Content of Essesntial Trace Elements in Hair from Children Lived in Keshan Disease District in China

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SUMMARY

The hair from 9 children living in Keshan disease prevalent district and from 10 children living in Keshan disease non-prevalent district in China was analyzed. At the same time, the hair from 35 children of same age residing in Tsukuba district in Japan was analyzed for comparison of the content of essential trace elements with that of children living in Keshan disease prevalent district. Selenium (Se) content was determined by fluorophotometric method and 16 other elements were analyzed by an ICP emission spectrometry.

Se content in the hair of children living in the prevalent district was very low, being one-tenth that of the Japanese. Even in children living in the non-prevalent district the content was about one-third that of the Japanese. In the disease prevalent district, Ca and Mg were low in content and Fe, Al, Ti and Pb were relatively high in content. Mn content of both districts in China was very high when compared to that of the Japanese.

The results of this study showed that the low Se content in Keshan disease is in agreement with previously reported data and one of the factors causing this disease was considered to be based upon the ecological points including nutrition.

INTRODUCTION

Keshan disease as well as Kaschin-Beck's disease are known to be endemic diseases of Asia. Keshan disease is characterized with the presence of myocardial necrosis and dilatation of the heart and is primarily seen in remote corners of the country, particularly on the mountain sides. Keshan disease has been studied for more than 60 years, but the cause still remains unclear. However, it has been recently found that selenium (Se) concentration in the soil of Keshan disease prevalent district is very low, and vegetables and cereals produced in these prevalent districts show a very low concentration of Se. Se content in the hair and blood from persons living in the prevalent district is low. It has thus been reported that Se is effective in preventing Keshan and Kaschin-Beck's diseases.[1]

Se is an essential element for the human body, but the difference between the essential value and the toxic value is farily small. The sources for the intake of trace elements in the body from the environment are considered to be food, drinking water and air. It is assumed that trace elements in the body are characteristically concentrated in residents of different localities attributable to the balance between their accumulation and excretion. Some of the heavy metals and trace elements are accumulated in the head hair with its value being higher than that in blood or urine. The content of

such elements in hair can be used for evaluating the continuous condition of health, which reflect some disease or environmental contamination. It is thus possible that they can serve as a health monitor and an indicator of nutrition.

An attempt was therefore made to compare the essential trace elements in the hair of Chinese children including children with Keshan disease and of Japanese healthy children in order to elucidate the cause of Keshan disease, because the nutrition of the people of these districts is different. The results of this study were compared with the previously reported data on Se content in hair of different countries.[2]

MATERIALS AND METHODS

1. *Collection of hair*

Hair was collected from children living in Keshan disease prevalent district (Chuxiong County) and Keshan disease non-prevalent district (Muojiang County). The details of these places are shown in Table 1. At the same time, the hair from children of the same age but living in A or B district of Tsukuba City in Japan was collected.

Table 1. Epidemiological pattern of Keshan disease prevalent and non-prevalent districts in Yunnan Province in China

Place	Sample No.	Height above sea (m)	color of soil	Mean temp. in year (°C)	Rain fall (ml)	Principal food	Side dish	Unbalanced diet
Non-Prevalent district								
Beexi in Muojian County	1–10	1800	purple red	13–15		Rice Corn Wheat	Low in meat fish and egg	slightly
Prevalent district								
Muding of Chuxiong County	11–15	2000	purple red	12.7	827	Rice Corn Wheat	Low in meat fish, egg and beans	severely
Dungua of Chuxiong Country	16–19	2000	purple red	12.7	827			

2. *Preparation of hair samples for analysis*

All the samples were immersed and shaken for 10 minutes in a solution of non-ionic surface active agent at 0.001% of "NONION, NS206 (Polyoxy-ethylene-octylphenol-ether)". This detergent was excluded from the sodium element. After removing dust on the hair surface, hair was rinsed in distilled water and finally rinsed with acetone for a few minutes. Then, the hair was placed on a clean filter paper for drying at room temperature.

3. *Analysis of Se and trace elements in the hair*

About 500 mg of each sample was used in the experiment, except for a few cases. Se content was determined by a fluorophotometric method and the other elements were analysed by an Inductivity

Coupled Plasma (ICP) emission spectrometry.

RESULTS AND DISCUSSION

1. *Content of Se in hair*

Average Se content was 0.086±0.018 μg/g (n=9 with average age of 5.9 years, in the range of 1 to 13 year-old of males) in the prevalent district. and 0.25±0.087 μg/g (n=10 with average age of 7.4 years, in the range of 5 to 11 year-old of males) in the non-prevalent, district. The value of Japanese children in A district was 0.63±.013 μg/g (n=13 with average age of 8.1 years, in the range of 4 to 13 year-old of males and females) and in B district 0.75±0.16 μg/g (n=22 with average age of 7.5 years, in the range of 4 to 12 year-old of males and females). The results was shown in Fig. 1. The statistical analysis was made on the data.

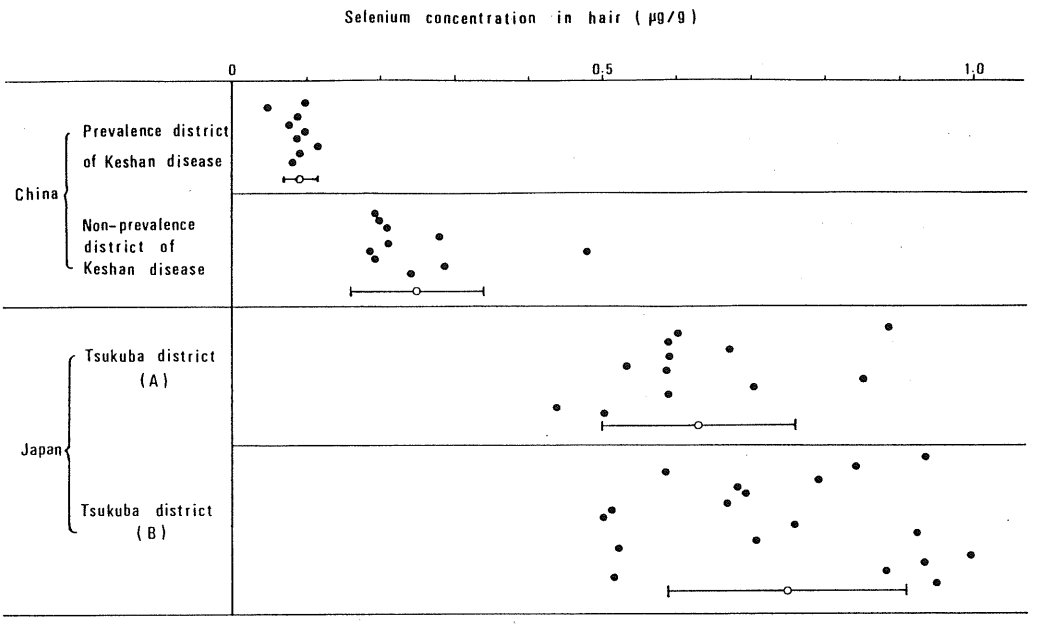

Fig. 1. Concentration of Se in hair.

2. *Content of other trace elements*

Other trace elements, such as Mg, Sr, Al, Fe, Cu, Zn, Mn, Cr, Ni, Ti, Pb and Cd were determined, and also essential elements of Na, K, Ca and P were determined. The average content of Al, P, Mn, Fe, Ti and Pb in the prevalent district were higher than other three districts and those of Ca, Mg, Cr, Na and Ni were lower than other districts. However, Mn, Fe and Al in the both of prevalent and non-prevalent districts in China were high in the content. Especially, Mn content in the Chinese who were examined was in about thirty times higher than the Japanese. These results were shown in Fig. 2, Fig. 3 and Fig. 4. These facts indicate that the difference be originated from an ecological impact including nutrition which is caused by food, drinking water and soil etc.

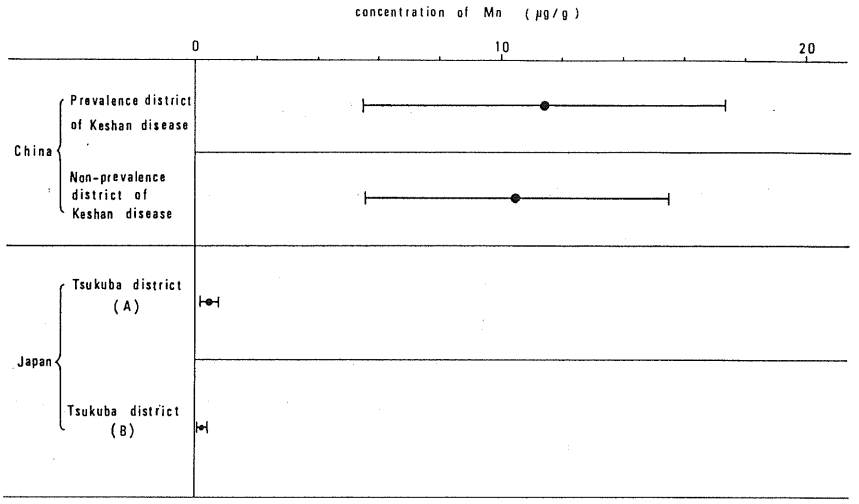

Fig. 2. Concentration of Mn in hair.

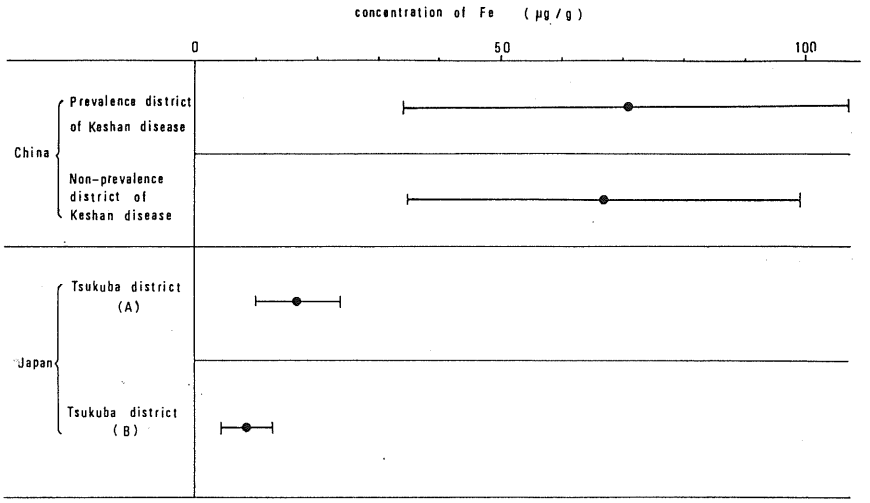

Fig. 3. Concentration of Fe in hair.

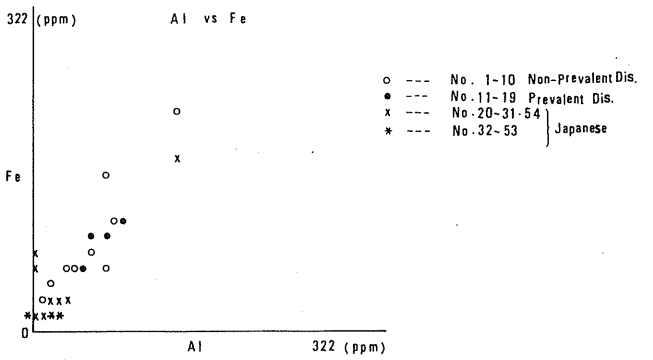

Fig. 4. Correlation to the content of Al and Fe.

3.

Keshan disease ethiology has been proposed in conjuction with the disease due to Se deficiency[3]. Moreover, Se intervention has been proved to be very effective in the prophylaxis of Keshan disease. So the result of Se content in hair on this study is in good agreement with those of previously reported data. The content of both children and adults in healthy persons in those different countries was approximately the same order[2]. On the contrary, the Se value from the prevalent district of Keshan disease was one-tenth that of the Japanese and one-third that of the non-prevalent district of the Chinese.

From the results of other trace elements, it was considered that we needed to discuss more about their effects on health.

CONCLUSION

The hair from nine children living in Keshan disease prevalent district (Chuxiong Country) and from 10 children living in Keshan disease non-prevalent district (Moujiang Country) on the southern mountain side of China was analyzed for trace elements. At the same time, the hair from 35 children of same age living in Tsukuba A or B district in Japan was also analyzed for comparison with the hair of children in China regarding the nutrients of this disease in order to eludicate the cause of this disease.

Se analysis was performed by the fluorophotometric method and the other elements were determinend by the ICP emission spectrometry.

The average Se content was 0.086 ± 0.018 ($n=9$ with average age of 5.9 years) in the disease prevalent district and 0.25 ± 0.087 ppm ($n=10$ with average age of 7.4 years) in the non-prevalent district. The value of Japanese children living in A district was 0.63 ± 0.13 ppm ($n=13$ with average age of 8.1 years) and that in B district 0.75 ± 0.16 ppm ($n=22$ with average age of 7.5 years). Mn content of both districts in China was about 30 times higher than that in Japan. The content of Fe, Al, Ti and Pb were relatively high in the prevalent district. Ca and Mg content were low.

Se content in Keshan disease was in agreement with previously reported data. Se content of Japanese children was almost the same in value as reported previously[2]. As for other trace elements, Keshan disease was considered to be dependent on ecological points such as nutrition.

REFERENCES

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