The Effect of Chromium Exposure on Creatinine and Bun Level of Tanners in Leather Industry in Magetan

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Abstract

Chromium in the leather tanning industry can have an impact on workers' health. Kidney disease is often referred to as a side effect from exposure to chromium. Measurement of creatinine and BUN level is a method of examining kidney function.

The purpose of this study was to analyze the effect of chromium exposure on creatinine and BUN level in leather tanning workers in small leather industry in Magetan. This type of research is observational with cross sectional design. The sample of the study was 13 exposed worker groups namely chromium operators and 13 unexposed groups namely administrative workers.

The results showed that there were differences in the average levels of urine chromium in chromium operators and administrative workers (p-value = 0,000), there were differences in the average creatinine levels in chromium operators and administrative workers (p-value = 0,031), and there were no difference in the average level of BUN in chromium operators and administrative workers (p-value = 0,644). There were no influence of chromium levels in urine on the increase in creatinine levels (p-value = 0,189) and BUN (p-value = 0,854) in tanning workers, with a significance value of p-value> 0,05.

The conclusion of this study had that chromium was no effect on creatinine and BUN levels. High levels of urine chromium in tanning workers indicate a health risk that requires control effort. Suggestion given is that the tanners need periodic health examination, keep personal hygiene before and after working as well as using Personal Protective Equipment (PPE).

Keywords : *chromium, creatinin, BUN, leather tanning*

Introduction

Chemical material used in tanning process in chromium (Cr), in which 85% of the world's leather is tanned by using chromium[1]. In tanning industry, chromium can affect the tanners' health. Chromium enters the body can be through direct contact of chromium with the skin, inhaled or swallowed by the body[2].

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Kidney illness is often called as the side effect of chromium exposure[3]. Chromium which is piled in the kidney will go through oxidation and reduction process where electrons are released. Electrons released have the characteristic of reactive or Reactive Oxygen Species (ROS). The increase of ROS in the body causes oxidative stress so that leads to damage of renal glomerulus cell[4]. According to Pearce (2006)[5], disorder of kidney function marked by the decrease of glomerulus filtration rate, so that the remaining metabolism substances including creatinine, urea, or BUN or creatinine which should be disposed causes the level decreases in urine, and increases in the blood instead.

The result of research conducted by Rasoul *et al* (2017)[6] obtained that the exposure of chromium on the tanners in Egypt causes the significant mean of BUN and creatinine level on the tanners group who were exposed

to chromium (18,01±5,2 and 0,61±0,26 mg/dl) higher than the group controlled (15,5±4,8 and 0,49±0,19 mg/dl). The increase of BUN and creatinine level in blood is one of the indicators of kidney function disorder[5].

Result of the work environment measurement on the preliminary survey in January 2019 using PDS (Personal Dust Sampler) obtained that from 3 points for 2 work hours, it was known that the chromium level in the air <0,0014 mg/cm^3 which means that the chromium level in the air was still below the normal limit determined by the Regulation of the Ministry of Manpower of the Republic of Indonesia no. 5 of 2018 regarding the occupational safety and health of the work environment[7] which is 0,5 mg/m^3. However, based on the interview result on the indication of health complain conducted in the preliminary survey in 10 tanning industrial location in 10 chromium operators obtained data of health complain related to its workers which is itchy skin (60%), dizzy (40%), breathless (40%), tired (30%), dehydration (30%), low back pain (20%) and urinary disorder (10%) during working. This is also supported by the previous research conducted by Wibowo (2018)[8], Based on the research, it was known that the mean of chromium level in the tanners' blood was 36,1 µg/L which was more than the standard of health complain experience by the tanners.

Complain of low back pain ad urinary disorder are ones of the indications of kidney function disorder symptoms[9]. According to Pusdatin (2017)[10], the indication of chronic kidney disorder is the decrease of glomerulus filtration along with complain of being weak, nausea, decreased appetite, and decreased of body weight. The health complain occurred is possibly caused by the exposure of chromium. Based on the explanation above, it is considered that the analysis of the effect of chromium exposure on creatinine and BUN level on tanners in small leather industrial environment in Magetan is needed.

Method

The research design was observational through cross-sectional. This research was conducted in tanning industrial in Magetan in April-Mei, 2019. The research sample was 13 chromium operators who were exposed to chromium and 13 administrators who were not exposed to chromium. The data collection was performed through interview as well as urine and blood sampling. The examination of chromium level in urine used Atomic Absorption Spectrometry (AAS), while the creatinine and Blood Ureum Nitrogen (BUN) level were measure using Barthelot method. The data analysis was carried out using Mann-Whitney, anova and linear regression test.

Results

A. *Characteristics of Worker*

The individual characteristics in this research included were the education level, knowledge, personal hygiene, and the use of Personal Protective Equipment (PPE) including mask, glove, and boot. The illustration of workers characteristic frequency distribution was shown in Table 1.

Table 1. Distribution of characteristics frequency on tanners in Magetan

Characteristics	Category	chromium operators		Administrators	
		N	%	n	%
Education	Primary school	2	15.38	0	0
	Secondary schools	6	46.15	2	15,38
	High school	5	38.46	7	53,85
	College	0	0	4	30,77
Knowledge	Bad	3	23.08	2	15.38
	Poor	4	30.77	2	15.38
	Enough	3	23.08	3	23.08

Cont... **Table 1. Distribution of characteristics frequency on tanners in Magetan**

	Well	3	23.08	6	46.15
Personal hygiene	Bad	2	15,38	2	15,38
	Poor	7	53,85	6	46,15
	Well	4	30,77	5	38,46
PPE Use of Mask	No	7	53,85	8	61,54
	Sometimes	4	30.77	3	23,08
	Yes	2	15,38	2	15,38
PPE Use of Gloves	No	7	53,85	11	84,61
	Sometimes	4	30,77	2	15,39
	Yes	2	15,38	-	-
PPE Use of Boots	No	7	53,85	8	61,54
	Sometimes	2	15,38	3	23,08
	Yes	4	30,77	2	15,38

Based on Table 1, in terms of the education level, 6 chromium operators, 6 (46.2%) were Secondary schools, while 7 (53.85%) workers of the administrators were high school. The knowledge was determined based on their understanding on the chromium risk effect known by the workers. The chromium operators who had poor knowledge were 4 workers (30.77%), while the administrators who had good knowledge were 6 workers (46.15%).

Chromium operators who did poor personal hygiene were 7 (53.85%) workers, while the administrators who did well personal hygiene were 6 (46.15%) workers. The use of PPE was seen based on the equipment used by the workers including mask, glove and boot. Most of the chromium operators did not use mask as many as 7 (53.85%) workers, while the administrators who did not use mask were as many as 8 (61.54%) workers. In terms of the use of glove as PPE, most of the chromium operators did not use glove for as many as 7 (53.85%) workers, while the administrators who did not use glove were as many as 11 workers. In terms of the use of boot as PPE, 7 (53.85%) chromium did not use boot, while the administrators who did not use boot were as many as 8 (61.54%) workers.

B. *The effect of workers' characteristic on chromium level in urine*

This research was conducted in order to know whether there was an effect of characteristics on the chromium level in urine on the chromium operators and administrator which was presented on table 2.

Table 2. The Effect of characteristic to urine chromium on tanners in Magetan

Characteristics	Category	Urine Chromium					
		Chromium operators		p-value	Administrators		p-value
		Mean	SD		Mean	SD	
Education	primary school	46,514	13,114	0,035	0	0	0,023
	secondary schools	38,434	11,703		13,75	0,899	
	high school	24,711	3,362		5,452	5,189	
	College	0	0		1,334	2650	
Knowledge	Bad	51,610	1,221	0,017	13,75	0,899	0,029
	Poor	30,405	4,715		9,122	5,392	
	Enough	28,874	10,969		4,414	0,548	
	Well	28,037	6,357		2,002	4,883	
Personal hygiene	Bad	57,434	2,330	0,001	13,75	0,899	0,025
	Poor	31,806	5,597		5,719	5,631	
	Well	27,419	9,417		1,837	2,556	
PPE Use of Mask	No	42,456	11,032	0,013	5,759	5,357	0,887
	Sometimes	26,691	1,749		3,996	6,905	
	Yes	21,613	2,039		6,472	9,140	
PPE Use of Gloves	No	42,456	11,032	0,013	4,796	5,729	0,345
	Sometimes	26,691	1,749		9,122	5,392	
	Yes	21,613	2,039		0	0	
PPE Use of Boots	No	42,129	11,530	0,021	5,759	5,357	0,887
	Sometimes	28,972	0,340		3,996	6,905	
	Yes	23,585	2,575		6,472	9,140	

Based on Table 3, the characteristics of education, knowledge, personal hygiene, the use of PPE of mask, glove and boot affect the urine chromium level at the chromium operators. The characteristics of education, knowledge and personal hygiene affected the urine chromium level at the administrators.

C. *The difference of Urine Chromium, Creatinine Level and BUN Level*

The mean difference between chromium operators and administrators can be seen in Table 3.

Table 3. The mean difference of urine chromium, creatinine level and BUN level on the tanners in Magetan

Parameter	Chromium operators	Adminis-trators	p-value
	Mean±SD	Mean±SD	
Urine Chromium (µg/l)	34,40±12,12	5,46±5,693	0,000
Creatinine (mg/dL)	1,046±0,105	0,861±0,236	0,031
BUN (mg/dL)	18,93±2,75	19,29±2,22	0,644

Based on Table 3, the mean of urine chromium level for the chromium operators was 34,40 µg/L, while the mean of chromium level in urine for the administrators was 5,46 µg/L. The urine chromium level of the chromium operators was higher than the administrators.

The mean of creatinine level for the chromium operators was as much as 1,0462 mg/dL, while the administrators' was as much as 0,8615 mg/dL. This means that the creatinine level at the chromium operators was higher than the administrators.

The mean of BUN level on the chromium operators was 18,93 mg/dL, while on the administrators was 19,29 mg/dL. This means that there was no difference on the BUN level between the chromium operators and administrators.

D. *The effect of urine chromium exposure on creatinine and BUN level*

This was carried out to know whether there was an effect of chromium level in urine on the creatinine and BUN level on the tanners using linier regression test. The research result can be seen in table 4.

Table 4. The effect of chromium exposure to creatinine and BUN level on the tanners on Magetan

Parameters	Creatinine		BUN	
	B	*p-value*	B	*p-value*
Urine Chromium	0,003	0,189	-0,005	0,854

Based on Table 4. The effect of urine chromium level on creatinine and BUN level on the tanners had significance value or p-value > 0,05, which means that the urine chromium did not affect the creatinine and BUN level on the tanners in Magetan.

Discussion

Based on this research note that the level of education affect chromium urine on workers operator chromium and administration. High education level encouraged the increase of health status since the knowledge of the danger of substances used in tanning process was known. One of the supporting factors of someone behavior is the education level. So, the education level of someone determines the level of someone in behaving and acting[11].

Personal hygiene on tanners was known to be poor. This caused the entrance of chromium into body and increased in urine during excretion. This was due to the workers who seem to wear clothes when they had their meal. According to Were et al., (2014)[12] on the research of tanners in Kenya, it obtained that poor personal hygiene caused the entrance of chromium into the body.

The result of the characteristic effect of the use of PPE including mask, glove and boot only affected the chromium operators and did not affect the administrators. The chromium operators did not use PPE such as mask, glove and boot during the tanning process. The custom of using PPE is one of the ways to decrease the workers' risk of chemical exposures during the production, considering the chromium exposure route is respiration, absorption on the skin, and digestion route[13].

The urine chromium level of the chromium operators was higher than the administrators'. According to Rosul et al., (2017)[6], on the tanners in Mesir, it was known that the urine chromium level on the workers who were exposed to the chromium was higher than the workers who were not exposed. According to ACGIH (2005)[14] BEIs (Biological Exposure Indices) of chromium in urine is as much as 25 µg/L.

The high level of chromium in the urine of chromium operators can be caused by the intensity of working period, the length period of working with chromium as well as the entrance path of chromium into the body. According to Rosul et al., (2017)[6], the working duration of tanners in Mesir who worked for more than 8 hours caused the tanners to be exposed to the chromium concentration in the air in the tanning working environment.

Creatinine level of the chromium operators and administrators was caused by their working activity, where the chromium operators were exposed to chromium every day. In addition, the chromium operators also need more energy because of their heavy work. This is different from the administrators whose working pattern was in the room so that they were not exposed to chromium and their activity was light so that they did not need more energy. The creatinine level does not only depend on muscle mass, but also the muscle activity, diet and health status[15]. The reference value of creatinine level in blood at adult male of 0,6 – 1,1 mg/dL, while for the female was 0,5 – 0,8 mg/dL[16].

There was no difference of BUN level between the chromium operators and administrators since both groups had BUN level above normal. The reference value of BUN level in blood as much as 6 – 20 mg/dL[16].

Based on the results of the impact that the level of known chromium urine will not effect the creatinin and bun on tanning leather workers in magetan. This research concluded that the effect chromium did not lead to the kidney function disorder yet, although the urine chromium mean value was above normal.

This could be possibly caused by other factors including eating pattern, diet, protein consumption, working period, and exposure frequency on the workers. According to Wang et al., (2010)[17], the determination of high chromium level in urine which can significantly increase the serum urea level, creatinine level and the excretion of urine micro albumin showed the existence of damage in kidney tubules.

Conclusion

This research showed that the chromium exposure did not affect the creatinine and BUN level. The high chromium level in urine on the tanners showed that there was health risk so that effort of control was needed. Suggestion given is that the tanners need periodic health examination, keep personal hygiene before and after working as well as using Personal Protective Equipment (PPE).

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