# Studies of some Heavy Metals Profile in Hair, Nail and Plasma Samples of Normal and Allergy Patients of Sargodha Zone

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**Summary**: Various metal concentrations in hairs, nails and blood plasma of allergic and non-allergic (as a control) patients were assessed using atomic absorption spectroscopy (AAS). Remarkable changes were observed in concentration of Co, Ni, Mn and Cr while almost same concentration of Cu, Cd and Zn were observed in all patients and control subjects. While in blood plasma increase in concentration of Zn was observed in all patients in contrast to Cu that have increased in male while remain unchanged in females. The concentration profile of heavy metals in different parts of the body showed key impact on allergy disease. The aim of the present study was to compare the concentration of some trace metals in allergic subjects and healthy controls. The study was taken using three body parts, nail, hairs and blood, of 18 allergic females and 15 non smoker allergic male patients were investigated by using atomic absorption spectrophotometer. Decrease in concentration of Co, Ni and Mn were observed while that of Cr was increased and almost change were seen in the concentration of Cu, Cd and, Zn. All allergic subjects are compared to their respective controls. While the concentration of Co, Ni and Mn was decreased and the concentration of Cr was increased in both male and female allergic subjects as compare to their respective controls. In case of plasma the concentration of Zn was increased in both male and female allergic subjects. But the concentration of Cu was increased in male allergic subjects and in female allergic subjects its concentration remained almost same as for controls. The concentration of Cr and Cd remains the same in both male and female allergic subjects. While the concentration of Mn, Ni and Co was decreased in both male and female allergic subjects.

Key Words: Allergy, Heavy metal profile, Smoker, Spectrophotometer.

## Introduction

Metals have been used by man since antiquity. Anthropogenic uses have led to global dispersion of metals in the environment. Man, animals and plants are exposed to a variety of metals through environment, food, water and soil. Metals, being non-biodegradable moieties, persist in the environment for a long period and cause serious ecotoxicological problems. Additionally, many metals like zinc, copper, calcium, and iron are essential for life and their compounds have formed complex bio-geochemical cycles [1]. Some other metals are reported harmful to health, for example, As, Pb, Cd, Sb, Cr and Hg have no known beneficial biological functions and long-term exposure may be toxic even at low doses. Although some individuals are exposed to toxic elements chiefly in the workplace, for most people the main route of exposure to the toxic elements is through the diet [2]. Consequently, information concerning metal contents in dietary intake is of the utmost importance in being able to assess threat to human health [2]. Heavy metals enter the human body through inhalation of dust, contaminated drinking water, and direct ingestion of soil and consumption of food plants grown in metal-contaminated soils [3]. Such problems are becoming more serious all over the world especially in developing countries. Heavy metals, in general, are not biodegradable, have long biological half-lives and have the potential for accumulation in different body organs leading to side effects [4]. Heavy metals are known to be highly toxic to human body. Increased concentration of heavy metals in the human body may cause fungal infections; growth and hormonal disorders and imbalances; migraines and other types of headaches; kidney and bladder infections; thyroid dysfunction; digestive ailments of all kinds; multiple sclerosis; degenerative brain diseases such as sinus; and Alzheimer's, lung and ear infections and different type of allergies (e.g smoke allergy, dust mite allergy etc.). Imbalancing of the trace and heavy metals cause Hypersensitivity disorder of the immune system that lead to different types of allergies. Ni, Cr and Co are big triggerer of threatening allergic reactions [5]. These contents of metals may accumulate into different body parts like hairs, nail and in the stream of blood. Commonly asthmasis appeared in the [6,7] people working at electroplating industries due to Ni and Cr [8]. In present study we report the concentration of some trace metals in hair,

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nails and plasma of allergic patients and compare them with healthy control subject. It is a unique work in the sense that very little work has been done in this research field.

**Results and Discussion**

Concentration of Cd, Co, Zn, Mn, Ni, Cu and Cr were determined for males and females allergic subjects separately. Concentration of above mentioned metals in 15 non-smokers allergic male subjects, were determined and compared with 24 non-allergic male controls (Table 1-3). In case of nails and hair no significant difference was noted for the concentration of Cd, Zn and Cu between allergic subjects and controls ($P>0.05$). But the concentration of Ni, Co and Mn was lower in allergic patients as compared to controls as described by A. Kocyigit et al. [9]. The concentration of Cr was increased in allergic subjects as compared to healthy controls ($P<0.05$). In case of plasma, concentration of Zn and Cu was higher in allergic subjects as compared to controls ($P<0.05$) as described by H. Vural et al. [10]. Concentration of Ni, Co and Mn was decreased as compared to controls. The concentration of Cr and Cd remained almost same for both controls and allergic subjects as studied by Dlugozan et al. [12]. In case of female, concentration of above said metals were determined in 18 allergic female subjects and compared to 18 controls (Table 4-6). In case of nails, and hair results were same as for male subjects (Table 4 and 5). But relative concentration of metals was low in female allergic subjects and controls as compared to male non-smoker allergic subjects and controls. But in case of plasma, concentration of Zn was higher in female allergic subjects as compared to controls as described by Satoshi Urashidate et al. [11]. There was no significant difference in concentration between allergic subjects and controls in case of Cu, Cd and Cr as studied by Dloguzan et al. [12]. Concentration of Mn was lower in allergic subjects, as described by A. Kocyigit et al [9]. Similarly concentration of Co and Ni was also decreased in Subjects as compared to controls (Table 4).

**Experimental**

*Chemicals and Materials*

100 glass vials (5 mL), $Na_2EDTA$, 100 Sterilized Syringes, 300 sample vials (20 mL), $H_2O_2$ and 60 % $HNO_3$.

*Selection of Subjects*

42 allergic and 42 control subjects were selected for present study from six areas of Sargodha. These were fully age matched (belonging to elder age group 45-60 years). Among 42, 18 were female and 24 were males allergic and likewise for control subjects. Among 24 allergic males, 15 were non-smoker and 9 were smoker allergic patients.

*Collection of Samples*

1 gram of nails and 1g of hairs were taken from both the allergic and control subjects. These were stored in polyethylene bags. Five milliliter of blood from each of the 42 allergic subjects and 42 controls was taken by sterilized syringes. This sample was stored in glass vials and $Na_2EDTA$ was sprinkled in each vial. These samples were stored in Refrigerator at 4°C till further analysis.

*Washing of Samples*

Hair and nail sample were washed with acetone and water in order to remove oil, dust and gel from hair and nail polish from nails [13].

*Nails Sample Preparation*

One gram washed nails samples were cut into small pieces and took into labeled digestion flask (100 mL). Using wet acid digestion, each sample was soaked in ultra pure nitric acid (5 mL, 60%) over night followed by addition of $H_2O_2$ (1 mL) and digested on hot plate at 180°C until the completion of digestion [14]. Volume of each sample was made up to 20 mL with the help of doubly distilled de-ionized water. Each sample was stored in labeled sample vial until analysis.

*Hair Sample Preparation*

One gram of each hair sample was digested as described for nails.

*Blood Sample Preparation*

Plasma from each blood sample was isolated by centrifugation at 1000 rpm. Volume of plasma sample was recorded and transferred to digestion flask. In each sample 5 mL $HNO_3$ (60%) was added and kept overnight. One milliliter of $H_2O_2$ was added into each sample and digested on hot plate at 180°C for 2-3 minutes. After digestion volume of each plasma sample was made up to 15 mL with doubly distilled de-ionized water and stored in sample vials till further analysis.

Table-1: Mean ± S.D. concentration (µg/g) in nails of Non-smoker male allergic subjects and controls.

| Subjects | Ni | Cr | Cd | Zn | Cu | Co | Mn |
|---|---|---|---|---|---|---|---|
| Allergic N=15 | 2.55±1.22 | 2.66±1.65 | 1.344±1.57 | 16.32±5.05 | 17.5±3.55 | 9.3±2.95 | 4.15± 2.33 |
| Non-Allergic N=15 | 3.25±1.15 | 1.08±1.62 | 1.11±1.22 | 14.66±4.96 | 15.86±2.06 | 15.95±2.75 | 7.88±3.45 |
| P-Value | P<0.05 | P<0.05 | P>0.05 | P>0.05 | P>0.05 | P<0.05 | P<0.05 |

(P>0.05 = No Significant difference) (P<0.05= Significant difference)

Table-2: Mean ± S.D. concentration (µg/g) in hairs of Non- smoker male allergic subjects and controls.

| Subjects | Ni | Cr | Cd | Zn | Cu | Co | Mn |
|---|---|---|---|---|---|---|---|
| Allergic N=24 | 2.34±1.85 | 1.85±1.65 | 0.55±1.33 | 45.32±5.95 | 18.5±4.05 | 7.05±3.05 | 6.15± 3.83 |
| Non-Allergic N=24 | 3.40±2.20 | 0.99±1.32 | 0.55±1.22 | 42.36±6.06 | 16.26±5.03 | 14.25±4.05 | 11.08±4.05 |
| P-Value | P<0.05 | P<0.05 | P>0.05 | P>0.05 | P<0.05 | P<0.05 | P<0.05 |

(P>0.05 = No Significant difference) (P<0.05= Significant difference)

Table-3: Mean± S.D.concentration (µg/mL) in plasma of Non-smoker male allergic subjects and controls.

| Subjects | Ni | Cr | Cd | Zn | Cu | Co | Mn |
|---|---|---|---|---|---|---|---|
| Allergic N=24 | 0.84±1.15 | 0.39±1.02 | 0.278±1.1 | 5.78±3.75 | 5.15±3.01 | 1.45±1.5 | 0.88±1.009 |
| Non-Allergic N=24 | 1.92±1.33 | 0.502±1.32 | 0.322±1.2 | 3.22±2.32 | 2.97±2.32 | 2.89±1.58 | 2.02±1.47 |
| P-Value | P<0.05 | P>0.05 | P>0.05 | P<0.05 | P<0.05 | P<0.05 | P<0.05 |

(P>0.05 = No Significant difference) (P<0.05= Significant difference)

Table-4: Mean ± S.D. concentration (µg/g) in nails of female allergic subjects and controls.

| Subjects | Ni | Cr | Cd | Zn | Cu | Co | Mn |
|---|---|---|---|---|---|---|---|
| Allergic N=18 | 1.80±1.9 | 2.02±1.91 | 1.110±1.8 | 12.28±2.12 | 13.88±3.52 | 7.12±3.92 | 2.78± 1.99 |
| Non-Allergic N=18 | 2.72±1.52 | 1.008±1.22 | 1.082±1.2 | 11.22±2.89 | 12.22±2.82 | 11.77±4.02 | 5.08±2.92 |
| P-Value | P<0.05 | P>0.05 | P>0.05 | P>0.05 | P>0.05 | P<0.05 | P<0.05 |

(P>0.05 = non-significant difference) (P<0.05= Significant difference)

Table-5: Mean ± S.D. concentration (µg/g) in hairs of female allergic subjects and controls.

| Subjects | Ni | Cr | Cd | Zn | Cu | Co | Mn |
|---|---|---|---|---|---|---|---|
| Allergic N=18 | 1.81±2.022 | 1.02±1.33 | 0.632±2.005 | 36.28±5.62 | 36.28±4.99 | 5.08±2.22 | 4.22±3.63 |
| Non-Allergic N=18 | 2.79±2.302 | 0.65±1.012 | 0.754±1.0022 | 34.82±4.97 | 12.66±3.32 | 8.27±4.05 | 6.75±2.82 |
| P-Value | P<0.05 | P<0.05 | P>0.05 | P>0.05 | P<0.05 | P<0.05 | P<0.05 |

(P>0.05 = No Significant difference) (P<0.05= Significant difference)

Table-6: Means ± S.D. concentration (µg/mL) in plasma of female allergic subjects and controls.

| Subjects | Ni | Cr | Cd | Zn | Cu | Co | Mn |
|---|---|---|---|---|---|---|---|
| Allergic N=18 | 0.41±1.0022 | 0.320±1.003 | 0.234±1.005 | 4.22±2.622 | 3.34±2.84 | 0.976±2.005 | 0.42± 1.2 |
| Non-Allergic N=18 | 1.11±1.0042 | 0.284±1.0014 | 0.22±1.008 | 3.02±2.83 | 3.06±2.92 | 1.88±2.0055 | 1.322±1.32 |
| P-Value | P<0.05 | P>0.05 | P>0.05 | P<0.05 | P>0.05 | P<0.05 | P<0.05 |

(P>0.05 = No Significant difference) (P<0.05= Significant difference).

*Analysis*

Using flame atomic Absorption spectro-photometer, concentration of Ni, Cr, Cd, Zn, Cu, Co and Mn was determined in all the three types of samples both for allergic subjects and controls.

*Statistical Analysis*

In order to evaluate significant and non-significant difference of concentration of above mentioned metals between allergic subjects and controls, student's t-test was used. Calculated value was matched with tabulated "t" at 0.025 due to biasing of data.

## Conclusions

From the present study, it can be concluded that in both male and female allergic subjects Zn concentration is higher in plasma as compared to their respective controls. But concentration of Cu is greater in male allergic subjects in plasma as compared to female allergic subjects where Cu concentration has no significant difference as compare to controls. The concentration of Ni, Co and Mn is lower in plasma in both male and female allergic subjects as compared to their respective controls. But there is no significant difference in the concentration of Cd and Cr in plasma in both the male and female allergic subjects as compared to their respective controls. In case of hair and nail samples, concentration of Co, Mn and Ni decreases and concentration of Cr increases in both male and female allergic subjects as compared to their respective controls while there is no significant difference for the concentration of Cd, Zn and Cu in both male and female allergic subjects as compared to their respective controls.

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