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The δ -Aminolaevulinic Acid Level as an Indication of Lead Contamination in School Children

Poziom kwasu δ -aminolewulinowego jako wykładnik skażenia ołowiem młodzieży szkolnej

INTRODUCTION

The dynamic development of industry is accompanied by the increased exposure of the human health connected with the environmental contamination with the chemical compounds. The air contamination level depends mostly on the concentration of the contamination sources. Thus, the highest air contamination can be found in towns where the industrial production is carried out on the limited areas and great amounts of carbon and fuels are used. The contaminations emitted by the car transport seriously threaten the human health due to very dangerous compounds contained, such as carcinogenic hydrocarbons, nitrogen oxides and lead which cannot be converted and contaminate the environment for good (15). The studies showed that, depending on the car traffic intensity and the meteorological conditions, the lead concentrations near the roads reached $10 \mu\text{g}/\text{m}^3$, which is almost the same amount as near the leadworks (10).

THE PAPER'S OBJECTIVE

Children and teenagers absorb lead quicker and in bigger amounts than adults, which is connected with the dynamic body development and higher physical activity (7).

The aim of the present paper was to show the relationships between the amounts of δ -aminolaevulinic acid excreted in urine by children and teenagers and the place of residence.

MATERIAL AND METHOD

The children aged 7 and 14 from the elementary schools of Puławy, Kazimierz Dolny and Nałęczów were examined. Nałęczów and Kazimierz Dolny are the tourist and health resorts

with slight environmental contamination while Puławy is a moderately industrial town of high car traffic intensity. "Nitrogen Works" -- a big chemical centre is situated near Puławy. The δ -aminolaevulinic acid (ALA) level in urine was tested in 240 children. ALA was determined by means of the Grabecki and Haduch's method (3). The results were statistically evaluated using *t*-Student test (9).

RESULTS

The ALA level in urine collected from girls and boys from Nałęczów (A), Kazimierz Dolny (B) and Puławy (C) is presented in Table 1. In children, both girls and boys, aged 7 and 14 from Nałęczów no differences in ALA levels depending on sex and age were found while such differences were observed in children from Kazimierz Dolny. Statistically significant differences in ALA levels in girls aged 14 in comparison with the same age group of boys were observed. Moreover, ALA levels were markedly higher in boys aged 14 than in those aged 7. The highest ALA levels in both age groups were found in Puławy. The above values are significant in comparison with those obtained in children from Nałęczów and Kazimierz Dolny.

Table 1. ALA urine excretion in children from the selected towns of the Lublin region

No.	δ -aminolaevulinic acid in mg/100 cm ³ ($\bar{x} \pm SD$)				
	Sex and Age	Number	Nałęczów	Kazimierz Dolny	Puławy
1	Girls aged 7	20	0.24 \pm 0.09	0.25 \pm 0.11	0.30 \pm 0.05
2	Boys aged 7	20	0.26 \pm 0.11	0.24 \pm 0.08	0.29 \pm 0.06
3	Girls aged 14	20	0.29 \pm 0.07	0.27 \pm 0.08	0.40 \pm 0.07
4	Boys aged 14	20	0.32 \pm 0.09	0.35 \pm 0.06	0.42 \pm 0.08
5	All	80	0.28 \pm 0.09	0.28 \pm 0.09	0.35 \pm 0.09

DISCUSSION

The degree of lead intoxication is measured by the amount of ALA excreted in urine. The ALA level is proportional to the resorbed lead and represents the precise indication preceding some other intoxication symptoms (46). The lead inhaled with air causes the activity inhibition of ALA dehydratase enzyme (11).

The observations performed by us in 3 towns of potentially different contaminations with lead compounds revealed the highest ALA urine levels in Puławy where the traffic is most heavy and "Nitrogen Works" may create the additional danger. Just to compare, the previous results obtained in the Świdnik region were 0.44 \pm 0.08 mg/100 cm³ of urine ALA. In the two remaining

places, Nałęczów and Kazimierz Dolny, the ALA values are slightly lower (0.28 ± 0.09) and are comparable with the values observed in the Bystrzyca Stara region (0.26 ± 0.1) (8). The similar studies were performed by A. Gębala and M. Ziółkowska-Stupczyńska in the hospitalized children. Their results were slightly higher than ours — 0.59 for children aged 7 and 0.61 mg/100 cm³ for those aged 14. The children lived in the regions of various lead contamination (2). The ALA values presented by us cannot be always treated as the actual degree of the environmental lead contaminations. Lead can penetrate the child's organism in many ways, most often it gets there through the digestive tract and then air passages. In our studies there are differences observed in the ALA levels in boys and girls. The higher levels in boys may be the result of their higher physical activity.

Conclusions

1. The urine ALA level is increased in children living in the regions of higher lead exposure.
2. In boys aged 14 the urine ALA levels are higher in comparison with the same age group of girls.

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Otrzymano 1993.12.16.

STRESZCZENIE

Badania prowadzone były na terenie Nałęczowa, Kazimierza Dolnego nad Wisłą i Puław. Założeniem pracy było wykazanie różnych poziomów ekspozycji związków ołowiu w środowisku zamieszkania. Badano dzieci i młodzież klas I i VII szkół podstawowych. Wykładnikiem narażenia na ołów jest występowanie podwyższonego poziomu kwasu δ -aminolewulinowego w moczu. Stwierdzono istotny statystycznie wzrost poziomu ALA u dzieci i młodzieży Puław w porównaniu do populacji dzieci z Kazimierza i Nałęczowa. Nie obserwowano istotnych różnic w poziomach ALA między młodzieżą z Kazimierza i Nałęczowa. We wszystkich trzech badanych miejscowościach u dzieci starszych (14 lat), zarówno u dziewczynek, jak i u chłopców, stwierdzono wyższy poziom ALA niż u dzieci 7-letnich. Dzieci zamieszkujące Puławy i okolice są szczególnie narażone na podwyższony poziom związków ołowiu pochodzących zarówno z powietrza, jak i z produktów spożywczych.