

Correlation Between Knowledge, Attitudes, and Behavior with Blood Cadmium Levels in the Population of Industrial Area

Teuku Heriansyah¹, Kumboyono Kumboyono², Fibe Yulinda Cesa³, Titin Andri Wihastuti⁴,
Shila Wisnasari⁴

¹Department of Cardiology, Faculty of Medicine, Universitas Syiah Kuala, Banda Aceh, Indonesia, ²Master 2 Department of Community Nursing, Faculty of Medicine, University of Brawijaya, Indonesia, ³Master Program in Biomedical Science, Faculty of Medicine, University of Brawijaya, Malang, East Java, Indonesia, ⁴Departement of Biomedicine Nursing Science, Faculty of Medicine, University of Brawijaya, East Java, Indonesia

Abstract

Objectives: The aim of this analysis is to investigate the correlation between knowledge, attitude, and behavior with cadmium level in the industrial population. **Methods:** This research is a non-experimental study with cross-sectional method. The subjects are 108 respondents live in industrial area. Questionnaires were used for measuring the level of knowledge, attitude, and behavior. Cadmium levels were measured using Atomic Absorption Spectrophotometry (AAS). **Results:** The result showed a strong correlation between levels of knowledge factor and cadmium with $r = -0,272^*$ in the population of industrial areas. Meanwhile, knowledge have significant correlation with attitude ($r = 0.528^{**}$). **Conclusion:** Knowledge factor has the significant relationship with cadmium levels in the population of industrial area. The government is suggested to improve the knowledge of the people in the industrial area in order to prevent high levels of cadmium. Therefore, the negative impact of metal waste exposure on health can be minimized.

Keywords: Cadmium, Knowledge, Behavior, Attitude, Industrial area

Introduction

Recently, industrial sector in Indonesia has been significantly increased by the time. From the data obtained from the Statistics Indonesia database in 2017, various kinds of industries about 33.577 have already growing rapidly and predicted to continue to expand ⁽¹⁾. This is the case with data provided by CEIC (World of Macroeconomic Data) which reports that the Indonesian industry prediction index increased by 2% in February 2020, which shows an increase of 0.8% from February 2020 ⁽²⁾.

With the increase in the number of industries, it will certainly be very beneficial for the country, especially in terms of improving social and economic welfare. If viewed from the other side -factory waste- are of particular concern, especially because of their impact, which is currently being followed up. Although indirectly and in inconspicuous amounts, exposure to airborne metallic waste in factory effluents can cause some health problems if accidentally inhaled or exposed to air or food. Many researches have shown that heavy metals can cause respiratory problems, cancer, and even death ⁽³⁻⁵⁾.

Cadmium is one of the heavy metals found in factory waste ⁽⁶⁾. Cadmium comes from the air mixed with the results of air waste and water waste in equipment found in factory machines in chimneys. Cadmium is reported to have many cases of exposure from children to adults ^(7,8). Previous research states that the level of cadmium exposure is increasing every year for someone who lives around industrial areas. Cadmium exposure

Corresponding Author:

Ns. Kumboyono, S.Kep., M.Kep., Sp.Kom
Address: Department of Community Nursing, Faculty of Medicine, University of Brawijaya Veteran Street, Malang, East Java, Indonesia
Email: publikasikoe@gmail.com

causes various health problems such as cardiovascular disease⁽⁹⁾, impaired kidney function⁽¹⁰⁾ and itai-itai disease⁽¹¹⁾.

Although evaluations continue to be carried out at a factory and the waste disposal regulations have been reviewed according to government policy standards, there are still cases of poisoning in someone who lives in an industrial area. Recent evidence suggests that adult people who live near industrial areas in the Amazon for more than 2 years have high cadmium levels⁽¹²⁾. The generalizability of much published research on this issue is problematic. However, habits and lifestyles have a strong relationship with a sufficient level of attitude and knowledge to address how to live in the industrial area. Up to now, far too little attention has been paid to know the correlation between knowledge, attitudes, and behavior correlated with blood cadmium levels. This paper attempts to show that basic factors can be a major cause for significant cadmium exposure. In this study, we focused on knowledge, attitudes, and behavior as basic factors of cadmium blood exposure.

Materials and Methods

This study is a cross sectional study design with a total sample of 108 people living in an industrial area. There are many criteria of inclusion such as: had a minimum of 1 year stay in an industrial area; distance of residence (within a radius of 5 km from industrial locations); and there are no respondents who had cardiovascular risk factor. The sample in this study was taken by purposive sampling from the study population living around an industrial area.

5 mL blood plasma from 108 respondents have been measured with atomic absorption spectrophotometry (AAS) in wavelength about 357.9 nm. Total cadmium content test method refers to the SNI 06-6989.17-2004 standard for testing metal content with AAS. The materials were obtained from the Laboratorium Terpadu Diponegoro University. A calibration curve is made to get the regression line equation then proceed with the measurement of the blood sample that has been prepared. Calculation of metal content is calculated using the equation below:

Total Concentration of Cadmium (mg/L) =
Concentration x fp (the dilution factor)

The questionnaire consisted of 10 questions to determine the level of knowledge, 15 questions to determine the level of attitude variables, and 10 questions for the level of behavioral factors (a total of 35 questions) distributed to 108 respondents (data not shown). The Cronbach's Alpha value for all questionnaires is > 0.6 and all question items have a positive correlation ranging from 0.3 to 0.6 so it can be assumed that all of the questionnaire question items are valid and reliable. The totals of these statements were then used for further analysis using Pearson's correlation. In this study, the relationship between the factors of attitude, behavior, and knowledge was correlated with cadmium data that had been done previously.

Findings

The results obtained showed that the level of cadmium exposure was 82.41% which exceeded the normal threshold, namely > 50 ng/mL. The next result was followed by the normal category which was not much different from the abnormal category, namely 8.33% and 9.26%, respectively (Table 1).

Table 1. Cadmium Levels

Category	N	%
Normal (<5 ng/mL)	9	8.33
Not Normal (5.0 - 50 ng/mL)	10	9.26
Acute toxicity (> 50 ng/mL)	89	82.41

In this study, we divided it into three levels for each factor. These factors include knowledge, attitudes and behavior. The results obtained from the data tabulation show that the knowledge that has a high level of respondents is 55.56%, the attitude has the highest proportion and 100% has a high attitude, then for behavior, it has a low level of 46.30 with the proportion highest in the observed population (Table 2).

Table 2. Factors Category

Variabels (N=108)	High		Medium		Low	
	N	%	N	%	N	%
Knowledge	60	55	24	22	24	22
Attitude	108	100	0	0	0	0
Behavior	30	27	28	26	50	46

In this study, shown in Table 3 are the results of research which indicate a significant relationship between the level of knowledge and cadmium levels ($r = -0.272^*$; $P = 0.047$) in the industrial area population.

The attitude factor has a significant relationship with the knowledge factor ($r = 0.528^{**}$; $P = 0.000$) followed by a significant positive correlation between behavior and attitude ($r = 0.269^*$; $P = 0.049$).

Table 3. Correlation Between Factors (Cadmium Levels, Knowledge, Attitude, and Behavior)

Variable		Cadmium	Knowledge	Attitude	Behavior
Cadmium	r	1	-0.272*	-0.23	0.012
	P		0.047	0.095	0.932
Knowledge	r	-0.272*	1	0.528**	0.148
	P	0.047		0.000	0.284
Attitude	r	-0.23	0.528**	1	0.269*
	P	0.095	0.000		0.049
Behavior	r	0.012	0.148	0.269*	1
	P	0.932	0.284	0.049	

Discussion

Cadmium (Cd) is a metal that can cause toxicity and is a risk factor for cardiovascular disorders. It was also stated that Cd is classified as toxic for humans and plants⁽¹³⁾. In humans, exposure to Cd that is too high in the long term can cause various cardiovascular complications including hypertension, as well as other diseases such as decreased kidney function and many other organ disorders⁽⁸⁾. Cadmium has atomic number 48, atomic mass number 112, melting point 321 ° C, and boiling point 765 ° C is an element that is odorless or tasteless, and is very toxic⁽¹³⁾. One of the mechanisms of action of cadmium is to cause oxidative stress⁽¹⁴⁾. After entering the body, cadmium can replace the ion content in the body from the cytoplasm and membrane proteins such as ferritin which will reduce ion levels. These free ions will later experience oxidative stress through the Fenton reaction^(15,16).

In industry, cadmium waste gets special attention, because metal compounds are a type of pollutant that has a high level of toxicity even though the exposure is at low concentrations⁽¹⁷⁾. According to Yu et al (2010)⁽¹⁸⁾, in a study conducted in the Hangzhou area,

China stated that industrial areas have the highest level of Cd when compared to several other places such as residences and highways. This is consistent with the research we conducted where the cadmium contained in the respondents we studied was in a high range. Approximately 82.41% of the total population we studied had levels of exposure to blood cadmium that exceeded the toxicity threshold with acute toxicity levels, meaning that they exceeded 50 ng / mL. Cd found on a normal blood test is <5.0 ng / mL, with most results in the range 0.5 to 2.0 ng / mL⁽¹⁹⁾. Lack of nitric oxide (NO) will cause decreased homeostasis of blood vessels which will lead to endothelial dysfunction⁽²⁰⁾. Impaired endothelial function will cause oxidation stress and will later become a factor in the occurrence of cardiovascular disease⁽²¹⁾. This shows a high urgency because if it is not followed up immediately, it is feared that it will increase the level of exposure and the level of disease that is at risk of causing death. Previous research has shown that cadmium levels are reported to be significantly higher among residents in industrial estates than among non-exposed residents⁽²²⁾. Our study shows that knowledge is negatively correlated with knowledge with a correlation coefficient of -0.272. The results of the analysis indicate that the

increasing knowledge will have an effect on decreasing metal content and vice versa. According to Adebamowo (2006) ⁽²³⁾, the domain factor that is very important for the formation of one's actions is called knowledge. Our results are consistent with this statement, where there is a correlation between attitude and knowledge with a correlation coefficient of 0.528. This shows that with increased knowledge, it will be followed by an increase in attitude. The existence of this linear relationship has convinced us that knowledge is an important factor in improving attitudes in dealing with environmental pollution that occurs around industrial areas. With more attention to knowledge, it is hoped that cadmium levels will decrease⁽²³⁾.

Our results show no correlation between knowledge and behavior. Another research also shows that environmental knowledge does not have a significant direct effect on pro-environmental behavior⁽²⁴⁾. The study explains that although there is no significant relationship between knowledge and behavior, knowledge remains an important factor in determining a person's attitude and behavior. Our research shows that there is a relationship between attitude and behavior with a correlation coefficient of 0.269. This relationship is classified as having a positive correlation, namely the higher the attitude, the higher the behavior factor. In other words, we found that knowledge does not have a direct impact on behavior, but that the awareness of attitudes will create a behavior that is aware of environmental pollution. In our research, cadmium metal exposure is more pronounced. This is in line with research conducted by Faize and Akhtar (2020)⁽²⁵⁾ which conducted studies on students regarding increasing knowledge and attitudes to the environment which can be done by providing further explanations with nature and providing understanding of scientific argumentation that increases knowledge and attitudes.

Conclusion

Our study shows a correlation between the knowledge factor and cadmium levels with a negative correlation, where the increased knowledge will cause a decrease in cadmium levels. The knowledge factor also has a positive relationship with the attitude factor, if increased knowledge is carried out it will improve attitudes. Attitude factors correlate with behavioral

factors, so that if there is an increase in attitude as a result of increased knowledge, behavior can also increase. Therefore, from the results of our research, it is very important for the local government to evaluate the knowledge improvement of people living in industrial areas in an effort to reduce the impact of cadmium exposure and minimize cardiovascular risk due to long-term exposure. Increased knowledge can be in the form of increased education, further education on cadmium exposure, and can also be in the form of other programs to increase the knowledge factor. Thus, research on the knowledge factor of reducing cadmium levels can also be applied as suggestions for further research in the future.

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Ethical Clearance: This research was carried out when it had received ethical clearance from the UB Ethics Commission, Faculty of Medicine with number 014/EC/KEPK. Respondents included in the inclusion criteria determined in the study were given informed consent and a statement to be willing to participate in this study. If the respondent is not willing, it will be excluded and not included in the study.

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