Conference Paper

The Differences in the Urinary Phenol Levels between Operators and Administrators at Gas Station in Surabaya

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Abstract

Benzene that enters the body will undergo metabolism, will became benzene epoxide in the liver which is an unstable compound and will change the phenol form to excreted in the urine. This study aimed to analyze the differences in urinary phenol levels between operators and administrator officers at a gas station in Surabaya. The method of this analytical study was observation with a cross-sectional study. Research sites were gas stations of Sisingamangaraja street XIII, Kenjeran Street 99 and Sumatera Street 25. The research conducted from March to July 2014. The population of this study was two populations that were the operator of a gas station and the administrative officers of a gas station in Surabaya with some criteria. Sample size had 22 persons that were taken by simple random sampling, 11 persons from each operator and administration worker. Data analyzed used independent t-test — the results of this study showed that there were differences in urinary phenol levels between operators and administrators at gas stations in Surabaya ($p<0.05$). This study concluded that exposure to benzene vapor increased urinary phenol levels. Operators would potentially have higher levels of phenol urine than administrative officers — periodic monitoring of urine phenol levels in the gas station workers in Surabaya to determine intoxication benzene vapor. These results suggest the use of personal protective equipment for workers at filling stations which may include a gas mask, gloves, shoes, and unique clothes. Washing hands after work should make a habit.

Keywords: Exposure of benzene vapor; gas station; phenol urine level

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1. Introduction

Benzene that enters the body is metabolized and becomes benzene epoxide in the liver which is an unstable compound and will change to be phenol that will remove in the urine. Therefore, phenol urine used as a biological indicator of benzene exposure for workers. The higher levels of phenol in urine indicate the higher degree of benzene poisoning (Kirkeleit J et al. 2008; Marwati and Novianti 2011).

Benzene gets in the human body through the respiratory tract (throat and lungs), gastrointestinal and the skin. When a person inhales benzene in high concentrations, the

half of these concentrations will enter the airways and go into the bloodstream (ATSDR 2006; ATSDR 2007).

Levels of benzene in the air have a concentration between 0.002 to 34 ppb. People who live in cities or industrial environment can generally be exposed to a high level of benzene. People will be exposed to benzene at a high level when he worked in the oil industry such as oil processing units, gas stations and petrochemical industries (ATSDR 2007).

Benzene exposure occurs through food and drink, and for the most part, will go into the gastrointestinal tissues and blood. A small portion of benzene will enter through the skin by direct contact between the skin and the benzene or products that contain benzene. In the blood, benzene will circulate throughout the body and can be temporarily stored in the bone marrow and fat and will be converted to be a metabolism product in the liver and bone marrow. The output of the metabolism will go out through the urine about 48 hours after exposure (ATSDR 2007).

Research shows the median and interquartile range of each metabolite concentrations between groups of 30 subjects which were grouped by exposure to benzene. Exposure to benzene increased, also increased metabolite level (coefficient correlation for phenol median value 0.973, 0.945 benzoquinone, catechol 0.934, 0.973 muconic acid and S-PMA, p: 0.001). This shows benzene exposure significantly increases the level of metabolites. Increased exposure, benzene contribution of each metabolite is consistently increasing (Kim 2006).

Research also shows the measurement results of benzene in petrol stations Surabaya exceed 5 point NAB is 9.6085 ppm, 9.7215 ppm, 11.7375, 10.4705 and 10.2975 ppm. Measurements of phenol urine at gas station workers showed that 6 of 28 respondents had phenol level >10 mg / l (not normal). Continuous exposure can lead to chronic effects that affect the health of workers, including workers' immune system. Disorders of the immune system can lead to being easily sick and decreasing productivity and causing lost work days. By learning and anticipating the continued effects caused by exposure to benzene; it is necessary to measure the moisture content in the air for benzene and phenol level in the urine of workers filling stations in Surabaya (Putranti 2011).

Based on the above study, researchers will analyze the differences in urinary phenol level between the operators and the administrators at the petrol station in Surabaya.

2. Methods

This research is an analytic observational cross-sectional study (cross-sectional). The location of research was at the pump Jl. Singamangaraja XIII, Jl. Kenjeran 99 and Jl.

Sumatra 25 Surabaya. The research was conducted during March-July 2014. The study population consisted of two populations, a gas station operator and the comparison group, station administration. This study had the following inclusion criteria:

1. Male
2. Worked at least one year continuously - again
3. No pain in the last two weeks before the examination
4. Did not smoke
5. Willing to be a respondent

Based on the above criteria, a large study population was 13 operators and 12 administrative workers. The research sample was taken randomly (simple random sampling), and there was a sample size of 11 people. A sampling of benzene in the air was done using GC / FID & HC analyzer with flame Ionization methods and reference NIOSH METHODE 1501. A sampling of phenol in the urine used the urine bottle. Samples were analyzed by spectrophotometric method. To analyze the differences in urinary phenol level in the exposed and unexposed groups, it used independent samples t-test.

3. Results and Discussion

3.1. Benzene vapor

A sampling of benzene in the air was done using GC / FID & HC analyzer with flame Ionization methods and reference NIOSH benzene METHODE 1501. Measurements were conducted in the administration and the operator work areas based on Minister of Manpower and Transmigration No.Per.13 / MEN / X / 2011 on the Threshold Limit Value Factor Physical and Chemical Factors at Work, stating that the threshold value should be below 0.5 ppm benzene. Level of benzene in the administrators and the operators can see in Table 1.

Table 1: Distribution of benzene vapour.

Location	Benzene vapour (ppm)	
	Administration room	Operator room
Gubeng gas station	0.0569	1.3202
Kenjeran gas station	0.0638	2.0714
Pelikan gas station	0.2495	0.9446
Mean (SD)	0.1234 (0.0884)	1.4454 (0.4857)
Based on Permenakertrans No. 13/MEN/X/2011 about 0,5 ppm		

Table 1 showed the average level of benzene in the administrators was 0.1234 ppm to 0.0569 ppm, becoming the lowest value and the highest value owas 0.2495 ppm while the average level of benzene in the operator was 1.4454 ppm to 0.9446 ppm, the lowest value and the highest value was 2.0714 ppm. Level of benzene in the operator exceeded the threshold value. This study is in line with other research, which shows the results of measurements of benzene in petrol stations Surabaya exceed 5 point NAB by 9.6085 ppm, 9.7215 ppm, 11.7375, 10.4705 and 10.2975 ppm(Putranti 2011).

This study was also in line with the previous studies, stating that level of benzene in the air had a concentration of between 0.002 to 34 ppb. People who lived in cities or industrial environment could generally get exposed to benzene at level greater. Benzene exposure had been shown to be higher for those working in the oil industry in oil processing units, gas stations and petrochemical industries (Kirkeleit J et al. 2008; Marwati and Novianti 2011).

3.2. Phenol urine level

Phenol urine was analyzed using a spectrophotometric method. According to WHO (1996) on occupational exposure, urine phenol content of <10 ppm did not show any significant exposure. Phenol urine in exposed and unexposed groups can see in Table 2.

Table 2: Distribution of phenol urine based on groups.

Phenol urine (ppm)	Groups				Total	
	Exposed		Unexposed		n	%
	n	%	n	%		
0 – 12	0	0	10	91	11	50
13 – 25	4	36	1	9	4	18
26 – 38	1	9	0	0	1	5
39 - 51	4	36	0	0	4	18
52 - 65	2	19	0	0	2	9
Total	11	100	11	100	22	100
Mean (SD)	36.6064 (15.667)		2.9773 (5.108)			

Table 2 showed the average level of phenol in the urine of an unexposed group was 2.9773 ppm to 0 ppm, showing the lowest value, and the highest value was 16.34 ppm while the average phenol urine of 36.6064 ppm exposed group with the smallest amount of 18.04 ppm and 64.06 ppm highest value.

Differences in phenol urine of exposed and unexposed groups could be determined by using independent samples t-test. Differences in phenol urine for exposed and unexposed groups could bee seen in Table 3.

TABLE 3: The analysis result of phenol urine.

Parameter	The differences		p
	Exposed group	Unexposed group	
	Mean (SD)	Mean (SD)	
phenol urine	36.606 (15.667)	2.977 (5.108)	0.000

Table 3 showed that the difference between the level of phenol urine in exposed and unexposed groups was statistically significant at $p < 0.05$. This may imply that the phenol urine exposed group was higher than the unexposed group. Research showed the measurements of phenol in the gas station workers in Surabaya showed that 6 out of 28 respondents had phenol level> 10 mg / l (not normal) and phenol urine was affected by the standards of benzene (Putranti 2011).

4. Conclusions

The conclusion of this study was that the level of benzene in pump operator areas is more significant than in the administration room. Phenol urine average of an operator was 36.6064 ppm whereas the standard for administration workers was 2.9773 ppm. There were differences in urine phenol level between gas station operators and administrators in Surabaya.

5. Suggestions

Monitoring urine phenol level periodically in the gas station workers in Surabaya to determine intoxication due to benzene vapor is recommended. It is also recommended that personal protective equipment used by workers at filling stations which includes gas masks, gloves, shoes, and unique clothes. Washing hands after work should make a habit.

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