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Edisi ini, Vol 12, No 2 (2020): Biomedika Agustus 2020, kami memuat artikel-artikel yang bertemakan pada basic medical science/ilmu kedokteran dasar. Harapan kami semoga artikel-artikel yang tercantum dalam edisi ini dapat memberikan kontribusi dalam pengembangan ilmu kesehatan dan kedokteran serta menjadi bahan referensi bagi peneliti lain. Kami juga mengharapkan para peneliti lain untuk mempublikasikan hasil penelitiannya di BIOMEDIKA pada edisi yang akan datang.

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CORRELATIONS OF CADMIUM EXPOSURE WITH THE UREUM AND CREATININE SERUM LEVELS IN BATURADEN ORNAMENTAL PLANT FARMERS

KORELASI PAPARAN KADMIUM TERHADAP KADAR UREUM DAN KREATININ SERUM PADA PETANI TANAMAN HIAS BATURRADEN

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ABSTRACT

Baturaden ornamental plant farmers use pesticides and fertilizers containing cadmium to increase growth and plant diseases control. Cadmium is a very toxic heavy metal. Small doses of cadmium exposure in over a long time through respiratory tract, digestion, and skin penetration causes a workload on the kidneys. It resulting kidney damage that characterized by increased ureum and creatinine serum levels. The aimed of this study was determine the correlation of cadmium exposure to kidney function in terms of urea and creatinine serum levels. The research design was an observational analytic approach with cross sectional method. The respondents were 43 farmers. Research data were collected by interviews, measured the urea and creatinine serum levels, also the cadmium urine levels. Data were analyzed by Spearman test. The results showed that there was a weak significant correlation between cadmium urine to ureum ($r = 0.399$ and $p = 0.008$) and creatinine serum levels ($r = 0.331$ and $p = 0.03$). We concluded that cadmium exposed correlated with increased ureum and creatinine serum levels.

Keywords: Cadmium, Urea Serum Level, Creatinine Serum Level, Ornamental Plant Farmers

ABSTRAK

Petani tanaman hias di Baturaden menggunakan pestisida dan pupuk yang mengandung kadmium untuk meningkatkan pertumbuhan dan pengendalian penyakit tanaman. Kadmium adalah logam berat yang sangat beracun. Paparan kadmium dosis kecil dalam jangka waktu yang lama melalui saluran pernafasan, pencernaan, dan penetrasi kulit menyebabkan beban kerja pada ginjal. Hal tersebut mengakibatkan kerusakan ginjal yang ditandai dengan peningkatan kadar ureum dan kreatinin serum. Penelitian ini bertujuan untuk mengetahui hubungan paparan kadmium terhadap fungsi ginjal ditinjau dari kadar ureum dan kreatinin serum. Desain penelitian adalah observasional analitik dengan metode cross sectional. Respondennya sebanyak 43 petani. Pengumpulan data penelitian dilakukan dengan wawancara, pengukuran kadar urea dan kreatinin serum, serta kadar kadmium urin. Data dianalisis dengan uji Spearman. Hasil penelitian menunjukkan bahwa terdapat hubungan bermakna yang lemah antara kadar kadmium urin dengan kadar serum ureum ($r = 0,399$ dan $p = 0,008$) dan kreatinin ($r = 0,331$ dan $p = 0,03$). Kami menyimpulkan bahwa paparan kadmium berkorelasi dengan peningkatan kadar ureum dan kreatinin serum.

Kata Kunci: Kadmium, Kadar Ureum Serum, Kadar Kreatini Serum, Petani Tanaman Hias

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INTRODUCTION

Cadmium is a very toxic heavy metal and classified as a carcinogenic compound in humans (Agency for Toxic Substances and Disease Registry (ATSDR), 2008). In Indonesia, farmers use pesticides and fertilizers containing cadmium to increase growth and control pests and plant diseases. Cadmium levels in pesticides were found at 0.018 ppm and 11 ppm in fertilizer (Kusdiarti *et al.*, 2014). Pesticides and fertilizers are often used excessively and continuously, causing adverse impacts on the environment and human health (Nopriani, 2011).

Cadmium enter the tissues of living things through the respiratory tract, digestive tract, and skin penetration. Cadmium that has entered the body, will be absorbed and blood transported to the liver and kidneys. It bind to Metallothionein (MT) in the blood (Kim *et al.*, 2015). Small doses of cadmium exposure in over a long time cause kidney accumulation. It cause a workload on the kidneys, resulting kidney damage characterized by proteinuria, glycosuria, increased ureum and creatinine serum levels, as well as decreased Glomerular Filtration Rate (GFR) (Sudarmadji *et al.*, 2006). Weaver *et al.* (2011) states that there is a significant relationship between increased levels of urine

cadmium with increased ureum and creatinine serum levels in lead workers. Swaddiwudhipong *et al.* (2007) research showed a significant relationship between increased levels of cadmium with decreased kidney function in farmers.

Farmers, including Baturaden ornamental plant farmers, are one of the great risk groups of cadmium exposure derived from pesticides and phosphate fertilizers, but there is still little research related to the impact of cadmium exposure on the health of workers whose daily contact with cadmium in Indonesia such as ornamental plant farmers. This study was conducted to determine the correlation of cadmium exposure to the kidney function in terms of urea and creatinine serum levels in ornamental plant farmers.

METHOD

The research was conducted in January 2016. Blood and urine collection from ornamental plant farmers was carried out around Baturraden. Urea and creatinine serum tests were conducted using enzymatic kinetics methode at the Main Laboratory of Medico Labora Purwokerto and examination of cadmium urine levels was carried out using Atomic Absortion Sprectometry (AAS) at the Laboratory of

Chemistry, Faculty of Mathematics and Natural Sciences, Gajah Mada University, Yogyakarta.

This research design was an observational analytic approach with cross sectional method. The respondents were 43 ornamental plant farmers in Baturaden. The inclusion criteria was respondents with a minimum working period of 1 year who were willing to sign informed consent. The exclusion criteria were respondents who had a history of diabetes mellitus and hypertension.

This research ethical clearance got from the Ethics Commission of the Faculty of Medicine, Jenderal Soedirman University and obtained approval with No Ref. 001/KEPK/I/2016. Data on the measurement of the parameters of cadmium urine, ureum and creatinine serum levels were analyzed with Spearman test.

RESULT AND DISCUSSION

Cadmium Urine Levels

The frequency distribution of cadmium urine ($\mu\text{g/L}$) in respondents can be seen in table 1.

Table 1. Frequency Distribution of Urine Cadmium ($\mu\text{g/L}$) in Respondents

	Cadmium Levels
<i>N</i>	43
<i>Mean</i>	5,34
<i>Median</i>	5,00

<i>Mode</i>	5,00
<i>Minimum Value</i>	5,00
<i>Maximum Value</i>	10,00
<i>Standard Deviation</i>	0,12

From table 1 it is shown that the average cadmium level in all respondents is above the normal threshold, which is above 2 $\mu\text{g/L}$. This shows that all respondents experienced high levels of cadmium exposure.

The process of using pesticides and fertilizers containing cadmium causes these substances to enter the body of ornamental plant farmers through the respiratory tract, digestive tract, and skin penetration. Cadmium that enters the body through the respiratory tract is caused by cadmium-contaminated work environment air pollution (Palar, 2008).

The amount of cadmium in the body can be influenced by several things, such as: age, smoking habits, sex and diet (Adnan *et al.*, 2012; Malgorzata *et al.*, 2008; Mortensen *et al.*, 2011; Menke, 2009).

Ureum and Creatinine Serum levels

The frequency distribution and correlation cadmium exposure to respondents ureum-creatinine serum levels can be seen in table 2. The average of ureum and creatine serum levels respondents were 25.79 mg/dL and 1.17 mg/dL (within normal limits). The mean, median

and mode values indicate urea and creatinine serum levels were still within normal limits too.

This means that the majority of respondents have normal urea and creatinine serum levels.

Table 2. Frequency Distribution and Correlation Cadmium Exposure to Respondents Ureum-Creatinine Serum Levels

	Ureum Levels (mg/L)	Creatinine Levels (mg/L)
N	43	43
Mean	25.79	1.17
Median	19.00	1.16
Mode	21.00	1.18
Value	16.00	0.97
Value	53.00	1.58
Standard Deviation	10.78	0.15
<i>p</i> value	0.008	0.03
<i>r</i> (correlation power)	0.399	0.331

Heavy metal poisoning cause an increased of urea and creatinine serum levels (Sugiharto *et al.*, 2016). In addition, the other things that affect urea and creatinine serum levels in the human body are: fluid factors, protein and carbohydrate diets and the use of drugs (National Kidney Foundation, 2009; Hidayati *et al.*, 2008).

The results of the analysis with the Spearman correlation test showed there was a weak significant correlation between cadmium urine levels with ureum ($r = 0.399$ and $p = 0.008$) and creatinine serum levels ($r = 0.331$ and $p = 0.03$). A positive r value indicates that the higher of cadmium urine level made the higher of ureum

and creatinine serum levels. This studies result was consistent with Weaver *et al.* (2011) research that showed a significant relationship between increased of cadmium urine levels with increased ureum and creatinine serum levels. Research conducted by Kim *et al.* (2015) also mentioned that the decrease in GFR and the increase in creatinine can be caused by continuously cadmium exposure.

Continuous cadmium exposure cause kidney function decreased. Cadmium that enters the body will mostly accumulate in the liver and kidneys. Cadmium that has entered the body be distributed through blood circulation and reach the liver. Furthermore, cadmium in the liver will bind to the protein Metallothionin (MT) to form the Cd-MT complex which produce Cd^{2+} which is toxic (Bernard, 2008). After passing through the liver, the Cd-MT complex will re-circulate in the blood circulation and end up in several tissues and human organs, one of which is the kidney. The presence of cadmium in the body inhibit the work of various enzymes, including the Superoxide Dismutase (SOD) enzymes, catalase (CAT) enzymes, Glutathione Peroxidase (GPx) enzymes, Glutathione S-Transferase (GST) enzymes and dehydroginase enzymes. These enzymes inhibition cause the kidney's cadmium

accumulation. The long half-life of cadmium, the low excretion rate, and the excretion of cadmium which usually starts at the age of 50 increase the amount of cadmium accumulation. Furthermore, the cadmium accumulation be excreted in the urine resulting the increased of cadmium urine levels (Houston, 2007).

Most cadmium destroys nephrons. Nephron damage occurs because the cadmium is released into the tubules lumen and causes the renal tubular protein membrane damaged (Johri *et al.*, 2010). This damaged cause the kidney's ability to filter and reabsorb various substances lost. Albumin excretes to the urine and toxic substances such as ureum and creatinine accumulates in the body (Kim *et al.*, 2015).

CONCLUSION AND SUGGESTION

Cadmium exposure is associated with decreased kidney function in ornamental plant farmers characterized by increased levels of ureum and creatinine serum levels.

Suggestions that can be given for ornamental plant farmers is to use personal protective equipments such as masks, gloves and boots when working to avoid exposure to pesticides and fertilizers containing cadmium. Ornamental plant farmers are also advised to consume healthy foods such as fruits, especially

those containing high vitamin C because it contains high antioxidants.

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