

Conference Paper

Effect of Exposure of Toluene to Eyes and Skin on Footwear-factory Workers in Bogor, West Java

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Abstract

Workers in footwear factories use adhesives that contain toluene. Toluene is one of aromatic hydrocarbon compounds, insoluble in water, but toluene can dissolve other substances. In this case, this research is to know toluene concentrations in the workplace, symptoms of eyes and skin irritation, to determine the relationship between toluene concentrations in the workplace and eye and skin irritation. The design of this research is cross-sectional in footwear factory in Ciomas, Bogor, West Java on August till September 2017. The variables are toluene concentrations in the workplace, symptoms of eyes and skin irritation. With the amount of 40 respondents, the data is collected by questionnaire and measurement. Air samples were collected at nine points to measure toluene concentrations in the workplace and analyzed with Gas Chromatography (GC). Data are analyzed in *univariat* and *bivariat* with 95%CI ($\alpha = 0.05$). The result of analysis showed that the average toluene level in workplace is 0.9628 ppm, with a range of 0.00238–6.02806 ppm. Workers who experienced eyes irritation were 35 percent with 25 percent red eyes complaints, 27.5 percent watery eyes, 32.5percent a foreign body sensation, 32.5 percent sore eyes, and 5 percent with eyes feeling hot. Workers who has got a skin irritation were 30 percent with 15 percent skin redness, 35 percent itchy skin, 27.5 percent dry skin, 7.5 percent cracked skin, and 5% dermatitis. There was no relation between concentration toluene in the workplace and eye irritation complaints with p -value 0.188. Also, there was no relation between concentration toluene in the workplace and skin irritation with p -value 0.284. We hope workers use personal protective equipment such as masks and eye protection when working so as to be not exposed to toluene at workplace.

Keywords: toluene, eyes irritation, skin irritation, footwear factory

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1. Introduction

In the process of making footwear, chemicals can harm the health workers among others the use of adhesive. From the measurement levels steam of organic solvents 3.567 company in a small scale to large in Japan by Ukai et al. [1] between 1999 and 2002 got that in general company that greater lower levels of steam organic solvents in the workplace than corporations smaller. This is because the larger scale in general better and conducted well control technique in the workplace [1]. National Institute of Occupational Safety and Health reported 9.8 million people workers in the United States and 400.000 workers in Denmark exposed organic solvents. Benzene, toluene, xylene and styrene is organic solvents aromatic most often used to industry [2].

Footwear manufacturers in Indonesia are divided into two groups, large-scale and export-oriented subcontracted manufacturers for overseas shoe brands and small to medium-sized producers that generally supply the local market. Producers a small scale this can be found in several cities in East Java and West Java [3]. Ciomas Bogor is one of the areas in West Java that many producing footwear. On the production process footwear in ciomas using adhesive containing the solvent one of them is toluene. Workers can be exposed to adhesive then inhale chemical vapors and absorbed through the skin because the adhesive is often used by hand. Can also ingest chemicals when smoking, eating or drinking at work.

Toluene is one of aromatic hydrocarbon compounds, insoluble in water but toluene can dissolve other substances [4]. Toluene as a solvent that much used as a substitute for solvent benzene more toxic. So that continuous exposure can be bad for the health of the workforce. Workers who use toluene as a solvent can cause health problems such as dizziness, vertigo, irritation of the eyes, irritation on the skin, respiratory disorders, hepatic impairment, kidney disorders and central nervous system disorders [2].

2. Methods

This research is a quantitative research with cross sectional approach, which is a research to know exposure toluene in the air of work environment and the incidence of eyes irritation and skin by using questionnaire and measurement, data collection or observation from independent variable and dependent variable observed only once a time (point time approach) [5].

The research was conducted in the footwear factory located in Ciomas Sub-district, Bogor District. The study was in August until September 2017. The population in this

study were workers in the informal footwear factory in 2017 with a total of 476 people. The sampling technique in this research is multistage random sampling, then the sample is 40 people who spread in 3 footwear factory.

Data were collected using Eye Irritation Questionnaire with 5 questions (≥ 2 questions symptoms experienced were eye irritation), skin irritation questionnaire with 5 questions (≥ 2 questions symptoms were skin irritation) and Air samples were collected at 9 points to measure toluene concentrations in the workplace and analyzed with Gas Chromatography (GC). then data processing in the form of editing, coding, entry and cleaning. Univariate and bivariate data analysis used Man Whitney test with 95% CI ($\alpha = 0.05$).

3. Results

3.1. Workers characteristic

The results of the study showed 32 (80%) respondents a men and women 8 (20%) respondents. The age of the average is 33 with standard deviations 11.337, the youngest 16 years and the oldest 58 year. Working period average is 11 years with standard deviations 8.215.

3.2. Toluene concentration in the workplace

The results of the analysis of air samples in the work environment at 9 sampling points show the presence of toluene exposure in all footwear factory that are sampled. All working air samples analyzed containing toluene are still below the threshold values established by the Ministry of Manpower and Transmigration RI No PER.13/MEN/X/2011 [6]. The average toluene level in workplace is 0.9628 ppm, with a range of 0.00238–6.02806 ppm.

3.3. Symptoms of the eyes and skin irritation

Workers who experienced eyes irritation is 35 percent with complaints red eyes 25 percent, the watery eyes 27.5 percent, a foreign body sensation 32.5 percent, sore eyes 32.5 percent and eyes feels hot 5 percent.

TABLE 1: Toluene concentration in the workplace.

Sampling Points	Toluene Concentration
1	0.05077
2	0.08993
3	0.03811
4	0.00238
5	0.6046
6	1.21195
7	0.3146
8	0.32553
9	6.02806

While worker who has got a skin irritation is 30 percent with skin redness 15 percent, itchy skin 35 percent, dry skin 27.5 percent, cracked skin 7.5 percent and dermatitis 5 percent.

TABLE 2: Percentage of eye and skin irritation symptoms on workers.

Symptom	N	%
Eyes Irritation	14	35
Red eyes	10	25
The watery eyes	11	27.5
A foreign body sensation	13	32.5
Sore eyes	13	32.5
Eyes feels hot	2	5
Skin Irritation	12	30
Skin redness	6	15
Itchy skin	14	35
Dry skin	11	27.5
Cracked skin	3	7.5
Dermatitis	2	5

Analyzed bivariat with man Whitney test with 95% CI ($\alpha = 0.05$) got that there was no relation between concentration toluene in the workplace and complaints eye irritation with p -value 0.188. Also, there was no relation between concentration toluene in the workplace and skin irritation with p -value 0.284.

4. Discussion

In the footwear production process in Ciomas Bogor using glue containing toluene solvent. Workers may be exposed to glue and inhale chemical vapors can also be absorbed through the skin because glue is often used by hand. It can also be through the eyes, ingested chemicals when smoking, eating and drinking in the workplace.

The concentration of toluene at 9 points of measurement in the footwear factory in Ciomas Bogor is still below the value of the applicable exposure limit in Indonesia, which is 50 ppm as stipulated by the Minister of Manpower and Transmigration No. PER.13/MEN/X/2011 and Indonesian National Standard (SNI) 19-0232-2005, the limit set in Indonesia equal to the threshold value set ACGIH (1995) [6–8].

The toluene exposure pathway in the human body through eye contact can cause disturbance of the mucous membrane of the eye, toluene fluid that enters the eye can result in corneal injury. Meanwhile, through repeated or prolonged skin contact with liquid toluene can damage the skin, causing it to crack and peel. Toluene absorption through the skin occurs when there is contact between toluene and the skin. Absorption through the skin is very slow between 14 and 23 mg/cm²-hour [9].

Based on the results of research in Ciomas 30 percent of respondents experienced skin irritation, same thing with the results of research ILO (2004) study explains that there were five health problems that are often experienced by workers in the shoe industry Tasikmalaya and Ciomas one of them is skin irritation is as much as 9 percent [3]. Mixtures of organic solvents have been associated with dermatitis, mucous membrane irritation, eye irritation and sore eyes [10].

5. Conclusions

The average toluene level in workplace is 0.9628 ppm, with a range of 0.00238–6.02806 ppm. Workers who experienced eyes irritation is 35 percent with complaints red eyes 25 percent, the watery eyes 27.5 percent, a foreign body sensation 32.5 percent, sore eyes 32.5 percent, and eyes feels hot 5 percent. Worker who has got a skin irritation is 30 percent with skin redness 15 percent, itchy skin 35 percent, dry skin 27.5 percent, cracked skin 7.5 percent, and dermatitis 5 percent.

There was no relation between concentration toluene in the workplace and complaints eye irritation with *p*-value 0.188. There was no relation between concentration toluene in the workplace and skin irritation with *p*-value 0.284.

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