

Analysis of Minerals in the Hair of Mental Retardation

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Abstract : Several heavy metals are known to give some kinds of mental retardation although abnormal X-chromosome is closely connected with genetic disease such as mental retardation. This study dealt with the influence of minerals in the hair of mental retardation people. Minerals were analyzed by Inductively Coupled Plasma Mass Spectrometer (Sciex Elan 6100, Perkin-Elmer corporation, Foster, CA, USA). The nutritional elements such as Ca, Na, K were higher level ($p < 0.01$) in normal group than in the mental retardation group. The toxic elements such as Cd ($p < 0.01$) and As were higher level in the mental retardation group than in normal group. But Pb is not significant difference among the all groups including normal group.

Keywords : hair, mental retardation, group lodging, minerals content, toxic element

Introduction

The reasonable ratio of nutritional elements can predict the healthy and nutritive conditions.¹⁾ The unbalance of minerals is arisen from many factors, such as mother at birth, drinking water, stress, shock, aluminum can, cooking tool, touch with chemicals, medicine, shampoo, working condition, and food menu. In case of a mental retardation investigated the two five -years old children, their mother have taken water containing Pb of high concentration during pregnant period.²⁻⁴⁾ The 29 percent of mental retardation children was born at the heavy mercury(Hg) pollution area, and had the chromosomal abnormalities.⁵⁻⁷⁾

Some minerals were caused a serious disease, such as itai itai or mental retardation. Pb can lead to mental retardation disease, and also abnormal X-chromosome (Fragile X Syndrome).

If lead(Pb) is contained over 50 ppm in the hair, it gives rise to anemia and mental retardation. In the children who have a good grade in school, their hair contained a plenty of the zinc and copper. Besides, in the lower-grade children, their hair contained a plenty of the cadmium(Cd) and lead.⁸⁾

Zinc(Zn) is a composition of insulin, and involves the enzyme activity that is necessary to catalyze the alcoholic resolution, and also involves to the growth and metabolite of the cell and tissue.⁸⁾

Therefore, this study dealt with the influence of minerals in mental retardation people. we detected thirty eight minerals. They were constituted the fifteen kinds of nutritional elements, eight kinds of toxic elements, and fifteen kinds of other elements.

Materials and Methods

Hair samples were collected from 89 person; twenty eight mental retardation (Western in Busan, experimental A group), twenty eight mental retardation (Eastern in Busan, experimental B group), thirty-three normal children in Busan from August 2003 to November 2003. We asked for sampling to the mental retardation welfare institution that go used to beauty service action (hair cut and perm) once a month from May 2003.

They (experimental group A,B) had been lodging more than one year, and their hair samples were directly collected by correspondent author. The hair samples of control group were collected at a barber shop and a beauty shop after intensive training of sample collectors.

All samples were scalp virgin hair (no- perm, non-dyeing), were collected on the occipital area of scalp heads. The quantity of each samples was 200 mg or more.

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Mean ages of experimental group A (western in Busan), B (eastern in Busan), and control group were 15.5 ± 2.1 in group A, 18.2 ± 3.1 in group B, and 16.8 ± 2.8 in group C, respectively. Each group were 16 men 12 women in group A, and 13 men 15 women in group B, and 17 men 16 women in control group, respectively.

The mental retardation in experimental groups were from first to third class.

Minerals were analyzed by using Inductively Coupled Plasma Mass Spectrometer (Sciex Elan 6100, Perkin-Elmer corporation, Foster, CA, USA). Analysis of hair asked Trace Elements, Inc., (Dallas, Tx, USA). To sum up, hair samples were washed about two times with the deionized waters, and cut them in 3 mm, and measured weight with an

electronic balance. And then, put them into a test tube with the nitric acid and dissolved them with a microwave oven (CEM Mars 5 plus microwave digestion apparatus, CEM corporation, Matthews, NC, USA) following the heating process of two phase. Finally, it diluted with the deionized waters to measure the final mineral content.

Statistical assay of analysis results was played with t-test by SPSS-PC program.

Result

The analysis result of mineral in hair was shown in Table 1.

The nutritional elements of Ca, Na and K in the A and B group were significantly low in A group

Table 1. A Comparison between control and mental retardation A and B groups on the nutritional, toxic, additional elements of hair mineral contents

① Nutritional elements

	Control	Group A	Group B
Ca	191.5 ± 236.0	93.7 ± 55.8**	81.4 ± 67.4**
Mg	14.6 ± 15.7	9.54 ± 3.94	6.45 ± 3.05**
Na	58.1 ± 50.5	25.4 ± 19.5***	17.8 ± 10.1***
K	33.6 ± 27.5	15.8 ± 14.4**	10.5 ± 4.4***
Cu	1.15 ± 0.15	1.58 ± 0.33***	1.30 ± 0.61
Zn	13.4 ± 1.80	17.4 ± 2.09***	17.1 ± 1.48***
P	13.3 ± 2.93	15.5 ± 2.30***	15.8 ± 1.48***
Fe	1.35 ± 0.73	1.50 ± 1.02	0.82 ± 0.25***
Mn	$4.2 \times 10^{-2} \pm 1.9 \times 10^{-2}$	$7.7 \times 10^{-2} \pm 6.1 \times 10^{-2}$ ***	$3.4 \times 10^{-2} \pm 3.7 \times 10^{-2}$
Cr	$5.0 \times 10^{-2} \pm 7.0 \times 10^{-2}$	$5.0 \times 10^{-2} \pm 1.4 \times 10^{-2}$	$5.0 \times 10^{-2} \pm 9.4 \times 10^{-3}$
Se	$5.4 \times 10^{-2} \pm 1.1 \times 10^{-2}$	$6.6 \times 10^{-2} \pm 0.4 \times 10^{-2}$ ***	$5.5 \times 10^{-2} \pm 0.2$ ***
B	$6.8 \times 10^{-2} \pm 5.1 \times 10^{-2}$	$3.0 \times 10^{-2} \pm 4.2 \times 10^{-2}$	$8.0 \times 10^{-2} \pm 6.0 \times 10^{-2}$
Co	$1.9 \times 10^{-3} \pm 1.2 \times 10^{-3}$	$2.8 \times 10^{-3} \pm 2.2 \times 10^{-3}$	$1.1 \times 10^{-3} \pm 0.5 \times 10^{-4}$
Mo	$5.2 \times 10^{-3} \pm 8.3 \times 10^{-4}$	$4.4 \times 10^{-3} \pm 1.4 \times 10^{-3}$	$3.8 \times 10^{-3} \pm 1.0 \times 10^{-3}$
S	3940.2 ± 211.0	4230.7 ± 196.6	4135.0 ± 144.2

Unit ; Mean ± SD, Sig.(T-Test) * < 0.05 ** < 0.01 *** < 0.001

② Toxic elements

	Control	Group A	Group B
As	$9.0 \times 10^{-3} \pm 4.1 \times 10^{-3}$	$1.2 \times 10^{-2} \pm 8.7 \times 10^{-3}$	$1.7 \times 10^{-2} \pm 1.0 \times 10^{-2}$
Hg	$7.6 \times 10^{-2} \pm 5.9 \times 10^{-2}$	$7.0 \times 10^{-2} \pm 1.3 \times 10^{-2}$	$6.1 \times 10^{-2} \pm 4.8 \times 10^{-2}$
Cd	$1.4 \times 10^{-2} \pm 1.8 \times 10^{-2}$	$3.6 \times 10^{-2} \pm 4.7 \times 10^{-2}$ **	$3.4 \times 10^{-3} \pm 1.7 \times 10^{-3}$ ***
Pb	$0.27 \pm 4.5 \times 10^{-2}$	0.27 ± 0.22	0.10 ± 0.00***
Al	0.46 ± 0.25	0.72 ± 0.52**	0.41 ± 0.25

Unit ; Mean ± SD, Sig.(T-Test) * < 0.05 ** < 0.01 *** < 0.001

③ Additional elements

	Control	Group A	Group B
Ge	$7.5 \times 10^{-3} \pm 1.5 \times 10^{-3}$	$1.3 \times 10^{-2} \pm 1.9 \times 10^{-2}$	$5.1 \times 10^{-3} \pm 3.5 \times 10^{-4}$
Ba	0.34 ± 0.46	0.31 ± 0.22	$3.0 \times 10^{-2} \pm 0.11$
Bi	$3.9 \times 10^{-3} \pm 3.4 \times 10^{-3}$	$2.0 \times 10^{-3} \pm 0.00$	$3.8 \times 10^{-3} \pm 4.6 \times 10^{-3}$
Rb	0.15 ± 0.22	$2.0 \times 10^{-2} \pm 1.8 \times 10^{-2}$	$9.7 \times 10^{-3} \pm 3.2 \times 10^{-3}$
Li	$1.2 \times 10^{-3} \pm 4.3 \times 10^{-4}$	$1.0 \times 10^{-3} \pm 0.00$	$1.0 \times 10^{-3} \pm 0.00$
Ni	0.11 ± 0.12	$0.13 \pm 7.9 \times 10^{-2}$	$8.5 \times 10^{-2} \pm 8.3 \times 10^{-2}$
V	$5.9 \times 10^{-3} \pm 2.6 \times 10^{-3}$	$6.0 \times 10^{-3} \pm 2.7 \times 10^{-3}$	$6.5 \times 10^{-3} \pm 1.7 \times 10^{-3}$
Sr	1.01 ± 1.25	0.59 ± 0.43	0.34 ± 0.39
Sn	$2.7 \times 10^{-2} \pm 2.0 \times 10^{-2}$	$1.7 \times 10^{-2} \pm 1.0 \times 10^{-2}$	$1.2 \times 10^{-2} \pm 7.1 \times 10^{-3}$
Ti	$7.2 \times 10^{-2} \pm 1.0 \times 10^{-3}$	$8.8 \times 10^{-2} \pm 3.3 \times 10^{-2}$	$6.4 \times 10^{-2} \pm 1.0 \times 10^{-2}$
Zr	$1.0 \times 10^{-2} \pm 0.00$	$1.0 \times 10^{-2} \pm 0.00$	$1.0 \times 10^{-2} \pm 0.00$

Unit ; Mean \pm SD, Sig.(T-Test) * <0.05 ** <0.01 *** <0.001

and in B group compared to the normal children group ($P < 0.01$). And the Zn, P and Se level in the A and B group were very significantly high A group, in B group compared to control ($P < 0.01$).

According to another researches,⁹⁾ concentrations of Zinc(Zn) in serum and hair from more than 600 healthy children aged between 7-12 years living in Turkey were measured to determine if their dietary zinc intakes and general zinc status were satisfactory. There was a positive association between zinc concentrations in serum and hair both in females and males. The socioeconomic status of the children was strongly associated with levels of zinc in these samples and the lowest concentrations of zinc were found in children from the families with poor incomes and in children who rarely consumed meat.⁹⁾

The Cu level was high in the A group compared to control group, and the Mg level was also low in the B group alone compared to them.

Cd level was significantly high in the A group compared to the normal children ($P < 0.01$), and the As level was also significantly high in the B group compared to them. Our results of Cd level similared with the result of Gibson SL³⁾ and Park SW.¹⁰⁾

Rb and Sn level in the A group and B group were low in A group, in B group compared to the control group, respectively.

Discussion

The mental retardation can originate from not

only the genetic disease and brain injury by congenital factors but also postnatal factors. It reported that if growing rat fed to feed which contained Pb, the brain give rise to biochemical abnormalities by increasing concentration of Pb in the circulating blood, and by decreasing brain tissue significantly, which can cause mental retardation,¹¹⁾ and that if children suck the piece of tree coated paint frequently, they can become a permanent injury of brain or a mental retardation by accumulating Pb of more than standard level in the brain.¹²⁾ Also, it estimated that one person out of five hundred persons would become a mental retardation in the industrial society these days.¹³⁾

This study showed that the Pb levels was not difference between the control and the mental retardation groups. Accordingly, we considered that mental retardation in our study group was not caused by accumulated Pb, but caused by genetic factor rather than postnatal factor.

It said that the excessive accumulation of Cd and Pb caused the learning disorder and IQ decrease of children,³⁾ and that the excessive accumulation of Cu and Zn caused atopic dermatitis and vitiligo,¹⁴⁾ and that the excessive cumulation of Se caused alopecia arata,¹⁵⁾ respectively. Also, it said that if Fe, Zn and riboflavin were not supplied sufficiently in the feeding of rat, the rat developed alopecia symptom¹⁶⁾ and that human will be the same results as this.¹⁷⁾ This study showed that Fe and Zn contents were normal levels in the all group, and each groups were not discovered alopecia symptom.

Meanwhile, pollutions of heavy metal were influenced by life circumstances and food habits. It said that pica was discovered in 9.2 percent among the mental retardation lodging an social institution house, and that the more intelligence was low, the more pica was high: pica materials were order of clothes, dust or waste, toy, and paper.¹⁸⁾ Cd intake by food was largely caused by soil pollution from sludge or phosphate fertilizer. In other words, human could be exposed to heavy metal by taking in the grain poisoned by Cd that exist in the soil acidified by the release from an incinerator, a melting furnace, acid rain, and sewage. This study showed that the Cd and Pb contents are high, which prove this assertion partially.

In case of woman, the level of toxic elements in the hair was increased till 40 years old and was decreased after 40 years old,¹⁹⁾ and the level of Cd in the hair reached the maximum at 40 to 50 years old. While, in case of man, Zn was increased till 12 years old and decreased after that, and Cd was increased till 20 years old and remained unchanged or somewhat decreased after that. It proved that heavy metals were undergo the influence by ages.

In our results of comparing 46 men with 43 women, the level of nutrients such as Ca and Mg are very significantly low in man compared to women ($p < 0.001$). and that the level of nutrients such as Na, K, Zn, Cr, Se, B, and Mo are significantly high in man compared to women ($p < 0.02-0.001$). Also, the level of toxic elements such as As, Hg, Pb and Al are high in man compared to women, and the level of other elements such as Ba, Ni and Sr are low in men compared to women, while the level of V and Ti are high in men compared to women. This our result was similar to Kim's report²⁰⁾ which the level of Na, Cr, As and V were significantly high in the boys, and which the level of Ca, Mg, Ba, Ni and Sr were also significantly high in the girls. But his reported differed from our results on the rest substances such as K and Zn.

Meanwhile, Our study showed that nutritional elements and additional elements were high in the control compared to mental retardation A, B group, and that toxic elements were high in the mental retardation compared to control group.

Therefore, further study is required genetic analysis

whether Fra-X Gene is contain or not in the mental retardation A, B group.

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