day at Welding Automotive X Jakarta 2016

	Categories	Crystalluria				Total	%
		(+)	%	(-)	%		
Amount of Mineral Water Consumption	Less	76	40,6	111	59,4	187	100
	Enough	10	30,3	23	69,7	33	100
Drinking time interval	Over 2 Hours	45	42,1	62	57,9	107	100
	Less 2 Hours	41	36,3	72	63,7	113	100

**Table 3.** Respondents Reasons for Less Drinking Per Day in the Working Area at Welding Automotive X Jakarta 2016

Reason	Categories	Crystalluria				Total	%
		(+)	%	(-)	%		
Glass or dispenser dirty/weird taste	Yes	24	49	25	51	49	100
	No	62	36,3	109	63,7	171	100
Distance of working area and water dispenser	Yes	41	36,9	70	63,1	111	100
	No	45	41,3	64	58,7	109	100
Workload	Yes	21	46,7	24	53,3	45	100
	No	65	37,1	110	62,9	175	100
Forbidden to bring drinking water to the work area □	Yes	11	33,3	22	66,7	33	100
	No	75	40,1	112	59,9	187	100

Due to complaints about the weird taste of drinking water in the work area, been performed testing of mineral water in the area complained. The measurements used calibrated Spectrophotometer HACH DR / 2700. The results were drinking water had a chlorine content amount of 3.54 mg/liter. (Table 4). This amount exceeds the threshold limit value, which is suggested in SNI 01-3553-2006; the maximum amount is 0.1 mg/liter [22]. The high free chlorine (Cl<sub>2</sub>) in the drinking water of this in humans could be at risk of irritation of the esophagus, burning sensation in the mouth and throat, sores in the organ tissue (tissue injury), and acute asthma. Whereas in mice experiments, Cl<sub>2</sub> consumption in a long time causes a decrease in saliva glands, kidney weight loss, and potential leukemia [23]. Until these studies are complete on the date of June 15, 2016, this finding is still under investigation by an EHS Division Automotive X Jakarta, so the basic cause still unknown.

**Table 4.** Result of Physical and Chemistry Analysis for Mineral Water at Welding Automotive X Jakarta 2016

Parameter	Unit	Tested Result	SNI 01-3553-2006 Recommendation
Smell	-	Smelly	No Smell
Flavor	-	Weird	Normal
pH		7,59	6,0 – 8,5
Turbidity	NTU	0,181	Max. 15
Total dissolved solids	mg/liter	174	Max. 500

Chloride (Cl)	mg/liter	4,3	Max. 250
Organic substances (KMnO4)	mg/liter	0,00	Max. 0,1
Sulfate (SO4)	mg/liter	8	Max. 200
Ammonium (NH4)	mg/liter	0,001	Max. 0,15
Iron (Fe)	mg/liter	0,00	Max. 0,1
Nitrate (NO3)	mg/liter	5,7	Max. 45
Nitrite (NO2)	mg/liter	0,003	Max. 0,005
Fluoride (F)	mg/liter	0,39	Max. 1,0
Copper (Cu)	mg/liter	0,00	Max. 0,5
Cyanide (CN)	mg/liter	0,049	Max. 0,05
Manganese (Mn)	mg/liter	0,000	Max. 0,05
Chlorine (Cl <sub>2</sub> )	mg/liter	<b>3,54</b>	Max. 0,1

Crystalluria is related to food consumption, especially foods containing high purine, high oxalate, diuretics, and salt. The research found, from the four categories of these foods. Statistically, high-purine foods had a meaningful relationship with the case of urine crystallization. Actually, consumption of high-purine food reached 163 times per month or about 5 times per day. □

**Table 5.** Overview of Respondents Crystalluria Case Distribution Monthly

Kind of Food	Crystalluria	Mean	Std. Deviation	Std. Error Mean	P-Value□
High Purine	(+)	<b>163</b>	237.1	25.6	<b>0,04</b>
	(-)	122.2	95.6	8.3	
High Salt	(+)	31.3	64.2	6.9	0,559
	(-)	27.1	40.8	3.5	
High Oxalate	(+)	47.5	52.4	5.7	0,140
	(-)	38.5	37.7	3.3	
Diuretic	(+)	48.1	46.1	5	0,226
	(-)	40.9	41.1	3.6	

**Table 6.** Overview of Respondent's Individual Factors Distribution (age; the history of another abnormality urine sediment (exclude crystalluria); the history of drug consumption that contain antimicrobial, antiviral agent & diuretic; heredity; physical activity; body mass index; mineral water consumption; body fluid balance; urination frequency)

Variables from Individual Factor	Categories	Crystalluria				Total		P-value	OR 95% CI
		(+)		(-)		N	%		
		N	%	N	%				
Age	>= 40 tahun	3	42,9	4	57,1	7	100	0,836	1,18 0,26 – 5,38
	< 40 Years old	83	39	130	61	213	100		
History of another abnormalities urine sediment (exclude crystalluria)	Yes	39	43,8	50	56,2	89	100	0,236	1,39 0,81 – 2,42
	No	47	35,9	84	64,1	131	100		
history of drug consumption that contains antimicrobial, antiviral agent & diuretic	Yes	5	50	5	50	10	100	0,469	1,59 0,45 – 5,67
	No	81	38,6	129	61,4	210	100		
Heredity	Yes	14	35	26	65	40	100	0,558	0,81 0,4 – 1,65
	No	72	40	108	60	180	100		
Physical activity	Less	13	34,2	25	65,8	38	100	0,498	0,78 0,37 – 1,62
	Enough	73	40,1	109	59,9	182	100		
Body mass index	Over – Obes	26	53,1	23	46,9	49	100	<b>0,031</b>	1,38 1,09 – 1,92
	Underweight	4	21,1	15	78,9	19	100		
	Normal	56	36,8	96	63,2	152	100		
Mineral water consumption	Less	76	40,6	111	59,4	187	100	0,262	1,58 0,71 – 3,5
	Enough	10	30,3	23	69,7	33	100		
Body fluid balance	Unbalance	62	55,4	50	44,6	112	100	<b>0,005</b>	5,77 2,79 – 11,33
	Balance	24	22,2	84	77,8	108	100		
Urination frequency	Less	51	40,8	74	59,2	125	100	0,551	1,18 0,68 – 2,05
	Enough	35	36,8	60	63,2	95	100		

## Job Factors Related to Crystalluria

The research found that from the six job factors variables, there are none of them having a significant statistical relationship because of P-value or all variables less than 0.05. However, the variable heat needs more attention because the average temperatures index work area reaches to 28,16°C. (Table 7,8). Based on the measurement of wet-bulb globe temperature at eight sampling points using Questemp 34, the result is some work area has a value exceeding threshold limit value (TLV) (Table 9).

**Table 7.** Overview of Respondents Distribution by Job Factor: Work Period, Heat and Exposure Interval

Variable	Crystalluria	Mean	Std. Deviation	Std. Error Mean	P-Value
Work Period (year)	(+)	8,17	3,4	0,4	0,788
	(-)	8,04	3,9	0,3	
Heat (°C)	(+)	28,16	0,3	0,1	0,230
	(-)	28,23	0,3	0,1	
Exposure Interval (month)	(+)	317,31	48,4	5,2	0,175
	(-)	304,81	75,9	6,6	

**Table 8.** Overview of Respondents Distribution by Job Type, Work Shift, and Work Area

Characteristic	Kategori	Crystalluria				Total		P-value	OR 95% CI
		(+)		No		N	%		
		N	%	N	%				
Job Type	<i>Sedentary</i>	20	51,3	19	48,7	39	100	0,085	1,834
	<i>Non-Sedentary</i>	66	36,5	115	63,5	181	100		0,914 – 3,683
Work Shift	Shift A	53	40,2	79	59,8	132	100	0,840	0,911
	Shift B	17	35,4	31	64,6	48	100		0,581 – 1,429
	Non Shift	16	40	24	60	40	100		
Work Area	<i>Body 1</i>	47	41,2	67	58,8	114	100	0,722	1,321
	<i>Body 2</i>	25	38,5	40	61,5	65	100		0,832 – 2,097
	BQC	14	34,1	27	65,9	41	100		

**Tabel 9.** Wet-Bulb Globe Temperature Result

Sampling Location	Area	Sk (°C)	Sba (°C)	Sg (°C)	Rh (%)	ISBB	NAB
Body 1	Under front	30,7	27,4	31	65,7	<b>28</b>	28
	Underbody	31	27,5	31,4	65,7	<b>28,5</b>	28
	Main body	30,1	27,5	30,8	64,9	<b>28</b>	28
	Metal finish	31,4	27,3	31,5	69	<b>27,8</b>	28
Body 2	Under front	30	26,7	30,6	73	<b>28</b>	28
	Underbody□	31,7	27,4	32,0	70	<b>28,4</b>	28
	Main body	30,8	27,1	31,2	71	<b>27,9</b>	28
	Metal finish	30,9	26,9	31,1	70	<b>28</b>	28

#### 4 Conclusion

Of the ten types of variables examined individual factors, there are three variables of individual factors that have a statistically significant relation to the case of crystalluria. There are body mass index, body fluid balance, and food consumption with high purine. As well, the variable factor of six occupations studied, there are no variables that have a statistically significant relation to the case of crystalluria. But the heat temperature in the work area must get more attention because the result of wet-bulb globe temperature measurement is exceeded TLV.

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