Environmental exposure of children to lead
Past – Present - Future

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Rationale 1

Lead is a heavy metal with a wide range of **toxicity .**
Affected organs: cardiovascular, gastrointestinal, renal, endocrine, reproductive, immune and haematological systems and –first of all- the **central and peripheral nervous system**.

1979: Needleman et al.: Deficits in Psychologic and Classroom Performance of Children with Elevated Dentine Lead Levels

Children are at the highest risk

HIGH EXPOSURE

- Hand-to-mouth activity
- Pica

HIGH ABSORPTION

- Fraction of absorption from the gastro-intestinal tract is 40% in children compared to 10% in adults

HIGH SUSCEPTIBILITY

- At the critical periods of brain development
- Immature blood-brain barrier

Rationale 2

Exposure routes: **oral**, inhalation, transplacental

After entering the body, lead in the blood is bound to red blood cells. Its biological half life in the blood is about 3 weeks, then lead is distributed to the brain, liver, kidney and bones. It is stored in the teeth and bones.

Human biomonitoring of lead exposure measures **inorganic lead** in blood, bones, teeth. urine. **The most reliable marker of lead exposure is blood lead level (PbB). -** unfortunately

PbB is a very useful source of information but we have to be aware that **there is no known safe blood lead level in children.**

History of health-based guidance value of PbB in children

Until 1985 the same as in adults (40 µg/dL)

1985: CDC: 25 µg/dL (as intervention level)

1991: CDC: 10 µg/dL (as „level of concern”)

2012: CDC: 5 µg/dL – as a reference value (97.5th percentile of the population PbB in children aged 1-5 years)

2018: UBA: reference value for children: 3.5 µg/dL

A harmonized European biological guidance value is needed!

PAST

Leaded petrol. Tetra-ethyl lead was used from the 1930s to the 1970s as a petrol additive (anti-knocking agent) to improve engine performance, thus comprising major part of atmospheric lead which was a significant contributor to the body burden of lead.

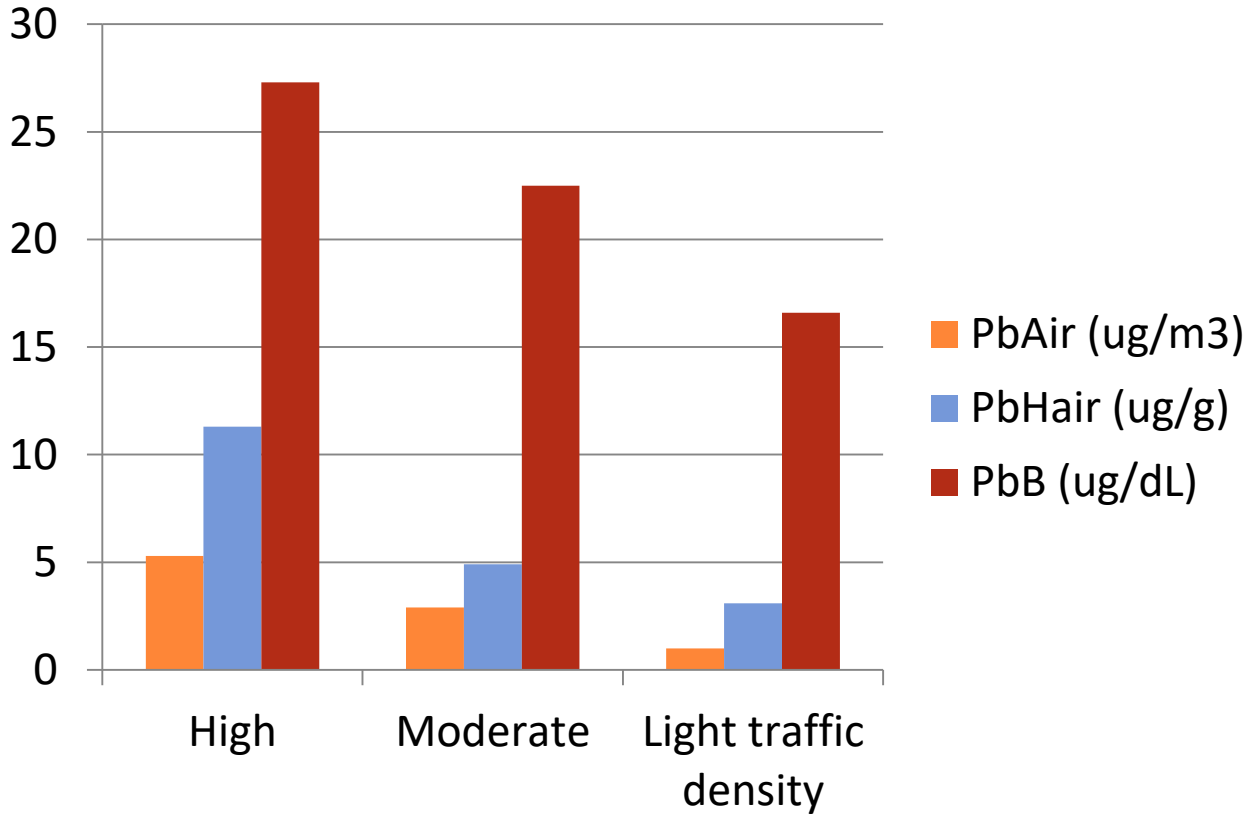
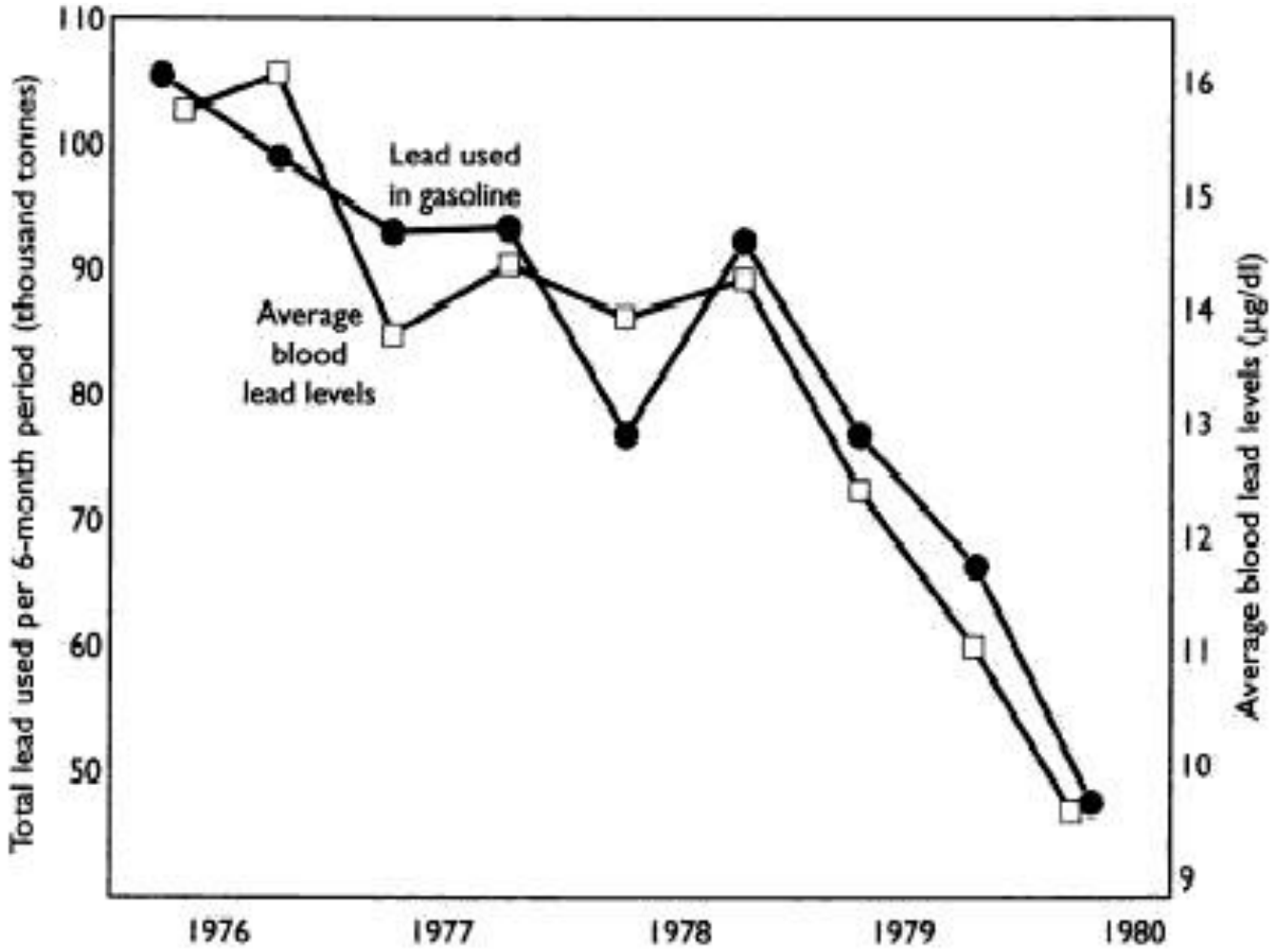


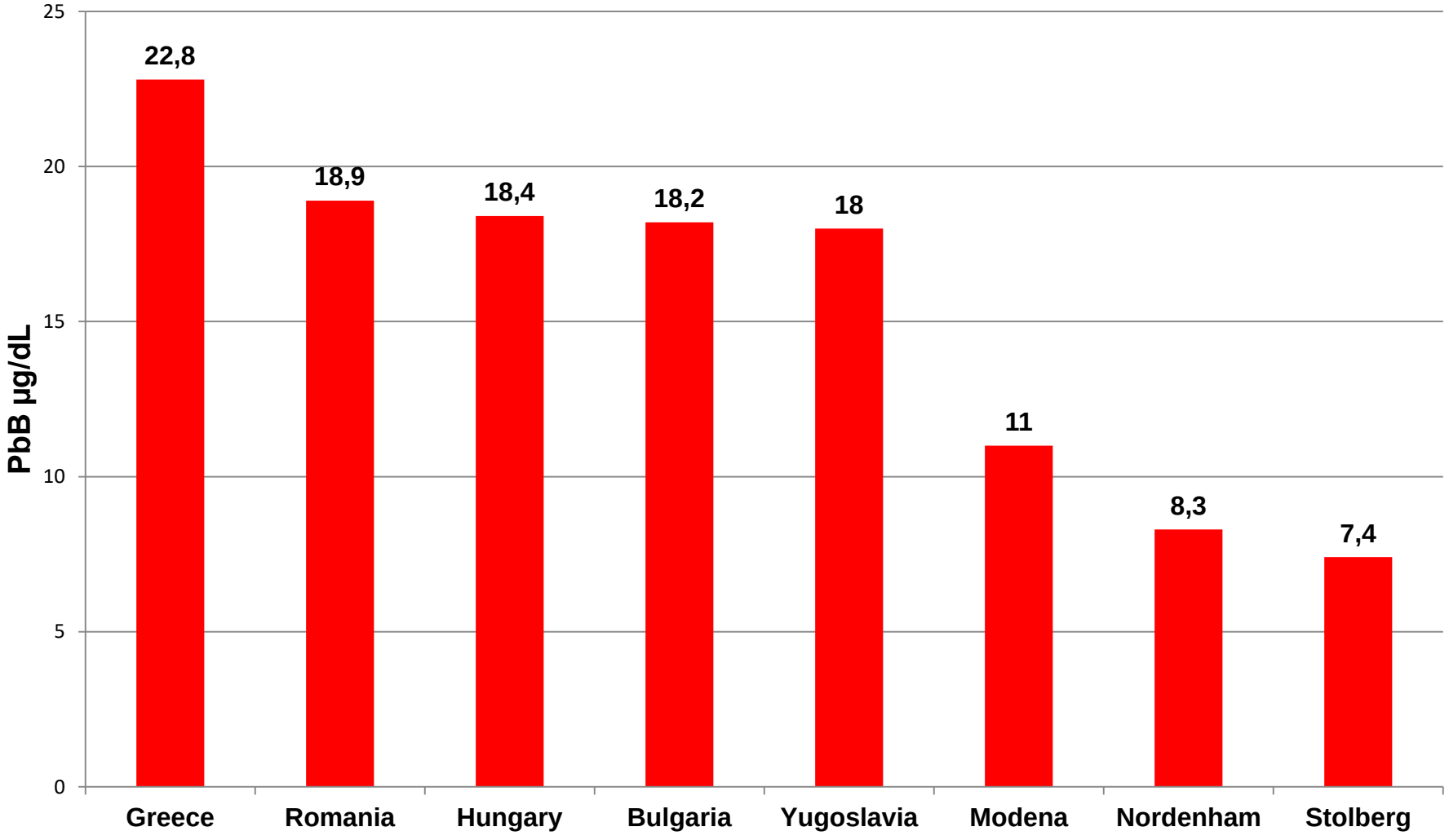
Figure 1. Lead concentration in the air, and hair and blood samples of children in parts of Budapest with high, moderate and light traffic density (1986)

LEADED PETROL – MAJOR SOURCE

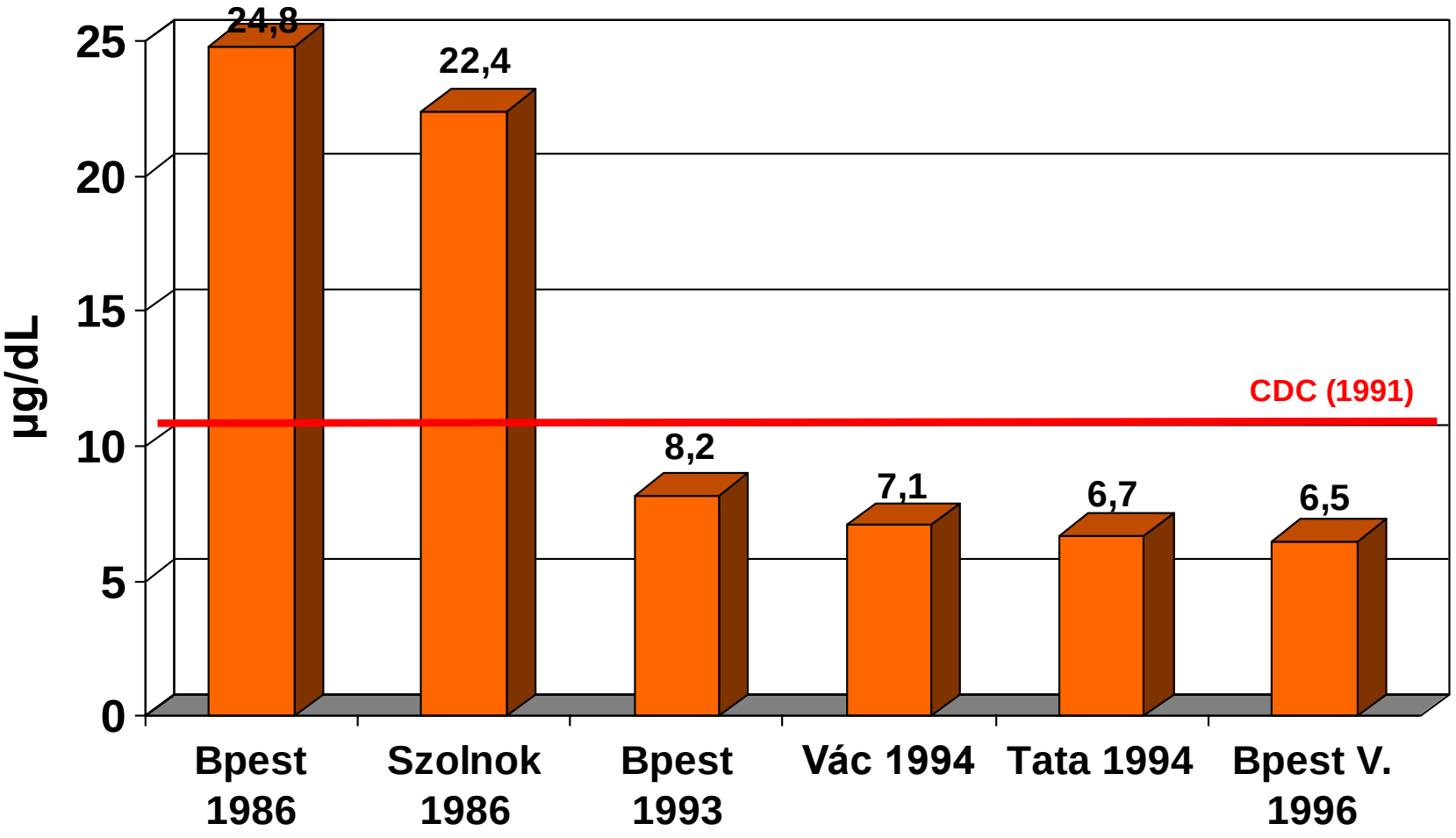


Institute of Medicine, EPA, 1996

Geometric mean concentrations of PbB in European children, 1986



Mean blood lead levels of children living in areas with high traffic density of Hungary, 1986-96



Associations of of some independent variables with blood lead levels of kindergarten children in Budapest, 1996 (n= 341)

VARIABLES	Regression coefficient	S.E.	t	p
Age	- 0,0117	0,1255	- 0,094	0,925
Gender	- 0,4475	0,2661	-1,682	0,093
Mother's education	*-0,1716*	*0,0504*	*-3,405*	*0,001*
Father's education	*-0,1423*	*0,0468*	*-3,042*	*0,003*
Number of smokers	***0,3610***	***0,1689***	***2,137***	***0,033***
Number of rooms	*-0,4615*	*0,1606*	*-2.873*	*0,004*
Buying fruits in shops	*-0,6704*	*0,3312*	*2,024*	*0,044*
Regular Cola drinking	***1,5757***	***0,3750***	***4,201***	***<0,001***
Fruit juice consumption	*-0,5875*	*0,3057*	*-1,922*	*0,056*

Distribution of leaded petrol was ceased in Hungary from April 1, 1999.

Lead exposure hot spots in Hungary

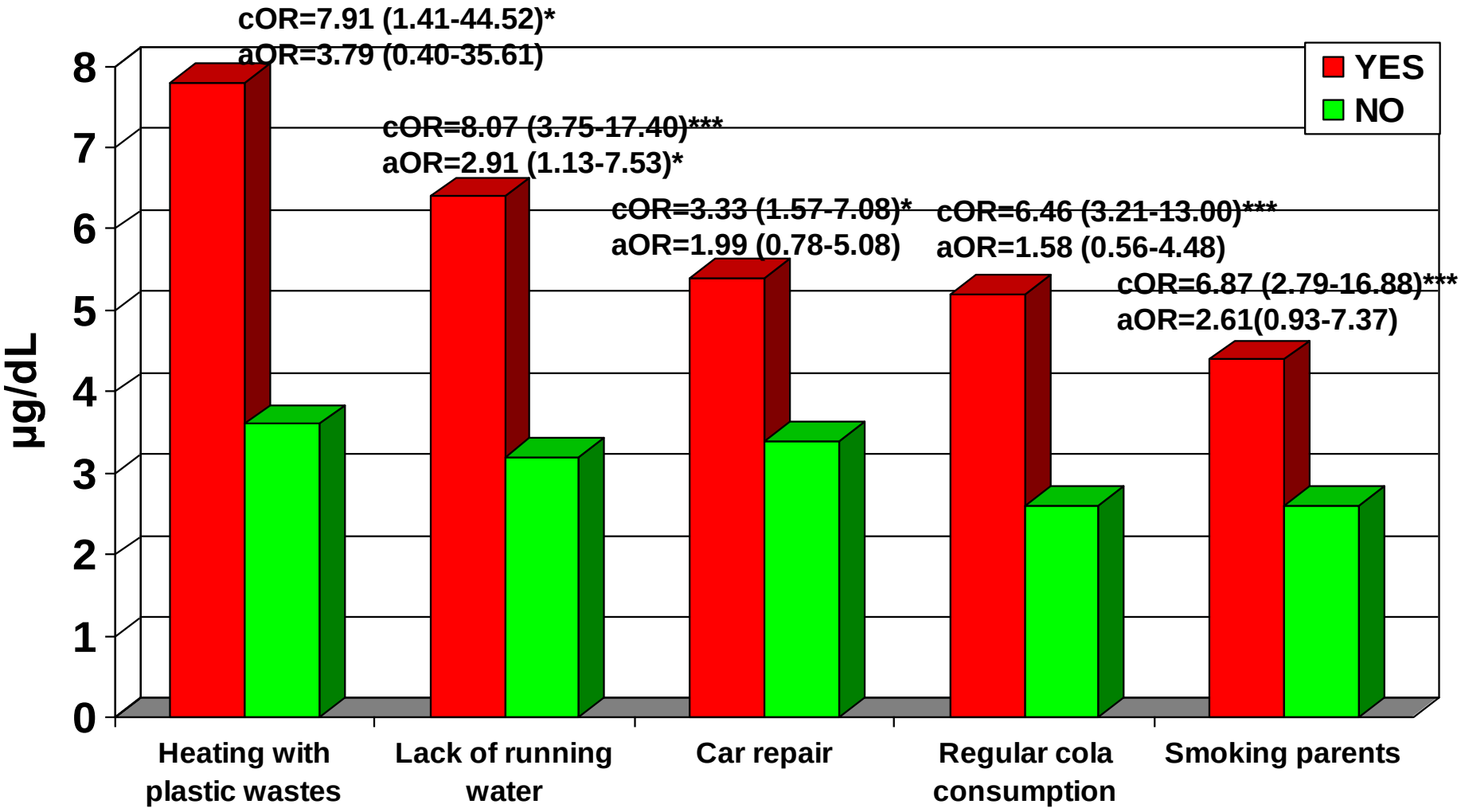
- **Romhány:** 1970-80s years (industrial ceramic factory)
- **Gyöngyösoroszi**: lead mine – up to 1985
- **Budapest**: METALLOCHEMIA (secondary lead smelter) – up to 1989
- **Heves:** disassembling of car batteries at home, smelting lead for resale, 1995
- **Parádsasvár**: leaded glass factory – up to 2005

PRESENT

PbB of children living in former hot spot areas (2006)

Settlement	n	PbB (µg/dL) Geom. mean	PbB >10 µg/dL
Heves	109	4,7	11 (10,1%)
Gyöngyösoroszi	22	3,4	1 (4,6%)
Parádsasvár	16	3,0	0
Romhány	23	2,7	0
Budapest XXII.	95	1,9	0
Altogether	265	3,0	12 (4,5%)

Mean PbB levels of Hungarian children exposed to various environmental risk factors (2006)



Adjusted for: age, gender, mother's education, study area

*p<0.05; **p<0.01; ***p<0.001

European situation at present

- Phasing out of leaded petrol was performed at different times in different parts of Europe
- After phasing out – decreased interest in lead exposure
- **Decreasing trend** in blood lead level of children could be observed with lowering lead content of petrol and finally phasing out leaded petrol in various countries.
- However, e.g. in Sweden after 2009 the decrease in the blood lead level discontinued (Wennberg et al., 2017) which means that **there must be still other existing lead exposure sources to be detected and eliminated**.
- Reported data on PbB measured during the past 5 years were found to be available only from 7 countries, among them only from 4 countries about children's PbB.

Availability of HBM data

Countries	Number of children	Geometric mean of blood lead concentration (µg/L)	Range (µg/L)
Croatia	46	**17.9**	10-42
Czech Republic	8	**15.5**	12-22
Poland	27	**16.3**	8.0-28
Slovakia	57	**19.4**	8.0-47
Slovenia	42	**13.4**	6.9-24
Sweden	41	**14**	6.0-25

(Source: Hruba et al., 2012)

Societal concern

Economic burden:

IQ decrease in children below 6 years of age (Lanphear et al, EHP, 2005)

- **0.513 IQ point / 1 µg/dL (in the range between 2-10 µg/dL)**
- 0.19 IQ point / 1 µg/dL (in the range between 10-20 µg/dL)
- 0.11 IQ point / 1 µg/dL (above 20 µg/dL)

Consequence: **lost life-long productivity**

- **2% (1.76-2.37%) per IQ point**
- **EU (**~ 500 million population) 55 billion USD
- Lost life-long productivity makes up 0.5% of GDP

Exposure of children to lead is not only a health hazard but also a serious economic burden**.**

Identification and elimination of still existing lead exposure sources are not only of public health but also of economic interest.

FUTURE activities needed

- In order to eliminate still existing lead sources (e.g. lead-contaminated dust, water from leaded pipes, food from lead-glazed or lead-soldered containers) in countries showing interest in participation, we propose **to conduct a survey** where we identify their importance in the exposure of different population subgroups (e.g. children 1-3 years, **4-6 yrs**, 7-14 yrs and 15-18 yrs, as well as adults (19-40 years; 41-65 years; > 65 years). Special attention should be paid to **pregnant women**, they should be a separate group in the survey.
- **Parallel measurements** of blood lead levels should be performed **from capillary and venous blood samples** in small groups of children in order to demonstrate the feasibility of using capillary blood samples for screening purposes.

Thank you

for your

attention