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Mineral Intake by Low Income Group Women in Sewage and Tubewell Irrigated Areas Around Ludhiana City (Punjab)

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Ludhiana is the industrial city of Punjab and the industries located here include cycle and cycle parts, sewing machine, textile, dyeing, electroplating etc. Waste water discharged from these industries contain high amounts of undesirable minerals like lead, cadmium and nickel and is thrown into sewage discharge without much treatment. The farmers utilise this polluted water partially for irrigating their agricultural land. The crops cultivated on such soil get accumulated with high concentration of heavy metals (Rana and Kansal, 1985). Thus the population living around sewage water irrigated area is likely to consume high amounts of these toxic heavy metals in their daily diets. Besides gastrointestinal disturbances, lead is known to affect reproduction and possibly also cause cardiovascular and mutagenic effects (Abdulla et al.,1995).High cadmium intake results inpathological changes in kidneys, liver, GIT, heart, testes, bone, pancreas etc. Anaemia is a common feature of chronic cadmium toxicity to all species (Braithwaite et al., 1993). The increased consumption of heavy metals is likely to affect the health of the population especially women who suffer from high incidence of anaemia. The present study is an attempt to determine the mineral intake by adult women residing in sewage and tubewell irrigated areas around Ludhiana city.

MATERIALS AND METHODS

The area for survey was purposively selected to include sewage and tubewell irrigated areas. Sewage irrigated area was near Jalandhar bye pass in the vicinity of Budha Nala and Chhauni Mohalla of Ludhiana city. Village Aayali Kalan on the other side of the city represented tubewell water irrigated area. Normal and apparently healthy non-pregnant non-lactating adult women from 50 families in each area in the age group of 20-40 yrs were selected for the study. Per capita family income was taken into consideration while selecting the subjects which ranged from Rs 200-450 per month in both the areas.

The weight of the subjects was recorded using Salter Spring balance to an accuracy of 100g, The height was measured using anthropometer rod to the nearest 0.5 cm, The data on food intake of these subjects were collected from December 1996 to January 1997 by 24 hr recall-cum-weighment method for two days. In addiion to various foods, the amount of water consumed by the individuals was also noted. Weighed amounts of cooked food samples and water were also collected from all the subjects. Food samples of each subject were homogenised, dried at 60+2° C and analysed for Pb, Cd, Ni, Fe, Mn, Cu, Ca and Zn after wet digestion using Atomic Absorption Spectrophotometer (Varian AA-20). Daily intake of minerals by the women were calculated using analysed values of the minerals and the total amount of food consumed.

The consumption of foods and minerals among the two groups were statistically tested using analysis of variance and critical difference was calculated where F-ratio was significant. Correlation coefficients between food and mineral intake were calculated wherever applicable.

RESULTS AND DISCUSSION

The data on general information of the subjects (Table 1) revealed that family size was between 3-5 members for majority of the subjects in both the areas. Majority of the women were illiterate and only 4 and 2 per cent respectively in sewage and tubewell irrigated areas studied upto higher secondary. Occupation of the family was labour for majority in sewage irrigated area and farming in tubewell irrigated area. Main source of drinking water in sewage irrigated area was municipal water supply and shallow boring hand-pumps while in tubewell irrigated area it was deep boring hand pump. Main source of cereal supply was mill and chakki flour for

Table 1: General information and dietary background of the subjects (%)

Particulars	*Sewage irrigated area(n=50)*	*Tubewell irrigated area(n=50)*
Family Size		
3-5 members	86	64
6-8 members	14	36
Educational Level of Subjects		
Illiterate	38	40
Primary	12	16
Middle	32	20
Matric	14	22
Higher secondary	4	2
Family Occupation		
Labourers	42	30
Farming	20	50
Others	38	20
Per Capita Income		
Rs 200-300	34	52
Rs 300-450	66	48
Source of Drinking Water		
Municipal watery supply	44	0
Shallow handpump	46	20
Deep handpump	10	80
Cereal Supply		
Mill & chakki wheat flour	82	20
Locally purchased grains	8	70
Home grown grains	10	10
Vegetable Supply		
Home grown	22	32
Purchased from same locality	60	42
Purchased outside the locality	18	20
Milk Supply		
Milk plant	12	0
Own milch animal	0	60
Vendors from locality	72	40
Vendors outside locality	16	0

sewage irrigated area and grains purchased from the locality for tubewell irrigated area. Majority of the families in both the areas purchased vegetables from the same locality. Milk was purchased from vendors in the locality by majority of families in sewage irrigated area while in tubewell irrigated area almost 60 percent had their own milch animals.

Average weight of women in sewage and tubewell irrigated area was 49.9+0.89 and 57.0+0.75 kg, respectively and the differences were significant ($P< 0.01$). However average height of the women in the corresponding area was 1.55+0.01 and 1.56+0.01 m, respectively. Data on food intake by women in table 2 revealed that cereal consumption was less than ICMR's least cost balanced diet (ICMR, 1987) in both

Table 2: Daily food intake by women of sewage and tubewell irrigated area (Mean+SE)

Food (g)	*Sewage irrigated area (n=50)*	*Tubewell irrigated area (n=50)*	*Least cost balanced diet (ICMR, 1987)*	*F-ratio*	*C.D. at 1%*
Cereals	28±10.7	310±20.1	440	58.5**	8.6
Pulses	30±5.5	45±3.8	45	12.12**	14.2
Milk	168±11.1	245±7.6	150	32.6**	40.9
Green leafy vegs.	97±8.1	210±19.7	100	13.0**	58.7
Root and other vegs.	58±11.2	126±10.9	90	34.5**	60.9
Visible fat	20±0.7	23±1.6	25	25.2**	5.2
Sugar& jaggery	24±1.1	40±5.1	20	26.5**	17.5
water(ml)	793±31.6	968±24.4	-	14.51**	25.7

the areas while pulse consumption was higher in tubewell irrigated area and lower in sewage irrigated area than the suggested value. Intake of both cereals and pulses was significantly more in tubewell irrigated area. Average daily milk consumption was more than ICMR's (1987) suggested value by women in both the areas, though intake was significantly more by subjects in tubewell irrigated area. Intake of green leaves was nearly same as the ICMR's suggested value in sewage irrigated area and was almost twice the recommendations by women in tubewell irrigated area. Intake of roots and other vegetables by women in sewage irrigated area was less than ICMR's suggested value while intake of sugar and jaggery in both the areas were more than recommended value and visible fat intake was slightly below the recommendations. Low intake of cereals and higher intake of milk, green leaves and fat by Punjabi subjects has been reported by various workers (Hira et al., 1993; Grewal and Hira,1995; Grover et al., 1992) compared to Indian population in other states (NNMB, 1991 and Thimmayamma et al.,1982).

Mineral intake data by women (Table 3) indicated that average intake of lead was found to be six times in sewage irriaged area as compared to tubewell irrigated area.Daily intake of cadmium and nickel by women in sewage irrigated area was 3-4 times of tubewell irrigated area. Intake of lead by women in sewage irrigated area was slightly more than the tolerable limits prescribed by WHO (1972). Intake of cadmium was higher by the women in sewage irrigated area

Table 3: Daily mineral intake by women of sewage and tubewell water irrigated areas (Mean ±S.E)

Mineral	*Sewage irrigated area n=50*	*Tubewell irrigated area n=50*	*Recommendations/ tolerable limits*	*F-Ratio 1%*	*C.D. at*
Pb, ug	457 ±24.3	70 ±5.9	430[a]	17.8**	72.1
Cd, ug	208 ±13.9	64 ±7.6	65[b]	10.3**	46.8
Ni, ug	403±37.9	108±20.5	600[c]	5.7**	125.5
Ca, mg	749 ±32.8	1099±44.0	400[d]	51.4**	151.5
Fe, mg	55 ±2.3	43 ±1.5	28[d]	10.1**	8.1
Zn, mg	8.7±0.9	10.4±0.4	5.5[d]	2..3[NS]	-
Cu, mg	3.9 ±0.3	2.4 ±0.1	2.2[d]	2.4[NS]	-
Mn, mg	3.7±0.2	3.4±0.2	5.5[d]	0.86[NS]	-

** Significant at 1%, a WHO, 1972; b WHO, 1993; c WHO,1996; d ICMR, 1990; NS - non-significant.

than the maximum tolerable limits of 65 mg/d while nickel intake in both the areas was less than its tentative safe level (600 mg) in both the areas. Similar higher intake for lead, cadmium and nickel for sewage irrigated area compared to tubewell irrigated area have been reported by Setia et al. (1998). Daily intake of lead in representative dietary samples of adults of USA (200-300 mg) and Europe (400 mg) as reported by WHO (1973) was higher to that in tubewell irrigated area of the present study. Jathar et al. (1981) have reported 550 mg/d of lead by Indian population which was comparable to the intakes by women in sewage irrigated area. Becker and Kumpulainen (1991) have reported lower intake of cadmium in the Swedish dietaries. Nickel intake by the subjects in sewage irrigated area was nearly equal to the value of 472 mg/d reported for young US adults (Schoeder et al., 1961) while it was much lower in tubewell irrigated area (108 mg/d). Nickel intake in tubewell irrigated area was slightly more than half of the value of 182 mg/d reported by Anke et al (1991) for women of Central America. Thus the heavy mineral intake by population is more a reflection of type of soil and water of the area rather than the amounts of foods consumed by individuals.

Calcium intake by women in both the areas was 2-3 times the RDA (ICMR, 1990) which was comparable to the earlier reports for population in Punjab (Grover et al., 1992; Grewal and Hira 1995; Hira et al., 1993) primarily due to higher milk consumption. Iron intake by women in both the areas was found to be higher than ICMR (1990) allowances. Lower iron intake has been reported by Grewal and Hira (1995) and Mann et al. (1997) while Setia et al. (1998) have reported values similar to the present investigation. Most of the literature reports used food Table values for calculating iron intake from raw foods while in this investigation analysis of cooked foods have been used and amount of water consumed has also been considered for mineral intake data. Intake of zinc and manganese was found to be lower while copper intake was higher than their suggested levels (ICMR, 1990). Lower values for intake of these minerals have been reported by various authors (Lewis and David, 1988; Nagi and Mann, 1991 and Grewal and Hira; 1995). These differences might be due to variations in mineral content of food and water as such variations from region to region have been observed even in the present investigation.

Correlation coefficients of minerals with various foods indicated that both zinc (r=0.47**) and lead (r=0.39**) were found to be positively associated with cereal intake in both the areas. Intake of calcium (r=0.50*) lead (r=0.69**) and nickel (r=0.41**) was positively associated with green leafy vegetable consumption in both the areas. Further, it was observed that lead, cadmium, nickel, iron and copper content of water in sewage irrigated area was almost twice compared to tubewell irrigated area while zinc content of water was almost same in two areas. Water contributed 8 and 9.5 per cent, respectively of daily intake of lead and nickel, in sewage irrigated area compared to 3.0 and 4.8 per cent in tubewell irrigated area. Contribution of other minerals by water was less than 2.5 per cent. Thus it was observed that contamination of water with undesirable minerals results in high intake of these minerals than the permissible levels and could possibly have ill effects on health of individuals living in these areas. Public Health Department should take steps to treat the sewage/ industrial affluents so as to reduce heavy metal content of water and also ensure safe drinking water in such areas. Population residing in these asreas also need to be educated about ill effects of heavy metals on health.

KEY WORDS Food. Mineral. Female. Punjab.

ABSTRACT A dietary survey was carried out on women (20-40 years) of low income group from sewage and tubewell irrigated areas (50 each) around Ludhiana city. Food samples from all the subjects were collected and analysed for minerals. Data revealed that the intake of Pb, Cd and Ni in sewage irrigated area was 3-6 times that in tubewell irrigated area. Dietary lead intake by subjects of sewage irrigated area was slightly more than maximum tolerable limits while dietary Cd was more than four times the maximum tolerable limits. Intake of calcium and zinc by subjects of sewage irrigated area was less as compared to that of tubewell irrigated area while intake of iron, copper and manganese was higher by the women in sewage irrigated area. Lead, cadmium, nickel, iron and copper content of water in sewage irrigated area was almost twice as compared to tubewell irrigated area while zinc content was almost same in the two areas. Dietary intake of Ni, Fe and Ca was positively associated with green leafy vegetable consumption.

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