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Comparative analysis of minerals found in male and female hair of different age groups

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Abstract

In present scenario of pollution and UV radiation, it is our urgent requirement to determine the baseline levels of mineral constituents in human beings. It causes major health problems in general population. This paper deals with quantitative determination of minerals in human hair. Biological samples were collected for environmental quality investigation randomly from male and female subjects of selected group aged from 5 year to 60 year of different social status. Sample collection and preparation were carried out using standard procedures. Levels of minerals (calcium, magnesium and phosphorus) were estimated using analytical methods. The levels of all the minerals studied and mean concentration of female hair were significantly higher. Significant levels of minerals in human hair samples indicate the type of exposure of male and female subjects

Keywords: *Calcium, exoskeleton, magnesium, minerals, phosphorus, scalp hair*

Introduction

The air is full of deadly elements and harmful gases along with dust particles. Various gases present in air emitted from the vehicles and through the chimneys of factories affect the health of people in one or the other way and lead to several diseases. Sulphur di oxide and nitrogen oxide affect skin, hair, lungs, nervous system, respiratory system and decreases immunity towards various diseases (Chaudhary, 2003). The determination of trace elements in hair has been the subject of continuous interest in the biomedical and environmental sciences (Arnold and Sachs, 1994). Hair can be considered to be an excretory product, the trace element contents of which reflect mineral metabolism in the body. However, their concentrations bear little relation to the levels in other tissues (Kaluza *et al*.2001). It should be noted that human hair is an attractive biological material because of the simplicity of sampling, transport and handling as well as providing information about concentrations of some trace elements that are considerably more concentrated in hair than other biological materials, which makes analysis easier (Zhunk and Kist, 1995). Among many human tissue, hair and nails are widely used as biomarkers of environmental burden of toxic metals due to ease of sample collection, transportation, storage, and preparation for analysis (Nowak, 1993; Chaudhry *et al*. 1995; Agahian *et al*.1990; Schegel-zawadzka, 1992; Das *et al*.1995). The importance of these examinations is attested by the fact that there are several trace elements in the human body that are important in biochemical processes (Abdulrahmani *et al*. 2012).Researches have been carried out with the aim of correlating various diseases (Wang *et al*. 1995). An excess or absence of these essential trace elements causes serious problems in the physiology of the body (Dombovári and Papp, 1998) (Dombovári *et al.* 1999).Human hair and nails were analysed with the same analytical technique as biological samples for bio monitoring body burden of elements and occupational exposure to metal pollution (Wilhelm *et al*.1994; Chen *et al*. 1999; Egeland *et al*.1999; Hira *et al*. 2004). The bioaccumulation of heavy metals in human hair and nails is rather a complex process and influenced by several factors like environmental quality, age, sex (Chakraborti *et al*.1998; Steinmaus *et al*. 2000; Aharoni and Tesler, 1992).The Central Pollution Control Board, Faridabad carried out Comprehensive Environmental Pollution Index Assessment (CEPI) study in association with Indian

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Institute of Technology, Delhi for 88 industrial clusters in the country. Based on the study, 43 industrial clusters have been declared as critically polluted having CEPI of more than 70 and the District Faridabad has been listed at the 18 th place. Pollution and UV exposure cause major health problems in general population. This paper deals with quantitative determination of minerals as calcium (Ca), magnesium (Mg) and phosphorus(P) of male and female hair in different age groups.

Material and Methods

Samples were collected from the people working in offices and factories, school and college going students, road side and residential area. The criterion of collection was based on age groups i.e. (5-10 year), (15-20 year), (25-30 year), (35-40 year), (45-50 year) and (55-60 year). Five samples of each category of male and female subjects were taken for the analysis. For subsequent analysis each of samples was sealed in plastic cover till it was washed, dried, digested and converted into solution. Samples were washed thoroughly in separate beakers by several changes of distill water and dried in air at room temperature for 36 hours. Whole samples of each group taken together and grounded separately in an electrical grinder. Considering the importance of quality assurance of analytical technique as reported (Subramanian and Sukumar, 1988). Moisture was determined by keeping 1 gm. of the air dried material in an aluminum cup in an electric oven at 100°C for 24 hours and then weighing the oven dried material. Ash content was determined by keeping 1 gm. of the material in a muffle furnace at 900°C till the weight of the ash was constant. Estimation of Ca, Mg and P was done by analytical method. Meticulous care was taken to avoid external contamination of samples during analytical procedure. The study was carried out for the time period of one year from January 2009- February 2010.

Process

For estimation of Ca, about 100 mg of ash was dissolved in the minimum quantity of HCI and Ca was precipitated as calcium oxalate and determined volumetrically. Using standard $KMnO_4$ solution after liberating free oxalic acid by dissolving the precipitate in dil. H_2SO_4. For estimation of Mg, about 500 mg of ash was taken which was determined calorimetrically after removing calcium as calcium sulphate precipitate using the reagent Erichrome black-T (Snell and Snell, 1967).For estimation of P, about 20 mg of ash was dissolved in the minimum quantity of HNO_3 and phosphorus was precipitated as canary yellow ammonium phosphomolybdate then determined by alkali metric method (Cumming and Kay revised 1956).

Results and Discussion

The Mean concentration of male and female hair in different age groups are tabulated in table 1 and 2 and figure 1 and 2.Mineral analysis of human hair in different age groups indicated that Ca, Mg and P are the principal salts occurring in exoskeleton tissues of human beings. The concentration of Ca has higher range value than Mg and P. Ca is an essential element that is involved in many physiological functions. Ca might result in malfunction of the parathyroid gland. The variation in values is due to food habits and probably to the exposure of various substances causing high variation of mineral levels. In hair, ratio of Ca and Mg was approximately 8:1. Females have significantly higher Ca levels than males. After age of 10 year level becomes quite stable. Females have higher Mg levels than males. Detergent washing reduced the element concentration more than the organic solvent washing (Harrison and Tyree, 1971). However, for heavy metals, washing procedure does not essentially influence their concentration because of the strong complex with the disulphide groups in the keratin proteins (Chen *et al*., 1999). Nail samples were observed to accumulate higher concentrations of heavy metals when compared to hair samples, such differences might be attributed to the incorporation of elements into the keratin structure of hair which takes place by binding to the sulfahydryl groups that are present in the follicular protein. In this regard, the detergents such as soap, shampoos, hair pomades, lotions, hair bleaches and dyes actually compete with the complexing ability of these reactive sites, thus leading to a significant leaching of elements from the shaft bulk (Buchancoca *et al*., 1993). Iron welders showed higher concentrations of heavy metals when compared to liquor users and non-liquor users, such variation might be attributed to the fact that the major sources of heavy metals in occupational

Table 1: Mean concentration of male hair in different age groups (values are expressed in mg./kg.)

Minerals	Age Groups (in Year)					
	5-10	15-20	25-30	35-40	45-50	55-60
Ca	551	902	1147	869	1001	923
Mg	113	125	170	152	127	114
P	195.4	200.4	230.03	211.5	194	171

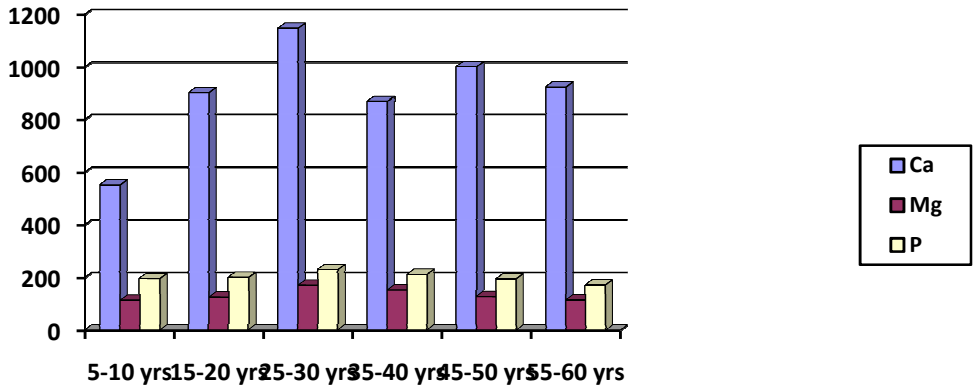

Figure 1: Graphical representation of minerals in male hair in different age group

Table2: Mean concentration of female hair in different age groups (values are expressed in mg./kg.)

Minerals	Age Groups (in Year)					
	5-10	15-20	25-30	35-40	45-50	55-60
Ca	561	1966	1924	1731	1668	1660
Mg	113	224	216	194	180	175
P	197.3	210.4	222.3	215.4	207.3	201.5

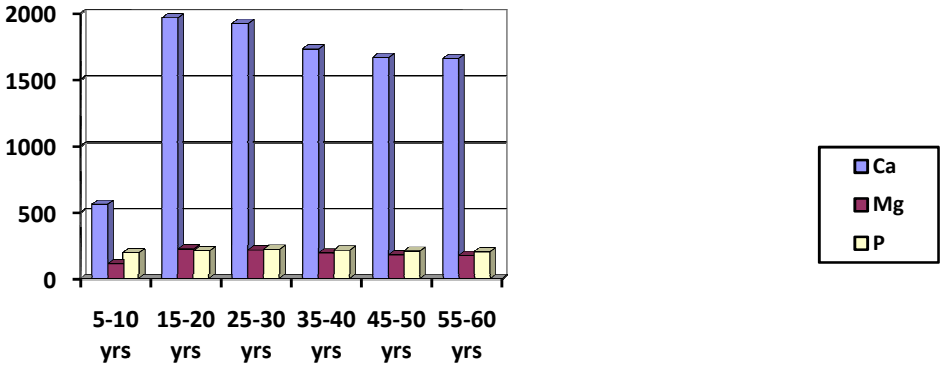

Figure 2: Graphical representation of minerals in female hair in different age group

exposed worker includes batteries, alloys and electroplating metal parts among others (Buchancoca *et al*., 1993).Ca levels of male hair increases upto certain age group. Mean concentration of Mg level of male hair fluctuates with age. Level of P in male and female hair increases upto certain age than falls gradually. Ca level of male and female hair was higher in middle age group (35-40 years) than in older age group (55-60 years) and younger age group (5-10 years). Mg level of male and female hair was higher in middle age group than younger age group and older age group. P level of male hair was higher in middle age group and gradually falls afterwards. P level of female hair is highest in middle age group than older age group and younger age group. The data in Table I and II clearly supports the hypothesis that at each age level, the female mean concentration level was significantly higher than the male. Female calcium, magnesium and phosphorus levels were consistently higher at all age levels. Trace elements accumulate in the body over given periods of time, therefore, they reflect the biomedical and environmental history of the body as well as long term metabolic changes (Suhonen and Dawber, 1999) (D'Ili o *et al*, 2000).It is concluded that the effects of air pollution or harmful chemicals on human are in many cases life- threatening, and can be fatal. WHO statistics report (1994) that over 2 million people leads to the fatalities and attributed to air pollution. Consistent exposure to pollutants leads to the development of a large number of diseases. Human hair is the most exposed part of the body. It can be very easy to predict the future health problems through hair analysis. Increased or decreased mean concentrations of minerals would be helping in estimation of forthcoming diseases or health complications. Analysis of minerals in male and female subject show requirement of nutrient and energy change throughout life cycle. Diet we eat matters a lot in constitution of our exoskeleton tissues. The mean concentration was maximum at middle age group (25-30 year) because of diet and exposure. Females have excess Ca in their tissues in comparison of Mg. Eating too much sugar is one of the major reason for Ca imbalance.

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