Insurance as Efforts to Control Risk Disease Caused by Benzene for Home Industry Shoes Workers

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Abstract: This study aimed to determine the risk characteristics of workers exposed to benzene and their insurance as an effort to control the risk of occupational diseases in the shoe home industry in Surabaya. The research method was a descriptive study by describing the risk control with insurance based on the characteristics of the exposure to benzene. The sample size was 20 shoe home industry workers. The data analysis used was descriptive. The results showed that the highest benzene concentration was 7.44 mg/m^3, the average intake of benzene was 0.00363 mg/kg/day, and that the Excess Cancer Risk of the 20 respondents >10^{-5} means that the exposure to benzene was not safe for their health. The safe duration for the workers between 0,03 - 3.53 years means that the workers have a high risk of suffering from leukemia due to their exposure to benzene. Because it is high risk, the workers must be insured. However, based on the research results, 100% of the workers had no insurance (BPJS Ketenagakerjaan); the home industry had no Pos Upaya Kesehatan Kerja. From the results of the study, it has been concluded that the workers have a high risk of exposure to benzene. The workers had no insurance (BPJS Ketenagakerjaan) and no Pos Upaya Kesehatan Kerja so there was no protection for the workers.

1 INTRODUCTION

Benzene is in the working environment of shoemakers. Therefore it is an absolute necessity to know the level of risk of the exposed groups. This study has measured 8 work sites to determine the broader picture of benzene concentration.

One of the UKMs in Indonesia is the informal industry of shoe craftsmen. In the early 1990s, the footwear industry became a major contributor to Indonesia's Gross National Product as the third largest national income after the wood and textile industry. About 40 percent of Indonesia's shoe exports are shipped to the US market, while 33 percent are shipped to Europe. The rest are exported to African, Middle Eastern and South American countries.

The efforts of shoemakers to maintain the quality and existence of their products are often not matched by the protection from the occupational risks associated with harmful equipment and materials. The use of hazardous materials or chemicals in shoe crafting includes using glue as a material for the process of making shoes. The process consists of several stages of work, starting with making the shoe design, preparing the tops of the shoes (patterning, pattern cutting, stripping, decorating, sewing and insoles), preparing the bottom of the shoe (outer soles, gluing, coat, sewing, nailing) finishing (cleaning, smoothing) and packing for subsequent delivery to the consumer/market in the production process using a variety of equipment (Maryiantari, 2016).

Shoe work is a risky job. Long working hours not supported by a safe and comfortable workplace, uncomfortable body position, and harmful equipment. Equipment used in the production process includes electric heating/ fire (oven), nails and hammer, raw materials made of fabric, synthetic leather or plastic materials. For the process of gluing, the workers use two types of glue; yellow glue Pro ARDico Brand, glue LK and white glue PU-Weber brand, DS-Bond DNS 818. Yellow glue is used to connect the openings so it is usually used in the surface and finishing, while white glue is

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generally used to patch the soles because of the much stronger adhesion force. In a normal situation (normal day), within a month they can use 30-40 kg of yellow glue and white glue by approximately 30 kg. The use of the glue means that it is poured in to small containers such as bottles, drinks with open positions or directly from a container of 3kg glue size (Maryiantari, 2016). Based on the research conducted by Hendra, it stated that there is an organic solvent in the glue in the form of benzene by about 1-2%.

The various equipment and materials used in the shoe making process is one of the high risk hazards involved. The use of chemicals can be detrimental to the health of the shoemakers. One of them is the use of glue. In the process, there is an organic solvent vapor contained in the glue that is very likely to have an impact on health if inhaled continuously for long periods of time (Lu, 2006).

Benzene, when inhaled, can cause aplastic anemia and leukemia. Research conducted in Europe, America and Mexico has shown a significant relationship between elevated levels of benzene in the air and increased rates of cancer and local leukemia. In other studies in the United States, it has been shown that inhaling benzene even at the threshold can cause chromosomal abnormalities in sperm cells.

Indonesian National Standard in 2005 refers to Permenaker No. 13 of 2011 which contains the time-weighted avarage of workplace-treated chemical substances, with the number of working hours of 8 hours per day or 40 hours per week. It states that benzene is included in the A2 group (Chemical substances estimated to be human carcinogens) and has a NAB of 10 ppm or 32 mg/m^3 benzene in the air (SNI 2005).

The occurrence of health problems due to benzene exposure in shoe workshop workers is reported to occur in China, which is the largest shoe manufacturer in the world. A restrospective cohort study of 75,000 workers exposed to benzene from 1987 to 1991 in 12 Chinese cities found that 43 groups of workers were exposed to benzene. This study suggests that the workers exposed to benzene are at a higher risk of dying from leukemia with a relative risk of 2.3 compared with the workers not exposed to benzene (Chen and Chan, 1999).

Risk control is a preventive method that is done in such a way that the risk does not occur. One effort to control the risk of disease in workers is with insurance. Health insurance is an insurance product that provides a finance security guarantee to the policy holder at the time of health problems due to illness or an accident (Tualeka, 2015). By insuring a company's property when there is a big risk, it transfers the impact of the risk to the insurer. Insurance will not reduce the risk probability but it will reduce the impact of those risks.

2 METHOD

This research was a descriptive and observasional study conducted in the home industry of shoes workers in Tambak Oso Wilangon, Surabaya. While in terms of time, the type of approach used in this study was a cross-sectional research design using a risk analysis paradigm by taking one component, namely the risk assessment/risk assessment (NRC, 1983). Risk assessment was used to calculate the extent of cancer incidence, and if the duration of work (Dt) was safe. Participation in relation to insurance was done by interview.

This research was conducted at 8 locations of work with the research subjects totalling 20 respondents. The measurement of benzene concentration in the work environment was done by using the NIOSH 1501 measurement method with an active carbon absorbent pipe (choarcoal) by using the Gas Chromatography (GC) technique by a trained officer from UPTK3 Surabaya. To know the ownership of insurance, we used the interview method.

3 RESULT

Benzene in the working environment of shoemakers makes it an absolute necessity to know the level of risk of the exposed groups. This study measured 8 work sites to determine the picture of benzene concentration.

Table 1: Benzene Concentration Distribution in Working Environment of Shoemakers in Tambak OSO Vilagge Wilangun Surabaya 2016

Concentration Benzene (NAB= 1,6 mg/m^3)	N	Percentage (%)
≤ 1.6 mg/m^3	6	75
> 1.6 mg/m^3	2	25
Total	8	100
Mean	1.3475	
Median	0.6350	
Std. Deviation	2.54762	
Min-Max	0.04 - 7.44	

In Table 1, the concentration of benzene by as much as 6 points (75%) is still below the determined brick threshold value of 0.5 ppm or 1.6 mg/m^3. The average benzene concentration is 1,6313 mg/m^3. The lowest concentration level was 0.04 mg/m^3 and the highest concentration was 7.44 mg/m^3.

The pattern of activities to be covered includes exposure, frequency and the duration of exposure. The working hours of each work location are not the same. In addition to the working hours, other variables that must be considered are the number of working days and long working hours in the home industry shoe of Tambak Oso Wilangun.

Table 2: Distribution of Descriptive Frequency of Pattern of Workers Activity of Shoemaker in Tambak Oso Vilagge Wilangun Surabaya 2016

Info.	(tE)	Amount		(fE)	Amount		(Dt)	Amount	
		n	%		N	%		N	%
	≤ 8 hours	1	5	≤ 265 day	-	-	≤ 25 year	10	50
	>8 hours	19	95	> 265 day	20	100	> 25 year	10	50
Total		20	100		20	100		20	100
Mean	hours /day	10.55		day/year	346.75		year	24.93	
Std. dev		3.086			30.680			10.957	
Med		9.50			365			24.50	
Min		6			260			3	
Max		17			365			43	

Table 2 illustrates the frequency distribution of exposure time, exposure frequency, and the duration of exposure. Exposure time (tE) is categorised into two ie ≤ 8 hours / day and> 8 hours / day.

The result showed that 1 worker (5%) had an exposure time of ≤ 8 hours / day and 19 workers (95%) had an exposure time of > 8 hours/ day. The average exposure time of 10.55 hours/ day shows that each work location has a different exposure time. The exposure frequency (fE) is categorised into two, ie ≤ 265 days and> 265 days. The result of the research is that all workers have an exposure frequency > 265 days. The average worker in a year works for 346.75 days. Exposure duration (Dt) is categorised into two, i.e. ≤ 25 years and> 25 years. The results showed a balanced result between the two for each of 10 workers (50%). The average duration of exposure was 24.93 years.

Based on the results of the interviews, it is known that workers have worked for a long time before, therefore this needs to be considered because this can give the idea that they are always in an environment that allows for exposure to benzene.

The result showed that one of respondents with serial number 1 had a body weight of 51.4 kg (Wb). Every day they worked 9 hours/day (tE) for 313 days (fE), and had worked for 34 years (Dt). With an inhalation rate (R) of 0.6 m^3/hr and the tavg for carcinogenic substances was 10950 days. The result of the benzene air measurement showed a concentration of (C) 0.04 mg/m^3, so the amount of non-carsinogenic intake (intake) was:

$$= \frac{0{,}04\ mg/m^3 \times 0{,}6\ m^3/hours \times 9\ hours/day \times 313\ hours \times 34\ years}{51.4\ Kg \times 10950\ day}$$

= 0,004084 mg/kg.day

The known benzene intake per day for the first worker was 0.004084 mg/kg.day. As for the calculation of the carcinogen intake using the formula and value of the same variable, but using the tavg for carcinogenic substances, the result was 25550 days. Here is the calculation of the carcinogenic intake per day for the workers:

$$= \frac{0{,}04\ mg/m^3 \times 0{,}6\ m^3/hours \times 9\ hours/day \times 313\ day \times 34\ year}{51.4\ Kg \times 25550\ day} \quad (1)$$

= 0,0018 mg/kg.day

The know benzene intake per day for the first worker is 0,0018 mg/kg.day.

If ECR $>10^{-5}$, then the concentration of benzene exposure may cause a carcinogenic health effect.

The risk characteristics for cancer effects can be determined by multiplying the value of cancer-causing substance intake with CSF values with the following formula:

$$ECR = \text{Intake Karsinogenik } (I_k) \times CSF \quad (2)$$

If ECR $\leq 10^{-5}$, then the concentration of benzene exposure has not made the workers be at risk of causing carcinogenic effects.

From the ECR calculation, it is known that the ECR value for the current exposure is 5 years for the 30 workers with an ECR> 10^{-5}. As many as 20 people (100%) are at risk of the health effects of cancer.

After the risk assessment was done and got results that are beyond the threshold value, the next thing that was done was to conduct risk management. This was done to minimise and even eliminate the risk of danger posed by the hazard in the workplace.

Table 3: Percentage of current Excess Cancer Risk (ECR) value, 5 th, 10 th, 15 th, 20 th, 25 th, and 30 th Shoemakers in Tambak Oso Village Wilangun Surabaya 2016.

Exposure	ECR	Amount		Total
		N	%	
ECR First	ECR ≤ 10^{-5}	0	0	20
	ECR > 10^{-5}	20	100	
ECR 5 th	ECR ≤ 10^{-5}	0	0	20
	ECR > 10^{-5}	20	100	
ECR 10 th	ECR ≤ 10^{-5}	0	0	20
	ECR > 10^{-5}	20	100	
ECR 15 th	ECR ≤ 10^{-5}	0	0	20
	ECR > 10^{-5}	20	100	
ECR 20 th	ECR ≤ 10^{-5}	0	0	20
	ECR > 10^{-5}	20	100	
ECR 25 th	ECR ≤ 10^{-5}	0	0	20
	ECR > 10^{-5}	20	100	
ECR 30 th	ECR ≤ 10^{-5}	0	0	20
	ECR > 10^{-5}	20	100	

In relation to carcinogens, the risk management used is the value of ECR by applying the formula as follows:

$$ECR = I_k \times CSF \quad (3)$$

$$I_k = \frac{ECR}{CSF} \quad (4)$$

$$\frac{C \times R \times tE \times fE \times Dt}{Wb \times tavg} = \frac{ECR}{CSF} \quad (5)$$

Based on the above calculation formula of carcinogenic effect, it can be used to find the safe value of C, t, and D safe as follows:

$$C\ safe = \frac{Wb \times tavg \times ECR}{R \times tE \times fE \times Dt \times CSF} \quad (6)$$

$$tE\ safe = \frac{Wb \times tavg \times ECR}{C \times R \times fE \times Dt \times CSF} \quad (7)$$

$$Dt\ safe = \frac{Wb \times tavg \times ECR}{C \times R \times tE \times fE \times CSF} \quad (8)$$

For the full calculation, the results can be seen in the following table:

Table 4: The result of calculating the value of safe exposure of benzene carcinogenic health effect on benzene shoes worker in Tambak Oso Village Wilangun Surabaya 2016

No. Worker	C (mg/m^3)	C safe (mg/m^3)	tE (hours/day)	tE safe (hours/day)	Dt (year)	Dt safe (year)
1	0,04	0.004	9	0.93	34	3.53
2	0,04	0.005	15	1.88	20	2.50
3	0,04	0.004	17	1.79	16	1.69
4	0.06	0.003	8	0.40	40	2.02
5	0.06	0.002	14	0.58	36	1.49
6	0.06	0.008	10	1.40	17	2.39
7	0.06	0.006	8	0.74	30	2.77
8	0.06	0.053	8	7.06	3	2.65
9	0,15	0.007	8	0.36	25	1.12
10	0,15	0.009	6	0.37	24	1.46
11	1,12	0.002	13	0.02	43	0.08
12	1,12	0.016	12	0.18	8	0.12
13	1,12	0.003	9	0.02	43	0.12
14	1,27	0.003	15	0.04	23	0.06
15	1,27	0.007	8	0.04	20	0.11
16	1,27	0.005	10	0.04	27	0.10
17	1,27	0.004	9	0.03	31	0.11
18	2,91	0.007	10	0.02	25	0.06
19	7,44	0.008	14	0.02	20	0.02
20	7,44	0.017	8	0.02	14	0.03

From the above data, the researchers took the safe value by choosing the safe cancer risk from the calculation data most likely applied by the workers of shoe craftsman in Tambak Oso Village Wilangun, Surabaya. Safe was 0,003 mg/m^3, t_E safe equals 7.06 hours/ day and Dt Safe is 3.53 years.

Table 5: Have Known about JKK (*Jaminan Kecelakaan Kerja*)

ECR	Have Known about JKK		Amount
Respondens	Yes	No	
$> 10^{-5}$	5	15	20
	(25,00%)	(75,00%)	(100,00%)
$\leq 10^{-5}$	0	0	0
	(0,00%)	(0,00%)	(0,00%)

In Table 5 above, the respondents who are ECR> 10^{-5} or are not carcinogenically safe 75,0% do not know about JKK and 25,0% 25,0% have known about JKK.

Table 6: Have Known about JKM (*Jaminan Kematian*)

ECR	Have Known about JKK		Amount
Respondens	Yes	No	
$> 10^{-5}$	5	15	20
	(25,00%)	(75,00%)	(100,00%)
$\leq 10^{-5}$	0	0	0
	(0,00%)	(0,00%)	(0,00%)

In Table 8 above, for the respondents who are ECR> 10^{-5} or are not carcinogenically safe 75,0% do not know about JKM and 25,0% 25,0% have known about JKM.

Table 7: Workers Insurance (BPJS Employment)

ECR	Have BPJS		Amount
Respondens	Yes	No	
$> 10^{-5}$	0	20	20 (100,0%)
	(0,00%)	(100,00%)	
$\leq 10^{-5}$	0	0	0
	(0,00%)	(0,00%)	(0,00%)

In Table 7 above, for the respondents who are ECR> 10^{-5} or who are not carcinogenically safe, 100% have no insurance with BPJS Employment.

Table 8: Pos Upaya Kesehatan Kerja (Pos UKK) / Post Work Healt Effort

ECR Responden	Has Pos Upaya Kesehatan Kerja (Pos UKK)		Amount
	Yes	No	
$> 10^{-5}$	0	20	20
	0,00%	(100,00%)	(100,00%)
$\leq 10^{-5}$	0	0	0
	(0,00%)	(0,00%)	(0,00%)

In Table 8 above, for the respondents who are ECR> 10^{-5} or are not 100% carcinogenic in the home industry of shoes in Romokalisari Surabaya do not have Pos Upaya Kesehatan Kerja (Pos UKK) or Post Work Health Effort.

Table 9: Why not have BPJS Ketenagakerjaan?

Why not have BPJS ketenagakejaan	Respondens		Amount
	Yes	No	
No information	5	75	20 (100,0 %)
	(0,00%)	(100,00%)	
No socialitation	20	0	20 (100,0 %)
	(100,00%)	(0,00%)	
No enough money	20	0	20
	(100,00%)	(0,00%)	(0,00 %)

In Table 9, for the 20 respondents, 100,0% said that they had never been given information about BPJS but 100,0% also said that they had never been socialited by BPJS and had no enough money.

4 DISCUSSION

The measurement of benzene concentration was done at 8 sampling points at the location of shoemaker workers. Kelurahan Tambak Oso Wilangun in Surabaya showed the highest concentration of 2,333 ppm equal to 7.44 mg/m^3 and the lowest was 0,0129 ppm equal to 0,04 mg/m^3. The measured benzene concentration at each point was different. The high-measured benzene concentration is due to several things including the production of the shows and the glue used which also follows the amount of shoes produced.

The exposure time describes the number of hours worked per day in the work environment. The results of the study showed that the lowest worker worked at work for 6 hours per day, and the highest work for 17 hours per day. The results of the study above show that the threshold value of normal working hours the standard as 7 hours of work a day or 6 days a week, or 8 hours of work a day or 5 days a week. The highest working time is 17 hours a day due to high orders and fast production deadlines so that the workers strive to meet the target order.

The frequency of exposure indicates the time that the workers spend working in the shoe-making industry within the space of 1 year. The results indicate that the workers spend the least time or 260 days/year and the highest 365 days/year.

The calculation of the risk level of individual cancers at the current time is that for up to 30 years, as many as 20 people (100%) have the results of the ECR calculation of > 10^{-5}. The results explain that at the present time, exposure of up to 30 years are all at risk of cancer health and are in unsafe conditions against benzene exposure.

The concentration of benzene exposure towards the shoemaker workers in Tambak Oso Wilangun of Surabaya is influenced by the air condition at the worker's location as well as the materials in the form of shoe glue which is used in the shoe production process. From the calculation of the value of health risk, control of non-cancer effects and the effects of cancer on safe exposure of benzene to sharecropper workers in Kelurahan Tambak Oso Wilangun in Surabaya 2016 obtained a safe value of (C) of 0,003 mg/ m^3, safe snack time (tE) of 7,06 hours/day, exposure frequency (fE) of 322 days/year and an exposure duration (Dt) of 3.53 years.

Based on the research results, 100% of the respondents have no insurance.This can not protect workers from exposure to benzene-causing cancer because the ECR is greater than 10^{-5} which means a high risk with major consequences. In the United States, ECR 10^{-5} is established as a carcinogenic limit for workers. In Shingga, workers working in industries with an ECR larger than 10^{-5} should be protected, among others, by having medical insurance.

According to Presidential Regulation of the Republic of Indonesia No. 12 2013 on Health Insurance, health insurance is a guarantee of health protection for the participants so they can benefit from health care and have protection in meeting their basic health needs. A participant is any person, including foreigners, who work for a minimum period of 6 (six) months in Indonesia, and who have paid the contribution. From the observation, it is known that 100% of the workers do not guaranteed Health Insurance. The workers exposed to benzene have a high risk of leukemia because there is no protection against their health.

According to Kountur 2008, in Tualeka, A.R. (2016), the high risk control is because the consequences are carried out with the transfer of risk, among others, by the insurance. Thus, there is the need to control the risk of exposure to benzene workers such as insurance with BPJS Employment. In addition, in the area, there must also be Post Work Health Efforts. With insurance, it will not reduce the probability of the occurrence of the risk

but it will transfer the risk of the impact of benzene exposure from the workers to the insurer. Thus, the workers are not harmed by the losses borne by the insurer. According to the Ministry Menpower Regulation RI No.1 2006 about Insurance for Manpower in the informal sector who must have insurance.

More of the manpower in the informal sector have no BPJS insurance because the company has never done any solicitation in the home industry, and they have no money. Information about BPJS for the manpower in the informal sector is important to increase the knowledge about BPJS and to change the behaviour so then the workforce become members of BPJS.

5 CONCLUSION

Workers in the insecure home shoe industry are not encountering enough carcinogenic ingredients to encounter the high consequences of cancer. 100% of the shoe industry workers do not have insurance so they do not get protection due to their exposure to benzene, which is a cause of cancer.

The lowest benzene concentrations were present at work site 1 of 0.04 mg/m^3 and the highest concentration was found at work site 8 of 7.44 mg /m^3.

For the calculation of the cancer risk rate (ECR), most workers have an ECR value > 10^{-5}, meaning that at the time of the study, there were workers in unsafe conditions due to benzene exposure. The safe limits for the workers are as follows: safe concentration (C) 0.003 mg/m^3, safe travel time (tE) 7.06 hours/day, exposure frequency (fE) 322 days/year and exposure duration (Dt) 3.53 years.

The workers have a high risk of cancer because the benzene safe exposure time of only 7.06 hours/day and the duration of safe work is only 3.53 years.

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