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The Level of δ-Aminolaevulinic Acid and Creatinine in the Urine of Children and Youth from the Primary School in Bystrzyca Stara (the Lublin Province)

Poziom kwasu δ-aminolewulinowego i kreatyniny w moczu dzieci i młodzieży ze szkoły podstawowej w Bystrzycy Starej (woj. lubelskie)

INTRODUCTION

The area of minimal ecological degradation has been threatened so far by expansive industrial development and extensive road traffic. Automobile exhaust gases pollute the environment with lead compounds; various chemical fertilizers and pesticides used in greater and greater quantities result in chemicalization of agricultural products, water and soil.

A larger number of diseases caused by chemical pollution of the environment can be easily noted among country people living in the areas distant from big industrial centres. Lead and its derivatives which toxically affect first of all the nervous system and hemopoietic system is one of the most harmful compounds (7).

The main sources of lead pollution caused by man are: smoke, dust, industrial wastes, sewage and automobile exhaust gases (6). The highest lead concentration in the atmospheric air occurs over the areas of big road traffic and industry. This element gets into the body mainly via the airways (about 40%), alimentary tract (about 10%), and to a small extent via the skin (8). In children it is absorbed in greater quantities, which is related to the rate of the body weight growth and with greater physical activity of children and youth (8).

Lead poisoning is mainly manifested by intensified excretion of δ-aminolaevulinic acid (ALA) in the urine, which appears earlier than other symptoms of the disease. The quantity of ALS excreted with the urine is proportional to the quantity of resorbed lead, and precisely indicates the level of lead poisoning (5).

PURPOSES

The purpose of the research was to find a correlation between the quantity of ALA and creatinine excreted with the urine and the age of children from Bystrzyca Stara, the Lublin province. Bystrzyca Stara is an ecologically clean

area situated far from industrial centres, with slight road traffic. The aim of the test was to find out if there exist any differences in the quantities of ALA and creatinine excreted with the urine in children from 6 to 15 years of age with regard to sex.

METHODS

Urine samples taken from 388 children from the primary school in Bystrzyca Stara were tested for the level of ALA and creatinine. The children were from 6 to 15 years old; sex was considered as well. The level of ALA was measured by Grabecki, Haduch and Urbanowicz's method (2). The level of creatinine was measured by Folin's method with picric acid (1). N-Multistix test was used to examine the urine samples for *pH*, protein, glucose, ketone bodies, bilirubin, blood, nitrites and urobilinogen. The results were statistically evaluated by *t*-Student test (9).

RESULTS

Altogether, 388 children from the primary school in Bystrzyca Stara were tested for the level of ALA and creatinine in the urine.

Mean concentrations of ALA in the urine were in:

6 year-olds — 0.20 ± 0.08 mg/100 ml, 11 year-olds — 0.28 ± 0.06 mg/100 ml,
7 year-olds — 0.22 ± 0.07 mg/100 ml, 12 year-olds — 0.28 ± 0.07 mg/100 ml,
8 year-olds — 0.24 ± 0.06 mg/100 ml, 13 year-olds — 0.26 ± 0.05 mg/100 ml,
9 year-olds — 0.27 ± 0.06 mg/100 ml, 14 year-olds — 0.31 ± 0.07 mg/100 ml.
10 year-olds — 0.27 ± 0.06 mg/100 ml,

Mean concentrations of creatinine were in:

6 year-olds — 43.6 ± 17.5 mg/100 ml, 11 year-olds — 55.0 ± 13.4 mg/100 ml,
7 year-olds — 56.0 ± 18.3 mg/100 ml, 12 year-olds — 54.2 ± 13.9 mg/100 ml,
8 year-olds — 58.1 ± 13.2 mg/100 ml, 13 year-olds — 66.7 ± 19.6 mg/100 ml,
9 year-olds — 53.6 ± 14.2 mg/100 ml, 14 year-olds — 74.9 ± 16.5 mg/100 ml.
10 year-olds — 60.3 ± 12.2 mg/100 ml,

The lowest values of both parameters were found in 6-year-old children and the highest in the 14-year-old group.

Comparison 1:9, $p < 0.001$.

This considerable increase of ALA excreted with the urine in groups between 6 and 15 years of age can be explained by the fact that country children are not exposed to greater lead absorption until their school age (Fig. 1). Perhaps it is connected with the necessity of their going to school along communication routes. In their pre-school age country children stay mainly within their farm estates and their contact with lead compounds is rare.

The level of ALA in children who start their school education is low. It increases with the age and the extent of the exposure to lead compounds. The higher level of ALA did not go beyond the clinical norm in any of the tested urine

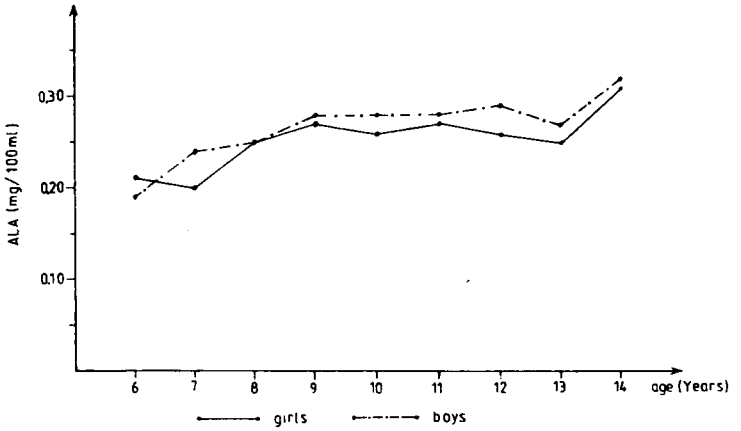

Fig. 1. ALA content in the urine of children with regard to sex and age

samples. In Grabecki, Haduch and Urbanowicz's method the norm is up to 0.60 mg/100 ml (12).

The level of creatinine excreted in the urine increases with children's age but it is within the physiological norms. The results obtained by N-Multistix stripes show the extent of changes occurring in the urine of children expressed in percentage. Most often the traces of proteins were found in the urine of children at the age of 11 years (44.1%) and in 14-year-olds (43.6%), most rarely in 6-year-old children (22.6%). Physiologically, proteins in the urine may be present after an excessive physical effort, a longer cold bath, or after eating much protein food (4).

Orthostatic albuminuria increases in 12-year-old children reaching the highest level in 14-16-year-olds (10). In these cases it is temporary and slight and is accompanied neither by such changes as haematuria, pyuria, changes in the specific weight of the urine and its quantity, nor by changes in other organs (11).

The highest percentage of ketone bodies (aceto-acetic acid) was found in the urine of 7-year-old children (32.3%), and in 13-year-olds (40.8%); the lowest was obtained in 9-year-olds (2.1%). Ketone bodies in the urine are the manifestations of ketonemia which develops in the conditions of malnutrition, starvation, after vomiting, fever, gastrointestinal diseases, and as a classic symptom of diabetes (3). The high percentage of ketone bodies in the urine, detected by the authors' studies, seems to be caused by nutritional deficiency. N-Multistix test did not show sugar in any of the tested urine samples, so the presence of ketone bodies is not related to diabetes (3).

Bilirubin was found in a 7-year-old child, in two 10-year-olds, and in two 11-year-old children. It appears in the urine in cases of damaged hepatic parenchyma, infectious and mechanical jaundice (3). Nitrites were most often found in the urine of 9-year-old children (29.5%) and 14-year-old ones (33.3%),

and were most rare in 6-year-olds (6.5%). Their presence in the urine proves the pollution of the environment with nitrogen compounds, mainly from chemical fertilizers. N-Multistix tests of the urine signal certain abnormalities in the urine structure, but the confirmation of more serious changes needs a detailed analysis.

Conclusions

1. The research proved a considerable increase in the values of ALA and creatinine in the urine of children from 6 to 15 years of age.
2. The higher level of ALA in the urine occurs in the urine of boys from all classes.
3. The creatinine level in the urine is higher in girls in all age groups.
4. Mean values of ALA and creatinine in the urine of children from Bystrzyca Stara are nearly twice lower than in children from the areas with moderate industry (Świdnik).

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STRESZCZENIE

Przedmiotem badań było wykazanie przyrostu wartości kwasu δ-aminolewulinowego (ALA) i kreatyniny w próbkach moczu dzieci w wieku od 6 do 15 lat z gminy Bystrzyca Stara z woj. lubelskiego. W wyniku badań uzyskano istotną różnicę w poziomie kwasu δ-aminolewulinowego i kreatyniny między dziećmi 6-letnimi, rozpoczynającymi naukę, a 15-letnimi oraz stwierdzono ciągły przyrost tych wartości w miarę dorastania dzieci.