CONCENTRATION OF HEAVY METALS IN DRINKING WATER OF DIFFERENT LOCALITIES IN DISTRICT EAST KARACHI

MUHAMMAD ASIF JALEEL, ROZINA NOREEN* AND ABDUL BASEER**

Departments of Bio-Chemistry and *Physiology frontier Medical College. Abbottabad and Department of Biochemistry. Margala Institute of Health Sciences

Background: Several heavy metals are present in drinking water that play important roles in the body provided their level remains within the specified range recommended by WHO. But now due to the industriali7ation and rapid urbanization, the problems of pollution have surfaced. This study was designed to ascertain the contents of some heavy metals and then their variations if any in drinking water in different localities of district East of Karachi, Pakistan. *Methods:* Drinking water samples were collected from different sources and localities of district East of Karachi. The concentration of the heavy metals i.e. Lead, Arsenic. Copper, Iron. Mercury, Chromium, Manganese, Nickel, Cadmium and Zinc were determined by Atomic Absorption Spectrophotometry. Phi was estimated by pH meter. Total dissolved solids (TDS) were calculated by formula. These concentrations of heavy metals, pH and TDS were compared with the standards set by WHO. ***Results:*** Concentrations of lead and nickel were found to be significantly elevated as compared to WHO recommended levels in all the three sources of water (Piped water. Hand pump water and Tanker water supply). Chromium was found to be raised in hand pump water. Arsenic and Mercury were not detected in any source of water. Copper, iron, manganese, cadmium and zinc were found to be within the safe limits in all the three sources of water. pH was found to be within the range of WHO recommended level in all the three sources of water. TDS was found to be elevated in hand pump water and tanker water. ***Conclusion:*** Concentrations of lead and nickel were found to be significantly elevated as compared to WHO recommended levels in all the three sources of water in district East of Karachi.

INTRODUCTION

Water is essential for life of every living thing from the simplest plant and one-cell organism to the most complex living system known the human body' Water is the most familiar and abundant liquid on earth and covers 70-71 % of the earth's surface.

Water is of outstanding importance to the body for its structure and functions. It is the most abundant constituent of living cells. Although two third *of the* body fabrics *are* made up of water, its ratio differs in different tissues. Fatty tissue and bone contain less, the grey matter *of* brain, glandular organs *and* muscle contain more and the body fluid most. The percentage of water is highest in the tissues where the chemical changes are most rapid, and also in those tissues which are called upon to function most frequently. The insufficient ingestion *of* water gives rise to headache, loss of appetite, disturbance *of* digestive functions and actions of bowels, nervousness and impaired capacity of work, mental or physical. *In* infant the excess loss of water may even cause death. The body of normal man contains about 67.85% of water. Because of its capacity as a solvent, water plays a fundamental role in cellular reactions.

The health risk due to toxic chemicals in drinking water differs from that caused by microbiological contaminants. The problem associated with chemical constituents of drinking water arise primarily from their ability to cause adverse health effects after prolonged periods of exposure; of particular concern are contaminants that have cumulative toxic properties, such as heavy metals, and substances that are carcinogenic. Guideline values have been set by WHO for potentially hazardous water constituents and provide a basis for assessing drinking water quality[8].

a. A guideline value represents the concentration of a constituent that does not result in any significant risk to the health of the consumer over a lifetime of consumption.
b. The quality of water defined by guidelines for drinking water quality is such that it is suitable for human consumption and for all don purposes, including personal hygiene. How r, water of a higher quality may be required for special purposes, such as renal dialysis.

c. When a guideline value is exceeded should be a signal:
   i. To investigate the cause with a view to taking remedial action.

   ii. To consult with, and seek advice from the am: responsible for public health.
   Although the guideline values describe a i| of water that is acceptable for lifelong consumption the establishment of these guideline values should be regarded as implying that the quality of drinks

water may be degraded to the recommended level Indeed; a continuous effort should be made to minimum drinking water quality at the highest possible level

e. Short term deviations above the guideline values do not necessarily mean that the water is unsuitable for consumption The amount by which and the period for

which, any guideline value can be exceeded without affecting public health depends upon the specific substance involved. It is recommended that when a guideline value is exceeded, the surveillance agency (usually (he authority responsible for public health) should be consulted for ad vice on suitable action, taking into account the intake of the substance from sources other than drinking water (for chemical constituents) the toxicity of the substance, the likelihood and nature of any adverse effects, the practicability of remedial measures nod similar factors.

f. In developing national drinking water standards based on these guideline values, it will be necessary to take account of a variety of geographical, socio-economic, dietary and other conditions affecting potential exposure This may lead to national standards (hat differ appreciably from the guideline values The important heavy metals present in the drinking water with their guideline values set by WHO are the following[8].

1	lead	0.01 mg/litre
2	Arsenic	0.01 mg/litre
3	Copper	2 mg/litre
4	Iron	2 mg/litre
5	Mercury	0 001 mg litre
6	Chromium	0.05 mg litre
7	Manganese	0.5 mg/litre
8	Nickel	0.02 mg litre
9	Cadmium	0.003 mg Litre
10	Zinc	3 mg/litre

RESULTS

The results of this study are summarized in table-1. Table shows comparison between mean levels of heavy metals. pH and TDS in piped water, hand pump water and tanker water supply in district East with WHO recommended level. Lead and nickel concentrations are raised in piped water, hand pump water and tanker water supply as compared with WHO recommended level with $p<0.001$ Chromium concentration in hand pump water is raised as compared with WHO recommended level whereas it is within WHO permissible level in piped water and tanker water supply. Total dissolved solids (TDS) is raised in hand pump water and tanker water supply as compared with WHO recommended level with $p<0.001$ Arsenic and Mercury are not detected in all three sources of water.

DISCUSSION

In recent years there has been a considerable and increasing interest in chemical composition of surface, sub-surface and domestic water.

Such information is required for various types of studies for assessing the extent to which drinking water provides source of heavy metals for essential and dietary intake by man, also for investigating the significance of heavy metals present in drinking water in relation to human health and disease.

As the drinking water is obtained from various sources, it may differ greatly in quality and suitability for human use. In developed countries great emphasis is placed in the quality of drinking water so that the disease that are to be caused by unwholesome water may be controlled in view of the large volume of water consumed by every individual, its importance in Me regarding the supply of heavy metals to human being, therefore, cannot be ignored. Developed countries have maintained the levels of heavy metals and other chemical constituents within the recommended level of WHO. In 1988, it was estimated that a lead level of 5µg/litre was exceeded in only 11% of public water distribution systems in the USA 1 be level of lead in drinking water samples collected in five Canadian cities was 2 µg/litre[4]

In the present study, 45 water samples obtained from different sources (piped water, hand pump water and tanker water supply) from different localities of District East of Karachi, were analyzed for heavy metals, TDS and pH. Particular stress was placed on Lead, Arsenic, Copper, Iron. Mercury. Chromium, Manganese. Nickel, Cadmium and Zinc as these constituents are in some way or the other involved in the association of health and disease with water.

The development of essential services including water and sanitation in many mega-cities of the economically developing countries of Asia cannot keep pace with their rapidly growing population and accompanying urban and industrial development. The inadequate water supply and poor sanitation services lead to contamination of their water supply. It also leads to the input of sewage water into the ground water. The problem is seriously acute in Karachi, the largest city in Pakistan with a population of over 12 million and growing at 6%. Many water samples have been found to contain heavy metals including Chromium. Lead, Nickel and Arsenic in amounts excessive of permitted standards.

The probable sources of contaminants for the various types of water (piped, vendors, wells) indicate that ground water may be the main contributor. The source of this ground water contamination is predominantly from sewage. The health hazards from consuming such contaminated water are obvious[7]. In our study Lead, Nickel, Chromium have been found but Arsenic is not detected in all the three sources of water i.e. piped water, hand pump water and tanker water supply. Lead is raised in all the three sources of water particularly hand pump water of District East.

Table-1: Comparison between mean levels of heavy metals in piped water, hand pump water and tanker water supply in district East with WHO recommended level (All values are in parts per million (PPM) *except pH*)

Parameters	Piped water	Hand pump	Tanker water	WHO recommended level		P Value	
					Piped water	**Hand pump**	**Tanker Water**
Lead	0.2083 ±0.0023	0.6406 ±0.0494	0.3734 ±0.0062	0.0100	< 0.001	< 0.001	< 0.001
Arsenic	ND	ND	ND	0.0100			
Copper	0.6470 ±0.0637	0.1114 ±0.0148	0.4635 ±0.0410	2.0000	< 0.001	< 0.001	<0.001
Iron	0.7004 ±0.0238	0.5599 ±0.0574	0.6025 ±0.0591	2.0000	< 0.001	< 0.001	< 0.001
Mercury	ND	ND	ND	0.0010			—
Chromium	0.0181 ±0.0013	0.0675 ±0.0050	0.0451 ±0.0037	0.0500	<0.001	< 0.01	n.s.
Manganese	0.0306 ±0.0032	0.0464 ±0.0051	0.0349 ±0.0023	0.5000	<0.001	< 0.001	<0.001
Nickle	0.0533 ±0.0017	0.1248 ±0.0096	0.0773 ±0.0025	0.0200	<0.001	< 0.001	<0.001
Cadmium	0.0012 ±0.0001	0.0016 ±0.0002	0.0016 ±0.0002	0.0030	< 0.001	< 0.001	< 0.001
Zinc	0.7286 ±0.0379	0.8363 ±0.0245	0.8402 ±0.0457	3.0000	< 0.001	< 0.001	<0.001
PH	6.9467 ±0.0387	7.0600 ±0.0898	7.0133 ±0.0351	6.5 to 8.5	Within range	Within range	Within range
TDS	447 ±16.585 1	4131 ±217.909 0	1635 ± 63.6299	1000	< 0.00!	< 0.001	< 0:00l

N.D = Not Detected N.S = Non-Significant

The Lead concentration in hand pump water of District East is 0.6406±0.0494 PPM which is significantly raised as compared with the WHO recommended level of 0.01 PPM. As Lead is used in the production of Lead acid batteries, solder, alloys, cable sheathing pigments, rust inhibitors, glazes and plastic stabilizers. Most of these industrial units are present in the industrial state of District East. Their waste effluents contain high concentration of Lead, so the concentration of Lead in sub-surface water is significantly raised as compared with WHO recommended level.

Overt signs of acute intoxication include dullness, restlessness, irritability, poor attention span, headaches, muscle tremor, abdominal cramps, kidney damage, hallucinations and loss of memory, encephalopathy occurring at blood lead levels of 100-120 µg/dl in adults and 80-100 µg/dl in children. Signs of chronic lead toxicity, including tiredness, sleeplessness, irritability, headaches, joint pains and gastrointestinal symptoms, may appear in adults at blood lead levels of 50-80 µg/dl. After 1-2 years of exposure. muscle weakness. gastrointestinal symptoms, disturbances in mood and symptoms of peripheral neuropathy were observed in occupationally exposed populations at blood lead levels of 40-60 µg/dl. Renal disease has long been associated with lead poisoning, however, chronic nephropathy in adults and children has not been detected below blood lead levels of 40 µg/dl[2]. There are indications of increased hypertension at blood lead levels greater than 37 µg/dl[6].

Wells located in the Korangi tannery area contain high total dissolved solids exceeding 5000 PPM and Chromium ranging between 0.048 to 0.39 PPM whereas wells located outside a radius of about 5 miles around the tannery sector contain low dissolved solids ranging between 976 and 1636 PPM and Chromium less than 0.001 PPM[1].

In our study, TDS in hand pump water in District East (which includes the Korangi tannery area) has been found to be 4131±217 PPM and Chromium concentration as 0.0675±0.0050 PPM. Our results regarding TDS and Chromium concentration in hand pump water in District East (which includes the Korangi tannery area) are compatible with the results of Beg et al[1].

CONCLUSION

- Lead is raised in all three water sources of District East of Karachi. The highest concentration of Lead is in hand pump water of District East which is 6406±0.0494 PPM. While WHO recommended level is 0.01 PPM.

- Nickel is also raised in all the three water-sources of District East. The highest concentration of Nickel is found in hand pump water of District East which is 1248±0.0096 PPM while the WHO recommended level is 0.02 PPM.

- Chromium is raised in hand pump water of District East. The highest concentration of Chromium is found in hand pump water of District East which is 0.0675±0.005 PPM while WHO recommended level is 0.05 PPM.
- TDS in hand pump water and tanker water supply is raised in district East of Karachi.
- Arsenic and Mercury are not detected in all the three water sources district East of Karachi.
- pH in all three water sources of district East of Karachi is within the range of WHO recommended level.
- Copper, Iron, Manganese, Cadmium and Zinc are found within the permissible level of WHO in all the three water sources of district East of Karachi.

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