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Full Length Research Paper

Chronic Renal Failure Associated with Heavy Metal Contamination of Drinking Water in Hail, KSA

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The main threats to human health from heavy metals are associated with exposure to Pb, Cd, Cu, Mo, Zn, Ni, Mn Co and Cr. is mainly *via* intake of drinking water being the most important source in most populations. These metals have been extensively studied and their effects on human health regularly reviewed by international bodies such as the WHO. Heavy metals have been used by humans for thousands of years. Although several adverse health effects of heavy metals have been known for a long time, exposure to heavy metals continues, and is even increasing in some parts of the world, in particular in less developed countries, though emissions have declined in most developed countries over the last 100 years. A strong relationship between contaminated drinking water with heavy metals from some of the stations of water shopping in Hail, KSA and chronic diseases such as renal failure, liver cirrhosis, and chronic anemia has been identified in this study. These diseases are apparently related to contaminant drinking water with heavy metals such as Pb, Cd, Cu, Mo, Zn, Ni, Mn Co and Cr. Renal failure is related to contaminate drinking water with lead and cadmium, liver cirrhosis to copper and molybdenum, and chronic anemia to copper and cadmium. Recent data indicate that adverse health effects of cadmium exposure may occur at lower exposure levels than previously anticipated, primarily in the form of kidney damage but possibly also bone effects and fractures. The general population is primarily exposed to mercury *via* drinking water being a major source of methyl mercury exposure, and dental amalgam. During the last century lead, cadmium, zinc, iron and arsenic is mainly *via* intake of drinking water being the most important source in most populations. Long-term exposure to lead, cadmium, zinc, iron and arsenic in drinking-water is mainly related to primarily in the form of kidney damage. Studies of these diseases suggest that abnormal incidence in specific areas is related to toxic materials in the groundwater and thereby led to the contamination of drinking water in these areas.

Keywords: Heavy metals, liver functions, kidney functions and Chronic Renal Failure

INTRODUCTION

The aim of this study is to determine the relationship between the contaminant drinking water and its impact on human health. Heavy metals are sometimes called “trace elements”. Streams and rivers collect impurities from surface run off and through the discharge of sewage and industrial effluents; these are carried to the rivers, lakes or reservoirs that supply our drinking water (Skeat, 1969). All of the chemicals generated by man will

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eventually end up in our water supplies. These dangerous products from industry, agriculture and other human activities enter the rivers, lakes, and underground water, and can contaminate our drinking water. Water pollution is a global concern. Fresh water in particular, which is Resource essential to human life, is becoming a limited resource due to the influence (Coresh, 2007) of population growth, pollution and global. Levey (2009) defined pollution as any substance or energy introduced to the environment by human activities that could have hazardous effects on human health, damage living resources and ecosystems, environment. destroy the structure, or interfere with the genuine use of the environmental Lioy 1995 Environmental sources of lead exposure include water from lead pipes (common in homes built before 1986), and contamination of air, soil, and water in areas close to lead smelters, old mines, or garages (Jennings et al., 1996). Environmental lead toxicity occurs mainly through ingestion, although exposure can also occur through cigarette smoke.5 Lead circulates in the blood, and can either be excreted by the kidneys or can deposit in the bone. Environmental sources of cadmium toxicity include foods such as sea food, vegetables and cereals, residence in cadmium polluted areas and Indian medicinal herbs. Webb (1979) Affected individuals presented with anemia, severe bone pain and osteomalacia, and kidney toxicity including reduced kidney function and ultimately death attributable to kidney failure (Stowe et al., 1972; Sakata et al., 1988). Cadmium has a long biological half-life, ranging from 7.4 to 16 years (Madsen, et al., 1990; Bent and Bohm, 1995). Environmental sources of arsenic include groundwater, pesticides (by causing food contamination), seafood. (Jennings et al.,1996). High drinking water arsenic levels have been associated with increased mortality from CKD (Madsen et al., 1990; Bent and Bohm, 1995) Arsenic levels in serum and blood cells correlate with worsening kidney disease, (NRC, 1989) with the development and progression of CKD attributed to arsenic-induced oxidative stress (Grounse et al., 1983). Environmental sources of mercury include contaminated water, fresh water fish from polluted waters and predatory ocean fish, fuel combustion, and whitening creams (US EPA, 1985, 1991). There is conflicting evidence of nephrotoxicity secondary to dental amalgam White et al., (1973). It is filtered by the glomerulus and reabsorbed in the proximal convoluted tubules, resulting in tubular toxicity with low molecular weight proteinuria and enzymuria (US EPA, 1999). Exposure to uranium is mainly oral, through groundwater and food, although dermal exposure has been reported for children playing in contaminated areas. Studies in occupationally exposed populations have also reported aminoaciduria and low molecular weight proteinuria.

The aim of this study is to determine the relationship between the contaminant drinking water and its impact on human health. A strong relationship between contaminated drinking water with heavy metals from some of the stations of water shopping in Hail, KSA and chronic diseases such as renal failure, liver cirrhosis, and chronic anemia has been identified in this study. These diseases are apparently related to contaminant drinking water with heavy metals such as Pb, Cd, Cu, Mo, Zn, Ni, Mn Co and Cr. Renal failure is related to contaminate drinking water with lead and cadmium, liver cirrhosis to copper and molybdenum, and chronic anemia to copper and cadmium.

MATERIAL AND METHOD

Drinking water samples were collected from some of the stations of water shopping and wells in Hail, KSA. Heavy metal analysis in drinking water was done to analyze lead (Pb), zinc (Zn), copper (Cu), cobalt (Co), cadmium (Cd), nickel (Ni), chromium (Cr), molybdenum (Mo), and manganese (Mn). These samples were analyzed by using ICP emission instrument on Perkin Elmer ICP-400 at the university of hail, KSA. Each station is represented by 10 drinking water samples for chemical and blood analysis with a total of 50 samples. Collect the water sample to determine the heavy metals in ground water through number of wells which used as sources for drinking water in Hail. Collect the blood samples to determine the heavy metals in blood samples for patients in King Khalid Hospital, Studying the types of prevalence diseases among these patients of kidney failure.

Statistical Analysis

Data were expressed as M ± SD. The SPSS program version 15 was used in analysis. One way analysis of variance (ANOVA) followed by Duncan post hoc test and/or t-test were used in analysis. Pearson correlation coefficient was used to study correlations. P-values less than 0.05 was significant.

RESULTS

The concentration of copper showed the highest values from stations 5 and 10 and the lowest from stations 8, which were 1.01 ppm and 0.91 ppm respectively. All areas exceeded the standard limit (0.05 ppm) in most of the drinking water samples as showed in table 1. **The** highest nickel concentrations were reported from stations 2 and 6 and the lowest from stations 5, which were 041 ppm and 0.05 ppm respectively. All areas

Table 1. Concentration of heavy metals in ppm from 10stations of drinking water in Hail, KSA

Elements	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	Station 7	Station 8	Station 9	Station 10
Cu	1.00	1.00	1.01	1.00	1.02	1.01	1.00	0.91	1.00	1.02
Ni	0.30	0.41	0.30	0.06	0.05	0.41	0.30	0.06	0.05	0.35
Co	0.10	0.05	0.09	0.09	0.05	0.05	0.09	0.09	0.05	0.10
Zn	0.37	0.12	0.13	0.12	0.17	0.12	0.13	0.12	0.17	0.37
Pb	0.20	0.11	0.07	0.10	0.10	0.11	0.07	0.07	0.10	0.20
Cd	0.01	0.01	0.02	0.03	0.02	0.01	0.02	0.03	0.02	0.02
Cr	0.01	0.01	0.02	0.01	0.01	0.01	0.02	0.01	0.01	0.00
Mo	0.03	0.03	0.02	0.10	0.07	0.03	0.02	0.10	0.07	0.07
Mn	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.00	0.01	0.01

Table 2. Concentration of heavy metals in ppm from three wells in Hail area, KSA

Elements	Station 1	Station 2	Station 3
Cu	1.00	1.01	1.00
Ni	0.30	0.41	0.30
Co	0.12	0.01	0.01
Zn	0.37	0.12	0.13
Pb	0.20	0.11	0.07
Cd	0.01	0.01	0.02
Cr	0.01	0.01	0.02
Mo	0.03	0.03	0.02
Mn	0.00	0.00	0.01

have exceeded the standard limit (0.03 ppm) in all samples. The highest lead concentration was reported from stations 1 and 10 with 0.20 ppm and the lowest from stations 3, 7, 8 are 0.07ppm respectively. All areas have exceeded the standard limit (0.1 ppm) in most of the drinking water samples. The highest concentrations of molybdenum were represented by stations 4 and 8. The concentration of cadmium slightly exceeded the standard limit (0.01 ppm) from all stations. Nickel also, the highest concentrations were represented in stations 2 and 6. The concentration of zinc in all areas fell low than the standard limit (2.00 ppm, table 1). The concentration of cobalt fell in all areas within the standard limit (1.00 ppm), which varies from 0.05 ppm to 0.1 ppm. The highest concentration of chromium were represented in stations 7. The highest concentration of manganees were represented in stations 3, 6, 7 and 10 as shown in table 1.

Table 2 represented that all water samples from three wells were exceeded the standard limit in all samples such as Pb, Cd, Cu, Mo, Zn, Ni, Mn Co and Cr.

The liver function and lipid profile are included in table 3. All of the biochemical parameters were comparable in males and females; the difference was not significant ($p < 0.05$) (Table 3).

With respect to the age groups, only total bilirubin showed a significant increase ($p < 0.05$) in the old age group than the younger one (Table 4).

Table 5. No significant difference could be detected between males and females with respect to the kidney function tests, electrolytes and glucose ($p > 0.05$ in all), (Table 5)

Table 6 summarizes the comparison between the two age groups (< 50 and > 50 yrs) for the kidney function tests, electrolytes and glucose. Most of the parameters are comparable in the two age groups. But for chlorine, there was a significant increase in the young age group than the older one ($p < 0.05$).

The mean values sharing the same letter do not vary significantly from each other. When dividing the concentration of uric acid into three groups; lower (< 5.4), medium (5.5 - 6.1) and higher (> 6.2), we obtained the following results: for ALP, the higher level of the enzyme was detected in the higher concentration of uric acid. For albumin, the higher level was detected in the medium group for uric acid level. The rest of the biochemical parameters showed no association with uric acid levels (Table 7).

Table 3. Liver function test and lipid profile of patients according to the gender.

	Males (n= 28)	Females (n= 22)	Total (n = 50)
AST	23.11 ± 7.67	28.86 ± 17.48	25.64 ± 13.11
ALT	42.28 ± 12.95	41.72 ± 14.44	42.02 ± 13.5
ALP	143.46 ± 76.89	146.91 ± 59.67	144.98 ± 69.2
GGT	69.78 ± 55.19	70.41 ± 45.38	70.06 ± 50.61
Total protein	71.47 ± 10.55	72.83 ± 9.17	72.08 ± 9.9
Total bilirubin	8.36 ± 4.08	7.78 ± 5.31	8.11 ± 4.62
Direct bilirubin	1.97 ± 1.35	1.94 ± 1.78	1.96 ± 1.54
Albumin	37.27 ± 8.21	34.47 ± 6.53	36.04 ± 7.57
Cholesterol	4.36 ± 1.11	4.08 ± 0.68	4.24 ± 0.95
Triglycerides	2.02 ± 1.15	2.35 ± 1.55	2.16 ± 1.34
HDL	2.92 ± 0.98	2.76 ± 0.70	2.84 ± 0.86
LDL	0.86 ± 0.25	0.25 ± 0.22	0.92 ± 0.25

* significant at $p < 0.05$.

Table 4. Liver function test and lipid profile of patients according to the age.

	< 50 yrs (n= 18)	> 50 yrs (n= 32)	Total (n = 50)
AST	27.72 ± 13.64	24.46 ± 12.87	25.64 ± 13.11
ALT	43.33 ± 14.96	41.31 ± 12.78	42.02 ± 13.5
ALP	160.39 ± 94.48	136.31 ± 49.56	144.98 ± 69.2
GGT	61.55 ± 43.41	74.84 ± 54.32	70.06 ± 50.61
Total protein	68.96 ± 13.76	73.82 ± 6.49	72.08 ± 9.9
Total bilirubin	6.43 ± 3.10	9.45 ± 5.09 *	8.11 ± 4.62
Direct bilirubin	1.65 ± 1.33	2.12 ± 1.64	1.96 ± 1.54
Albumin	33.88 ± 10.77	37.25 ± 4.79	36.04 ± 7.57
Cholesterol	4.27 ± 0.99	4.22 ± 0.94	4.24 ± 0.95
Triglycerides	2.28 ± 1.28	2.09 ± 1.38	2.16 ± 1.34
HDL	2.90 ± 0.72	2.81 ± 0.94	2.84 ± 0.86
LDL	0.89 ± 0.18	0.94 ± 0.28	0.92 ± 0.25

* significant at $p < 0.05$.

Table 5. Kidney function test, electrolytes and glucose in males and females.

	Males (n= 28)	Females (n= 22)	Total (n = 50)
Creatinine	211.11 ± 164.63	195.87 ± 130.96	204.41 ± 149.47
Uric acid	6.36 ± 1.90	6.42 ± 2.67	6.38 ± 2.25
Urea	11.63 ± 7.48	12.77 ± 8.82	12.13 ± 8.05
Na	138.87 ± 3.59	138.97 ± 4.72	138.92 ± 4.09
K	4.61 ± 0.56	4.39 ± 0.78	4.51 ± 0.67
Cl	103.89 ± 3.87	105.50 ± 3.14	104.60 ± 3.62
Ca	2.11 ± 0.18	2.07 ± 0.20	2.09 ± 0.19
Glucose	9.46 ± 3.65	8.24 ± 3.14	8.92 ± 3.46

* significant at $p < 0.05$.

Table 6. Kidney function test, electrolytes and glucose in the two age groups.

	< 50 yrs (n= 18)	> 50 yrs (n= 32)	Total (n = 50)
Creatinine	219.72 ± 164.01	195.79 ± 142.66	204.41 ± 149.47
Uric acid	6.56 ± 2.61	6.28 ±1 2.05	6.38 ± 2.25
Urea	13.52 ± 10.59	11.35 ± 6.22	12.13 ± 8.05
Na	140.0 ± 3.82	138.31 ± 4.16	138.92 ± 4.09
K	4.61 ± 0.82	4.45 ± 0.57	4.51 ± 0.67
Cl	106.11 ± 3.96*	103.75 ± 3.17	104.60 ± 3.62
Ca	2.06 ± 0.25	2.11 ± 0.15	2.09 ± 0.19
Glucose	8.38 ± 3.05	9.22 ± 3.68	3.46

* significant at $p < 0.05$.

Table 7. Biochemical parameters of patients according to uric acid ranges.

	Uric acid range			p-value
	< 5.4 (n= 17)	5.5 - 6.1 (n= 11)	> 6.2 (n= 22)	
AST	30.94 ± 19.47	24.45 ± 8.53	22.14 ± 6.41	0.107
ALT	42.58 ± 16.17	44.54 ± 16.38	40.36 ± 9.54	0.697
ALP	116.88 ± 42.36a	124.63 ± 50.47a	176.86 ± 81.67b	0.012*
GGT	57.94 ± 36.66	67.09 ± 51.03	80.90 ± 58.87	0.371
Total protein	68.72 ± 13.84	73.80 ± 6.98	73.6 ±.75	0.232
Total bilirubin	9.43 ± 6.78	8.36 ± 3.12	6.95 ± 2.69	0.251
Direct bilirubin	2.51 ± 2.03	1.81 ± 1.26	1.62 ± 1.12	0.195
Albumin	32.38 ± 8.99a	38.81 ± 5.38b	37.48 ± 6.45ab	0.041*
Cholesterol	4.22 ± 0.77	4.19 ± 0.91	4.26 ± 1.13	0.979
Triglycerides	2.10 ± 0.89	1.92 ± 0.68	2.32 ± 1.81	0.697
HDL	2.96 ± 0.79	2.87 ± 1.15	2.74 ± 0.78	0.739
LDL	1.00 ± 0.26	0.93 ± 0.32	0.66 ± 0.19	0.249

* significant (ANOVA test)

Table 8. Kidney function test, electrolytes and glucose according to uric acid ranges.

	Uric acid range			p-value
	< 5.4 (n= 17)	5.5 - 6.1 (n= 11)	> 6.2 (n= 22)	
Creatinine	165.42 ± 138.74	176.85 ± 174.25	248.31 ± 139.15	0.182
Uric acid	3.92 ± 0.81a	6.06 ± 0.54b	8.45 ± 1.31c	0.001
Urea	8.87 ± 6.23a	8.58 ± 4.73a	16.42 ± 8.71b	0.002*
Na	137.97 ± 4.75	139.05 ± 2.91	139.59 ± 4.05	0.476
K	4.21 ± 0.57a	4.42 ± 0.72ab	4.78 ± 0.62b	0.025*
Cl	104.0 ± 2.76	103.0 ± 3.34	105.86 ± 4.02	0.069
Ca	1.99 ± 0.16a	2.23 ± 0.09b	2.09 ± 0.19a	0.005*
Glucose	9.01 ± 0.31	10.11 ± 3.47	8.27 ± 3.46	0.361

Table 8 illustrates the association between uric acid range-groups and the other kidney function tests, electrolytes and glucose. Highly significant association was found between uric acid and urea ($p = 0.002$). For calcium, the higher level of the metal was detected in the middle concentration group of uric acid while the higher level of potassium was found in the higher uric acid group.

Table 9 summarizes the correlation between the kidney function tests, electrolytes and glucose. Creatinine was

Table 9. Correlation between kidney function tests, electrolytes and glucose.

	Creatinine	Uric acid	Urea	Na	K	Cl	Ca	glucose
Creatinine	1	0.154	0.753**	0.009	0.455**	0.012	-0.207	-0.111
Uric acid		1	0.392**	0.103	0.269	0.209	0.306*	-0.091
Urea			1	0.093	0.264	0.119	-0.092	-0.068
Na				1	0.050	0.552**	-0.094	0.041
K					1	0.176	-0.075	-0.085
Cl						1	-0.211	-0.268
Ca							1	0.233
glucose								1

** Correlation is significant at the 0.01 level.
* Correlation is significant at the 0.05 level.

Table 10. Correlation between kidney function test and other biochemical parameters.

	Creatinine	Uric acid	Urea	Na	K	Cl	Ca	glucose
AST	-0.287*	-0.250	-0.354*	-0.102	-0.245	0.272	-0.170	-0.305*
ALT	-0.365*	0.028	-0.256	-0.107	-0.247	0.031	0.048	0.101
ALP	0.559**	0.373**	0.619**	0.064	0.133	0.073	-0.176	-0.226
GGT	0.022	0.298*	-0.030	0.211	-0.157	0.031	0.039	0.038
Total protein	0.059	0.163	0.133	-0.241	-0.026	-0.216	0.406**	0.106
Total bilirubin	-0.251	-0.097	-0.365**	-0.081	-0.315*	-0.048	0.022	0.026
Direct bilirubin	-0.133	-0.122	-0.298*	0.021	-0.223	0.071	-0.203	-0.143
Albumin	0.052	0.293*	0.167	-0.221	-0.005	-0.316*	0.521**	0.119
Cholesterol	0.010	0.064	-0.057	-0.319*	0.013	-0.227	0.345*	0.084
Triglycerides	0.034	0.280*	0.079	-0.271	-0.184	-0.162	0.112	0.224
LDL	0.034	-0.112	-0.020	-0.243	-0.076	-0.179	0.168	0.160
HDL	-0.057	-0.221	-0.237	0.108	-0.070	0.007	0.032	-0.229

* significant at $p < 0.05$ ** significant at $p < 0.01$

positively correlated to urea and potassium. Uric acid was positively correlated to urea and calcium. Sodium was positively correlated to chlorine.

Table 10 illustrates the correlation between the studied parameters. With respect to liver enzymes, AST showed negative correlation with Creatinine, urea and glucose(r= -0.305, p <. ALT showed negative correlation with creatinine only ALP showed significant positive correlations with creatinine uric acid and urea. GGT showed significant positive correlation with uric acid only. Total protein level was positively correlated with calcium. Total bilirubin showed negative correlation with urea and potassium whereas direct bilirubin showed negative correlation with urea only. Albumin level was positively correlated with uric acid and calcium but negatively correlated with chlorine. For lipid profile, cholesterol level was positively correlated with calcium but negatively correlated with sodium. triglycerides level correlated positively with uric acid. Both of LDH and HDL showed no significant correlations with any parameter.

DISCUSSION

Environmental factors are an important cause of acute and CKD, especially in the developing world.. Toxic doses of chemicals cause either acute or chronic health effects. The levels of chemicals in drinking water, however, are seldom high enough to cause acute health effects. They are more likely to cause chronic health effects that occur long after exposure to small amounts of a chemical. Examples of chronic health effects include cancer, birth defects, organ damage, disorders of the nervous system, and damage to the immune system (USGAO reports 2000). The present study showed that concentration of copper showed the highest values from stations 5 and 10 and the lowest from stations 8, which were 1.01 ppm and 0.91 ppm respectively. All areas exceeded the standard limit (0.05 ppm) in most of the drinking water samples. The highest nickel concentrations were reported from stations 2 and 6 and the lowest from stations 5, which were 041

ppm and 0.05 ppm respectively. All areas have exceeded the standard limit (0.03 ppm) in all samples. The highest lead concentration was reported from stations 1 and 10 with 0.20 ppm and the lowest from stations 3, 7, 8 are 0.07ppm respectively. Pb, Cd, Cu, Mo, Zn, Ni, Mn Co and Cr are toxigenic and carcinogenic agents consistently found as contaminants in human drinking water supplies in many areas around the world (Groopman et al., 1985).This study shows a strong relationship between heavy metals such as lead, copper, nickel, chromium, cadmium and molybdenum and renal failure, liver cirrhosis, hair loss and chronic anemia diseases. Exposure to lead is cumulative over time. High concentrations of lead in the body can cause death or permanent damage to the central nervous system, the brain, and kidneys (Jennings et al., 1996). This damage commonly results in behavior and learning problems (such as hyperactivity), memory and concentration problems, high blood pressure, hearing problems, headaches, slowed growth, reproductive problems in men and women, digestive problems, muscle and joint pain. There is no evidence indicating its essentiality to humans. Also, the present study demonstrated that the total bilirubin showed a significant increase ($p < 0.05$) in the old age group than the younger one ALP, the higher level of the enzyme was detected in the higher concentration of uric acid. Cd appears to accumulate with age, especially in the kidney and it is considered also as a cancer and cardiovascular diseases. Webb (1979) reported that geochemical implications of Cd in human health related to: (a) bone and renal disease in populations exposed to industrially contaminated drinking water, (b) lung and renal dysfunction in industrial workers exposed to air-borne Cd and (c) implication in human hypertension. Galvanized steel is plated with zinc, which is normally contains about In low doses, cadmium can produce coughing, headaches, and vomiting. In larger doses, cadmium can accumulate in the liver and kidneys, and can replace calcium in bones, leading to painful bone disorders and to a renal failure. The kidney is considered to be the critical target organ in humans chronically exposed to cadmium by ingestion. Patients suffer from liver cirrhosis in this study were related to contaminant drinking water mainly with copper and molybdenum. Copper is essential substance to human life, but chronic exposure to contaminant drinking water with copper can result in the development of anemia, liver and kidney damage (Madsen et al., 1990; Bent and Bohm, 1995). This disease was a result of drinking water contaminated from corrosion of water pipes made of copper and industrial wastes. Diarrhea in small children could be also occurred due to high copper exposure. (Jennings et al., 1996). Molybdenum is an essential dietary nutrient, which is a constituent of several mammalian enzymes including xanthine oxidase, sulfite oxidase and aldehyde oxidase (NRC, 1989). Although molybdenum is an essential mineral, no deficiencies have been reported in humans. Molybdenum is present in very small amounts in human body. Its content can be varied in tissues such as liver, kidney and bone depending on the dietary intake (Grounse et al., 1983). High levels ingested molybdenum may be associated with potential mineral imbalance by increasing serum ceruloplasmin and urinary extraction of copper. Excretion of sufficient quantities of this element may put humans at risk for the hypochromic microcytic anemia associated with dietary copper deficiency (US EPA, 1985, 1991). The present study illustrated that the higher level of albumin was detected in the medium group for uric acid level. the association between uric acid range-groups and the other kidney function tests, electrolytes and glucose. Highly significant association was found between uric acid and urea ($p = 0.002$). For calcium, the higher level of the metal was detected in the middle concentration group of uric acid while the higher level of potassium was found in the higher uric acid group. White et al., (1973) reported that copper-molybdenum interaction appears to be critical to the development of gout-like symptoms at very high levels of molybdenum. Patients suffer from hair loss in this study were related to contaminant drinking water with nickel and chromium. It is considered as carcinogenic to human. Ambrose et al. (1976) reported that high-dose of nickel in rats and dogs were significantly decreasing their body weights. Kaaber et al. (1978, 1979) reported worsening of eczema for human exposed to high level for nickel. Hair loss patients are related to contaminant drinking water and nickel can be related to derma toxicity in hypersensitive humans. Subchronic and chronic exposure to chromic acid can cause dermatitis and ulceration of the skin (Koval'skiy et al., 1961; US EPA, 1999). Long-term exposure can cause kidney and liver damage, and damage too circulatory and nerve tissue. Chromium often accumulates in aquatic life, adding also to the danger eating fish that may have been exposed to high levels of chromium. Chronic exposure to contaminant drinking water with cadmium can result in the development of chronic anemia (Stowe et al., 1972; Sakata et al., 1988). Cadmium poisoning has been associated with kidney disease, hypertension, and chronic anemia (Lin et al., 2003; Jennings et al., 1996). Cadmium may interfere with the metallothionein's ability to regulate zinc and copper concentrations in the body that some patients showed some elevation in zinc in their urine samples. Metallothionein is a protein that binds to excess essential metals to render them unavailable. When cadmium induces metallothione in activity, it binds to copper and zinc disrupting the

homeostasis levels (US EPA, 1990). Cadmium is used in industrial manufacturer and is a byproduct of the metallurgy of zinc. Our results show that patients suffered from renal failure could be related to their contaminated drinking water with lead and cadmium, liver cirrhosis to copper and molybdenum, hair loss to nickel and chromium, and chronic anemia to contaminant drinking water with copper and cadmium. The present study was performed on a total of 50 hemodialysis patients including 28 males and 22 females of age range between 16 and 85 years, median of 59.5 y. Demographic characteristics of patients. World Health Organization, 1998 reported that the renal failure is related to contaminate drinking water with lead and cadmium, liver cirrhosis to copper and molybdenum, hair loss to nickel and chromium, and chronic anemia to copper and cadmium. Metals should be removed from drinking water if they are present at high levels for human safety.

CONCLUSION

Environmental factors are an important cause of acute and CKD, especially in the developing world. It is important to note that most environmental renal disease is in fact multifactorial. As an example, only approximately 1% to 2% of the residents Endemic Nephropathy progress to the disease. Studies for these diseases suggest that abnormal incidence in specific areas is related the groundwater and thereby led to the contamination of drinking water in these areas. These diseases are apparently related to contaminant drinking water with heavy metals such as Pb, Cd, Cu, Mo, Ni, and Cr.

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