

Research Article**DOES HAIR CARE ACTIVITIES INFLUENCE HAIR ELEMENTS LEVEL?****NAGARAJ G^{1*}, SUKUMAR A¹, LOKESH K S²**¹**Zoology Section, Regional Institute of Education (NCERT) Mysore - 570006, Karnataka, India.**²**Department of Environmental Engineering, Sri Jayachamarajendra College of Engineering, Mysore- 570006, Karnataka, India.****Corresponding author: Nagaraj G****ABSTRACT**

Trace elements are also being excreted through hair. Many investigations demonstrated that measuring metal concentrations in scalp hair could be a useful method for studying exposure and environmental pollution. Nevertheless studies concerning the status of elements exposure with reference to hair type and hair care are meagre. Therefore, the present study aims to find out influences of hair care activities and hair type on hair element level. Scalp hair samples and personal information were collected from both male (N=68) and female (N=52) subjects from rural (N=40) and urban (N=80) Mysore. Following standard procedure hair samples were washed, dried, digested with 4:1 ratio of HNO₃ and HClO₄ and the concentrations of Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb and Zn were estimated with ICP-AES. The mean element levels among the subgroups of hair characters and hair care activities of rural and urban Mysore subjects were compared. The results showed higher levels of Pb and Ni in black hair than in gray hair and Co and Fe in curly hair than in straight hair. It may be concluded that hair colour and type have an influence on hair elements level whereas hair care activities are not.

Key words: Shampoo, herbal powder, black and gray hair, trace elements and ICPAES.**INTRODUCTION**

Hair is considered as an important “excretory organ” for trace elements [1] and the amount of elements deposited in hair are functions of both ingestion and individual metabolic activities. Among many hair types (body hair, facial hair, pubic hair and scalp hair), the scalp hair in particular, has been of interest as the recording filament [2] in which trace element levels could possibly reveal retrospective information about an individual and their chronic exposure to elements [3]. Reference [4] reported that metal levels determined in hair depend on hair structure and thickness. No influence of hair structure on Cd, Cu, Pb, and Zn levels in scalp and pubic hair was noted [5]. However, studies regarding the status of elements exposure with reference to hair type and hair care are meagre. Therefore, the present study aims to find out influences of hair care activities and hair type on hair element level.

MATERIALS AND METHODS**Subjects**

The subjects are the urban and rural residents in and around Mysore, who visited to Kamakshi Hospital, Bassappa Memorial Hospital and Vickram Hospital Mysore, for consultation. Both male (N=68) and female (N=52) subjects were recruited randomly and grouped based on their places of residence (villagers (40) and urbanites (80)), hair characters and hair care activities.

Hair sampling

From the volunteers the scalp hair from the nape region of head was cut at the distal end using a clean scissor by adopting the International Atomic Energy Agency procedure for sample collation [6]. Prior to sampling, the subjects were briefed about the purpose clearly (even then some people refused to donate hair, because of personal sentiment, custom, tradition and taboos). To avoid contamination, the hair samples were collected from the volunteers who had not dyed their hair. In addition information about their hair characters & hair care activities also collected.

Preparation of sample for element analysis

Washing

Hair samples were washed with use of a magnetic stirrer in the medium of double distilled water (DDW) and acetone in the sequence of DDW - acetone - DDW - acetone for 10 minutes each by following the methods reported elsewhere [7], [8].

Drying

After washing, they were placed in a hot air oven at 50⁰ C and dried for 3 hr the time required to achieve a constant weight [8].

Digestion

The hair samples (500 mg - 1 g) were digested following the open digestion method by Kjeldhal apparatus attached with reflux condenser and in the acid medium of HNO₃ and HClO₄ in 4:1 ratio [8]. Simultaneously few blank and quality control samples were digested for every 20 hair samples. The wet acid digested hair, blank and quality control samples were made up to 10 ml by adding DDW and stored at 4⁰ C.

Element analysis

Inductively Coupled Plasma-Atomic Emission Spectrometer (model JY-IYON-2000-2) was used at Dept. of Environmental Engineering, Sri JayaChamarajendra College of Engineering, Mysore and the concentrations of Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb and Zn were estimated in µg/g by following the instrumental techniques of [9].

Quality control studies

Along with the hair samples a Certified Reference Material (CRM) (Human hair powder) supplied by National Institute of Environmental Studies, Japan was analysed as an external quality control material. The concentrations measured in CRM were in good agreement with the certified values and showing the reliability of analysis and accuracy of measurement.

RESULTS

The element levels (mean) among the subgroups of hair characters and hair care activities of rural and urban Mysore subjects were compared in the tables and the group wise noting is made as follows:

Element comparison between subgroups of hair characters of villagers

In the table 1 are shown the mean element levels of scalp hair of rural subjects who were grouped into many sub categories based on their hair characters. Subjects with black hair had more Ni (0.67±0.20) and Pb (1.27±0.52) than the subjects with more than 80% grey hair (0.36±0.17, 0.51±0.14). In the case of hair type, the curly hair showed higher level of Co (5.53±1.31) and Fe (6.12±0.92) than the strait hair (3.19±0.99, 3.55±1.0).

Element comparison between subgroups of hair care activities of villagers

It was observed from the table 2 that the use of hair oil, frequency of hair oil used and head wash and the use of shampoo or herbal powder did not affect the element levels. Besides, the hair levels of Cr and Zn were not affected between any subgroups of the rural subjects.

Table 1 Comparison of element levels of scalp hair between subgroups of hair characters of rural subjects around Mysore

S N	Hair characters	Subgroups	N	Mean elements concentration of scalp hair ($\mu\text{g/g}$) \pm SD							
				Co	Cr	Cu	Fe	Mn	Ni	Pb	Zn
1	Hair colour	Black hair	12	3.45 \pm 1.31	0.49 \pm 0.30	2.26 \pm 1.93	4.07 \pm 1.54	1.47 \pm 0.46	0.67 \pm 0.20*	1.27 \pm 0.52**	103.32 \pm 25.87
		Grey hair	28	4.08 \pm 1.65	0.29 \pm 0.10	5.65 \pm 9.06	4.42 \pm 1.66	0.99 \pm 0.49	0.36 \pm 0.17	0.51 \pm 0.14	93.04 \pm 2.88
2	Hair type	Curly hair	12	5.53 \pm 1.31**	0.49 \pm 0.29	3.68 \pm 2.67	6.12 \pm 0.92**	1.35 \pm 0.49	0.66 \pm 0.23	0.70 \pm 0.18	92.91 \pm 3.89
		Strait hair	28	3.19 \pm 0.99	0.29 \pm 0.10	5.04 \pm 9.18	3.55 \pm 1.00	1.05 \pm 0.52	0.37 \pm 0.17	0.76 \pm 0.54	97.50 \pm 16.00

Note: Significance: * -P \leq 0.05; ** -P \leq 0.01. N – Number of samples, SD- Standard Deviation.

Table 2 Comparison of element levels of scalp hair between subgroups of hair care activities of rural subjects around Mysore

S N	Hair care activities	Subgroups	N	Mean elements concentration of scalp hair ($\mu\text{g/g}$) \pm SD							
				Co	Cr	Cu	Fe	Mn	Ni	Pb	Zn
1	Hair oil used	Coconut oil	24	4.23 \pm 1.69	0.41 \pm 0.23	2.01 \pm 1.51	4.67 \pm 1.65	1.09 \pm 0.51	0.49 \pm 0.23	0.85 \pm 0.57	98.10 \pm 17.50
		Caster oil	16	3.38 \pm 1.27	0.27 \pm 0.08	6.56 \pm 5.69	3.79 \pm 1.42	1.21 \pm 0.57	0.40 \pm 0.22	0.58 \pm 0.12	93.16 \pm 2.62
2	Frequency of hair oil use	Daily	8	4.62 \pm 3.43	0.27 \pm 0.00	2.18 \pm 1.58	4.88 \pm 3.24	0.89 \pm 0.08	0.42 \pm 0.04	0.79 \pm 0.41	92.19 \pm 5.72
		Once in a week	24	3.78 \pm 0.96	0.39 \pm 0.24	5.73 \pm 9.86	4.21 \pm 1.10	1.21 \pm 0.64	0.44 \pm 0.27	0.77 \pm 0.57	98.32 \pm 17.34
		Twice in a week	8	3.51 \pm 1.71	0.32 \pm 0.07	3.79 \pm 3.87	4.07 \pm 2.02	1.19 \pm 0.34	0.53 \pm 0.26	0.61 \pm 0.18	93.46 \pm 0.56
3	Frequency of head wash	Daily	8	2.75 \pm 0.78	0.38 \pm 0.15	2.03 \pm 0.04	3.06 \pm 0.67	0.82 \pm 0.17	0.37 \pm 0.12	0.79 \pm 0.41	88.43 \pm 0.41
		Once in a week	24	4.00 \pm 1.80	0.36 \pm 0.23	6.12 \pm 6.68	4.41 \pm 1.78	1.29 \pm 0.56	0.47 \pm 0.25	0.80 \pm 0.54	99.47 \pm 16.81
		Twice in a week	8	4.71 \pm 0.02	0.29 \pm 0.11	3.75 \pm 3.92	5.29 \pm 0.29	1.01 \pm 0.58	0.50 \pm 0.31	0.51 \pm 0.32	93.77 \pm 0.13
4	Head wash material used	Herbal powder	20	3.93 \pm 2.03	0.43 \pm 0.24	1.53 \pm 0.99	4.32 \pm 2.03	1.05 \pm 0.44	0.46 \pm 0.22	0.69 \pm 0.27	90.96 \pm 3.55
		Shampoo	20	3.85 \pm 1.03	0.28 \pm 0.09	7.73 \pm 10.30	4.31 \pm 1.13	1.23 \pm 0.60	0.45 \pm 0.24	0.80 \pm 0.62	101.29 \pm 17.98

Note: No significance found in any element level, N – Number of samples, SD- Standard Deviation.

Table 3 Comparison of element levels of scalp hair between subgroups of hair characters of urban subjects from Mysore

S N	Hair characters	Subgroups	N	Mean elements concentration of scalp hair ($\mu\text{g/g}$) \pm SD							
				Co	Cr	Cu	Fe	Mn	Ni	Pb	Zn
1	Hair colour	Black hair	28	3.34 \pm 3.12	0.86 \pm 0.73	6.28 \pm 7.74	4.59 \pm 3.52	3.27 \pm 3.27	1.21 \pm 1.04	1.54 \pm 0.96*	120.77 \pm 48.37
		Grey hair	52	4.39 \pm 3.00	0.32 \pm 0.17	2.59 \pm 1.79	4.89 \pm 3.05	1.05 \pm 0.58	0.49 \pm 0.30	0.87 \pm 0.50	101.78 \pm 12.58
2	Hair type	Curly hair	16	4.08 \pm 1.59	0.39 \pm 0.26	2.97 \pm 2.21	4.77 \pm 1.27	1.41 \pm 0.74	0.65 \pm 0.41	0.84 \pm 0.43	102.85 \pm 12.32
		Strait hair	64	4.01 \pm 3.31	0.54 \pm 0.14	4.11 \pm 5.42	4.79 \pm 4.40	1.94 \pm 1.16	0.76 \pm 0.30	1.17 \pm 0.80	109.82 \pm 33.63

Note: Significance: * - $P \leq 0.05$, N – Number of samples, SD- Standard Deviation.

Table 4 Comparison of element levels of scalp hair between subgroups of hair care activities of urban subjects from Mysore

S N	Hair care activities	Subgroups	N	Mean elements concentration of scalp hair ($\mu\text{g/g}$) \pm SD							
				Co	Cr	Cu	Fe	Mn	Ni	Pb	Zn
1	Hair oil used	Coconut oil	60	3.89 \pm 3.22	0.60 \pm 0.17	4.31 \pm 5.62	4.76 \pm 4.38	2.16 \pm 2.27	0.86 \pm 0.34	1.24 \pm 0.81	109.67 \pm 34.15
		Caster oil	20	4.42 \pm 2.54	0.24 \pm 0.06	2.59 \pm 1.18	4.85 \pm 2.56	0.83 \pm 0.11	0.37 \pm 0.08	0.68 \pm 0.26	104.69 \pm 16.98
2	Frequency of hair oil use	Daily	24	4.69 \pm 3.24	0.36 \pm 0.23	3.12 \pm 2.11	5.26 \pm 3.23	1.13 \pm 0.66	0.62 \pm 0.40	0.99 \pm 0.57	104.57 \pm 13.32
		Once in a week	24	5.76 \pm 3.56	1.02 \pm 0.85	2.40 \pm 1.53	6.30 \pm 4.53	2.81 \pm 2.72	1.06 \pm 1.12	1.48 \pm 1.15	98.14 \pm 14.05
		Twice in a week	32	2.22 \pm 1.14	0.23 \pm 0.09	4.16 \pm 3.43	3.54 \pm 1.20	0.87 \pm 0.33	0.43 \pm 0.18	0.90 \pm 0.37	119.03 \pm 34.85
3	Frequency of head wash	Daily	40	3.06 \pm 2.66	0.74 \pm 0.43	4.71 \pm 5.81	4.15 \pm 4.01	2.72 \pm 2.22	1.05 \pm 1.02	1.23 \pm 0.94	113.02 \pm 41.41
		Once in a week	28	5.11 \pm 3.08	0.24 \pm 0.09	3.21 \pm 1.59	5.52 \pm 3.20	0.94 \pm 0.55	0.38 \pm 0.13	0.87 \pm 0.37	108.11 \pm 14.56
		Twice in a week	12	4.68 \pm 4.01	0.35 \pm 0.16	2.68 \pm 2.51	5.18 \pm 4.09	0.94 \pm 0.28	0.55 \pm 0.38	1.23 \pm 0.77	93.84 \pm 3.48
4	Head wash material used	Herbal powder	28	5.10 \pm 3.47	0.96 \pm 0.70	2.05 \pm 1.52	6.58 \pm 5.23	3.49 \pm 3.20	1.25 \pm 1.04	1.32 \pm 1.07	101.82 \pm 14.98
		Shampoo	52	3.44 \pm 2.69	0.26 \pm 0.11	4.87 \pm 4.84	3.81 \pm 2.82	0.94 \pm 0.44	0.46 \pm 0.22	0.99 \pm 0.51	111.98 \pm 36.24

Note: No significance found in any element level, N – Number of samples, SD- Standard Deviation.

Element comparison between subgroups of hair characters of urbanites

When the elemental levels of scalp hair were compared between two subgroups of urban subjects classified based on the hair characters (table 3), the Pb-H content was higher in the black haired subjects (1.54 ± 0.96) than the grey haired subjects (0.87 ± 0.50).

Element comparison between subgroups of hair care activities of urbanites

Table 4 shows that the hair type, hair oil used, frequency of hair oil used and head wash, and use of shampoo or herbal powder did not cause any change in the scalp hair element levels.

DISCUSSION**Influence of hair colour**

When compared to grey coloured hair, the Pb level was found higher in black hair in both urban and rural subjects, whereas Ni was found higher in black hair of rural subjects. Other investigations demonstrated the differences in element concentrations due to hair colour. Reference [10] reported higher Pb level in black hair than in grey and reference [11] observed Pb content was the highest for dark hair and decreased with increase in lightness in hair colour of unexposed Marida city residents. Similarly, increased levels were reported in black hair for Zn [12], Cu [13]. Further, reference [12] and [14] opined that enhanced Zn and Cu concentrations observed in black hair may be implicated in the production of the melanin pigments, which are the metal complexes derived from tyrosine and tryptophane. Likewise, reference [15] reported that high Mn content in hair of Indian Darjeeling subjects were related to its black colour. In addition to the above-mentioned elements, the present study shows that Ni is also found to be higher in the black hair. A reversible trend of element levels in hair due to colour was also predicted for the levels of Cd [16] and Pb [17], which were decreased from red hair to blond brown and black hair. On the other hand, no correlation was found between hair colour and levels of Pb, Ni, Cd [12] and Cr [18].

Influence hair type

Hair type (curly/straight) was found associated to element levels in hair. Co and Fe were significantly higher in curly hair than in straight hair of rural subjects around Mysore. There were not many studies available to discuss about agreement or disagreement of them with this study.

Influence of hair care activities

In the present study, hair care activities such as the type of hair oil used, the frequency of hair oil used and head wash (daily/once in a week/twice in a week), and the use of shampoo or herbal powder did not have any impact on hair elements levels. Using natural herbal powder like 'Arappu' or 'Chikkakai' is a specific custom/tradition in South India. But it did not cause any change on hair element levels. In contrast, other studies indicated the impact of using shampoo on element contents in hair [19]. Likewise, reference [20] reported that males using dandruff shampoo had significantly higher levels of Se and Ti than those using regular shampoo or conditioners. Further, reference [21] indicated higher element levels for hair samples receiving greater frequency of shampooing (3-7/week) against normal shampooing (1-2/week).

CONCLUSIONS

It may be concluded from the above result and discussion that, there exists a positive association/ influence of hair colour (black) and type (curly) on level of elements (Pb and Ni; Co and Fe respectively) of hair. Further hair care activities such as use of oil, shampoo, herbal powders and the frequency of head wash did not influence scalp hair elements level.

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