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STUDY ON THE MERCURY CONTENTS IN KOREAN SCALP HAIRS

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ABSTRACT: *The average value of total mercury contents in scalp hair of Korean male was found to be 1.66 ± 1.10 ppm (S.D.) and that of methylmercury was 1.02 ± 0.72 ppm (61.0% of the total mercury). In case of total mercury contents of female was 1.06 ± 0.46 ppm and that of methylmercury was 0.51 ± 0.27 ppm (48.4% of total mercury level). When compared with data reported by Japanese, the levels were about half. The levels of mercury in scalp hair of male subjects were significantly different with their occupations, but in case of female, the variation was not so much. The statistical coefficient of correlation between age and measurement level of total mercury in scalp hair of male was $r = +0.479$ ($p < 0.01$) and that of methylmercury was $r = +0.519$ ($p < 0.01$), respectively.*

Key words: *Measurement of the Mercury contents of Korean scalp hair*

INTRODUCTION

In recent year there has been much interest in the role of trace metal in human health and diseases (Brirke *et al.*, 1972; Clarkson, 1983; Calabrese *et al.*, 1985; Tsubaki *et al.*, 1986; Allen, 1988). Organizations such as the National Academy Science (NAS) have reported that scholary reports are dealing with the general issue of geochemistry and environmental health (NAS, 1974; 1977).

Mercury is one of the earth's rarest elements, rating seventy-fourth out of a list of 90. In its natural state it occurs mainly in combination with sulfur. The extent of exposure to mercury depends on a natural cycling process between the elemental and mercuric forms of mercury. Both industrially wasted and naturally occurring mercury, are mainly methylated in the bottom muds of oceans and lakes by microorganisms (NAS-NRC, 1977).

The nurotic action of methylmercury compounds has well described in both clinical and experimental studies. An incidence of well-known adverse effect on the nervous system is the Minamata disease in Japan (Tsubaki *et al.*, 1986). Thirtysix years have

passed since the first epidemic report in 1953. In 1964 a second epidemic occurred in Nigata. In late 1971 and early 1972 a large epidemic of alkylmercury poisoning was reported in Iraq (Amin-Zaki, 1976). In other areas of the world, several cases of methylmercury pollution of water and seafoods have been suspected, but fortunately other large epidemics have not been reported yet.

It has been well-known that scalp hair is apparently the best indicator media since the concentration of mercury in hair can indicate both past and present blood concentrations (Skerfving, 1974; Suzuki *et al.*, 1975; Sumino, 1980).

Scalp hair has advantages as an ideal tissue for epidemiologic study in which it is painlessly removed, simply discarded, and easily collected. Since trace elements have been measured in hair, this tissue may prove a practical dosimeter of metallic environmental pollutants (Yurachek *et al.*, 1969; Hammer *et al.*, 1971). Contents of trace metals in hair may also better reflect the total body pool of some elements than either blood or urine.

The author conducted an experiment in which the total mercury and methylmercury amounts in Korean scalp hair samples of 315 subjects in Seoul city in 1988.

MATERIALS AND METHODS

Materials

Two hundred and eleven samples of male scalp hair, and one hundred and four samples from female, and aged from under 10 to over 50 years old have been subjected to assay. All donors are living in Seoul city.

Instruments

The sampls were analysed by Rigaku Mercury Analyzer/SP for total mercury and Gas Chromatography(Simazu GC-4A) for mercury in scalp hair.

Analyses

Total mercury in scalp hair was measured by the Methods of Technical Report of Rigaku Mercury/SP(Rigaku, 1981), and methylmercury by the Sumino's Methods (Sumino, 1980).

RESULTS

Total mercury and methylmercury contents in Korean scalp hairs are summerized in Table1.

The average value of the concentrations of total mercury in scalp hair of male was found to be 1.66 ± 1.10 ppm ($\pm$S.D.) and that of methylmercury was 1.02 ± 0.72 ppm, giving a rate of 61.0% of the total mercury. The value of total mercury and methylmercury levels tend to increase with age. In case of female scalp hair samples, total mercury value was found to be 1.06 ± 0.46 ppm and that of methylmercury was 0.51 ± 0.27 ppm giving a rate of 48.4% of total mercury level. But it is not so much different among the various age groups.

Table 2 gives a summary of the levels of total mercury and methylmercury concen-

Table 1. Total mercury (TM) and methylmercury (MM) concentration as Hg in the scalp hair of Korean by age groups

Sex:	Age gr. / Item	Total	9	10-18	20-29	30-39	40-40	50
Male Age 29±10.7	N	211	5	18	121	30	24	13
	Total Mercury	1.66± 1.10**	1.33± 0.50	1.13± 0.3	1.38± 0.50	1.84± 0.67	2.11± 1.71	3.85± 2.05
	Range	0.50- 9.21	0.88- 2.07	0.67- 2.06	0.50- 3.41	0.60- 3.00	0.75- 9.16	1.41- 9.21
	Methylmercury	1.02± 0.72**	0.72± 0.28	0.67± 0.30	0.83± 0.34	1.14± 0.47	1.36± 1.16	2.42± 1.16
	Range	0.20- 5.84	0.46- 1.09	0.20- 1.61	0.27- 1.99	0.36- 2.02	0.44- 5.84	0.85- 5.00
	MM/TM (%)	61.0 ±13.1	54.2 ± 1.8	58.4 ±12.5	60.4 ±13.7	62.7 ±12.9	63.5 ± 9.9	62.9 ±13.4
	Range	22.6 ±96.8	52.3 -57.2	23.8 -84.3	22.6 -96.8	36.1 -88.8	33.8 -78.1	42.5 -90.
Female Age 37±16.6	N	104	4	13	18	23	20	28
	Total Mercury	1.06± 0.46	1.17± 0.23	1.18± 0.55	1.06± 0.58	1.14± 0.54	0.94± 0.32	1.00± 0.28
	Range	0.45- 3.03	0.98- 1.56	0.65- 2.90	0.50- 2.83	0.53- 3.03	0.45- 1.59	0.52- 1.60
	Methylmercury	0.51- 0.27	0.49- 0.18	0.51- 0.25	0.50- 0.36	0.53-0.30	0.42- 0.17	0.56- 0.24
	Range	0.16-1.46	0.29- 0.75	0.14- 1.08	0.15- 1.40	0.21- 1.38	0.23- 0.81	0.25- 1.19
	MM/TM(%)	48.4 ±15.0	41.8 ±15.9	45.8 ±19.3	44.9 -12.8	46.6 -13.7	46.6 -13.0	56.0 -13.9
	Range	13.0 -83.3	29.6 -68.8	13.0 -71.3	23.4 -66.7	27.1 -76.0	25.2 -66.7	25.0 -83.3

(M±S.D. ppm)

Table 2. Total mercury and methylmercury concentrations in the scalp hair of Korean by occupation

Sex: Item	Occupation	Students	Merchants	Businoss men	House-wives
Male	N	110	37	56	
	Total Mercury	1.34± 0.50	1.74± 0.59**	2.30± 1.78**	
	Methyl Mercury	0.78± 0.35	1.01± 0.39**	1.52± 1.10**	
	MM/TM (%)	58.8 ±13.7	58.9 ±12.4	67.1 ±10.5	
Female	N	17	13	17	39
	Total Mercury	1.10± 0.51	1.14± 0.36	1.10± 0.63	1.00± 0.45
	Methyl Mercury	0.49± 0.23	0.49± 0.27	0.53± 0.37	0.49± 0.25
	MM/TM (%)	46.4 ±16.4	41.5 ±12.6	48.3 ±14.7	49.3 ±14.6

(M±S.D. ppm)

tration in the scalp hair samples by occupation. In the case of samples collected from students group, the level appeared to be lower than that of other sample obtained from merchants and business men (male), but that of female samples was not so much different by jobs.

Table 3 shows that a survey previously reported and revised by Yamaguchi *et al.* (1975) later. When compared with those data of total mercury levels in Korean scalp hair, Korean male and female were half level than Japanese male and female ($p<0.01$). And those of data in Koreans were higher than Napales, who rarely have had seafoods. The differences in mean value among the each groups were statistically significant ($p<0.01$).

Fig. 1, shows the statistical coefficient of correlation between age and measurment level of total mercury in scalp hair of male was $r = +0.479$ ($p<0.01$) and the regres-

Table 3. Comparison of total mercury content of scalp hair

Nationality and Sex	Location	No. in Samples	Mean of Mercury	S.D.	t-Test (p)
A. Korean Male	Seoul	211	1.66	1.10	A:C $p<0.01$
B. Korean Female	Seoul	104	1.06	0.46	B:D $p<0.01$
C. Japanese Male	Fukuoka, Kyushu	111	4.35	2.45	
D. Japanese Female	Fukuoka, Kyushu	67	3.25	2.02	
E. Nepali Male	Silgarhi Doti, Dhangarhi	31	0.163	0.187	E:A $p<0.01$
F. Nepali Female	Silgarhi Doti, Dhangarhi	14	0.457	0.484	F:B $p<0.01$

unit: ppm, $^{*}p<0.05$, $^{**}p<0.01$

* Data modified from: Yamaguchi S.; Factors affecting the amount of mercury in human scalp hair, A.J.P.H., 65: 484, 1975

sion equation induced from it was $Y=0.0509X+0.1873$ (Y is expect total mercury level in ppm and X is age of subject). And that of correlation coefficient between age and methylmercury amount of male was $r=+0.519$ ($p<0.01$), the induction from it we obtained the following regression equation; $Y=0.0346X+0.0123$ (Y is expect methylmercury level in ppm and X is age of subject), in Fig. 2, respectively.

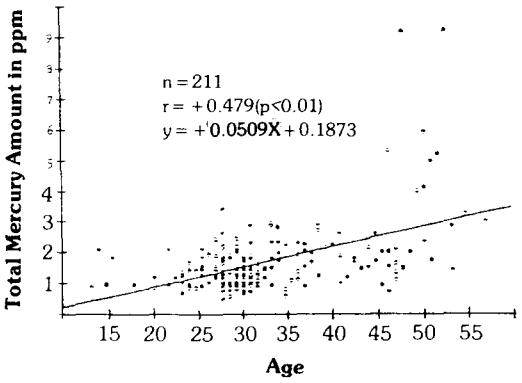

Fig. 1. Correlation coefficient between age and measurment level of total mercury in th scalp hair of Korean

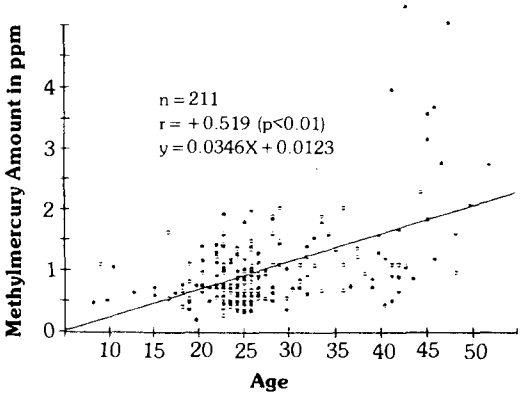

Fig. 2. Correlation coefficient between age and measurement level of total methylmercury in the scalp hair of Korean

DISCUSSION

The contents of a trace metal in human hair apparently depends on many factors (Hammer *et al.*, 1971). Mercury is in existence of a number of physical and chemical forms, each of which must be considered separately from the point of view of biological

monitoring.

The inorganic forms of mercury occur natually in the environment as well as being produced by man in mining and manufacturing activities (Clarkson, 1983).

Methylmercury is the only organic form of mercury known to be produced by natural processes. Biomethylation reactions carried out by methanogenic bacteria present in the sediments of bodies of fresh or saline water, and they are able to produce one or two methyl groups attachment to the inorganic mercury form. These mono and dimethyl forms of mercury accumulate in aquatic food chains and happen to enter the human diet(NAS, 1978).

Microorganisms are primarily responsible for methylation of mercury, and the initial studies on biological methylation of mercury were done with methanogenic bacteria (Wood *et al.*, 1973).

A wide variety of organic forms of mercury have been synthesized and manufactured by man over the past centuries (Hunter, 1969).

Humans are exposured mainly, if not exclusively, by two forms of mercury. The vapor of metallic mercury(mercury vapor) is the predominant form in occupational exposure. Monomethylmercury, present in seafood and its products, is the other form for human exposure.

The human adult body contains about 13 mg mercury, about 70% of which is present in fat and muscle tissue(Vengopal, 1978). Excreation is mainly via the feces urinary excretion that accounts for 20% or less of total excreation(WHO, 1976). Biological half of methylmercury in man is about 70 days(Miettien, 1973). Scalp hair is probably the best indicator media since the concentration of mercury in hair can indicate both past and present blood concentrations (Clarkson, 1983).

The results show that the average values of the concentration of total mercury in scalp hair of male found to be 1.66 ppm and that of methyl mercury was 1.02 ppm (61% of the total mercury). And in the case of female samples total mercury value was 1.06 ppm and that of methylmercury was 0.51 ppm (48.4% of total mercury level).

The importance of determining the ratio of methylmercury to the total mercury in biological specimens for an assessment of mercury absorption is also emphasized. On the other hands, the levels of total mercury and methyl mercury cocentration in male hair samples by their occupation appeared to be significantly different, but that of female samples was not so much. Correlation between age of subjects and levels of total mercury in male scalp hair samples was $r = +0.479 (p < 0.01)$ and that of methylmercury was $r = +0.519 (p < 0.01)$, respectively.

Finally, it is hope that those information will be used for references in futher study.

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