PHARMACIA

Pharmacia 67(3): 169–172
DOI 10.3897/pharmacia.67.e35080

Research Article

Prophylaxis of dental caries in children from polluted regions

Valentyn Avakov[1], Yuriy Oktysyuk[1], Mykola Rozhko[1]

1 *Ivano-Frankivsk National Medical University, Department of Pediatric Dentistry, Ivano – Frankivsk, Ukraine*

Corresponding author: Yuriy Oktysyuk (oktysyuk@gmail.com); Valentyn Avakov (valentyn.avakov@gmail.com); Mykola Rozhko (rector@ifnmu.edu.ua)

Received 2 April 2019 ♦ **Accepted** 22 February 2020 ♦ **Published** 15 september 2020

Citation: Avakov V, Oktysyuk Yu, Rozhko M (2020) Prophylaxis of dental caries in children from polluted regions. Pharmacia 67(3): 169–172. https://doi.org/10.3897/pharmacia.67.e35080

Abstract

To be living at the most advanced technological area in history is to exist and face pollution one of the most serious threats to all living things on the planet. There is evidence that anthropogenic and technological pollutions cause a considerable number of health problems and stomatological in particular. This article demonstrates the results gained by administration of vitamin-macro element complex "Calcinova" and sorbent "Enterosgel" in correction of enzymes responsible for biotransformation of xenobiotics in blood serum of children from the polluted areas. It has been established the high efficiency of recommended scheme on caries prophylaxis that is proved by positive biochemical indexes in blood serum of this children observed 30 month after the beginning of the investigation. As a result of the introduced prophylaxis, we have noticed the significant improvement of biochemical indexes in children with tooth decay. The findings reflect a certain rise in activity of enzymes responsible for elimination of xenobiotics such as alcohol-dehydrogenase (ADH) and glutathione-S-transferase (GST) obtained from the blood serum of children from the main group comparing to the control group.

Keywords

dental caries, xenobiotics, alcohol dehydrogenase, glutathione-S-transferase, prophylaxis

Introduction

The society must accept childcare as an important contribution towards societal good as children are the future wealth and continuation of society. The researches of (Horishna 2001; Kelly and Fussell 2015) demonstrated that the child's organism is the most vulnerable to different harmful environmental factors due to immaturity of their immune system, defense mechanisms, intensity of the metabolic processes as well as structural and functional characteristics.

No doubt, chronic impact of pollution leads to considerable number of illnesses. The investigations by (Antipkin 2005; Ataniyasova 2008) suggested that the most diagnosed diseases in the polluted areas are endocrine disorders, breathing, digestive and kidney problems, vegetative dystonia, genetic abnormalities, neurological reactions and behavior anomalies. The statistic of stomatological disorders is also on the growth. Epidemiological investigations conducted in regions with bad environment of Ukraine demonstrate that 33.8–96.7% of children have decayed teeth and in some parts of the country the statistic is even higher up to 100%. Intensity of caries among 12 years old children that usually are well adapted to stomatological diseases, is 4.57 ± 0.38–7.24 ± 0.40 teeth. According to data researchers (Bebeshko et al. 2003; Kuznyak and Hodovanec 2010; Kuzevlyak and Lachtin 2011; Shishniashvili et al. 2016) enamel hypoplasia fluctuates between 6.47–62.2%, periodontal disorders are diagnosed

PENSOFT.

in 14.3–77.2% of child population, the data of maxilla-facial anomalies is 47.53–59.98%.

It is very much in our interest to detect ecopathology at the early stages of organism's development and to reveal the body's predisposition to xenobiotics.

The figures provided by General Statistic Department (2009) of Ivano-Frankivsk area suggest that there are two regions with the highest level of anthropogenic load. The Snyatyn region is the most badly contaminated after the Chernobyl catastrophe (density of contamination with radionuclides by Cesium-137 is 4.60 Ki/km^2 and by Strontium-90–0.31 Ki/km^2). In Kalush, chemically polluted region, dominate inhaled xenobiotics and the density of their attacks is 212.4 ton per 1 square kilometer. The comparison shows that in Horodenka region, for example, the density of the xenobiotics attacks is 34 kg per square kilometer that is 6.000 times less than in Kalush region. The investigation by Fomenko (2004) also demonstrate the pollution by Cesium-137 in this area is 1.3 Ki/km^2 and by Strontium-90 is 0.08 Ki/km^2 that is four times less than in Snyatyn region.

It is vital to understand the need for study of stomatological health in children, damage of the hard dental tissues caused by toxic environmental factors and to develop scientific based prophylaxis that was a goal of our investigation.

Materials and methods

We have examined 120 12 years old children affected by caries. There were 59 children from radiation polluted Snyatyn region and 61 children from chemically polluted Kalush region, both Ivano-Frankivsk areas. The main groups in each region consisted of 30 children. Each control group consisted of 29 children. The comparison group was from Horodenka region and there were 30 children also affected by caries.

Dental examination was performed according to methods recommended by WHO (Ivanov et al. 2002). The caries activity was assessed by T.Vinogradova: compensated (DMF1-3); sub-compensated (DMF 4-6); de-compensated (DMF 7-9). Children from the main group were provided with caries treatment and professional oral hygiene. Children from main groups were appointed with vitamin-macro element complex "Calcinova" (KPKA, Slovenia), that contains vitamin D and other vitamins and microelements and influences mineral metabolism. Each tablet of "Calcinova" contains: Calcium- 100mg, Phosphorus – 77 mg, vitamin C – 15 mg, vitamin B6 – 0,4 mg, vitamin A – 1,000 ME, vitamin D3 – 100 ME.

There is a scheme of administration: 4 tablets a day – 2 tablets after breakfast and tooth brushing; 2 tablets after supper and tooth brushing. The tablets should be slowly chewed and completely dissolved.

Aside from, children from the main groups were appointed with pharmacological agent "Enterosgel" (CREOMA-PHARM, Kyiv, Ukraine). This agent is a natural phyto-sorbent and an ion exchanger. It is prescribed one teaspoon (10 g) 3 times a day taken 2 hours before or after meal.

Children from Snyatyn and Kalush regions were appointed by this prophylaxis twice a year at the spring and autumn and the course lasted for 14 days.

Children from the control group were introduced with individual oral hygiene and caries treatment.

The efficiency of the recommended scheme was assessed by measuring activity of alcohol-dehydrogenase (ADH) and glutathione-S-transferase (GST). Analysis of ADH that participates at phase-1 of bio-transformation of xenobiotics was conducted by Mezey et al. (1968). Activity of GST in the blood, (phase-2 of biotransformation) was determined (Mannervick and Danielson, 1988).

Was taken written permission from the parents to investigate a biological material of their children. That was blood collected from the elbow vein.

The study lasted 2.5 years.

Results

The indications of ADH were smaller in children from radiation polluted Snyatyn region before appointed treatment in contrast to the comparing group and in comparison, with children from chemically polluted Kalush region. Moreover, in case of decompensated caries this difference was statistically more certain ($p < 0.05$).

As a result of introduced treatment, there was a rise of ADH in 2,3 time observed in the main group of Snyatyn region from (0.0052 ± 0.001) to (0.012 ± 0.003) mckat/l ($p < 0.05$). There was also an increase of ADH in 2.8 time from (0.009 ± 0.003) to (0.025 ± 0.004) mckat/l ($p < 0.001$) in children from Kalush region. Both control groups show increase of ADH after the complex measures in contrast to the initial data: (0.0071 ± 0.003) mckat/l in children from Snyatyn region and (0.011 ± 0.004) mckat/l in children from Kalush region and was statistically not certain ($p > 0.05$).

We have established that activity of ADH has changed in children from Snyatyn region (Table 1), in case of

Table 1. Indications of ADH in children with different caries activity before and after the appointed prophylactic measures.

Caries activity	Indications of ADH activity						
	Snyatyn region			Kalush region			Comparison group
	Before treatment	After treatment		Before treatment	After treatment		
		Main group	Control group		Main group	Control group	
Compensative (DMF 1-3)	0.0075 ± 0.015	0.016 ± 0.006	0.008 ± 0.003	0.0011 ± 0.004	0.029 ± 0.014	0.014 ± 0.005	0.019 ± 0.010
Sub-compensative (DMF 3-6)	0.005 ± 0.002	0.013 ± 0.006	0.007 ± 0.004	0.009 ± 0.005	0.026 ± 0.013	0.011 ± 0.004	0.017 ± 0.010
De-compensative (DMF 7-9)	0.003 ± 0.001*	0.008 ± 0.003	0.006 ± 0.003	0.0075 ± 0.002	0.019 ± 0.007	0.008 ± 0.003	0.014 ± 0.004

* – between the indicators before treatment and the indicator of a healthy group; * – ($p < 0.05$); **- ($p < 0.01$). *** – ($p < 0.001$)
° – between the indicators of main and control groups after treatment ° – ($p < 0.05$); °° – ($p < 0.01$).

compensation caries was increased by a 2.3 times of ADH from (0.0075 ± 0.015) to (0.016 ± 0.006) mckat/l; in case of sub-compensative caries there was increased by 2.6 times from (0.005 ± 0.002) to 0.013 ± 0.006)) mckat/l; in case of decompensate caries there was increased by 2.6 times from (0.003 ± 0.001) to (0.008 ± 0.003) mckat/l ($p > 0.05$). Children from the control group of Snyatyn region, on the other hand, was exhibit increased by 1.3 times of ADH after the traditional prophylaxis ($p > 0.05$).

There was also an increase of ADH in children affected by different caries activity from Kalush region: in 2,6 time in case of compensative caries from (0.0011 ± 0.004) to (0.029 ± 0.014) mckat/l; in 2.9 time by sub-compensative caries from (0.009 ± 0.005) to (0.026 ± 0.013) mckat/l and by 2,5 time from (0.013 ± 0.002) to (0.19 ± 0.008) mckat/l by de-compensative caries ($p > 0.05$). Children from the control group of Kalush region show an increase of ADH in 1.2 time ($p > 0.05$).

The data appear to confirm that at the beginning of the study there was also a declined activity of GST in all children according to caries intensity: in children of Snyatyn region – from(1.82 ± 0.07) by compensate caries to (0.61 ± 0.05) un/ml by decompensated form of caries; of Kalush region – from (1.03 ± 0.08) to (0.31 ± 0.05) un/ml respectively; of Horodenka region from (1.96 ± 0.09) to (0.94 ± 0.07) un/ml. The figure of GST was lower in children from chemically polluted Kalush region in contrast to the comparison group and to the data of children from radiation polluted area ($p < 0.001$). The statistic of the study gives figures for a decline in the number with 2,4 time decrease of moderate activity of glutathione-S-transferase in children from chemically polluted region in contrast to the comparison group and was in 1,1 time lower than in children from radiation polluted region.

There was, however, a rise in the number with 1,3 time increase from (1.31 ± 0.04) to (1.65 ± 0.06) un/ml ($p < 0.05$) of GST in children of the main group of Snyatyn region recorded after the appointed correction. In the control group, on the other hand, we did not detect any significant changes of GST ($p > 0.05$). Children of the main Kalush group demonstrate an increase of GST in 2.1 time from (0.68 ± 0.06) to (1.45 ± 0.04) un/ml. Despite the fact that GST had climbed by numbers in the control group, it was not statistically certain ($p > 0.05$).

Analysis of GST- activity show that there was a notable improvement after the introduced measures as the GST has increased in children from Snyatyn region affected by compensative and sub-compensative caries in 1.2 time and in case of de-compensated caries in 1.4 time (Table 2). The data indicates a rise if GST in 1,6 time in main group of Kalush region by compensative caries, in 2.6 time in case of sub-compensative caries and in 3.6 time by de-compensative caries in comparison with the initial statistic ($p < 0.001$).

Discussion

There are major factors that being important in development of stomatological health in adults and children. According to some studies, the number of reasons such as anthropogenic, medico-biological and social work together and the level of their influence depend on individual characteristics and genetic adaptation of the person (Denha et al. 2007; Sukumar 2018).

The overwhelming problem we face nowadays is the misbalance in system «manhood-environment». Economic growth and technological progress have a massive impact on the nature and human beings. Many research findings have shown the role of bad environmental factors on general health and on damage caused to the hard dental and periodontal tissues in particular (Kovach 2005; Bezvushko and Klymchuk 2006).

The majority of xenobiotic agents do not exhibit any biological influence, although they experience biotransformation that consists of three phases- activation (Phase 1), detoxication (Phase 2) and withdraw (Phase 3). Phase 1 is provided mainly by cytochrome enzymes P450 and microsomal epiphysis hydrolysate (m EPHX). The aim of Phase 2 is neutralization of hydrophilic and toxic products by hydrolyses and transferases. They provide and complete detoxication and correct sometimes the mistakes of Phase 1. According to Scheupleina et al. 2002 the enzymes glutathione S-transferase, glucuronyltransferase, sulfotransferase, acetyltransferase and methyltransferase convert toxic intermediate products of Phase 1 into polar, water soluble, not toxic compounds that can be eliminated from the body at Phase 3- biotransformation.

Before the treatment there was a decrease of alcohol-dehydrogenase in children from both polluted regions and it's lower in those with higher intensity of caries that can be explained by exhaustion of its production influenced by genotoxic factors (Tchaikovska et al. 2010). The reduction of ADH in comparison group is described as being smoother.

Research has demonstrated that after the administered prophylactic measures there was an improvement in bio-

Table 2. Indications of GST in children with different caries activity before and after the appointed prophylactic measures.

Caries activity	Indications activity of GST						
	Snyatyn region			Kalush region			Comparison group
	Before treatment	After treatment		Before treatment	After treatment		
		Main group	Control group		Main group	Control group	
Compensative (DMF 1-3)	1.82 ± 0.07	2.27 ± 0.07	2.02 ± 0.08*	1.15 ± 0.08***	1.91 ± 0.07	1.18 ± 0.09°°°	1.96 ± 0.09
Sub-compensative (DMF 3-6)	1.49 ± 0.06	1.82 ± 0.06	1.64 ± 0.07	0.59 ± 0.04***	1.56 ± 0.06	0.64 ± 0.05°°°	1.56 ± 0.08
De-compensative (DMF 7-9)	0.61 ± 0.05	0.86 ± 0.08	0.65 ± 0.07	0.27 ± 0.05***	0.96 ± 0.07	0.42 ± 0.05°°°	0.94 ± 0.07

* – between the indicators before treatment and the indicator of a healthy group; * – ($p < 0.05$); **- ($p < 0.01$). *** – ($p < 0.001$);

° – between the indicators of main and control groups after treatment ° -($p < 0.05$); °° – ($p < 0.01$).

chemical indexes of Phase 1 and 2 (biotransformation of xenobiotics) observed in the main groups of children from Snyatyn and Kalush regions. It has to be admitted that there was better improvement in correction of GST (Phase 2 biotransformation) recorded in children affected by caries from Snyatyn region. Children of the main group from Kalush region, on the other hand, demonstrate better correction of ADH at the Phase 1 that can be considered, in our opinion, as a diagnosis and treatment markers of ecopathology in children affected by negative impact of environment.

Conclusions

There has been marked progress in ADH activity recorded 30 month after the introduced treatment as a rise with 2.3 time increase observed in children from radiation polluted Snyatyn region and a rise with 2.8 time increase in children from chemically polluted Kalush region reflecting the contrast with initial level ($p < 0.01$).

Activity of GST in the blood serum of children from Snyatyn region has also increased in 1.3 time recorded 2.5 years after the appointed treatment and in children from Kalush region in 2.1 time comparing with initial level ($p < 0.001$).

The biochemical changes in blood serum of children affected by dental caries reflected enhanced activity of the enzymes participating at phases 1 and 2 in detoxication of xenobiotics.

References

Antipkin YH (2005) The state of health in children influenced by different ecological factors. The art of treatment 2: 16–23. https://doi.org/10.1038/vital312

Ataniyasova PA (2008) The influence of polluted air on the health of preschool children. Hygiene and sanitary 2: 87–89.

Bebeshko VH, Darchuk LO, Zaverbna LV (2003) Structural changes of the hard dental tissues and alveolar bone in people affected by radiation. Journal of AMS of Ukraine 9(3): 556–568.

Bezvushko EV, Klymchuk MA (2006) The influence of bad environment on stomatological disorders in children. Environment and health 2: 65–68.

Denha OV, Nikolayeva AV, Shepak SV (2007) Prevalence of caries in children of Odessa region affected by different pesticides load. Gerald of stomatology 3: 38–44.

Fomenko NV (2004) Ecological audit of Ivano-Frankivsk urban-system. Scientific Gerald of Ivano-Frankivsk Gas and Oil University 1: 95–98.

Horishna OV (2001) Ecology of environment and health of children. Anthropogenic action of nitrates. Perinatology and pediatric 1: 60–64.

Ivanov VS, Denha OV, Chomenko LM (2002) The chart of stomatological examination of the child for epidemiological investigations. Gerald of stomatology 4: 53–56.

Kelly FJ, Fussell JC (2015) Air pollution and public health: emerging hazards and improved understanding of risk. Environ Geochem Health 37(4): 631–649. https://doi.org/10.1007/s10653-015-9720-1

Kovach IV (2005) Development of experimental caries by influence of xenobiotics. Modern stomatology 1: 148–151.

Kuzevlyak VF, Lachtin YV (2011) Intensity of caries in population that live in areas overloaded with salts of heavy metals. News of stomatology 3: 58–60. https://doi.org/10.1365/s35128-011-0049-x

Kuznyak NB, Hodovanec OI (2010) Stomatological status of children from nitrate polluted areas. News of stomatology 2: 83–85.

Mannervick B, Danielson UH (1988) Glutathione transferases structure and catalytic activity. CRC Crit. Rev.Biochem 23(3): 83–337. https://doi.org/10.3109/10409238809088226

Mezey E, Cherrick GR, Holt PR (1968) Serum alcohol dehydrogenase: An indicator of intrahepatic cholestasis. The New England Journal of Medicine 279(5): 241–248. https://doi.org/10.1056/NEJM196808012790504

Scheupleina R, Charnleyb G, Doursonc M (2002) Differential Sensitivity of Children and Adults to Chemical Toxicity: I. Biological Basis. Regulatory Toxicology and Pharmacology 35(3): 429–477. https://doi.org/10.1006/rtph.2002.1558

Shishniashvili TE, Suladze NN, Margvelashvili VV (2016) Primary Teeth and Hair as Indicators of Environmental Pollution. Journal of Clinical Pediatric Dentistry 40(2): 152–155. https://doi.org/10.17796/1053-4628-40.2.152

Sukumar A (2018) Human Exposure Assessment of Element Pollution for Environmental Health Implications: Teeth as a Biomonitoring Tool. Journal of Geoscience and Environment Protection 6: 37–53. https://doi.org/10.4236/gep.2018.63005

Tchaikovska HS, Hnateiko OZ, Moscovyak NV, Fedorenko VI (2010) Some markers of donozological diagnosis of the health state in junior scholars. Pediatric, obstetrics and gynecology 5: 49–51.