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Assessment of Heavy Metals Intake Among School Girls of an Industrial Town of Punjab

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INTRODUCTION

Environmental pollution is a worldwide phenomena. It is increasing day by day due to effluents and emissions from industries, solid waste disposal, automobile exhaust, degradation of soil by removing the green belt and high use of pesticides. Ludhiana city, being industrial capital of Punjab has maximum soil, water and environmental pollution. Majority of industries like textiles, dyeing, cycle motor parts etc. generate waste flow full of chemicals. These have serious repercussions on the health of the residents of the city. Heavy metals are known to affect human health adversely, like cadmium is known to cause dysfunctioning of kidneys. Nickel is known to cause cancer, paralysis, gastroenteritis and heart failure in humans (Prasad et al., 1995). There are severe neurological effects of lead on growing children (NIN, 1997). Children being vulnerable group are likely to be affected by heavy metal toxicity. Therefore, the present project was planned to study the effect of heavy metals on school girls.

MATERIAL AND METHODS

The study was conducted on 60 school girls in the age group of 7-9 years residing in handpump dependent Dholewal Industrial Area of Ludhiana city (experiment group) and handpump dependent rural area *i.e.* village Daad which is 6 km away from Ludhiana city (control group). Food intake of the respondents was recorded by "24-hour-recall-cum-weighment method" for three consecutive days including one holiday. Food, water, hair, blood and urine samples were collected from one third of the respondents and analyzed for lead, cadmium, nickel, zinc and copper by using Atomic Absorption Spectrophotometer and chromium in water by Inductively Coupled Atomic Absorption Spectrophotometer (ICAP-AES). In order to examine the statistical significance between experiment and control groups in respect of these selected heavy metals intake through food and water and their retention in hair, blood and urine, 't-test' was applied.

RESULTS

Food and water were the major determinants of heavy metals intake by the respondents. Results revealed that intakes of lead, nickel and zinc were significantly higher by the respondents of experiment group as compared to control group (Table 1). Mean intake of hexavalent chrome (Cr^{6+}) through water by the respondents of experiment and control groups was .022 to .015 mg/day, respectively. These values were less than the permitted limits of drinking water. It showed that the intake of Cr^{6+} through water in both the areas was within the safe limit. However, significant difference ($P<0.05$) in the intake of this element was found between the respondents of experiment and control groups.

Retention of heavy metals was noticed in hair and blood of the respondents of both the areas. It was found that significant higher levels of lead ($P<0.01$), were found in the hair of the respondents of industrial area as compared to the controls (Table 2). Similarly, in blood, lead and cadmium

Table 1: Daily intake of heavy metals (mg/day) by the respondents through food and water

Group	*Heavy metals (mean ±S.D.)*					
	Pb	*Cd*	*Ni*	*Zn*	*Cu*	*Cr^{6+} (in water only)*
Experiment group (n=20)	3.10± 1.06	1.09± 0.30	0.88± 0.35	4.30± 1.21	2.00± 0.48	.022± 14.4
Control group (n=20)	2.60± 0.83	0.93± 0.29	0.67± 0.24	3.30± 1.39	1.80± 0.29	.015± 4.3
't' value	1.89	1.67	2.22*	2.54*	1.33	1.71
Tolerable limit	0.4*	0.05*	-	10**	2.25**	50***

*Significant at 5% level
*WHO (1972)
**N.R.C. USA (1980)
*** Pawlisz et al. (1997)

Table 2: Heavy metal content in the hair of respondents (µg/g)

Group	Heavy metals (mean±S.D.)				
	Pb	Cd	Cu	Zn	Ni
Experiment group (n=30)	29.0+ 6.2	4.1+ 1.8	21.0+ 4.9	171.0+ 30.4	18.0+ 4.2
Control group (n=30)	22.0+ 2.2	3.1+ 1.5	19.0+ 4.5	138.0+ 49.0	15.0+ 3.2
't' value	3.20*	1.44	1.38	1.95	1.83
Normal value	20.0*	1.00*		-100-250**	0.3*

*Significant at 1% level
*Lenihan and Fletcher (1978)
** Shills and Young (1988)

were found significantly higher ($P<0.05$) in respondents of the experiment group. Likewise the retention of nickel and zinc was also found high in the blood of the respondents of experiment group (Table 3). Twenty-four hour urinary excretion of heavy metals was also noted and it was found that excretion of lead was significantly higher by the respondents of experiment group ($P<0.01$) (Table 4).

Table 3: Retention heavy in metals in the blood of the respondents (µg/g)

Group	Heavy metals (mean±S.D)				
	Pb	Cd	Cu	Zn	Ni
Experiment group (n=30)	283.0+ 28.4	65.0+ 24.9	211.0+ 41.6	271.0+ 99.9	194.0+ 54.4
Control group (n=30)	208.0+ 37.3	44.0+ 18.8	173.0+ 80.1	206+ 78.4	165.0+ 51.6
't' value	2.31*	2.31*	1.47	1.76	1.35
Normal value	100***		-100-200**	700*	-

*Significant at 5% level
*Claudio and Lagua (1991)
** Underwood (1966)
*** Kleiner et al. (1966)

Table 4: Excretion of heavy metals in the urine of the respondents (µg/g)

Groups	Heavy metals (mean±S.D.)				
	Pb	Cd	Cu	Zn	Ni
Experiment group (n=30)	165.96+ 26.40	5.22+ 1.23	56.32+ 23.41	66.17+ 48.68	99.93+ 27.49
Control group (n=30)	99.2+ 35.58	4.44+ 1.54	43.48+ 21.19	48.80+ 60.07	77.46+ 37.59
't' value	5.17*	1.36	1.41	0.78	1.67
Normal value	80*	3*	15-60	300-600*	10-70**

*Significant at 1% level
*Claudio and Lagua (1991)
**Underwood (1966)

DISCUSSION

It is clear from the present study that the intake of lead, nickel and zinc is significantly higher by the respondents of industrial area of Ludhiana. Food and water samples were collected in winter season and in Punjab during this season green leafy vegetables and root crops are generally consumed. These crops are known to accumulate high amounts of heavy metals (Dhaliwal and Kansal,1996). This may be the reason of higher intake of these elements among the respondents. Similar findings have been reported by Smigiel et al. (1987), Gupta (1994) and Dhillon (1997).

As a result of higher intake of heavy metals, the retention of lead, cadmium and zinc was more in the blood of the respondents of experiment group. Nath (1986) and Carvalho et al. (1995) also reported the higher blood lead and cadmium levels in people living near industrial areas. A number of factors are involved in the higher prevalence of elevated blood lead concentrations among young children since they are known to absorb more lead as compared to the adults. According to Mahaffey (1981) presence of pica and mouthing objects (lead pencil) in children may be the reasons of higher blood lead levels. Industrial lead emission is one of the major sources of high blood lead level for people living in the vicinity of the industry.

Heavy metals content of hair reflects its accumulation in body. The higher the intake, the higher is the heavy metals content of hair (Lee and Lee, 1987). Location is the most important factor which determines the variance for heavy metals (Wibowo, 1986). Children living near an industry have higher hair levels of heavy metals as compared to children living at other sites (Ferguson, 1990). In the present study also higher retention of heavy metals such as lead, zinc and nickel was observed, which may be attributed to the reasons discussed above.

Excretion of heavy metals in urine is correlated to body burden. Excretion of these metals is mainly via urine with little contri-bution from faeces and saliva. Seventy six per cent excretion of lead from the body is via urine (USEPA, 1980). In our study also excretion of lead was significantly higher ($P<0.01$) by the respondents of industrial area which may be due to its higher

intake; as excretion of heavy metals in urine varies with exposure to environmental pollution (Ferguson, 1990).

It is clear that children living near industrial area are more prone to heavy metal toxicity as compared to controls. They are inhaling/ingesting toxic metals through air, food and water. There is an urgent need to formulate certain policies at the government level for the proper treatment of effluent waste.

KEY WORDS Heavy Metals. Lead. Cadmium. School Girls. Industrial Town.

ABSTRACT Heavy metals intake among school girls in the age group of 7-9 years residing in the industrial and countryside of Ludhiana (Punjab) was assessed. Food and water were the major determinants for heavy metals intake. The intake of lead, nickel and zinc was significantly high in the respondents of the industrial area ($P<0.05$). The intake of hexavalent chrome through water was within the safe limits for both the area groups, however, the intake of Cr^{6+} by the respondents from industrial area was significantly higher ($P<0.01$). The retention of lead was significantly higher in the urine and hair of the children of industrial area ($P<0.01$); whereas the retention of element lead and cadmium in blood were found significantly high ($P<0.05$).

REFERENCES

Carvalho, F.M., Silvany-Neto, A.M., Barbosa, A.C., Cotrin, L.R.L. and Tavares, T.M.: Erythrocyte protoporphrin versus blood lead relationship with iron status among children exposed to gross environmental pollution. *Environ. Res. (New York)* **71 (1)**: 11-15. Cited from *Nutr. Abstr. Rev.* 1996 **66A (12)**: 1116 (1995).

Claudio, V.S. and Lagua, R.T. (Eds.): *Nutrition and Diet Therapy Dictionary*. Van Nostrand Reinhold, New York (1991).

Dhaliwal, G.S. and Kansal, B.D.: *Environmental Pollution*, Punjab Agricultural University, Ludhiana (1996).

Dhillon, N.: *Effect of Heavy Metal Toxicity on the Health of Children (7-9 yrs)*. MSc. Thesis, Punjab Agricultural University, Ludhiana (1997).

Ferguson,J.E.: *The Heavy Elements: Chemistry, Environmental Impact and Health Effects*. Pergamon Press, Oxford (1990).

Gupta, V.: *Effect of Heavy Metal Toxicity on the Health of School Children Around Ludhiana City*. M.Sc. Thesis, Punjab Agricultural University, Ludhi-ana(1994).

Kleiner, I.S., Dotr, L.B. and Neuwirth, I.: *Laboratory Instructions in Biochemistry*. C.V. Mosby Company, Saint-Louis (1966).

Lee, K.W. and Lee, H.B.: The effects of dietary cadmium, zinc, copper, iron on concentrations in tissues and hair of rats. Korean *J. Vety. Res.*, **27(2)**: 361-383. Cited from *Nutr. Abstr. Rev.*, **59A(12)**: 990(1989).

Lenihan, J. and Fletcher, W.W.: Measuring and monitoring the environment. *Environment & Man*. **Vol.7** Blackie and Glasgow, London (1978).

Mahaffey, K.R.: Nutritional factors in lead poisoning. *Nutr. Rev.* **39(10)**: 353-362 (1981).

Nath, R.: *Environmental Pollution of Cadmium. Biological, Physiological and Health Effects*. Interprint, New Delhi (1986).

NIN: *Nutrition News*. National Institute of Nuatrition, ICMR, Hyderabad, **Vol. 18(2)** (1997).

N.R.C., U.S.A. Cited from Swaminathan, M.: *Essentials of Foods and Nutrition*. Vol.I. BAPPCO, Bangalore (1980).

Pawlisz, A.V., Kent, R.A., Schneider, V.A. and Jefferson, C.: Canadian water quality guidelines for chromium. *Environmental Toxicology and Water Quality.*, **12(2)**: 123-183. Cited from *Food Science and Technology Abstracts* 1997. **29(11)**: 154 (1997).

Prasad, T.S., Singh, R.P. and Sastry, K.V.: These vegetables could be cancerous. *Indian Express*, 13th April, p.7 (1995).

Shils, M.E. and Young, V.R.: *Modern Nutrition in Heal-th and Disease*. Lea and Febler, Philadephia (1988).

Smigiel,D., Chorazy, W.Bliwert, K., Filip, J. and Podsiadlo, R.: Contents of heavy metals (lead and cadmium) in meals given to children in nursery schools. *Roczniki Panstwowego Zakladu Higieny*, **38(6)**: 480-484. Cited from *Nutr. Abstr. Rev.* 1989. **59A (5)**: 307 (1987).

Underwood, E.J.: *Trace Elements in Human and Animal Nutrition*. Academic Press, New York (1966).

USEPA: *Ambient Water Quality Criteria for Lead: Office of Water Regulators and Standards*. Washington D.C. (1980).

WHO: Environmental health criteria for cadmium. Ambio 6, 207. Cited by Cester, J.N. 1987. In: *Heavy Metals in Waste Water and Sludge Treatment Processes*. Vol.I. CRC Press, Florida. pp.12-22 (1966).

Wibowo, A.A.E., Herber, R.F.M., Das, H.A., Roeleved, N. and Zielhuis, R.L.: Levels of metals in hair of young children as an indicator of environmental pollution. *Environ. Res.* **40(2)**: 346-356 (1986).

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