Correlation Between Hair Element Concentration, Sex, and Body Mass Index in Young Italian Population

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INTRODUCTION & AIM

Human hair is a valuable biological marker for assessing human health status. It reflects both the body's mineral balance and the accumulation of toxic metals resulting from chronic or acute exposure. The incorporation of these elements into the hair matrix is primarily driven by their strong affinity for sulfhydryl group of amino acids that make up keratin chains. This study aims to investigate the relationship between the concentration levels of 32 elements in the hair of Italian adolescents (aged 14-16) and their Body Mass Index (BMI).
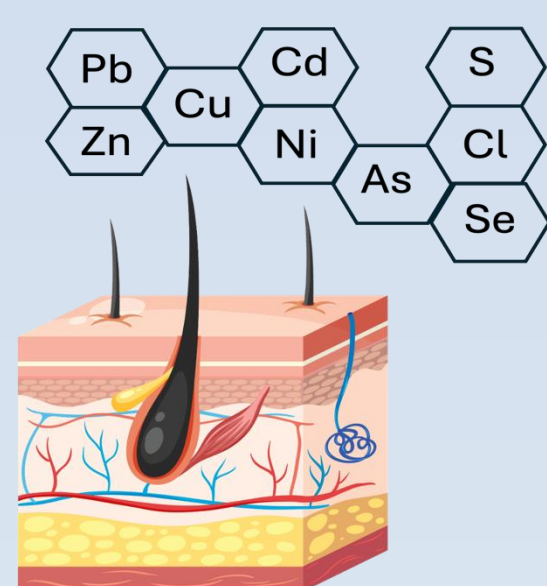
METHOD

SAMPLING

Hair sampling was performed cutting hair samples ($\simeq$ 1-3 grams) from the nape area of each individual.

Nape area
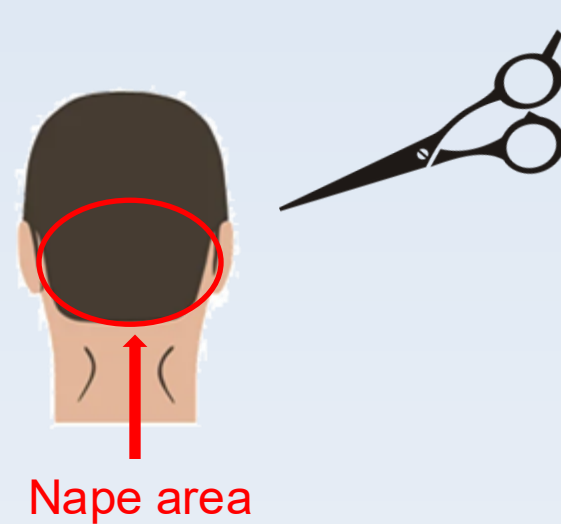
SAMPLE PREPARATION

Hair samples were washed with 25 mL of ultrapure acetone for 10 min, subsequently rinsed with ultrapure deionised H_2O, for three times.

ANALYSIS

Instrumental Neutron Activation Analysis (INAA) was used for an accurate quantification of elements in hair samples.

Rabbit - t=60 s		
S-37	(3102 keV; 5.05 m;	20 µg g^{-1})
Cu-66	(1039 keV; 5.1 m;	0.01 µg g^{-1})
Mn-56	(847 keV; 2.58 h;	0.05 µg g^{-1})

Standard and Sample

Lazy Susan - t=30 hrs		
As-76	(559 keV; 26.3 h;	0.001 µg g^{-1})
Cd-115	(527 keV; 2.3 d;	0.01 µg g^{-1})
Cr-51	(320 keV; 27.8 d;	0.005 µg g^{-1})
Fe-59	(1099 keV; 45.1 d;	0.5 µg g^{-1})
Hg-203	(279 keV; 46.6 d;	0.005 µg g^{-1})
Sb-124	(1691 keV; 60.9 d;	0.005 µg g^{-1})
Sn-113	(392 keV; 115.1 d;	0.1 µg g^{-1})
Se-75	(265 keV; 121 d;	0.001 µg g^{-1})
Zn-65	(1115 keV; 243.8 d;	0.01 µg g^{-1})

RESULTS & DISCUSSION

Data suggests zinc (Zn) as the most abundant chemical element (100 µg g^{-1}), followed by iron (Fe), copper (Cu), bromine (Br), aluminum (Al), titanium (Ti), strontium (Sr), sulfur (S), barium (Ba), tin (Sn), and mercury (Hg), each present at concentration greater than 1 µg g^{-1}.
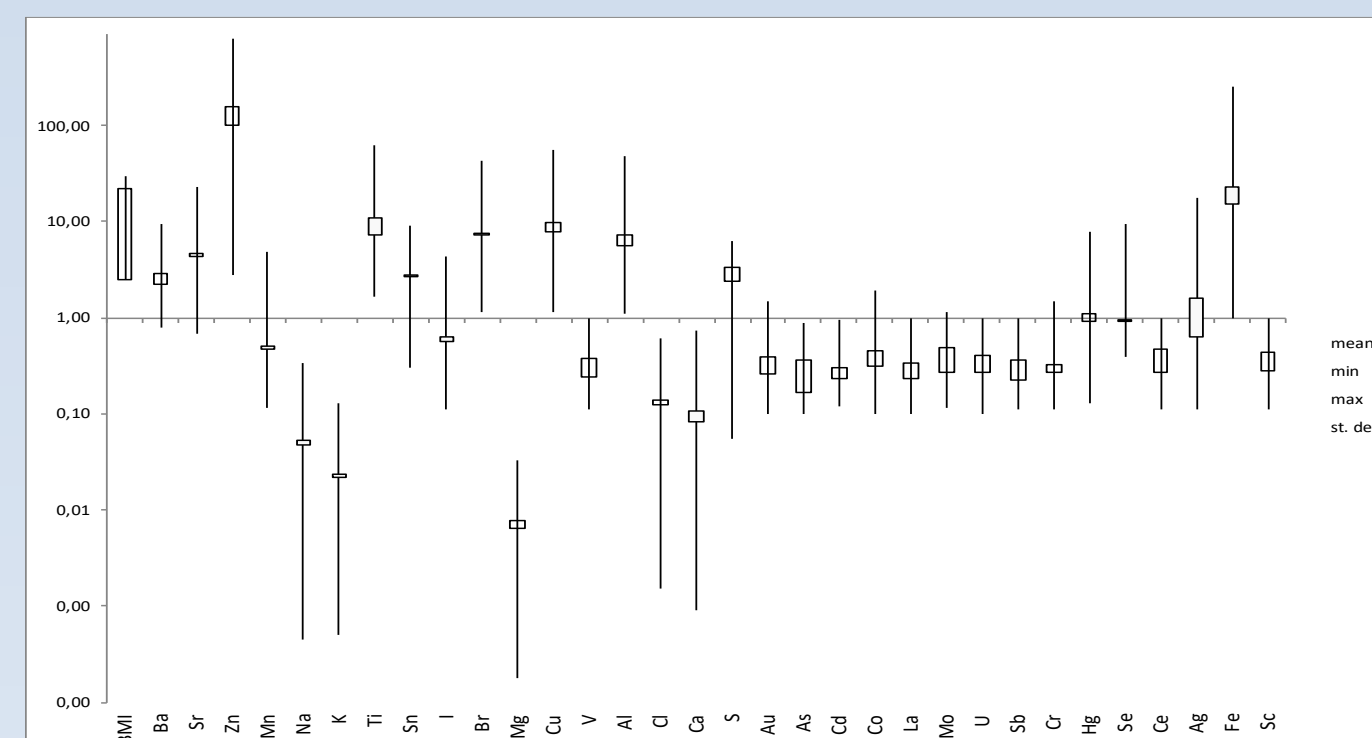

Figure 1. Box and whisker plot displaying mean, min, max and standard deviation of hair metal concentration (µg g-1, note log scale) for male (n=104) and female (n=27) subjects.

A weak positive association was observed between Zn levels (r = 0.11) and BMI (21.8) in both male and female, which could suggest an adequate nutritional status among the individuals. Conversely, vanadium (V) (r = -0.21), Hg (r = -0.18), iodine (I) (r = -0.13) and calcium (Ca) (r = -0.10) showed a weak negative association with BMI. Further statistical analyses indicated low similarity between S and chlorine (Cl) showing an indirect association to BMI. Data obtained were compared with concentrations detected in the inorganic fraction of particulate matter PM_{10} and $PM_{2.5}$, which showed very low levels in the fine fractions, such as arsenic (As) (1.06 ng m^{-3}), chromium (Cr) (3.3 ng m^{-3}), and nickel (Ni) (3.5 ng m^{-3}).

CONCLUSION

Our findings confirmed the effectiveness of INAA for the determination of inorganic elements in hair samples. Although no significant correlation was found between the concentration of elements in hair and BMI, the use of the BMI represents a valuable tool for better understanding the biological mechanism involved in the accumulation or release of toxic metals within the human body. In addition, these findings provide a baseline for assessing the effects of anthropogenic phenomena in urban area.

REFERENCES

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