

**ARAL SEA BASIN CONJECTURABLE ECOCATASTROHPE
AND CHILDREN STATE OF HEALTH.
METHODOLOGY AND RESULTS OF COMPLEX COMPARATIVE STUDY**
F.Ingel¹, Sh.Khussainova², L.Erdinger³, P.Eckl⁴, E.Utegenova⁵

¹A.N.Sysin Research Institute of Human Ecology and Environmental Hygiene of Russian Academy of Medical Sciences, Moscow, Russia fainangel@mail.ru;

²Scientific Center of Pediatrics and Children Surgery, Almaty, Kazakhstan

³University of Heidelberg Department for Hygiene and Medical Microbiology, Heidelberg, Germany;

⁴University of Salzburg, Institute of Genetics and General Biology, Salzburg, Austria;

⁵Kazakh sanitary-epidemiological station, Administration, Almaty, Kasachstan

Previously it has been reported (Jensen, S., Mazhitova, Z., Zetterstrom, R, 1977).that the health of children living in the Aral Sea region is generally poor, with a high morbidity, mortality, high rate of chronic diseases and retarded mental and physical development. The blood lipid concentration of PCB's in this region was shown to be higher than that of healthy children from northern Europe and some other pollutants, for example Hg⁺², were detected in children biosubstrates. Additionally, it is known that people, living in the region, are very poor.

Trying to understand the situation in complex we carried out multiparameter international investigation was focusing on medical, social, psychological, biochemical, genetic and immunological aspects. This investigation was supported by INTAS grant 1005 (2001).

The design of our study was based on H.Selye`s concept postulated that all influences independent of their nature can induce stress reactions in organisms, triggering, mediating and modifying practically all biochemical processes. This concept we expanded to genome, because previously (Ingel F et all, 1997, 2001) was demonstrated that emotional dysadaptation correlated with increased (animal, human) genome susceptibility.

In our comparative study we tried to verify the hypothesis that not only environmental pollution, but also social (economical) and, connected with this, psychological factors are influencing the health of children in the Aral Sea region. Therefore, a complex approach was created to determine in parallel: 1. the environmental pollution of air, soil and water with determination of mutagenicity of these samples; 2. social and emotional states adult members of their families (including economical status of families) as evidenced by psychological and social testing; 3. children stress expression; 4. somatic health of children as evidenced by medical examination; 5. immunological status of children as evidenced by analysis of saliva; 6. genomic instability of children as evidenced by blood cytogenetical analysis; 7. content of heavy metals, PCBs and DDE in blood serum of children.

Groups of children for this study (4-16 years old), living in Aralsk town, situated on the Aral Sea Basin (817 persons) and settlement Akchi – region of comparison, located in Central Kazakhstan (802 persons), were selected by direct computer randomization from all of living in the settlements for medical examination. In parallel adults in their families were tested with standard psychological scales (for determination of different types of psychological dysadaptation – psychological depression, anxiety and overfatigue) in complex with especially elaborated social questionnaire for evaluation of social and economical statuses of families. In addition groups of children of 5-8 years old were separated among all of medically examined ones by the results of psychological testing (Lusher 8-coloured test) thus that in each were equal part of boys and girls in state of psychological comfort and dysadaptation. Thus, 44 children from Aralsk and 34 ones from Akchi were examined for immunological status, genomic instability and individual genome susceptibility and content of heavy metals, PCBs and DDE.

The results of this study demonstrate that the growth and development of children of all ages – both from Aralsk and Akchi - were in accordance with the main biological indicators typical for such populations. However, the body height was significantly higher in Akchi than in Aralsk (p=0.05). The comparison of the increases in body height revealed a wide variation among children from Aralsk, an indirect evidence for changes of the growth process (p=0.01). A further comparison of the onset of menstruation in both settlements supports this assumption: on average the onset is delayed by 6 months in Aralsk. Determination of sickness rate of children revealed a higher level in Aralsk compared to Akchi: 3166 sicknesses per 1000 examined children in Aralsk versus 2371 per 1000 examined in Akchi. When the sicknesses and diseases are ranked according to the frequency of their occurrence diseases of the respiratory system (23.4%) with prevalence of obstructive bronchitis (21.4%) - rank number one. These are followed by diseases of the blood and anemia (22.2%), diseases of the

gastrointestinal tract (16.9%), diseases of the ears and the nasopharynx (7.1%), diseases of the cardiovascular system (6,3%), diseases of the central nervous system (5.9%), infections (3.0%) and diseases of the urogenital system (2.6%). Diseases of the skin (4.9%) and diseases of the eyes (1.6%) rank next. The analysis of morbidity structure in Akchi shows a close similarity to that found in Aralsk. Diseases of the respiratory system also rank first, however, the frequency of bronchitis was significantly lower (18.2%) than in Aralsk. Diseases of the gastrointestinal tract rank number two (21.0%), while diseases of the blood (anemia) rank number eight (3.9%).

Especially for children aged 5-8 years, the frequency of the main pathologies - anaemia and chronic respiratory diseases was significantly higher in Aralsk. It was observed that 36% of young children from Aralsk were in a state of oligotrophy (in Akchi: 2,9%). Moreover, the frequency of anaemia, chronic respiratory, infectious and cardiovascular diseases, dysfunctions of the immune system as well as common morbidity significantly ($P=0,05$) correlated with the social status of the families. On the other hand, children' anxiety expression correlated with both stress expression of their parents, social status and monthly income provided by 1 family member. Anxiety among children from Aralsk was expressed more often than in Akchi and correlated directly ($P=0,05$) with frequencies of oligotrophy, anaemia, chronic respiratory diseases and dysfunction of the immune system. Taking into consideration that in environmental samples we didn't detected increased level of toxic pollution as well as total mutagenicity, we can concluded that the Aral Sea Basin is a region of a social, but not environmental catastrophe.

To evaluate genome instability we chose the method of blood cell cultivation with cytochalasine B often used for detection genetic damage (micronuclei, MN) in blood cells. For detection of individual genome susceptibility we further measured radiosensitivity and adaptive response to gamma-irradiation in blood lymphocytes in vitro.

As a result we detected that children genome instability, determined as complex of changes characterises transformation of normal cell into tumoral, was more expressed in Aralsk. In addition, we detected significant positive correlations between children' anxiety expression and indices of rapid proliferation cells in culture (what is associating with early aging), frequency of MN in rapidly dividing cells under all experimental conditions and - most importantly - radiosensitivity of cells in vitro. Negative correlations with anxiety were observed for apoptosis and frequency of binuclear cells with MN.

Summarizing, these data allow to conclude that there is a direct connection between children anxiety expression and status of genome of blood lymphocytes. These correlations once more demonstrate that one of the main sources of increased genome instability of children in Aralsk is the non-adaptive level of anxiety expression, directly connected with social and economic catastrophe, existing in this region. Because increased genome instability has been shown to be connected with increased cancer risk, looking prospectively, the social catastrophe in the Aral Sea Basin may manifest into significantly increased tumour morbidity among young people. The fact that blood contamination with DDE (carcinogenic metabolite of DDT) in Aralsk was found to be higher than in Akchi and than in European countries, make our conclusion even more reasonable.

In total, we can conclude that the high morbidity as well as increased genome instability and susceptibility of children from the Aral Sea Basin is most likely a result of poverty and thus a social (indirect) consequence of the economic problems associated with the desiccation of the Aral Sea, and most probably not directly related to environmental contamination. The next conclusion is that problems concerning human health can't understand without taking into consideration all aspects of their life and the main among limiting indices is emotional stress expression, what influences on all of the parameters of an organism, including genome.

We expressed our appreciation to families permitted to inspect their children and also to the doctors, medical nurses and other medical staff as well as to representatives of administration and medical institutions of Almaty, Aralsk and Akchi, who helped on in realization of this research.