Keynote Lecture: Nutrition, environmental contaminants and disease.

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Epidemiological investigation in the east side of the Aral Sea, Kazakhstan has been proceeded as our project since 2000. Children's health has been targeted in our survey. Children's health reflects environmental contamination more sensitive rather than adults. Children at present should be healthy because they will deriver and owe the next generation.

[Background]

1. Desiccation of the Aral Sea

The history of desiccation of the Aral Sea is well known in not only the Central Asian countries but also all over the world. It is not necessary to mention here. Therefore, two photos taken from a satellite will be shown.

2. Effects of the desiccation of the Aral Sea on the residents' lives

As the Aral Sea is salty lake, the desiccation was resulted increase of the salt concentration. Aral City (previous name Aralisk) was famous fishery town, and there were many canning factories, but they became ruins. Fishing boats were left on the bottom of the lake with no water, and could not move anymore. They call it as the grave of the ships. This fact produced many unemployed persons. Actually about 50% children had jobless fathers when we investigated in this area in summer 2000. Not only economical situation but also meteorological change has occurred in this area. Namely strong wind blows from north-west to south-east of the Aral Sea, and it brings much sand and dust. It is considered that the sand includes sediments of the Aral Sea. It is considered that sediments may include agricultural chemicals, exhausted minerals from mines and factories which were brought to the Aral Sea by water stream and then deposited on the bottom, now exposed to the ambient. The residents become complaining their health problem.

3. Environmental Disease

A Kazakh lady pediatrician came to see me in Tokyo in 1994, and explained that there were many sick children in the east side of the Aral Sea. One child had several diseases. She thought environmental contamination was the cause of the diseases. They call the disease happening in this area as Ecological Disease which is no diagnostic standard. Kazakh government designated this area as Zone 3, which was severely contaminated area. And the government opened "Department of Ecological Disease" in Aksai Hospital in Almaty. Severe sick children aged 6 to 15 years old in Zone 3 were admitted to the Department of Ecological Disease, and received medical treatments and education for 3 months, then

returned home. This author visited the Department of Ecological Disease, and saw and talked with patients and physicians in 1998. She though there was malnutrition basically and some patients might have zinc deficiency.

At present this disease is called as Environmental Disease and duration of admission for children with this disease is for 3 weeks.

[Epidemiological investigation]

First epidemiological survey was developed in summer 2000 after preliminary small scale survey in May 2000. Nine villages in Kazalinsk county where was nearest district to the Aral Sea, and four villages in Zhanakorgan county where was most upper stream area of the Syr-Darya in the same state, Kyzylorda Oblast. Zhanakorgan was about 500 km east from Kazalinsk and was designated as the Zone 1, slightly contaminated area. Therefore Zhanakorgan was not the absolute control area; it was used as the control area in order to compare the results. The subjects of this survey were randomly selected 972 children aged 6 to 15 years old, born in 1985 to 1993, from both areas; 486 children each area. The interviewers, who were local nurses trained for one week in advance by a Japanese specialist, visited the selected subjects' homes with the informed consent sheets and explanation of this survey written in Kazakh language. Parents of selected children were asked to come to the health center near by with sighed informed consent sheets. In Kazalinsk (the close-by area) 383 and in Zhanakorgan (the far-away area) 432 were accepted this epidemiological survey. A total 815 children (response rate 84%) participated in this survey. This number corresponded about 20% of the same age children living in the same area. Numbers of boys and girls in both areas were not statistically difference. The same interviewers worked in both areas.

[Results of the survey]

1. Socio-Economic conditions

The responsible adults living with the subjects, mainly mothers, were asked family constituents, the order of the subject child, ages of the parents, education duration received by parents, annual income, possessive furniture and electric equipments etc. Fathers' unemployed rates were 48.8% (the close-by area) and 42.4 %(the far-away area), without statistical deference. The possessive rates of radio, TV apparatus, refrigerator, motorcycle, and car were significantly higher in families living in the far-away area except motorcycle. The diffusion of electricity was 89% and 99%, and that of telephone was 3.4% and 31% in the close-by area and the far-away area, respectively.

2. General health conditions

The prevalence of diarrhea, abdominal pain, lack of appetite, cough, and headache during the last 4 weeks was significantly higher in the close-by area than in the far-away area. No statistical difference was observed in the prevalence of nausea, vomiting, sore throat, sputum, dizziness, low back

pain, easy fatigue, and fever between the two areas. There was no significant difference in school absence due to any kind of illness between two groups. Over 90% of children living in the close-by area answered 'excellent' or 'good' for their health status.

2. Height, body weight, and Body Mass Index(BMI)

Average height +/- SD was 137.4 +/- 14.6 cm (n=190, boys, the close-by area), 137.2 +/- 14.6 cm(n=193, girls, the close-by area), 137.8 +/- 14.1 cm (n=217, boys, the far-away area), 139.6 +/- 15.1 cm(n=215, girls, the far-away area), body weight was 31.6 +/- 8.9 kg (n=190, boys, the close-by area), 31.6 +/- 10.4 kg (n=193, girls, the close-by area), 32.2 +/- 10.0 kg (n=217, boys, the far-away area), 33.5 +/- 11.0 kg (n=215, girls, the far-away area). The mean body mass index (BMI) with SD was 16.4 +/- 1.6 (n=190, boys, the close-by area), 16.3 +/- 2.4 (n=193, girls, the close-by area), 16.5 +/- 1.9 (n=217, boys, the far-away area), 16.7 +/- 2.4 (n=215, girls, the far-away area). The average BMI values of 2 areas were 16.3 +/- 2.0 (n=382) in the close-by area and 16.6 +/- 2.2 (n=432) in the far-away area (p=0.050). Stunting and wasting were found in 11.8% and 11.8% in the close-by area and 13.8% and 10.3% in the far-away area, respectively. These values had no significant difference between areas.

4. Anemia

Hemoglobin concentrations (mean +/- SD) were 11.7 +/- 1.0 g/dl in the close-by area, and 12.1 +/- 1.0 g/dl in the far-away area. The prevalence of anemia was found to be 62.0% in the close-by area and 38.6% in the far-away area. However, more than 95% of them were categorized as mild anemia according to the criteria by WHO.

5. Respiratory function

Respiratory function was assessed by electronic volume-flow spirometer. Measurements included forced vital capacity (FVC), forced expiratory volume in 1 second (FEV1) and forced expiratory flow in the time interval between 25% and 75% of the FVC (FEF25-75%). Obstructive pattern of pulmonary dysfunction was defined as FEV1% (FEV1/FVC) < 70%; restrictive pattern was considered to be %FVC (FVC/predicted FVC) < 80%. Prevalence of restrictive pattern was 10.6% in the close-by area and 2.6% in the far-away area ($p<0.001$). Prevalence of obstructive pattern was 1.1% in the close-by area abd 0.5% in the far-away area, which was insignificant different.

6. Renal function

Urinary concentrations of sodium (Na) and calcium (Ca) were extremely high; in the close-by area 0.33 +/- 0.30 Na mmol/mmol creatinine, 0.75 +/- 0.74 mmol Ca/mmol creatinine, and in the far-away area 2.89 +/- 1.69 Na mmol/mmol creatinine, 3.54 +/- 2.27 Ca mmol/mmol creatinine.

Both Na and Ca excretion in urine were significantly higher in the close-by area than in the far-away area.

N-acetyl-beta-glucosamidase (NAG) in urine was 0.77 +/- 0.58 U/mmol creatinine in the close-by area, and 0.62 +/- 0.37 U/mmol creatinine in the far-away area ($p<0.05$). Beta-2-microglobulin in urine was 41.8 +/- 54.8 ug/mmol creatinine in the close-by area and 22.5 +/- 20.4 ug/mmol creatinine in the far-away area ($p<0.01$). However, there was no correlation with cadmium concentrations in urine.

7. Food consumption

Two kinds of food questionnaire were prepared; food frequency questionnaire (FFQ) and 24 hours recall method. Almost all subjects replied to FFQ, but 107 families (11% children living in the close-by area and 15% children living in the far-away area) were interviewed for 24 hours recall method, because it took about 50 min per family.

From FFQ it was found that fish, dry fruits, and dairy products were more frequently consumed in the close-by area, on the other hands fresh vegetables, fruits, meats, eggs, confectionaries were more frequently consumed in the far-away area than in the close-by area. Frequency of tea and rice consumption was not statistically difference between two areas.

From the results of 24 hours recall method and Kazakh Nutrition Food Table, total calories, protein and main nutrient amounts per subjecting child were calculated. Especially, correlation between anemia and iron intake was scrutinized; intakes of bioavairable iron were calculated in each child from intakes of hem-iron, non-hem-iron, and enhancers of iron absorption such as vitamin C, fish, meet, and poultry, and inhibitor of iron absorption such as phytate. The subjects were divided into two groups; 49 with anemia and 48 without anemia. As the results bioavairable iron intake was significantly lower in the group with anemia than in the group without anemia. The reason why bioavairable iron intake was low in the group with anemia was estimated as higher phytate intake rather than total iron intake in the group.

According to the ambient condition it was considered there were much different kinds of food intakes between summer and winter. Follow-up survey was conducted in 4 villages in the close-by area in 2002 and 2003. Among 107 families received 24 recall method in summer 2000, 49 families were in close-by area, and 19 families were included in the 4 villages subjected follow-up survey. These 19 families were interviewed 24 recall method by the same interviewer in March 2002. When their food intakes were compared between summer and spring, it was found that meat and oil consumptions were significantly larger in spring than in summer, and green vegetables were consumed significantly larger amounts in summer than in spring, although energy intakes were not significantly different between summer and spring . There were no significant differences in consumptions of milk, fish and potato between two seasons. Concerning micronutrients intakes of iron, calcium, magnesium, vitamins Bi, B2, B6, C, folic acid, and carotene were significantly higher in summer than in spring. Intakes of vitamins A and D were higher in spring them in summer, however, it was not significant.

8. Drinking water

Samples of drinking water were collected in summer 2000, summer 2001, and spring and summer 2002 and 2003. All samples were analyzed various element concentrations. Bacteriological investigation was conducted in the samples collected in summer 2002 and spring and summer 2003. Element analyzes were done the other drinking water samples collected in Semiparatinsk, Chimkent, Tashkent, Singapore, and Tokyo.

Remarkable findings were as follows: sodium concentrations were extremely high, especially deep well water in the close-by area, which was about 50 times in comparison with the samples collected in Tokyo and the other countries. Some samples of the close-by area contained uranium.

As to the results of bacteriological tests, *Escherichia coli* group and general bacteria were determined. The numbers of the colonies were much higher in samples collected in summer than in spring. However, the results of summer 2003 were found to be improved. Exceptionally a few samples were detected residual chlorine, and these samples showed of course no bacteriological colonies.

9. Element concentrations in biological samples

Various element concentrations were determined in urine, whole blood, plasma, and hair collected in summer 2000. In the all materials sodium concentrations were higher in the subjects in the close-by area than in the far-away area. Zink concentrations were no statistical difference between two areas, however, they were low in comparison with the Japanese ones. Relation between the elements and human health status are under analysis and consideration.

[Discussion and the further study]

Kzylorda Oblast has long distance from west to east. The west is Kazalinsk county (the close-by area) where is steppe and short weeds are grown. The east is Zhanakorgan county (the far-away area) where weeds have tall height, and locates convenient place to the other cities such as South Kazakhstan Oblast where is known as fruit producing area. Residents' economical situation in east was slightly better than in west. It is considered that these conditions are deeply correlate with the residents' living custom. Measure for anemia may be useful of nutrition education for mothers, because education levels were high. As to the respiratory function, we set 10 dust traps along with the Syr-Darya and collected dust samples every month for one year. And the dust particle sizes and attaching chemicals were analyzed. As the results very low concentrations of organic chloride compounds were detected in some samples by screening tests for agricultural chemicals including 20 organic chloride and 20 organic phosphorus compounds. On the other hand, local residents complain that strong wind moves much dust from north-west to south-east of the Aral Sea. This dust might contain sediments which was previously bottom of the lake and contaminated. >From our analytical results the particle size might make them

problem, because 2.5 to 10 maicrometer particles were main size. Plantation may effect to prevent from movement of sands. We will learn and select which plants can grow in this environments and useful.

As to the drinking water there are many areas in the world which do not have drinking water supply at home. They come to water supplying source with water containers. If they have piped water supply at home, their gastrointestinal problems have to be reduced. But the real situation at present they must pay attention to keep drinking water clean especially in summer time. Chlorination is useful, therefore, suitable and simple disinfection techniques should be informed.

There are many problems in the Aral Sea region. If it is express by only one ward, it is salt problem. We strongly hope that our results investigated extensively are utilized for improvement of residents' quality of life.

[Original papers published]

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