Universal Decimal Classification: 616-053.5:612.014.4

T.V. Frolova, O.V. Ohapkina, I.I. Tereschenkova, I.R. Sinyayeva

IMPACT OF ENVIRONMENTAL FACTORS ON THE LEVEL OF PHYSICAL GROWTH AND DEVELOPMENT OF CHILDREN IN KHARKIV REGION

Kharkiv National Medical University

Department of Propedeutics Pediatrics No. 1

Abstract. *This study presents research results of the level of physical development of 2600 children, who live in different ecological regions of Kharkiv. Children living in the ecologically unfavorable regions were found to have the linear growth showings increment, and the increment degree of this index depends on the incorporation rate of conditionally-toxic micro-elements (r = 0.72). Gender peculiarities of ecological factors influence on the body weight of children index were found. Thus, in boys living in the ecologically unfavorable regions body weight measures are lower than age-related norms, while in girls decrease of these measures is found in ecologically favorable regions. Environmental degradation leads to disbalance and physical development periodicity disbalance, which has a negative effect on the health condition in general.*

Key words*: children, physical development, ecology.*

Increasingly frequently, scientists draw doctors attention to the low resistance of the growing organism to the action of harmful environmental factors [1-2]. Although in recent years in Ukraine there has been a significant decline in industry, the problem of air pollution is still quite acute. Road transport takes one of the first places among the sources of pollution, its overall emission of harmful substances in the air is about 52%. Some scientists claim child's body growth processes depend on the degree of environmental pollution,

the average degree of pollution activates the processes of acceleration and high degree of pollution leads to growth retardation of the child [3].

It is well known that physical growth and development (PGD) of the child is one of the main objective indicators of general state of health. The main PGD criteria include weight, height, head circumference, thoracic cage circumference and so on. The researchers note the fact that the processes of growth and development have a nonlinear dependence on the age of the child, but we must remember that these processes reflect physiological or pathological processes that occur in the body of the child. Given the impact of environmental factors on the PGD indices of the child, namely monitoring of PGD indices changes helps to analyze the reactions of the growing organism to exogenous factors. In addition, dynamic study of the impact of environmental factors on the PGD helps to develop and implement a set of preventive measures against failures of PGD.

The aim of the study was to establish the characteristics of the dynamics of growth of anthropometric indices in children and adolescents, depending on the environmental condition of the area of residence of the child.

Material and research methods. The method of expeditionary examinations of organized groups was used to examine 2600 children at the age rating from 7 to 17 years old, permanently residing in Kharkiv region. Groups of children were stratified on the basis of age, sex and environmental characteristics of the area of their residence. Thus, the environmentally favourable area, where there are no large industrial enterprises, included 676 children (group I); relatively unfavourable areas, where the average power level enterprises, of mainly agricultural direction prevail included 1291 children (group II) and environmentally unfavourable areas with large industrial complexes and a large number of road transport included 633 children (group III). The program of expeditionary examination of the representative number of children included: clinical and anamnestic testing, anthropometry, the study of alimentary

provision of nutritional homeostasis, determination of essential and conditionally toxic microelements in hair using a method of mass spectrometry with inductively coupled plasma using "ElvaX" device (2008). Hair was selected as the biological material because it is of the most informative nature and reflects long exposure of the elements in the human body. To take part in the ME status examination the child was prohibited to take vitamin and mineral preparations for the last 2 months prior to the examination.

Statistical analysis was held on the basis of parametric and non-parametric criteria (Student-Fischer test, Van-der-Waerden test, etc.), probability distribution of characteristics and correlation analysis.

The study was conducted according to international biotic standards.

Research results and its discussion. Analysis of results of the study of the mineral composition of hair of children showed that microelement profile of children of group I is characterized by imbalance of essential macro- and microelements (ME), namely calcium, magnesium and zinc on the background of a slight increase of cobalt, chromium and strontium (to not more than 15%). In children of group II ME imbalance occurs due to an increase in conditionally toxic microelements, there is a 20% increase of strontium and a 13% increase of lead. Group III of children shows a significant shortage of essential abovementioned ME and strontium accumulation to more than 40%, lead accumulation to 30%, aluminum accumulation to 30% and accumulation of other conditionally toxic microelements.

The analysis of the PGD of children of Kharkiv region as a whole showed retardation in growth rates which may be explained by the significant socio-economic difficulties of the last decade, namely dietary intake quality deterioration, unbalanced and irregular meals, reduced motor activity of children and adolescents, etc..

Analysis of results of growth rate research in the studied groups showed that the environmental impact of this indicator has a clear sex characteristics.

Thus, increases in linear growth indices in boys at any age was significantly higher in children of group III than in children of groups I and II ($p < 0.05$) and the similar dependence is observed between boys of the group II and group I ($p < 0, 05$) (Table. 1).

Thus, boys, permanently residing in environmentally unfavourable conditions show acceleration in linear growth indices, and degree of this indice growth is dependent on the degree of accumulation of conditionally toxic ME ($r = 0.72$), due to biostimulating heterosislike effect of industrial chemicals polluting the environment.

Table 1.

Age-sex height changes (cm) of children living in Kharkiv region

group/sex	I group		II group		III group	
Age	girls	boys	girls	boys	girls	boys
7 years old	120.3	120.5	121.6	121.5	118.3	122.4
8 years old	125.0	123.9	128.1	127.0	122.6	1349
9 years old	134.8	126.0	132.6	131.5	125.7	138.8
10 years old	139.7	127.5	137.3	137.4	**139.9**	142.8
11 years old	143.6	134.9	142.5	142.8	144.6	148.9
12 years old	**152.5**	138.7	147.0	147.4	151.5	152.5
13 years old	159.9	142.8	153.5	**156.2**	157.9	**160.8**
14 years old	166.5	**149.8**	**161.1**	159.2	166.0	163.0
15 years old	166.7	**156.8**	166.9	160.9	169.8	164.5
16 years old	169.8	160.3	173.1	164.2	174.1	168.3
17 years old	171.8	163.8	175.9	168.8	177.6	**176.1**

The analysis of linear growth indices in girls at the age from 7 to 14 years old, living in different ecological conditions revealed no significant differences. An increase of this indice is also observed in girls of group III. However, during puberty period, at the age from 15 to 17 years old significant differences of the

indices of growth among girls of groups I and III were observed, with an increase of this index in girls from environmentally unfavourable areas ($p < 0.05$).

The results of analysis of the dynamics of body weight index indicate its lack of clear gender orientation as opposed to growth. Thus, boys under 11 years old and girls under 16 years old showed no significant differences on dependence of the body weight index on the environmental characteristics of the area (Table. 2). It should be noted that indices of body weight in boys at these age periods is slightly higher among boys of group I than in boys of groups II and III ($p > 0.05$). Also body weight of boys from environmentally unfavourable areas during puberty period is lower the age norms compared to PGD of children in Kharkiv region.

Table 2.

Age-sex changes in body weight (kg) of children living in Kharkiv region

group/sex	I group		II group		III group	
Age	girls	boys	girls	boys	girls	boys
7 years old	24.5	21.7	24.7	25.0	24.3	23.3
8 years old	28.5	27.7	29.5	26.8	27.9	28.9
9 years old	31.7	31.4	31.2	27.8	30.2	29.0
10 years old	35.0	34.6	34.4	33.0	34.8	35.2
11 years old	39.5	**43.2**	37.3	37.5	40.2	36.2
12 years old	**45.0**	46.9	42.5	42.3	47.0	40.1
13 years old	50.0	52.4	49.6	48.3	49.3	45.6
14 years old	52.3	58.6	52.0	51.3	53.8	50.4
15 years old	56.9	64.0	56.5	52.9	56.3	**57.5**
16 years old	58.0	67.3	59.4	**62.0**	**66.1**	54.8
17 years old	60.7	68.8	**66.5**	64.0	68.8	56.4

Regarding girls, it should be noted that during puberty period weight of girls of group I is lower than the corresponding index in girls of group III ($p < 0.05$), whereas at the age of 17 years old body weight of girls of group I is slightly lower as opposed to girls of group II ($p < 0.05$).

It is known that adequate processes of PGD are characterized by cyclicity, accumulation of body weight precedes the process of linear growth increase, which primarily provides good health in general. The analysis of the growth rate of PGD in examined children showed that there is a significant impact of environmental factors on PGD cyclicity. Thus, among children of group I the largest increase of body weight is observed in girls at 12 years old and boys at 11 years old ($p < 0.05$). While the maximum increase in height is observed in girls at 14 years old, and in boys at 13 years old ($p < 0.05$). Thus, children who permanently reside in the areas of conventional environmental well-being, PGD processes occur due to age criteria of child development.

In children of group II the maximum increase in body weight is observed in 16-year-old boys and 17 year old girls. However, the highest increase in linear growth in boys is observed at the age of 13 years old ($p < 0.05$), and in girls at the age of 14 years old in girls ($p < 0.05$), which may be regarded as pathological basis for further PGD of the child. Violation of PGD cyclicity in children of group II on the average makes up $4 \pm 0{,}35$ years ($p < 0.05$).

The most unfavorable PGD is observed in boys of group III, in which the maximum increase in body weight is observed at the age of 15 years old (on the average it makes up not more than 15%, $p < 0.05$), and the maximum growth of the linear growth index is observed at the age of 13 years old (on the average it makes up 12%, $p < 0.05$) and at the age of 17 years old (on the average it makes up 12%, $p < 0.05$), which indicates a clear imbalance in the whole process of PGD in boys permanently residing in environmentally unfavourable areas in Kharkiv region. In girls of group III at the maximum increase in body weight at the age of 16 years old (on the average it makes up 20%, $p < 0.05$) maximum

growth of the linear growth occurs at the age of 10 years old (on the average it makes up 20%, $p < 0.05$). This violation of PGD cyclicity in girls of this group on the average makes up 6 ± 0.4 years ($p < 0.05$), which certainly has its impact on the physical health of the child.

Environmental degradation can lead to imbalance of certain processes of growth of PGD indices, which certainly affects the health of the child in general and requires the development of a set of preventive measures.

Conclusion

1. Children permanently residing in unfavourable environmental conditions show acceleration of linear growth indices, which can be explained by biostimulating heterosislike effect of industrial chemicals polluting the environment.

3. The degree of acceleration of growth indice in childhood has a correlation dependence on the degree of accumulation of conditionally toxic microlements ($r = 0.72$).

4. At puberty age body weight of boys who live in ecologically unfavorable areas is slightly lower the age norms for the physical development of children in Kharkiv region, while this indice is lower in girls who live in environmentally favourable areas.

5. Environmental degradation leads to imbalance of physical processes and deregulation of cyclical processes of accumulation of body weight and growth of dynamics of linear growth.

References

1. A.N. Stozharov Medical ecology // Minsk: Higher education institution, 2007. – 265 p.

2. T.V. Frolova, O.V. Ohapkina, N.F. Stenkova, O.P. Medvedeva Peculiarities of formation of population health in children in environmental conditions // Child’s health, 2012. – No. 2 (37). – pp. 24-27.

3. Physical development of children and adolescents at the turn of Millennium /A.A. Baranov, V.R. Kuchma, N.A. Skoblina. – M.: Publisher: Scientific Center of Children's Health. Russian Academy of Medical Sciences. 2008. – 216 p.

Резюме. Фролова Т.В., Охапкіна О.В., Терещенкова І.І., Сіняєва І.Р. Екологічний вплив на рівень фізичного розвитку дітей та підлітків Харківського регіону.

У роботі наведені результати дослідження рівня фізичного розвитку 2600 дітей, які мешкають у різних екологічних умовах Харківського регіону. Встановлено, що у дітей з несприятливо екологічних районів відбувається прискорення лінійного зросту, а ступінь прибавки цього показника у дитячому віці має кореляційну залежність від ступеню накопичення умовно-токсичних мікроелементів (r=0,72). Виявлені певні гендерні особливості впливу екологічних факторів на показники маси тіла дітей. Так, у хлопчиків мешканців екологічно несприятливих районів маса тіла нижче вікових нормативів, тоді як у дівчаток нижчі показники маси тіла спостерігаються у мешканців екологічно сприятливих районів. Погіршення екологічного становища призводить до дисбалансу та порушення циклічності фізичного розвитку, що негативно впливає на рівень здоров’я в цілому.

Ключові слова: діти, фізичний розвиток, екологія.

Резюме. Фролова Т.В., Охапкина О.В., Терещенкова И.И., Синяева И.Р. Влияние экологии на уровень физического развития детей и подростков Харьковского региона.

В работе представлены результаты исследования уровня физического развития 2600 детей, которые проживают в разных по экологическому благополучию районах Харьковского региона. Установлено, что у детей, проживающих в экологически неблагоприятных районах, происходит ускорение показателей линейного роста, а степень

прибавки данного показателя зависит от степени накопления условно-токсических микроэлементов (r=0,72). Установлены гендерные особенности влияния экологических факторов на показатель массы тела детей. Так, у мальчиков, проживающих в экологически неблагоприятных районах показатели массы тела ниже возрастных нормативов, тогда как у девочек снижение этих показателей отмечается в экологически благоприятных районах. Ухудшение экологического состояния приводит к дисбалансу и нарушению цикличности физического развития, что негативно влияет на состояние здоровья в целом.

Ключевые слова: дети, физическое развитие, экология.