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## ENGLISH VERSION: HYGIENIC EVALUATION OF ENVIRONMENTAL INFLUENCE ON THE HEALTH OF CHILDREN FROM RURAL REGIONS OF SOUTHERN UKRAINE\*

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*The article analyzes the complex hygienic assessment of harmful anthropogenic environmental factors on the health of children in rural areas of southern Ukraine and reasonable measures to prevent this impact on the health of children. It was established that the highest incidence and prevalence of disorders of respiratory, digestive, cardiovascular and urinary systems inherent in the south-western district of Odessa region with multi-ethnic composition of the population is characterized by high anthropogenic load. It has been proved that the diet of children in various districts of Odessa region is characterized by major imbalance of nutrients with predominance of food rich in carbohydrates and fats of animal origin. The program of preventive measures in areas with low environmental security should include correction of food, providing drinking water quality and regulatory measures on hygienic education of the children's population.*

Key words: anthropogenic factors, rural districts of Odessa region, hygienic evaluation of environmental influence.

### Introduction

The ecological situation in Ukraine remains extremely alarming and it is accompanied by deterioration in population's general health [23, 26]. Multiple harmful anthropogenic factors which a human constantly faces can become pathogenic if the force of their impact exceeds body's adaptation abilities, or changes its reactivity.

Health of the nation is determined, first of all, by children's health [1, 4, 7, 13, 27, 30, 51]. The level of young generation development, its physical and mental capacity are preconditions for scientific, technical and economic progress.

Low level of children's health in Ukraine is due to the adverse impact of environmental factors [25, 26, 28, 41, 64, 91], the way of life [24] and adverse socio-economic trends [94]. This points to the need of environmental hazards, nutrition, population social and environmental characteristics comprehensive study and their role in the formation of children's health and develop preventive measures aimed at strengthening children's physical development and psychological stability [67, 68, 79, 95, 97].

The objective of the work presented is to make a comprehensive hygienic assessment of harmful anthropogenic environmental factors and their influence on the health of children in rural areas of southern Ukraine and to ratiocinate the preventing measures against this effect.

### Materials and methods

The study was conducted in two stages: in autumn and winter (October-November) and in spring and summer (May-June). Along with anthropometric and anthroposcopic studies, the quality of diets has been

evaluated. Additionally, in-depth studies of state of health and factors of the environment relations have been made. These studies were conducted in the communities of Odessa region with predominantly mono-ethnic population composition and different in terms of environmental safety living conditions. The estimation of physical development, health and nutritional status was conducted on 737 children, where 160 were Russian Old Believers (1 community, Izmail district), 245 Ukrainians (9 communities of Sarata, Bilhorod-Dniester and Tatarbuniar districts) 182 Bulgarians (2 towns in Tatarbuniar and Bolgrad districts), 150 children were Gagauz (1 community in Bilhorod-Dniester district).

Thus, as a pilot area, the south-western districts of Odessa region with high environmental risk were elected. They are characterized by poor dynamics of children's health, including communities with mono-ethnic composition.

As a control region, areas with low anthropogenic load on the environment, optimal composition of drinking waters and low prevalence of socially significant pathology were chosen.

The researches have been conducted among boys and girls of the following age groups: prepuberty – the 3<sup>rd</sup> grade of school (8-9 years old), the 6<sup>th</sup> grade (11-12 years old); puberty – the 8<sup>th</sup> grade (14-15 years old) and the 11<sup>th</sup> grade (16-17 years old). The choice of the age groups was stipulated by the specific features of physical and sexual development and high sensitivity to exogenous influences typical to this age.

The children's physical development was evaluated by the definition of anthroposcopic (condition of skin and

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mucous membranes, degree of fat deposition, characteristics of musculoskeletal system (skeleton, the shape of the chest, spine, legs and feet), anthropometric (body's length and weight, circumference of chest) and physiometric indexes (lungs vital capacity) and their subsequent score on regression scale developed by the Laboratory of Hygiene of Children of the State Enterprise "Institute of Hygiene and Medical Ecology of Ukrainian Academy of Medical Sciences" [42] and WHO's centile scales in updating of the State Enterprise "Institute of Pediatrics, Obstetrics and Gynecology of Ukrainian Academy of Medical Sciences". In assessing the school-girls' physical development, living in the rural areas of Odessa region, the physical development standards designed in Odessa National Medical University were used.

In order to establish the impact of environmental factors on the children's health, ecological safety of rural districts in Odessa region was evaluated. During the reporting period sanitary-chemical indicators of 676 water samples were tested and 163 samples did not meet the regulatory requirements; microbiological parameters were studied in 419 samples, 180 samples did not meet the regulatory requirements. Thus, our observations showed the presence of a strong tendency towards deterioration of water supply and increased health risk to the population in communities under study.

In order to investigate the causes of physical disharmony development, the study of actual children's nutrition was conducted. The peculiarities of ethnic resettlement were taken into account. The children from rural areas belonging to different ethnic groups, Ukrainians, Bulgarians, Gagauz and Russian Old Believers were selected to the study.

### Results and Discussion

In our opinion, taking into account the higher quota of nitrogen supply with drinking water (up to 30%) and significant seasonal variations of nitrates in vegetables, at evaluation of their pollution impact on individual and population health of children living in rural areas of Odessa region it is necessary to consider qualitative and quantitative composition of the drinking water in the areas under investigation.

In most areas nitrates in underground reservoir drinking water over maximum permissible concentration were regularly registered. In some districts, the concentration of nitrates in drinking water averaged  $(39.1 \pm 2.3)$  mg/dm<sup>3</sup>, i.e. about 25% of the samples exceeded the level of 50 mg/m<sup>3</sup>. This allowed considering middle potable water as a major alternative to the existing water sources, which are prone to pollution by nitrates to a great extent.

Pesticide load per 1 ha of agricultural land in the area under study was near 4.9 kg/ha, while in southern control districts, it fluctuated in the range of 0.7 - 1.07 kg/ha, and in the North it did not exceed 0.32 kg/ha. On average, the pesticide load in the areas under study was by 2.5 times higher than in control ones. However, pesticide contamination over allowable in the soil in the fields of agricultural production (3.5% of the total) and in the zones with unsuitable fertilizer barns up to 35% of the total samples was established.

The frequency of nitrates excess in vegetables and melons was not more than 6%, but in early spring vegetables the content of nitrate in products that form the basis of food rations, in most cases exceeded the threshold of allowable concentration: in beet – up to  $(1463.4 \pm 80.4)$

mg/kg for, in potatoes – up to  $(285.3 \pm 12.3)$  mg/kg, in green onion – up to  $(544.2 \pm 12.8)$  mg/kg, in radish it was  $(1.155.5 \pm 23.2)$  mg/kg, in carrots –  $(532.1 \pm 22.2)$  mg/kg, for cabbage its amount was  $(654.0 \pm 23.3)$  mg/kg. For some vegetables in several areas of Odessa region the 2-5 fold excess of nitrate threshold of allowable concentration was noted.

Retrospective analysis of morbidity rate and prevalence of different forms of pathology among children in rural areas of Odessa region in the last 15 years has shown that the lowest level of population health is inherent in children of the areas directly adjacent to the city of Odessa, as well as in areas characterized by high level of soil contamination by nitrates and heavy metals, as well as physiologically unfavorable composition of drinking water. The most stable growth trends and prevalence of diseases of respiratory, cardiovascular, digestive and urinary systems were typical in the areas with unfavorable ecological situation.

To reveal the causes of the physical disharmony development, the study of children's nutrition has been conducted. It was done with taking into account the peculiarities of ethnic settlement. We found that the frequency of eating often did not meet the regulatory requirements of Ukrainian Ministry of Health Care. 6-23% of children had no breakfast before school hours, 25-38% of children under examination had no lunch in their diet. Many children reported in the questionnaire the lack of nooning (15%), the majority of children had meals three times a day. 30-40% of children had inadequate set of dishes for dinner. A significant number of children had a break between meals more than 6 hours, while only a small number of school-children regularly ate at the school canteen. The number of children with impaired diet increased in high school.

It should be noted that the frequency of violating the diet's qualitative and quantitative composition was high in all mono-ethnic settlements. We cannot but notice, that the most frequently violations of diet were observed in Ukrainian villages, which likely has less to do with ethnic characteristics, than with the socio-economic factors, in particular, a reason for this situation is the wrong organization of children's nutrition. Due to the said above, the analysis of the set of dishes used in children's diet is of considerable interest.

Our research has shown that a significant number of children use nutritional meals and fast food, snacks (snacks, crisps, chips), which does not comply with the existing hygienic requirements for childhood nutrition. On the other part, only a small number of children treated soups as part of their daily diet. In all the groups under observation the children ate cereal side dishes, meat, meat-and-vegetables and meat-and-cereal chopped culinary products. In the study of children's nutrition of different ethnicity, it was found that overall diets of the school-children had a strong carbohydrate orientation, and set of products provided only about 80% of children's energetic needs. As a result of lower consumption of meat, fish, dairy products, fruit and vegetables the child's body was supplied by complete proteins (deficit of 25%), vitamins A and C (deficit near 50%), vitamins of B –group (deficit to 20-30%).

Vitamin status of one in four surveyed children was rated as poly-nonvitaminous. In general, sufficient supply of vitamins around a set of indexes was observed in only 4.1% of the surveyed school-children. In many cases, the

lack of multivitamins was combined with deficiency of vital mineral elements.

In assessing the quality of the daily diet of children under observation, it was found that they contained a richer set of products than standard diets recommended for the pupils of organized groups. However, the range of food was often limited to 25-30 items, and was monotonous enough.

Physical development in a one-third of cases was disharmonic. The reasons for this phenomenon were mostly excess fat deposits in the weak development of muscles which was manifested by high values of body fat mass (BFM). Thus, the children under study had BFM from  $(12.5 \pm 0.4)$  kg to  $(21.4 \pm 0.6)$  kg, which was 15-20% higher than in the control group.

The best information performance was obtained at the use of Caliper metric method for the assessment of nutritional status. It allowed revealing children with both deficit and excess fat deposit, and also significantly increased the detection of disharmonious physical development. We did not find any marked ethnic differences in the characteristics of nutritional status under examination, but the deep study of physical development allowed revealing certain gender and age differences. Thus, in some age groups, more than half of children had disharmonious development. More frequent disorders of physical development in boys we associate with food derangement, quality of the rations, including consumption of alcoholic beverages.

One of the leading causes of disharmony, in our opinion, is the lack of protein and calcium, which is confirmed by correlation analysis data ( $r = 0.58$  and  $r = 0.63$ ;  $p < 0.05$ , respectively). In addition, a significant impact on the physical development of children in the regions under observation was provided by the environmental conditions – the presence of additional environmental risk factors increased incidence of disharmonious development and deviations from the pace of physical development by 2-3.5 times ( $p < 0.05$ ). In general, the performance of girls body mass indexes (BMI) were slightly lower than in boys, with those aged 9-10 years old, they ranged from 14 to 17.5 kg/m<sup>2</sup>, while the older girls BMI value fluctuated in the range of 18-21.5 kg/m<sup>2</sup>. In assessing the connection of the physical development and general physical health of the children from Odessa region rural areas we have obtained the following data: the frequency of disharmonious physical development closely correlates with protein deficiency ( $r = 0.75$ ;  $p < 0.01$ ) and unfavorable drinking water salt composition ( $r = 0.66$ ;  $p < 0.05$ ). Thus, the data obtained indicate that the main risk factors for the children living in rural areas are unsatisfactory social and environmental conditions and deficiency of essential nutrients. The greatest importance in determining the environmental safety of the region belongs to the unfavorable mineral composition of drinking water, particularly nitrate pollution and high levels of pesticide load in the territory of farmland.

### Conclusions

1. The highest incidence and prevalence diseases of respiratory, digestive, cardiovascular and urinary systems inherent in poly-ethnic south-western districts of Odessa

region is characterized by high levels of anthropogenic burden.

2. Dynamics of morbidity is characterized by the increasing number of children suffering from disorders of the gastrointestinal tract, obesity and diseases of the respiratory system.

3. The level of physical development of children living in rural areas is notable for high (54.5%) rate of disharmonious physical development, mainly due to deficiency of body weight and disproportionate development of the chest. A significant number of children under survey (37%) had a low food status. Body overweight was detected in 11.6% of boys and 60% of girls.

4. The children's diets in different districts of Odessa region are characterized by imbalance of major nutrients and predominance of food rich in carbohydrates and animal fats.

5. Frequency of disharmonious physical development closely correlated with nutritional deficiency ( $r = 0.75$ ;  $p < 0.01$ ), unfavorable salt composition of drinking water ( $r = 0.66$ ;  $p < 0.05$ ) and was virtually linked to the level of social and economic development of the community ( $r = 0.28$ ;  $p > 0.05$ ).

6. The program of preventive measures in the areas with low environmental security should include correction of food regimes, provision of drinking water quality and regulatory measures on hygienic education of the children's population.

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