Impact of air pollution on human health

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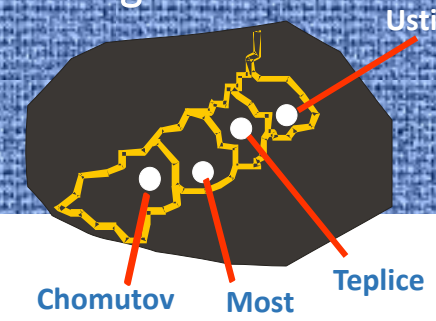
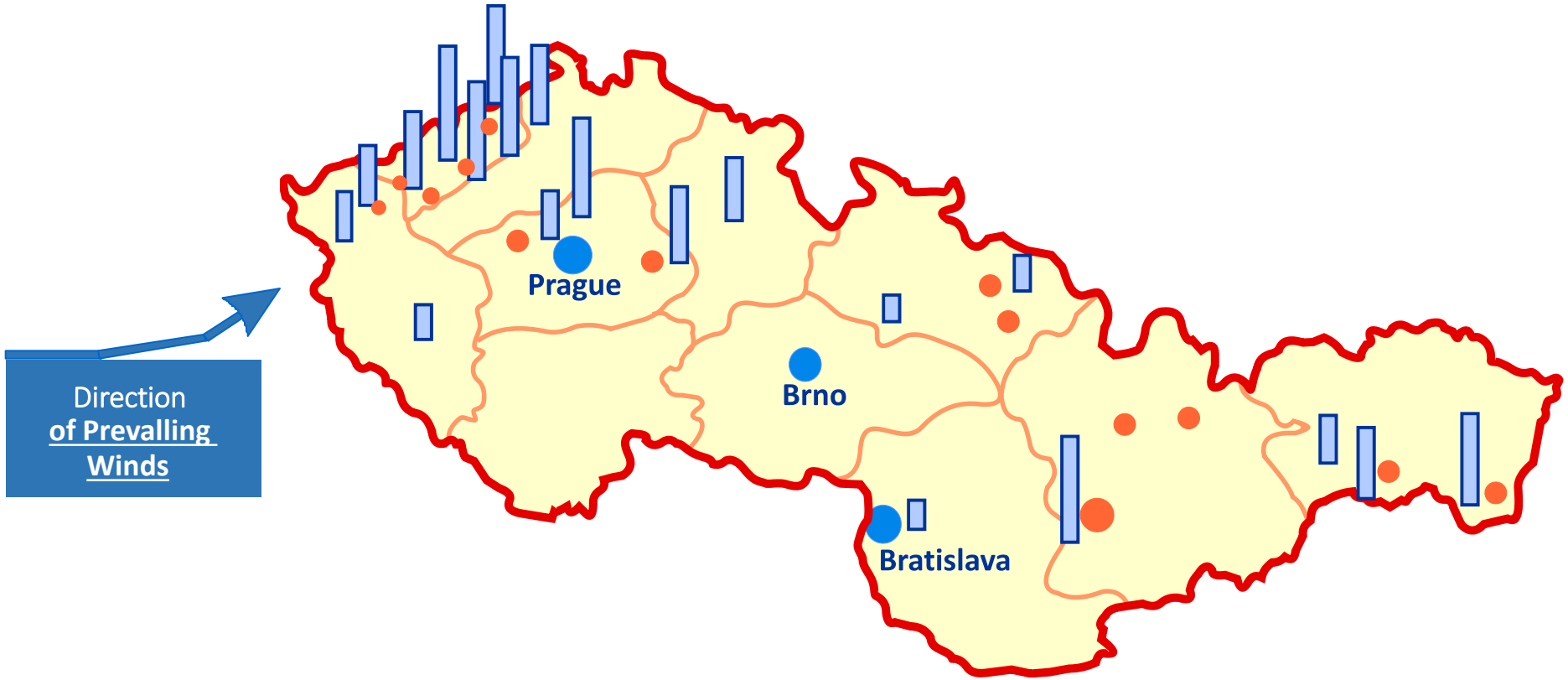
The Czech Academy of Sciences, Institute of Experimental Medicine, Prague, Czech Republic

Conference „Fighting Air Pollution“, Ostrava, November 19, 2018

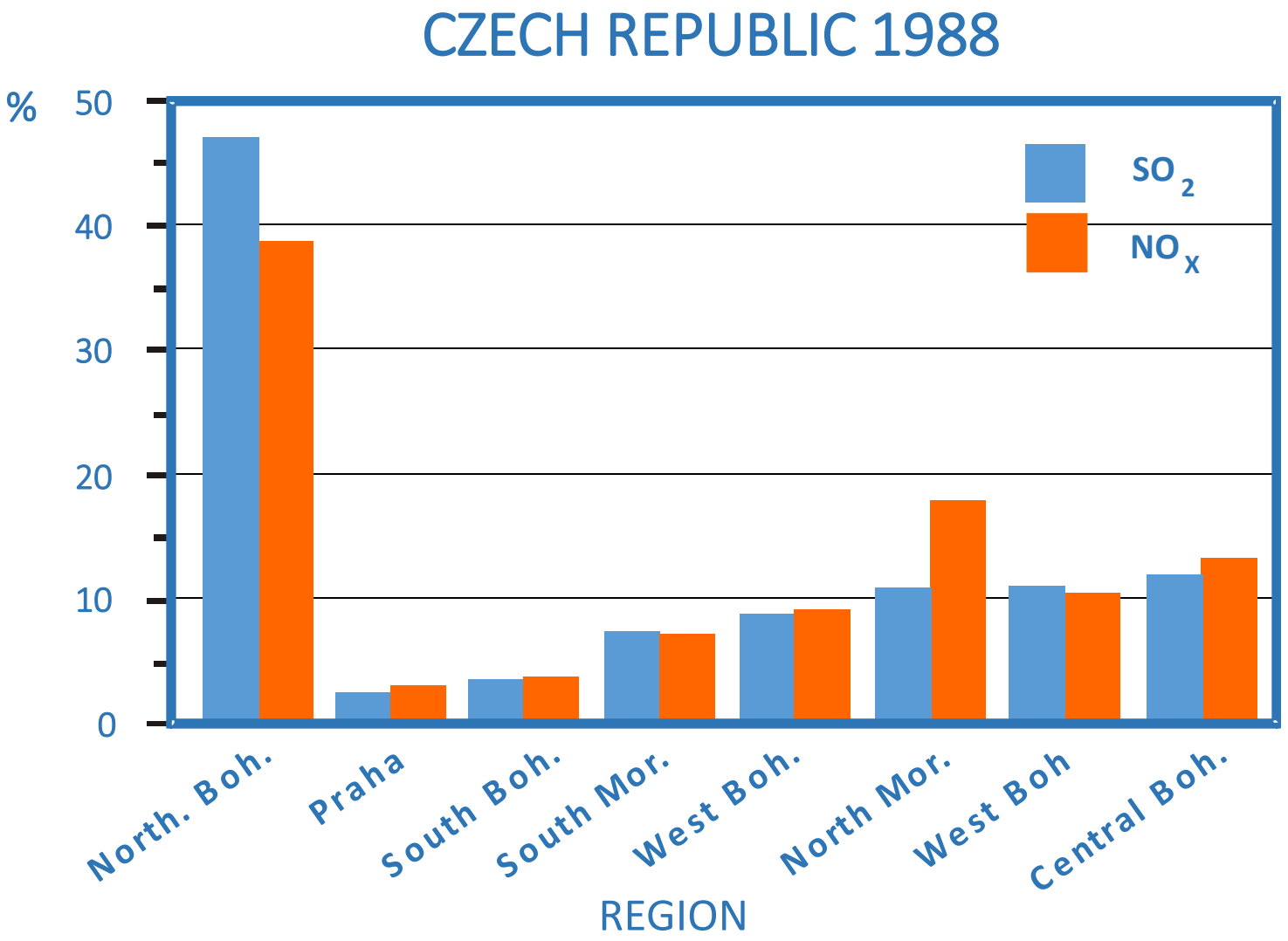
DISTRIBUTION OF THE MAIN EMISSION CENTRES IN CZECHOSLOVAKIA



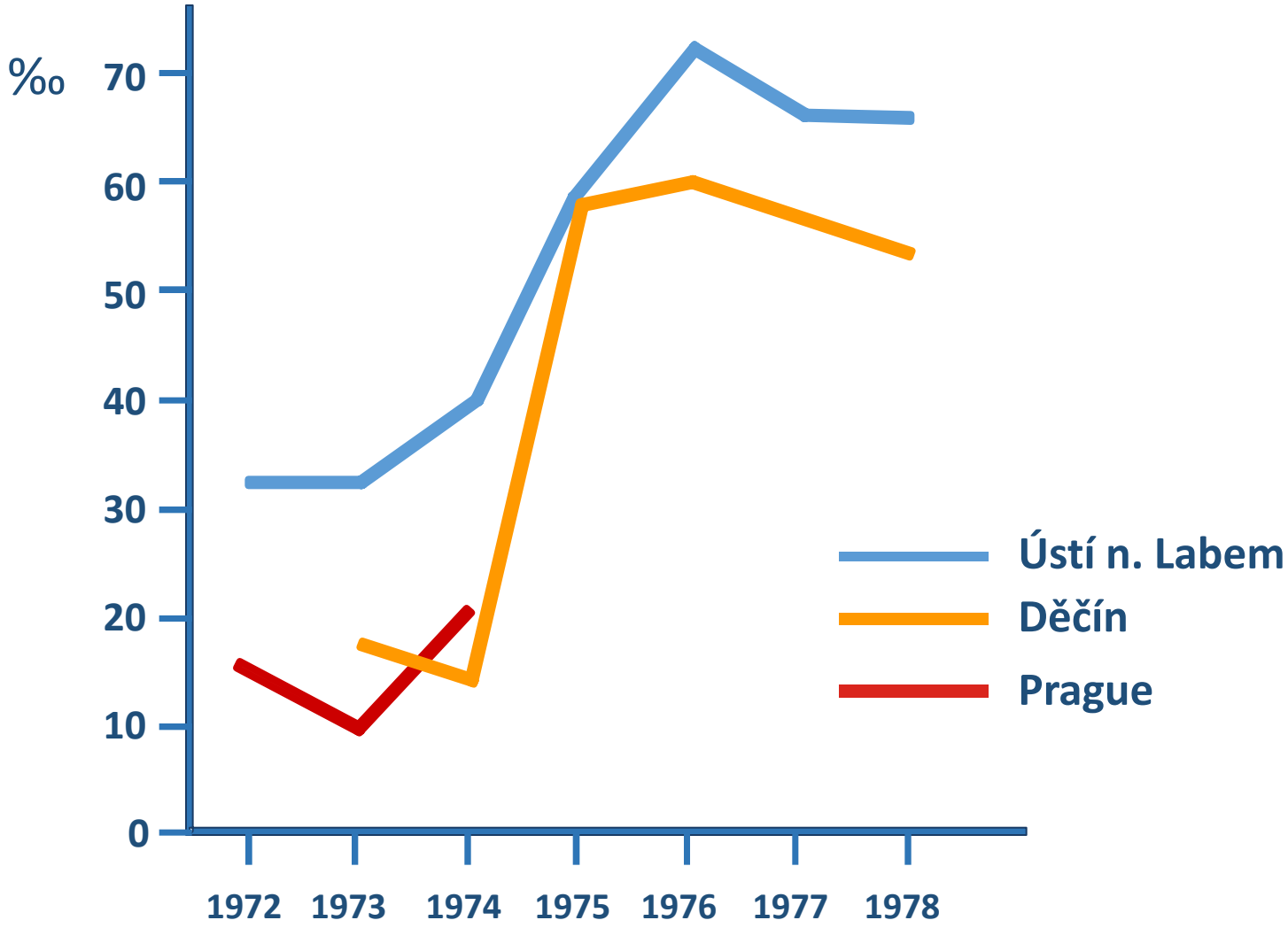
498,000 inhabitants



RATIO OF ABSOLUTE EMISSION



INCIDENCE OF BIRTH DEFFECTS



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THE FREQUENCY OF CHILDREN WITH DELIVERY WEIGHT LESS THAN 2500 G

Year	Teplice		Ústí n.L.		Jablonec	
	N	%	N	%	N	%
1882	1546	8.3	1591	8.1	1102	5.5
1983	1511	8.3	1551	8.4	1061	6.5
1984	1374	9.2	1460	7.7	1063	4.3
1985	1351	7.9	1510	7.5	--	--
1986	1408	6.5	1532	8.7	--	--

MORBIDITY OF CHILDREN IN THE MINING DISTRICTS IN THE REGION OF NORTHEN BOHEMIA (1988)

Disease	Morbidity of Children (No. of Cases/100)			
	Czech Republic		Mining Districts	
Urinary & Kidney (chronic)	0.89	(0-6 yrs. old)	1.12	(0-6 yrs. old)
Respiratory (unspecific)	0.54		2.90	
Allergy	1.70		2.93	
Mental illness	0.53		1.06	
Skin	0.65		1.29	
Urinary & Kidney (chronic)	1.42	(7-15 yrs. old)	1.68	(7-15 yrs. old)
Respiratory (unspecific)	0.45		1.40	
Mental illness	2.00		4.09	
Endocrine	1.17		1.54	
Skin	0.73		1.09	
Other Chronic	0.92		1.79	

Background

Air Pollution in the Teplice District, Czech Republic derives from the use of locally mined coal for industry and home heating, and is higher in winter than summer.

TEPLICE PROGRAM

IMPACT OF AIR POLLUTION ON HUMAN HEALTH

Model district

TEPLICE

(coal power plant
open pit mines
industry)

Control district

PRACHATICE

(agricultural
area)

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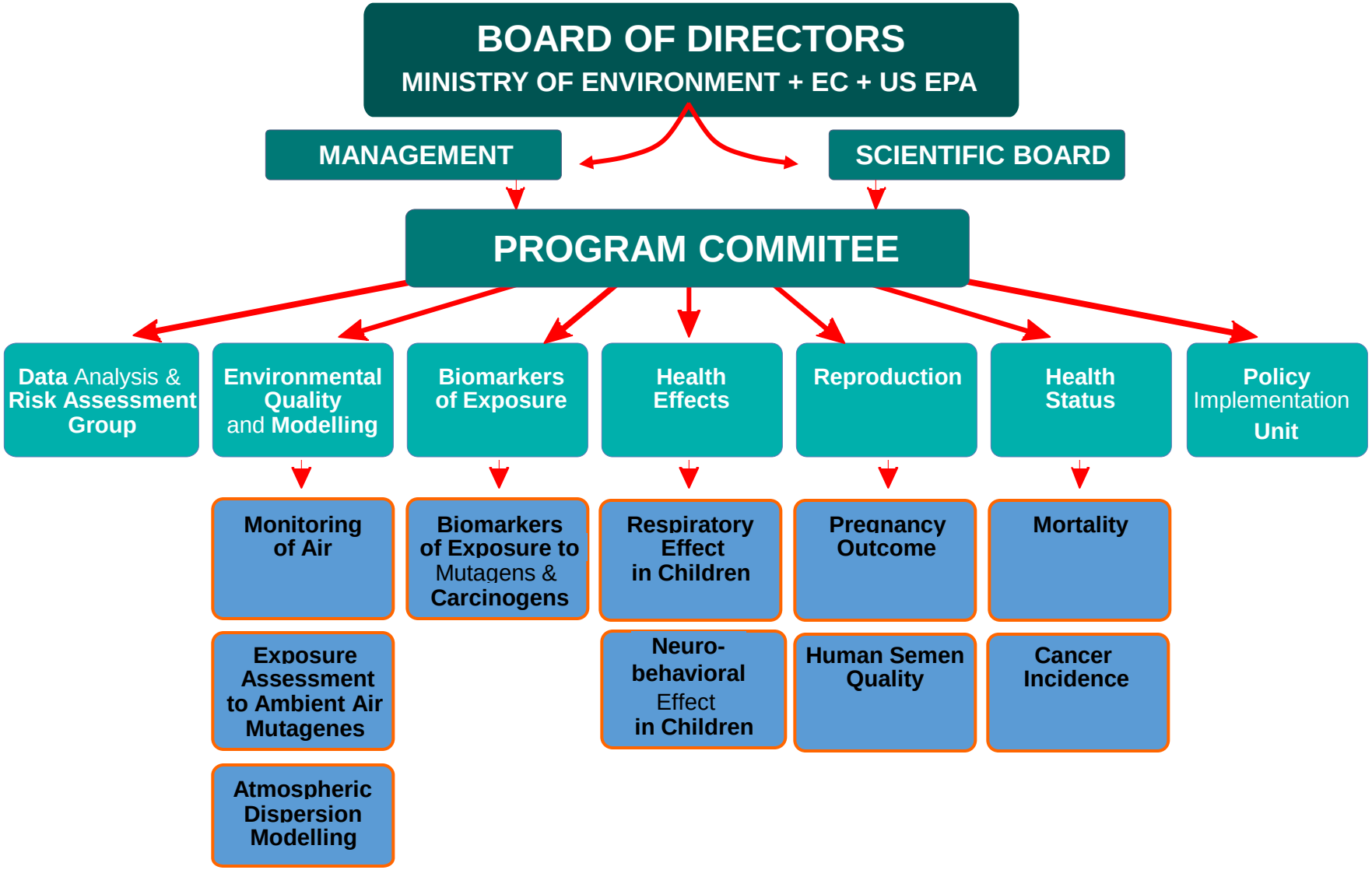
GERMANY
POLAND
Teplice
Prague
Prachatice
GERMANY
SLOVAKIA
AUSTRIA

TEPLICE PROGRAM



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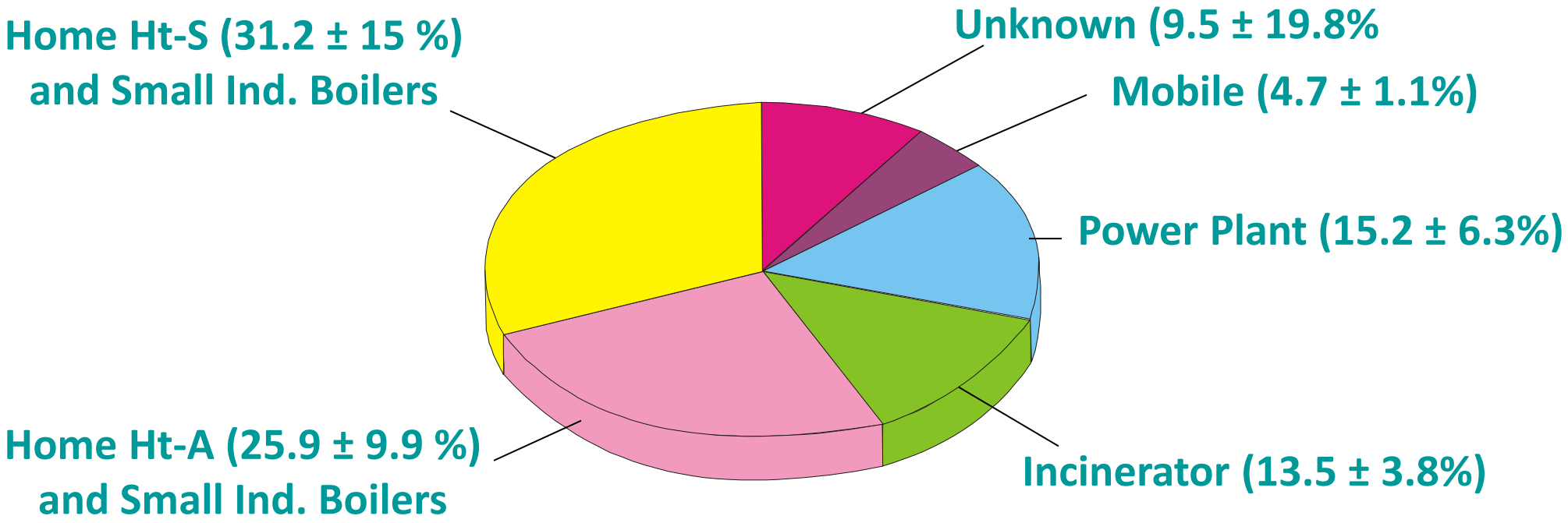
APPORTIONMENT OF TEPLICE FINE MASS

January – February, 1994



Average Fine Mass Concentration = 52.6 µg/m^3

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GENOTOXICITY AND EMBRYOTOXICITY OF URBAN AIR PARTICULATE MATTER IN VITRO

Characterization

of biologically active pollutants

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CONTRIBUTION OF THE MAJOR PAH-DNA ADDUCTS TO THE TOTAL DNA ADDUCTS LEVEL FROM URBAN SAMPLES

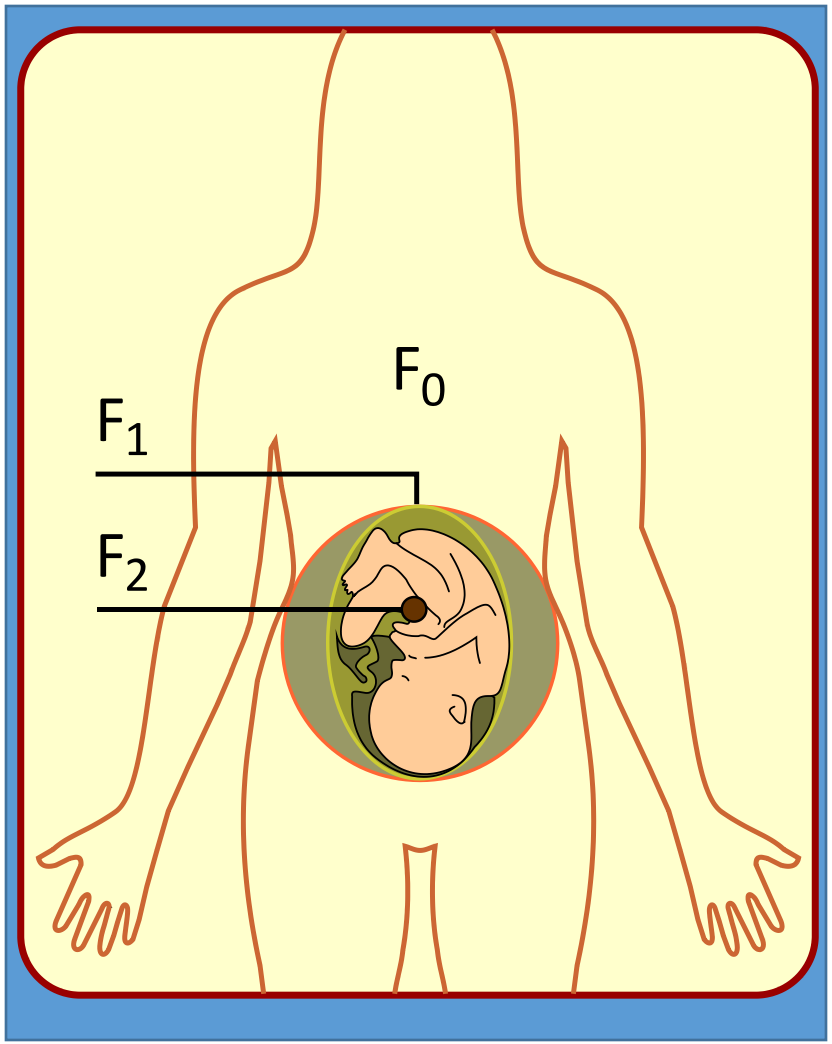
(Binková et al. 1999)

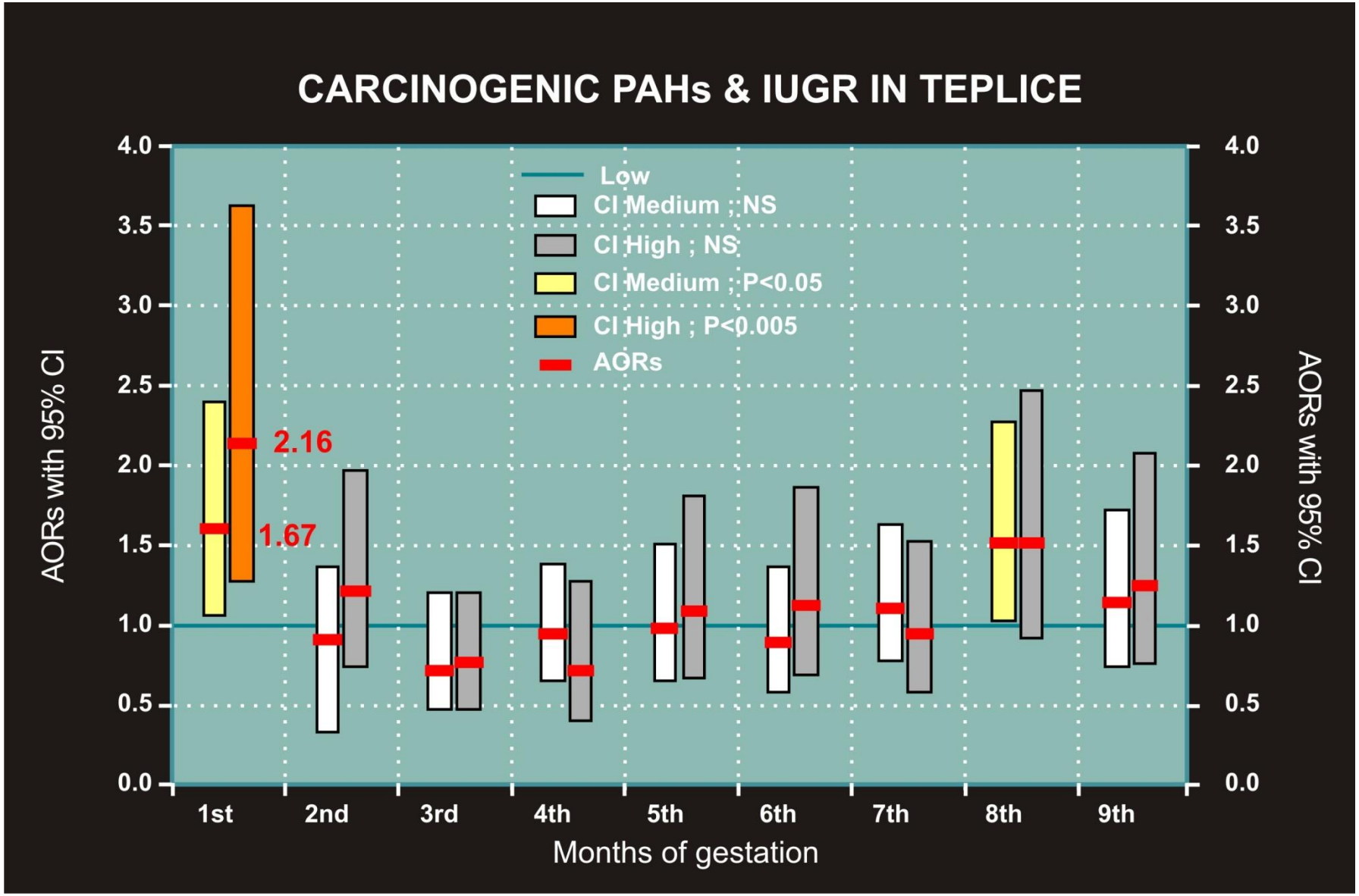
PAH-DNA adducts derived from

9-OH-B[a]P	B[j]F
anti - BPDE	CHRY
B[b]F	B[a]A
B[k]F	I[c,d]P

Total radioactivity from all DNA adducts detected approx. 50 %


AIR POLLUTION
PREGNANCY
OUTCOME


F0
F1
F2


CARCINOGENIC PAHs & IUGR IN TEPLICE
AORs with 95% CI
AORs with 95% CI
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Low
CI Medium ; NS
CI High ; NS
CI Medium ; P<0.05
CI High ; P<0.005
AORs
2.16
1.67
1st
2nd
3rd
4th
5th
6th
7th
8th
9th
Months of gestation

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PREGNANCY OUTCOME -RISK OF c-PAHs

AMBIENT EXPOSURE

to 15 ng c-PAHs/m^3/month

(2.8 ng B[a]P/m^3)

INDOOR EXPOSURE (50-60%)

approximately to 9 ng c-PAHs/m^3/month

(1.7 ng B[a]P/m^3)

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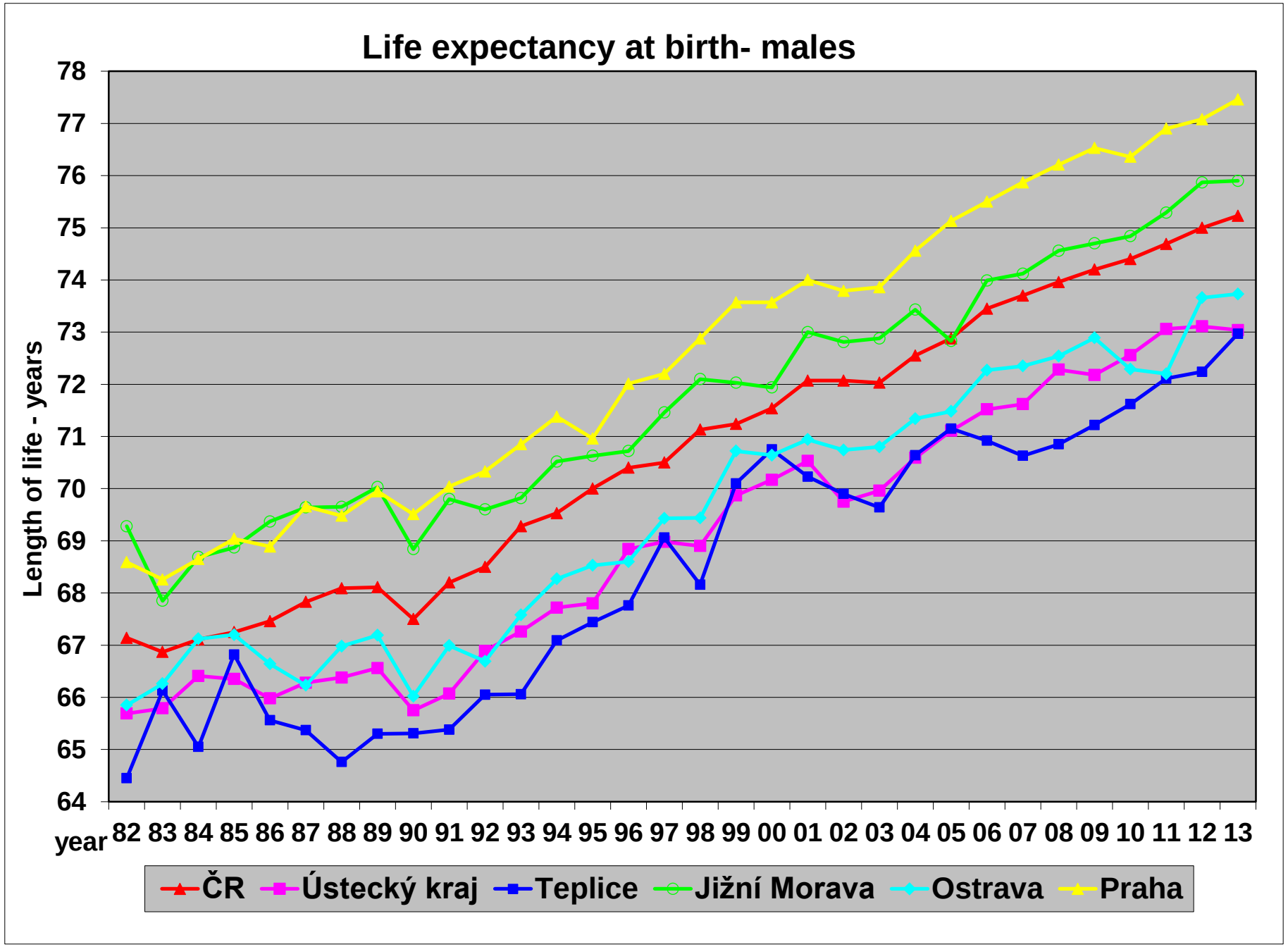
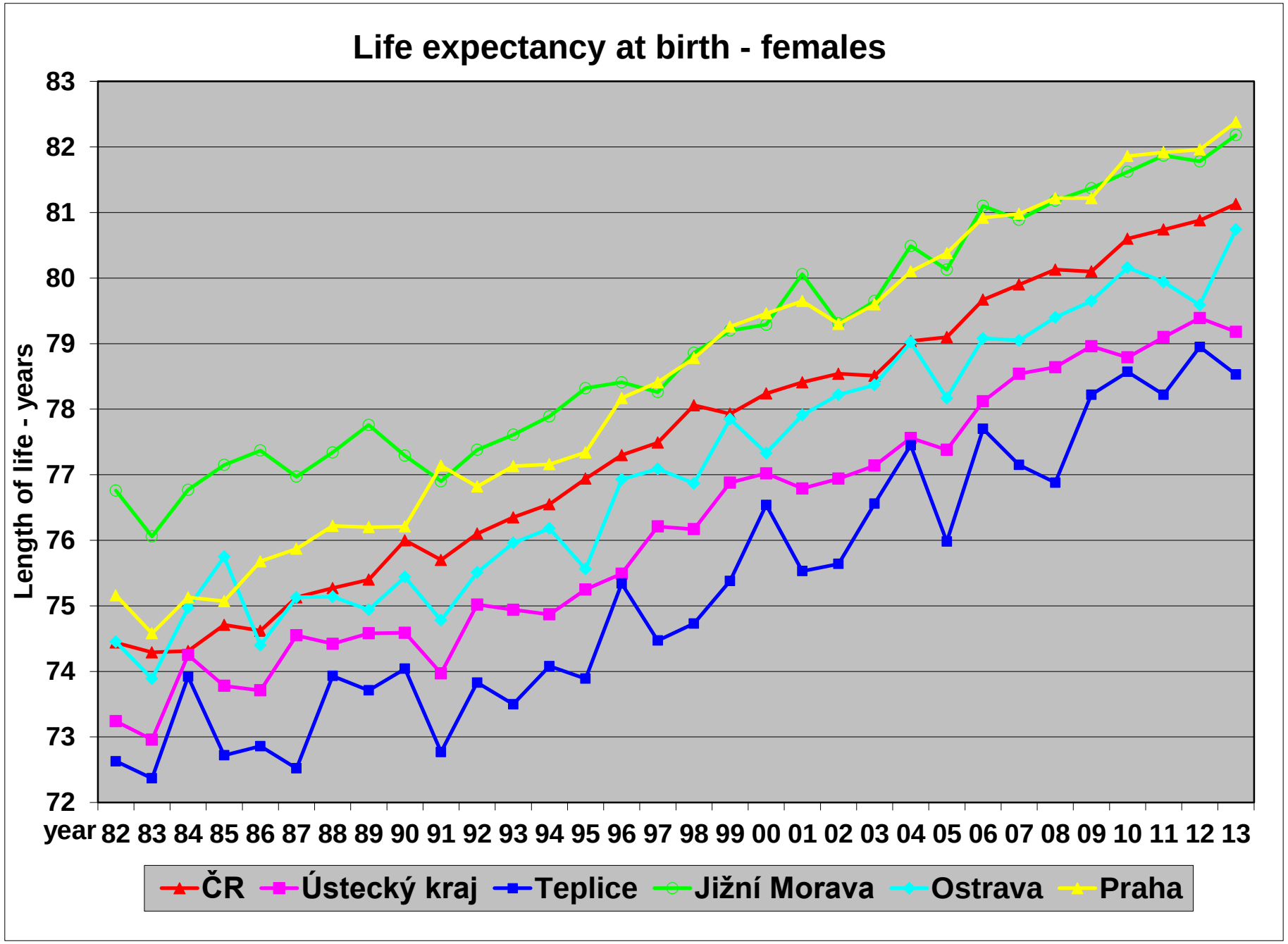
IMPACT OF IUGR

- Child Mortality
- Child Morbidity
- Delayed Growth
- Non-Insulin Dependent Diabetes
- Hypertension
- Ischemic Heart Disease


AIR POLLUTION
LIFE EXPECTANCY


Life expectancy at birth- males
Length of life - years
78
77
76
75
74
73
72
71
70
69
68
67
66
65
64
year
82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13
ČR
Ústecký kraj
Teplice
Jižní Morava
Ostrava
Praha


Life expectancy at birth - females
Length of life - years
83
82
81
80
79
78
77
76
75
74
73
72
year
82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13
ČR
Ústecký kraj
Teplice
Jižní Morava
Ostrava
Praha

EFFECT OF AIR POLLUTION TO POPULATION OF MINING DISTRICTS

1) Constantly decreased life expectancy of males and females

2) Constantly increased mortality to cardiovascular diseases

3) In children born in seventieth and eightieth we should expect in later adulthood the increased incidence of:
hypertension, ischemic heart disease, diabetes of 2nd grade, affected the sperm quality

4) Damage of genetic material(DNA) will unfavorably affect generations yet unborn

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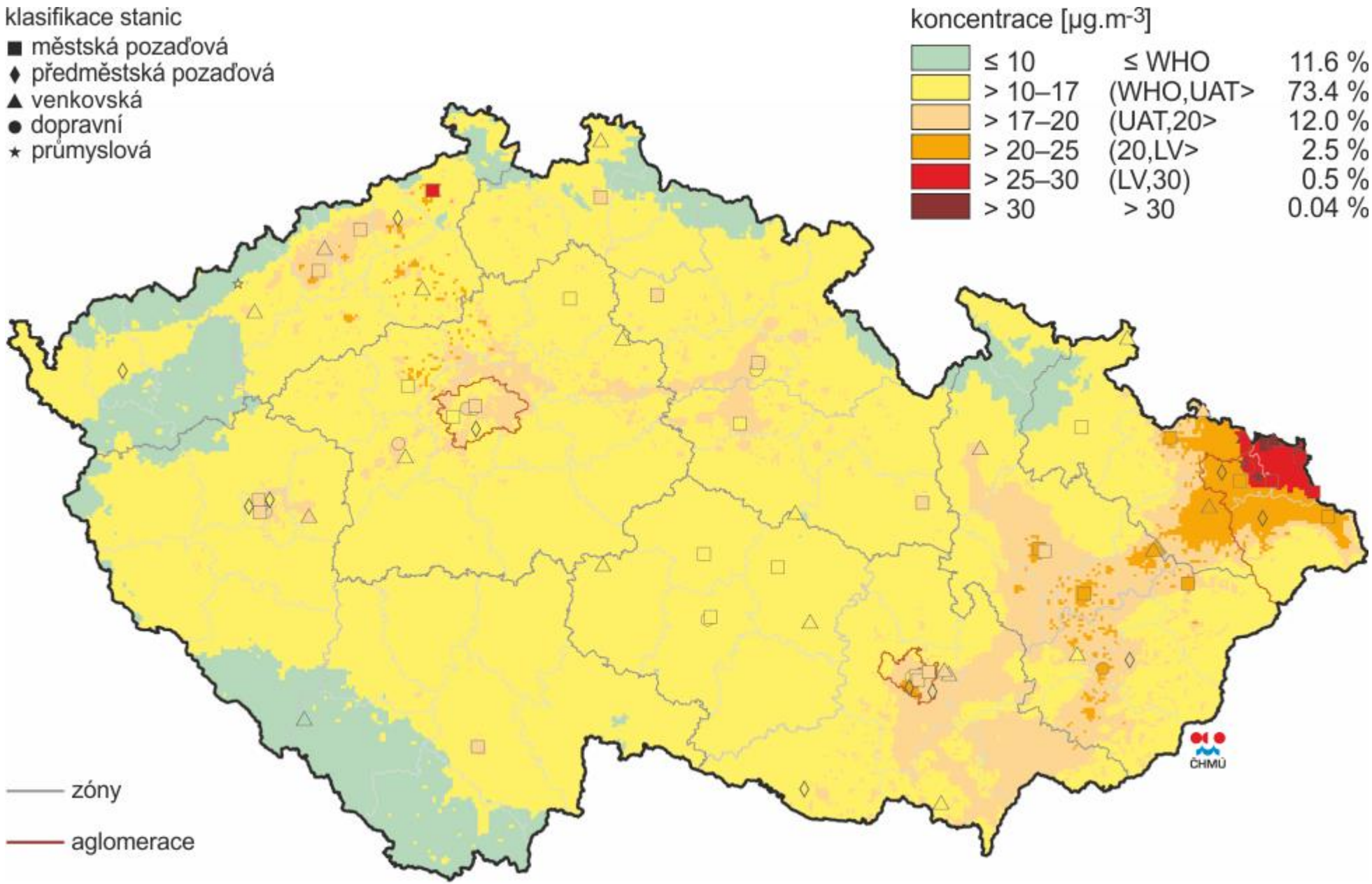
PM2.5

PM 2.5

EU	25	$\mu g/m^3$
USA	12	$\mu g/m^3$
WHO	10	$\mu g/m^3$



Obr. IV.1.4 Pole roční průměrné koncentrace $PM_{2,5}$, 2016

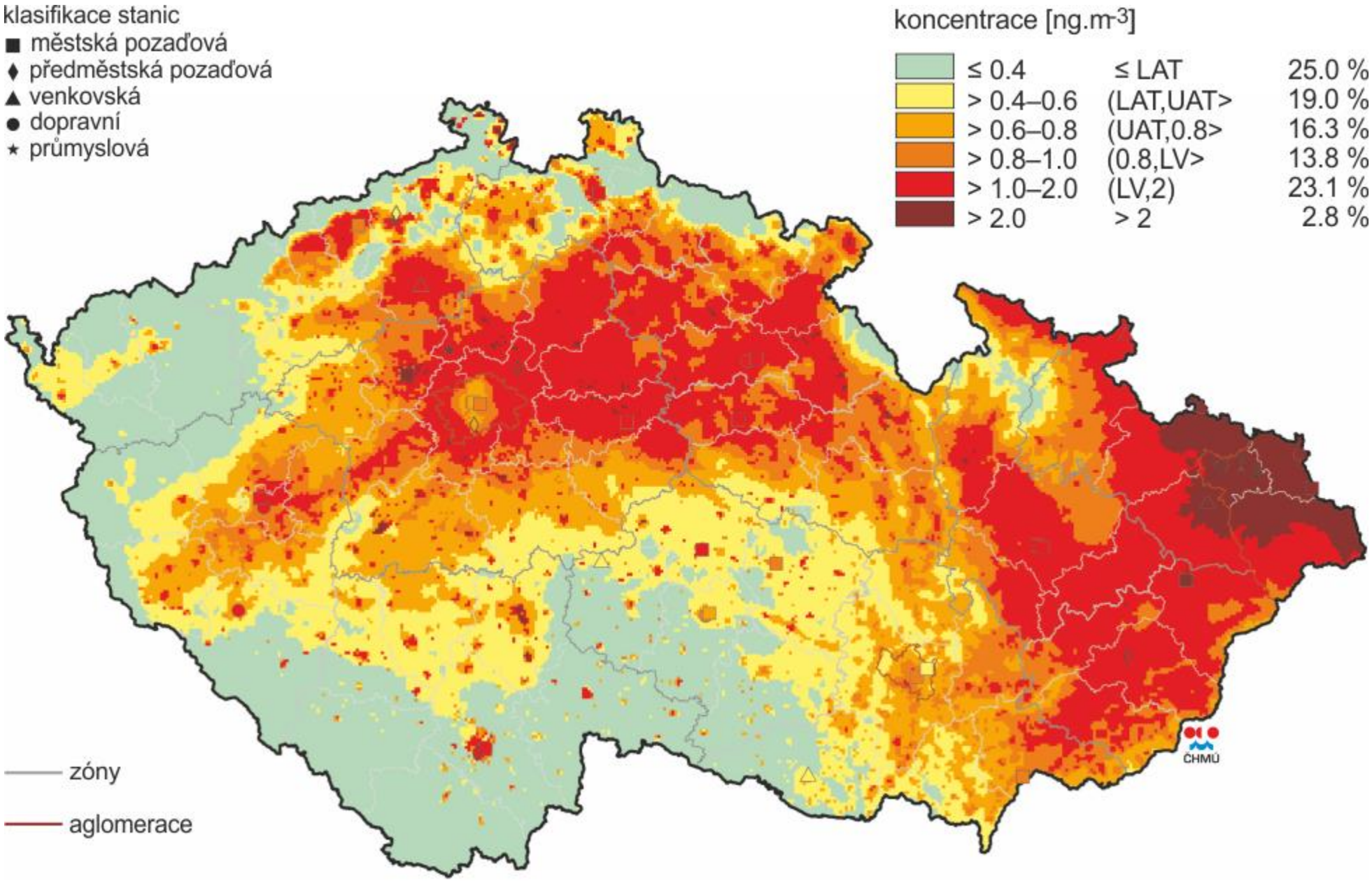
B[a]P

B[a]P

C.B.B. Guerreiro et al. “Benzo(a)pyrene in Europe: Ambient air concentrations, population exposure and health effects”, Environmental Pollution 214 (2016) 657-667

→ Acceptable risk level: 0.12 ng B[a]P/m^3

Increasing tendency in B[a]P emissions - implementation of climate mitigation policies promoting the use of biomass burning for domestic heating



Obr. IV.2.1 Pole roční průměrné koncentrace benzo[*a*]pyrenu, 2016

AIR POLLUTION 2010 – 2017

(CHMI)

Locality	PM10 µg/m^3	PM2.5 µg/m^3	B[a]P ng/m^3
Ostrava-Poruba	39.9 ± 41.4 /27.4 ± 21.5	32.2 ± 37.0/21.7 ± 15.9	3.8 ± 6.2/ 2.5 ± 0.7
Ostrava -Bartovice	61.7 ± 45.6 /35.1 ± 27.0	46.7 ± 38.2/ 35.5±29.8	7.2 ± 8.1/ 9.6 ± 6.0
Karvina	54.3 ± 50.0/35.3.8 ± 26.8	X/27.0 ± 19.2	6.3 ±8.8/ 3.9 ± 1.4
Prague-Smichov	37.9 ±20.1/31.0 ± 26.3	21.1 ± 14.2/22.0 ± 17.7	X
Prague -Libus	27.4 ± 16.9/21.1 ± 16.8	20.3 ± 13.1/16.7 ± 12.9	0.9 ± 1.2/ 0.9 ± 0.3
Ceské Budejovice	25.2 ± 16.9/18.5± 13.9	X/14.6 ±10.4	1.5 ± 1.8/ 1.3 ± 0.5

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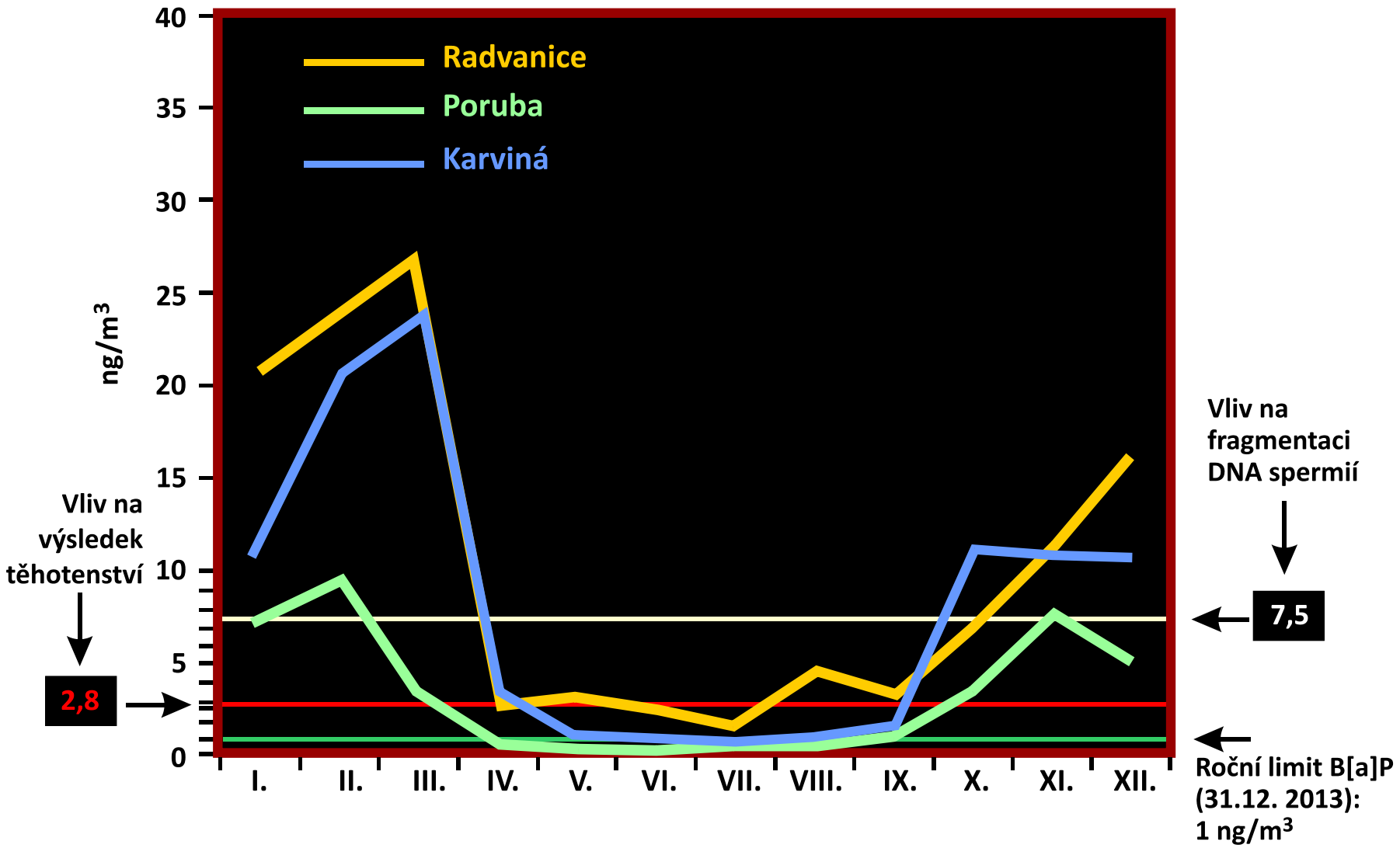
OSTRAVA STUDY

Měsíční koncentrace benzo[a]pyrenu

(2012)



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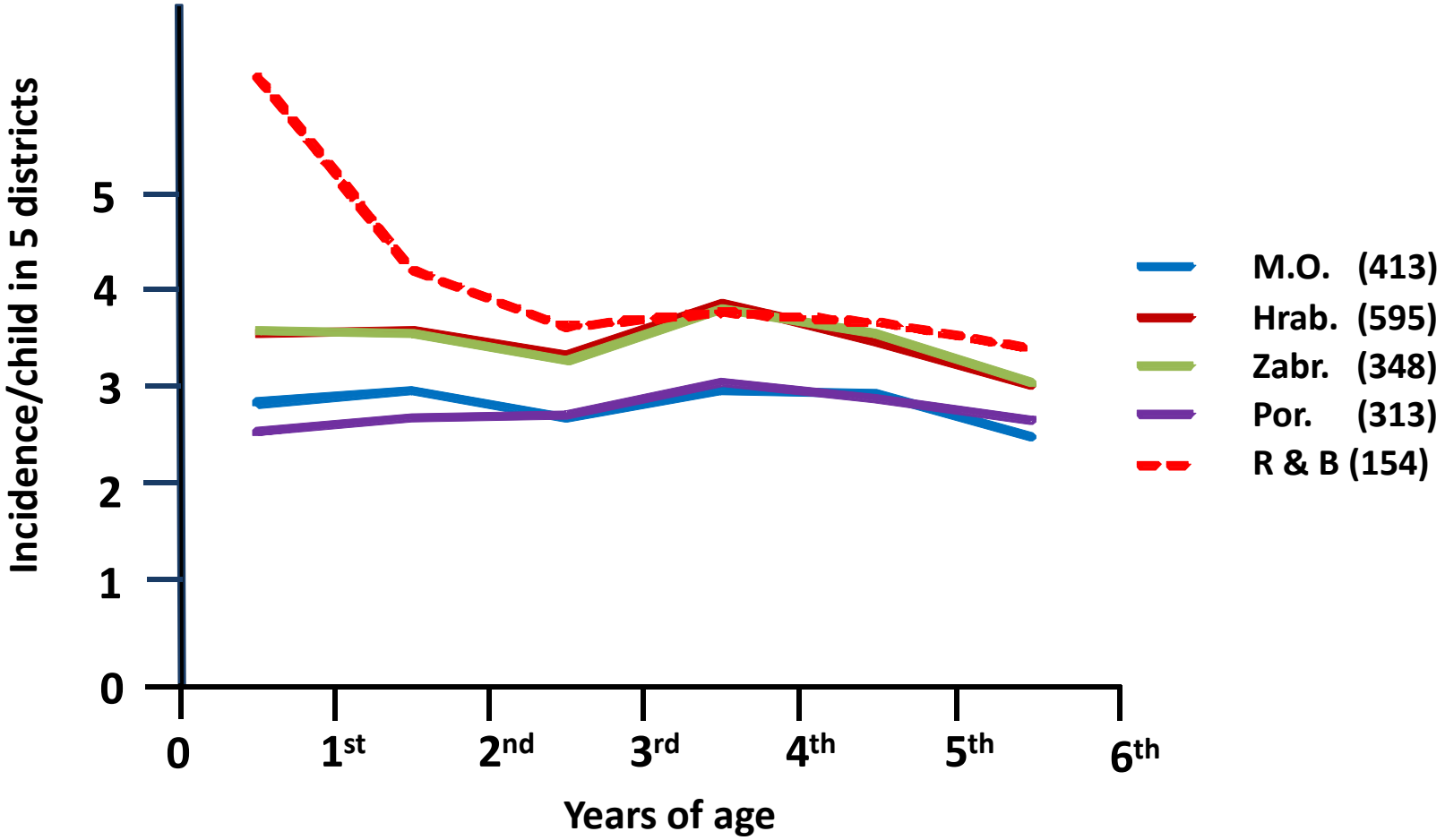
CHILDREN RESPIRATORY MORBIDITY

(URI + bronchitis + laryngitis + pneumonia + tonsillitis + otitis media)



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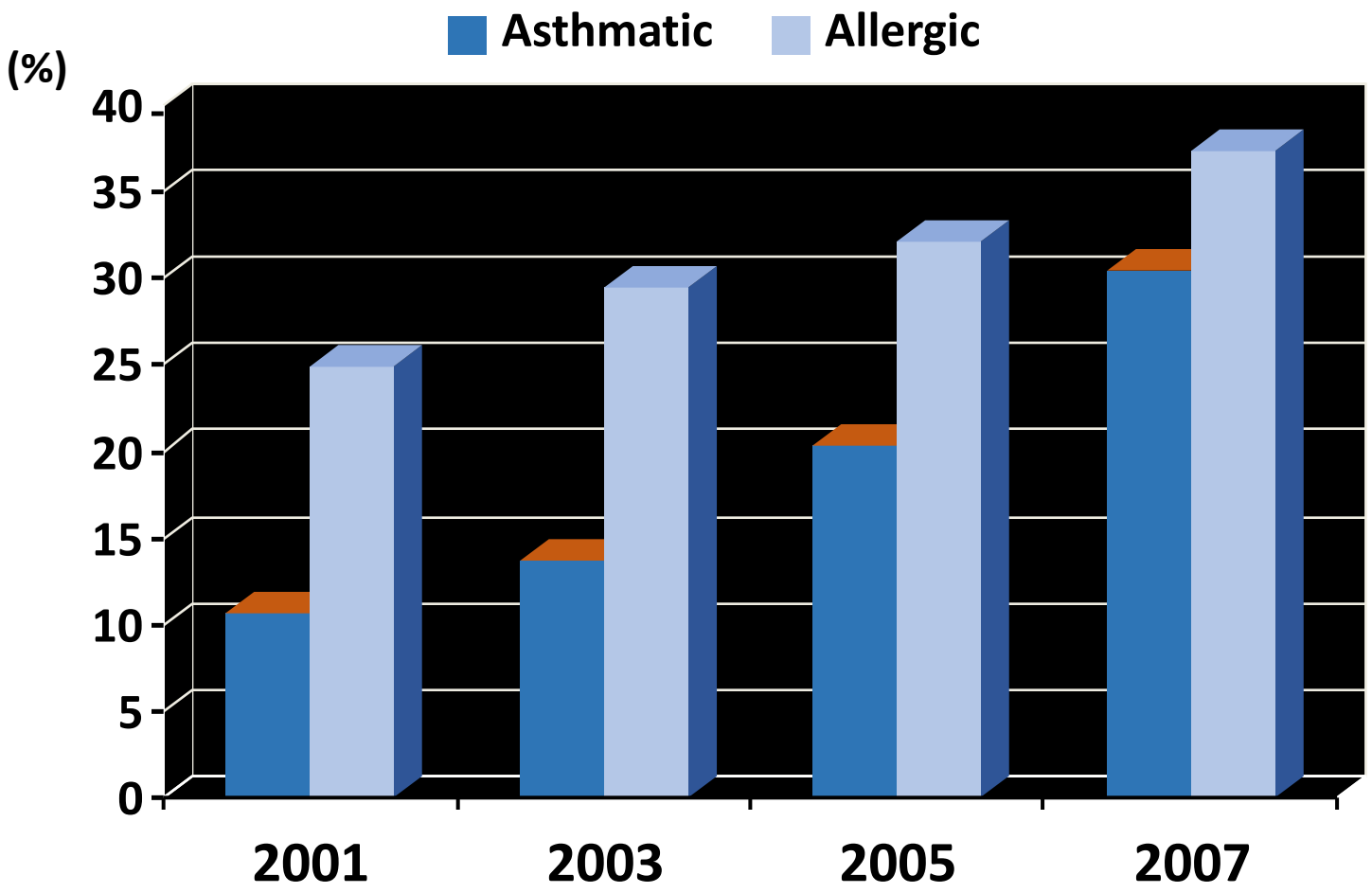
ASTHMATIC AND ALLERGIC CHILDREN

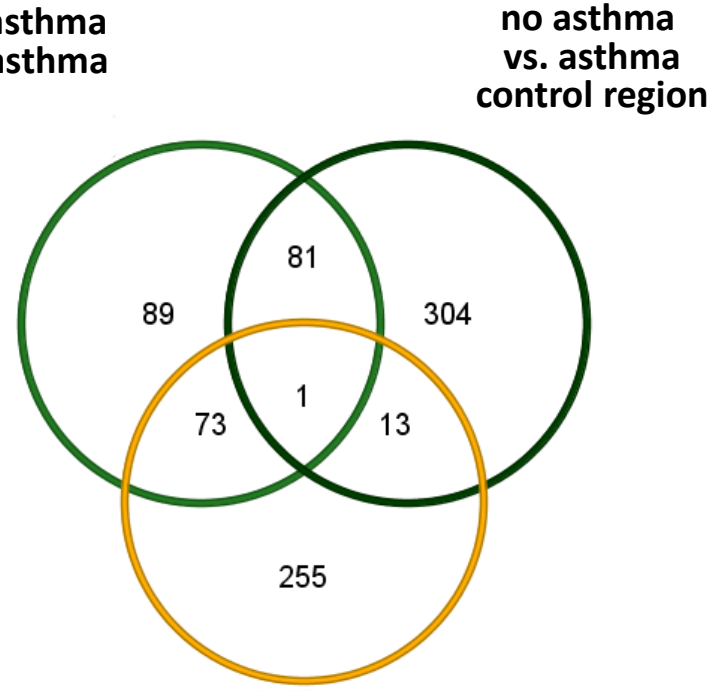
OSTRAVA – BARTOVICE 2001 - 2007



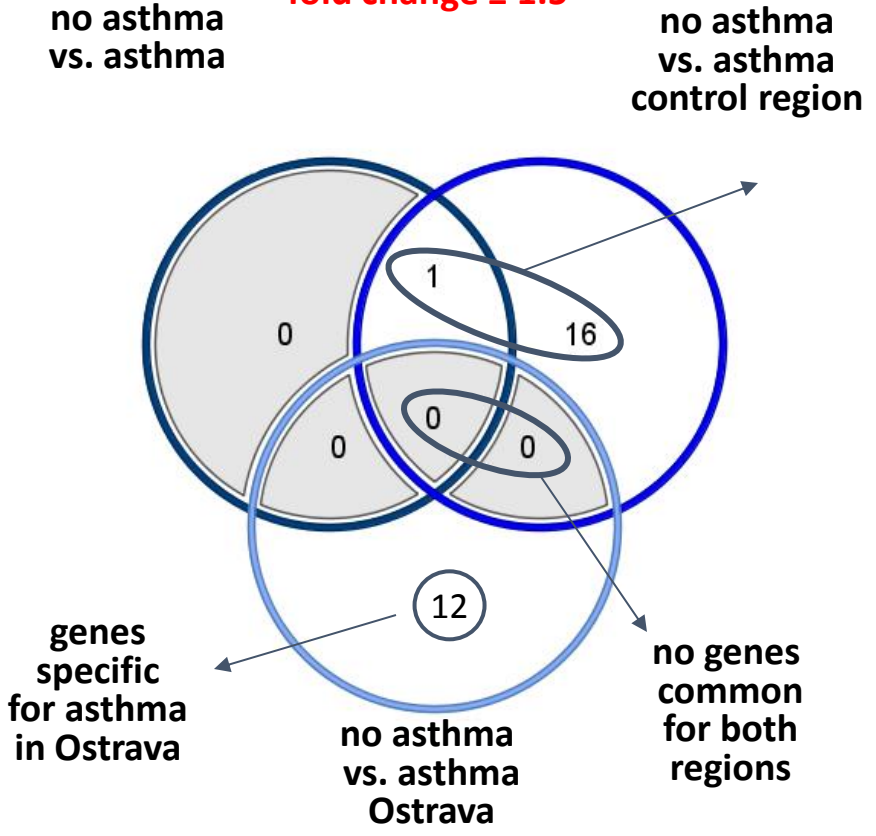
COMPARISON OF 'NO ASTHMA' VS. 'ASTHMA' T-TEST RESULTS

In the Venn diagrams shown below, the t-test results obtained using all experiments either with a p-value cutoff of 0.01 or a p-value cutoff of 0.01 and at least a 1.5 fold change are compared

P-value ≤ 0.01



P-value ≤ 0.01
fold change ≥ 1.5



SUMMARY

- Results indicate disease specific and region-dependent gene expression profiles.
- Gene expression profiles for asthma children are different between the polluted and control regions.
- In each region were observed specific transcripts comparing asthma vs. no asthma, 17 transcripts in the control region, 12 transcripts in the polluted region.
- Comparing “no asthma” or “asthma” groups, a strong region effect was observed (57 and 92 transcripts with > 1.5 fold changes).
- Asthma bronchiale in Prachatice – the allergic type of asthma response to allergens.
- Asthma bronchiale in Ostrava - the nonallergic type of asthma induced by irritants as air pollution, ETS, viruses.

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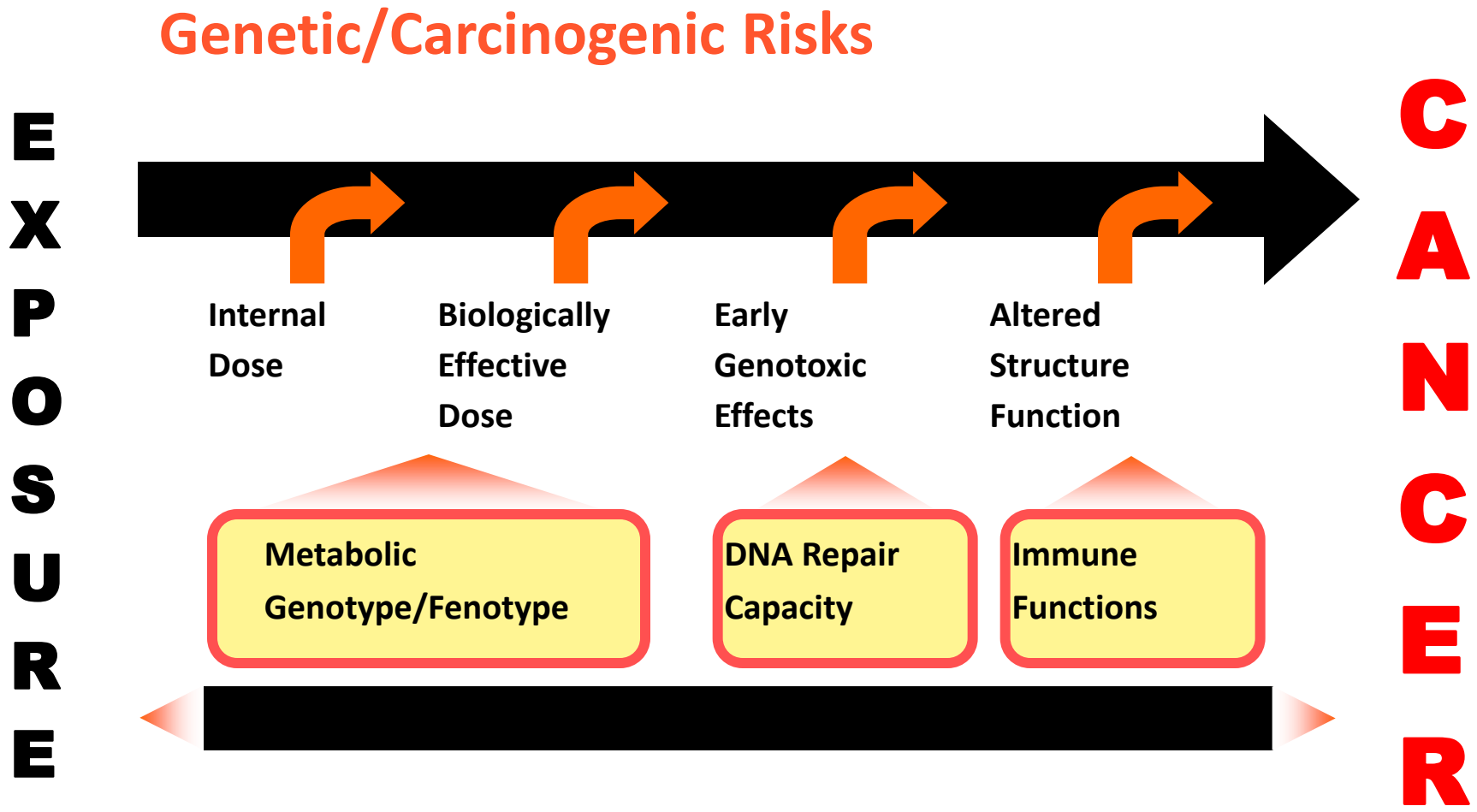
HUMAN BIOMARKERS



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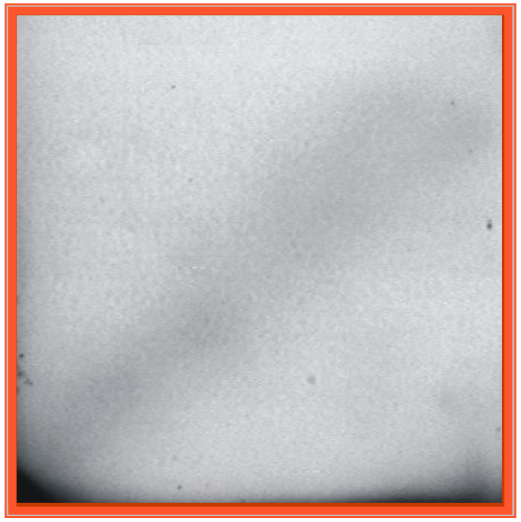
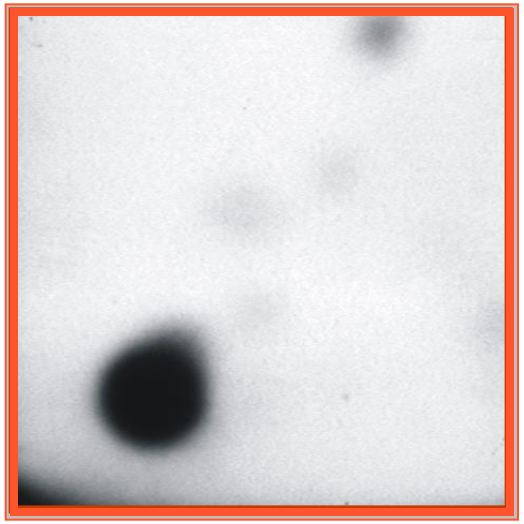
Environ Health Perspect 74: 3-9, 1987

Autoradiographs of thin layer chromatograms with DNA adduct pattern of:



DNA isolated from lymphocytes of subject sampled in January 2004 (1st sampling period)

Water blank



Positive control (DNA isolated from the lung of rats intraperitoneally treated with 100 mgB[a]P/kg b.w.)

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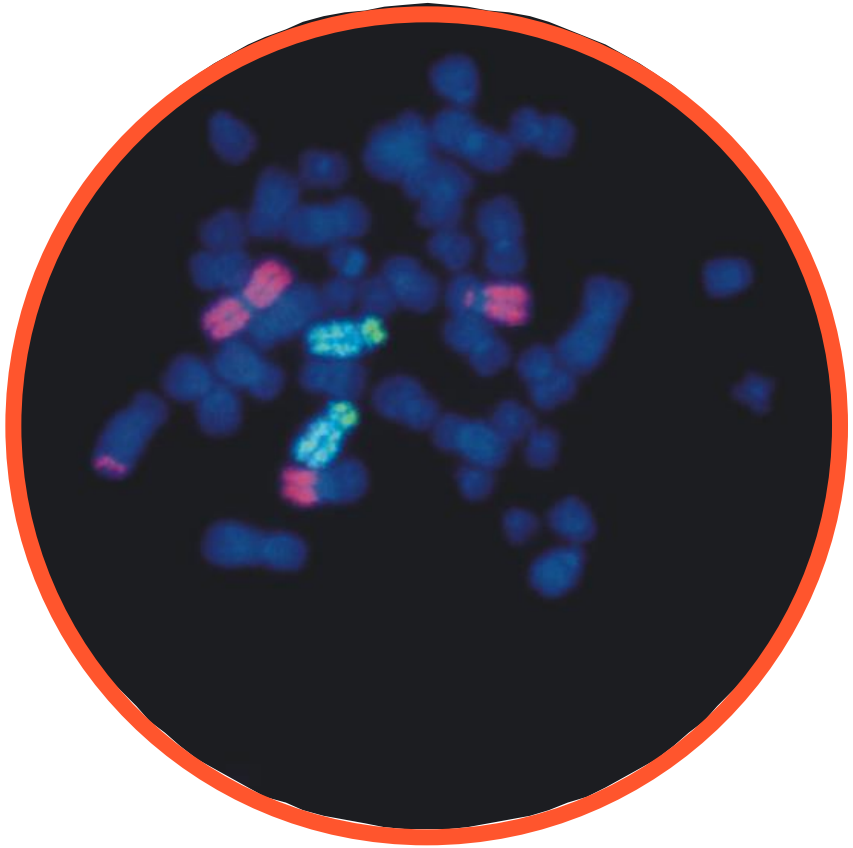
CYTOGENETIC ANALYSIS

FISH analysis



t(Ab);t(Ab);t(Ba)

Three translocations between chromosome 1 and unpainted chromosomes

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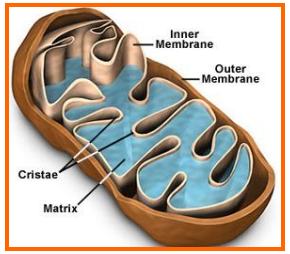
Reactive oxygen species

Endogenous sources



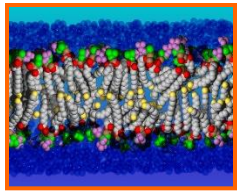
Exogenous sources




O_2^- —SOD→ H_2O_2 —Catalase→ $H_2O + O_2$

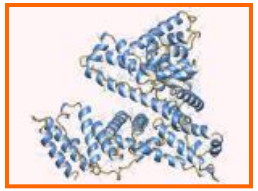
H_2O_2 —GPx→ H_2O

H_2O_2 → $OH^\bullet$



Lipid peroxidation

DNA oxidation



Protein oxidation

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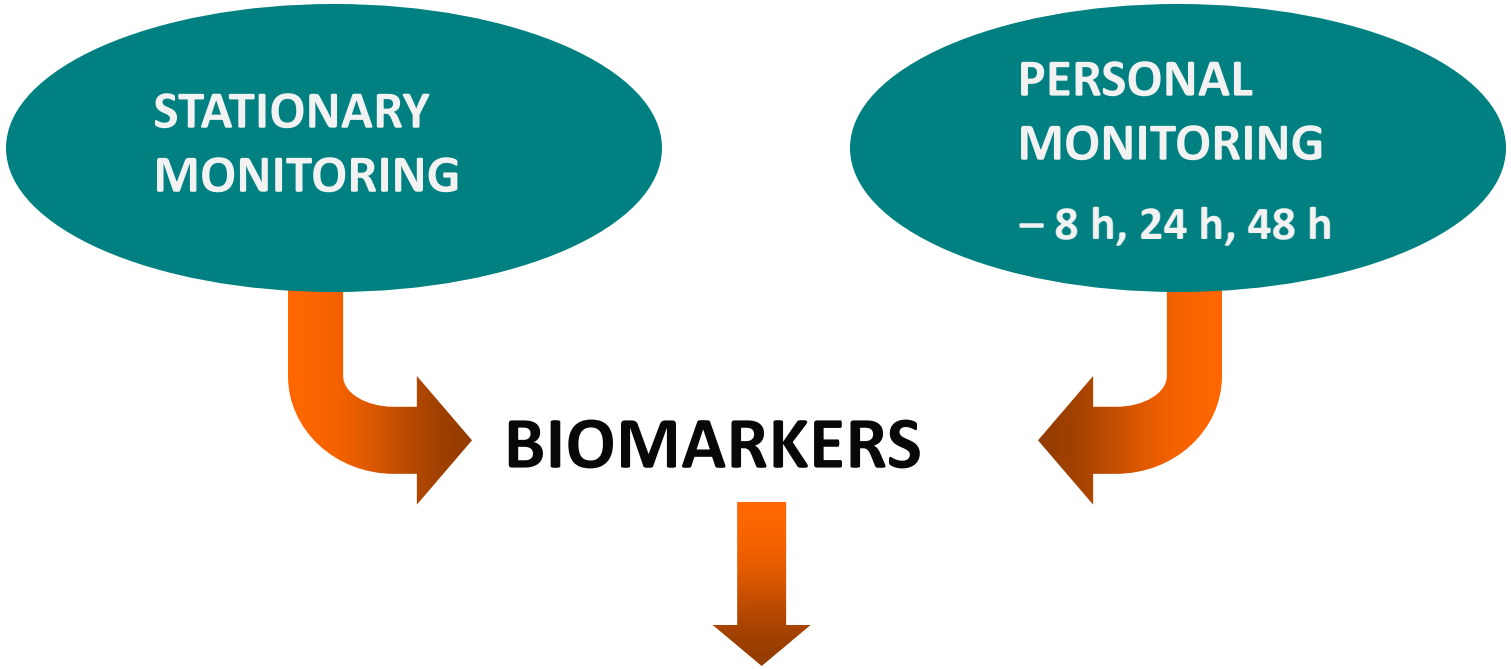
EXPOSURE VS. BIOMARKERS



hours (SCGE)

weeks (DNA adducts)

months (chromosomal aberrations)

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HUMAN STUDIES AND BIOMARKERS OF EXPOSURE, EFFECT AND SUSCEPTIBILITY

- PM2.5 Stationary monitoring
- c-PAHs Personal monitoring
  Stationary monitoring
- VOC Personal monitoring
  Stationary monitoring
- Cotinine
- Triglycerids, Total, HDL and LDL cholesterol
- Vitamins A, C, E
- DNA adducts by ^{32}P-postlabeling
- Chromosomal aberrations
  conventional, FISH,
  micronuclei
- Oxidative damage
  8-oxodG, 15-F2T-isoP, proteins, SCGE
- Genetic polymorphisms
- Gene expression

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PERSONAL MONITORING IN PRAGUE

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PERSONAL SAMPLING OSTRAVA

January 11 – 28, 2010

B[a]P → 14.6 ng/m³

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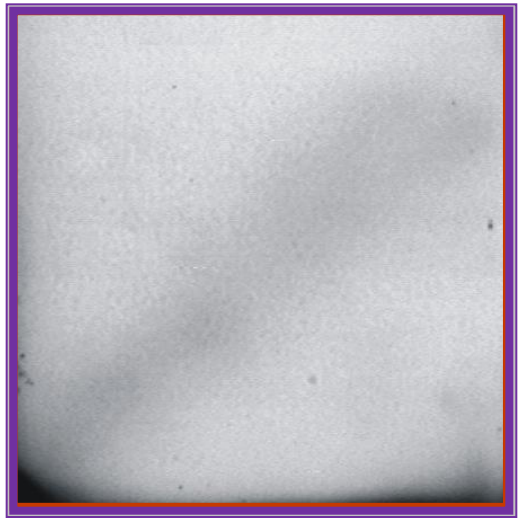
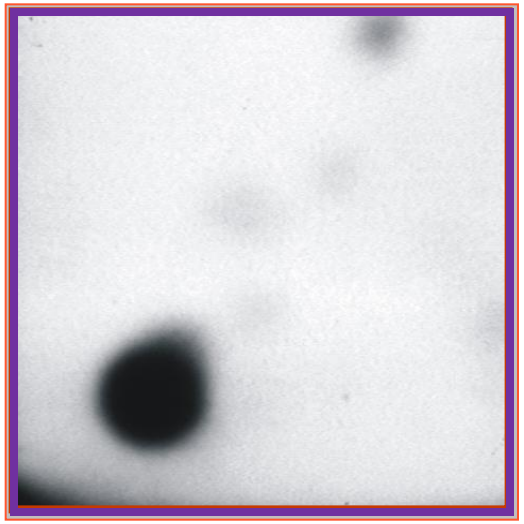
Autoradiographs of thin layer chromatograms with DNA adduct pattern of:



DNA isolated from lymphocytes
of subject sampled
in January 2004
(1st sampling period)

Water blank



Positive control
(DNA isolated from the lung of rats
intraperitoneally treated
with 100 mgB[a]P/kg b.w.)

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DNA adducts

	N	B[a]P ng/m³		B[a]P –"like"		Total	
		2009	2010	2009	2010	2009	2010
Prague	64	0.80 ± 0.55	2.86 ± 1.87	0.21 ± 0.06	0.25 ± 0.12	1.30 ± 0.41	1.37 ± 0.47
Ostrava	98	2.73 ± 2.60*	14.8 ± 13.3*	0.28 ± 0.08*	0.16 ± 0.06*	1.37 ± 0.37	1.03 ± 0.33*
Controls	42	0.80 ± 0.62		0.10 ± 0.03		0.76 ± 0.20	

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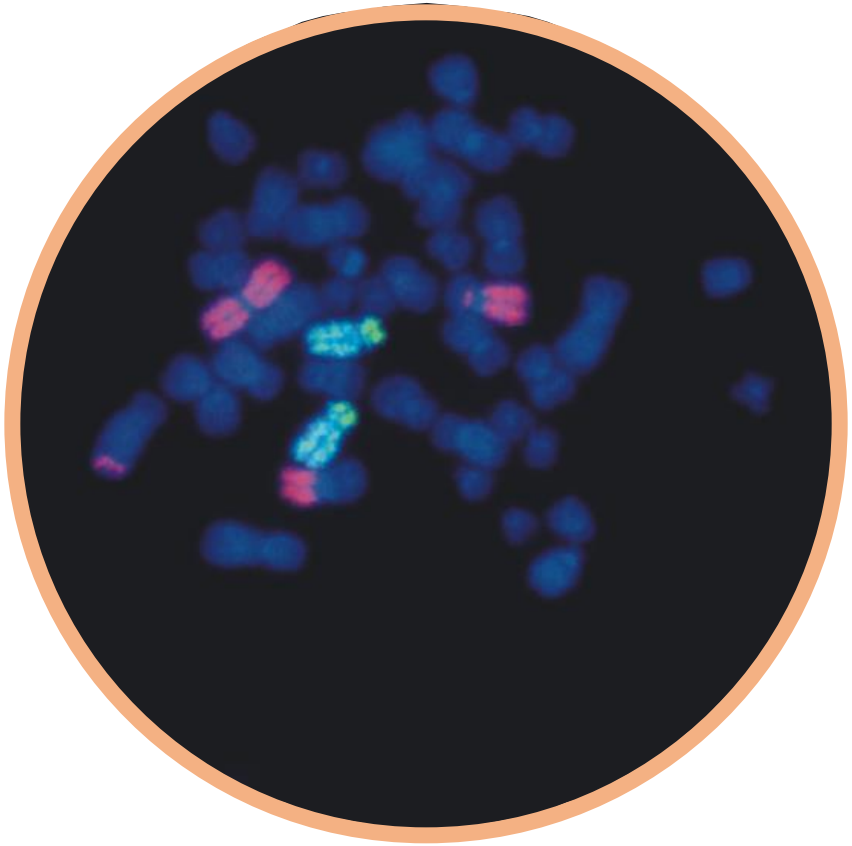
CYTOGENETIC ANALYSIS

FISH analysis



t(Ab);t(Ab);t(Ba)

Three translocations between chromosome 1 and unpainted chromosomes

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Genomic frequency of translocations (FISH)

	N	B[a]P ng/m³		% AB.C.		F_G/100	
		2009	2010	2009	2010	2009	2010
Prague	60	0.80 ± 0.55	2.86 ± 1.87	0.27 ± 0.18	0.23 ± 0.15	1.43 ± 1.15	1.39 ± 1.03
Ostrava	98	2.73 ± 2.60	14.8 ± 13.3*	0.26 ± 0.19	0.22 ± 0.18	1.44 ± 1.23	1.25 ± 1.18
Controls	42	0.80 ± 0.62		0.21 ± 0.16		1.13 ± 1.01	

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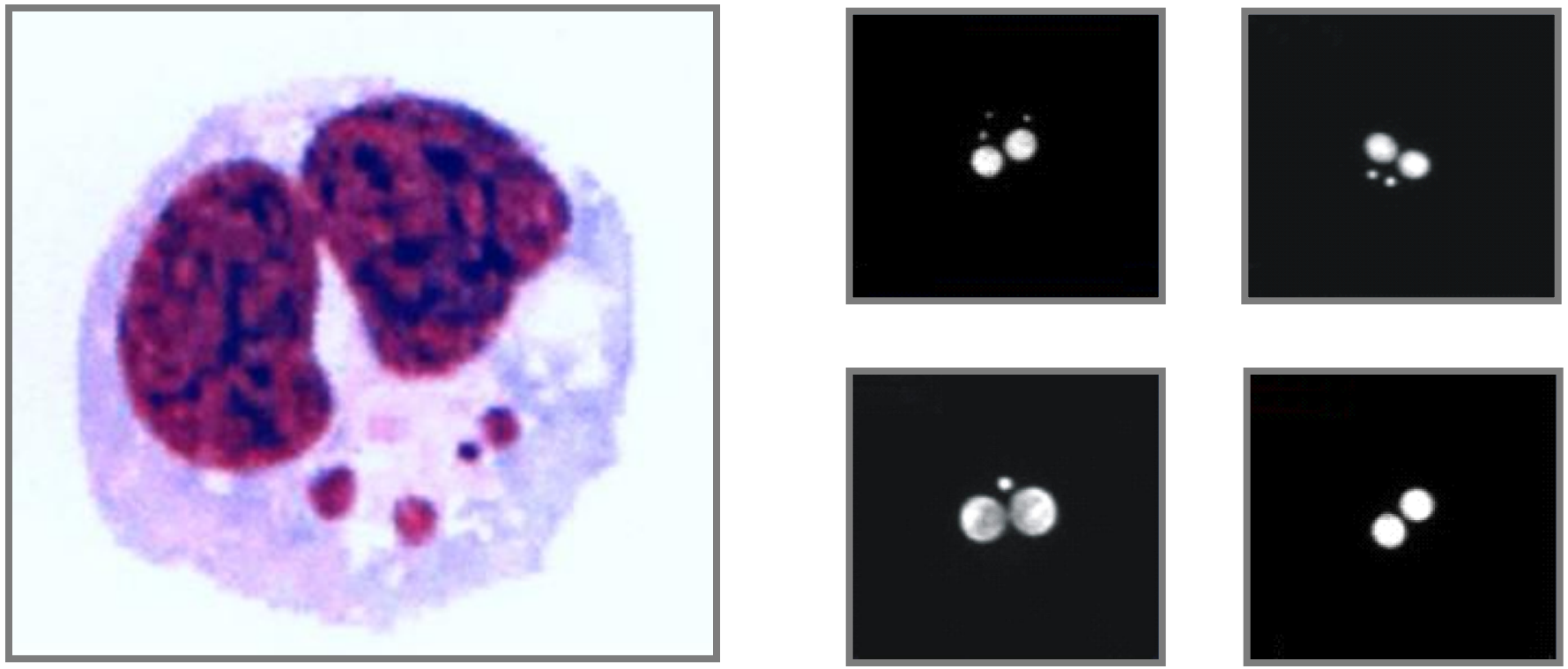
MICRONUCLEI



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FREQUENCY OF MICRONUCLEI

(impact of 3-weeks stay in Ostrava region, January 2010)

Groups	sampling	N (6000 b./person)	% AB.B. S MN	MN/1000
controls	I.	4	0.81 ± 0.15	8.32 ± 1.63
	II.	4	0.80 ± 0.14	8.47 ± 1.55
exposed	I.	4	0.74 ± 0.43	7.96 ± 4.92
	II.	4	1.14 ± 0.55	12.91 ± 6.49 *

* $p < 0.05$

Oxidative stress (in winter)
15-F2t-isoprostane (pg/ml)

	N	B[a]P ng/m^3		15-2Ft-IsoP	
		2009	2010	2009	2010
Prague	60	0.80 ± 0.55	2.86 ± 1.87	165.9± 41.7	256.5 ± 104.7*
Ostrava	98	2.73 ± 2.60*	14.8 ± 13.3*	279.3± 303.6*	279.5 ± 124.5

* $p < 0.05$

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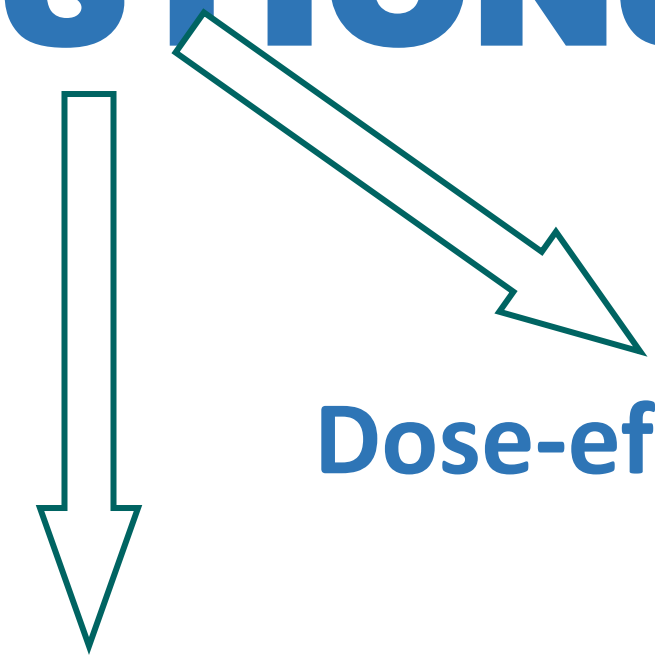
QUESTIONS



Dose-effect relationship?

Possible adaptive response ?

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PROJECT G-NEW

1) **100 mothers**

100 newborns

Summer 2013

Karvina (exposed)
Ceske Budejovice (control)

100 mothers

100 newborns

Winter 2014

Karvina (exposed)
Ceske Budejovice (control)

2) **Impact of diet**

10 mothers – diet for 7 days

Each season & location

PROJECT G-NEW

- PM2.5Hi-Vol monitoring
- c-PAHs Hi-Vol monitoring

- Mothers
- Urine 8-oxodG, PAHs
- Plasma 15-F2T-isoP, cotinine, metabolomics
- Milk PAHs

- Diet PAHs, questionnaires

- Newborns

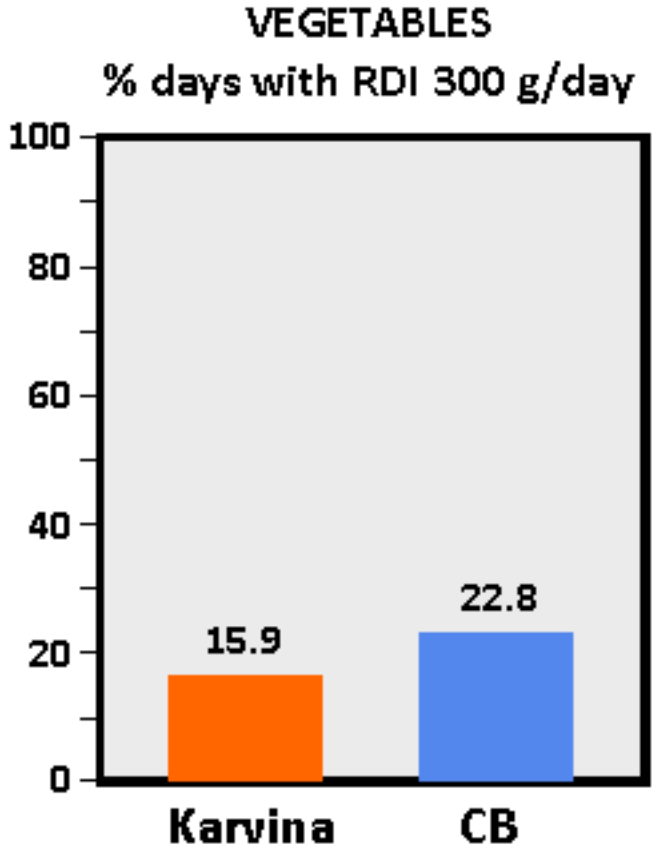
- DNA adducts by ^{32}P-postlabeling

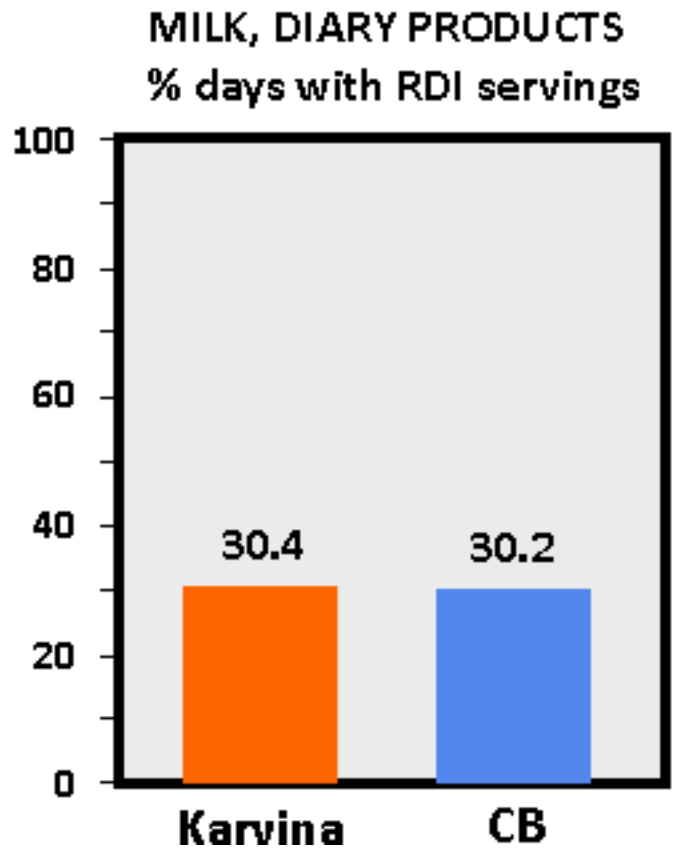
- Gene expression

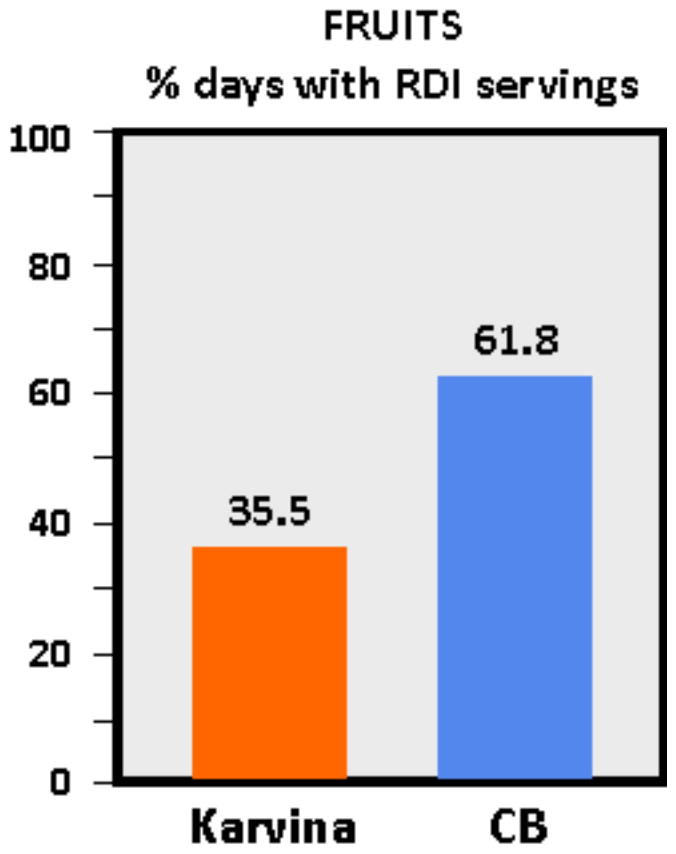
- Plasma 15-F2T-isoP, metabolomics

- Urine 8-oxodG, PAHs

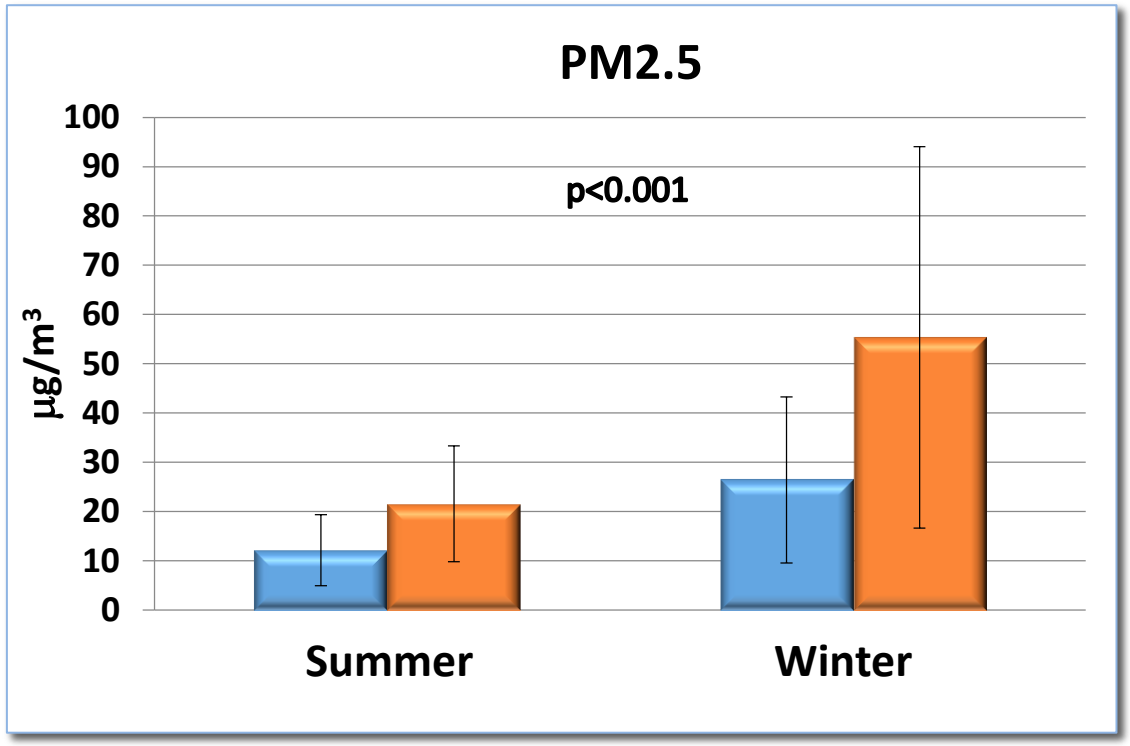
NUTRITIONAL QUALITY OF DIET

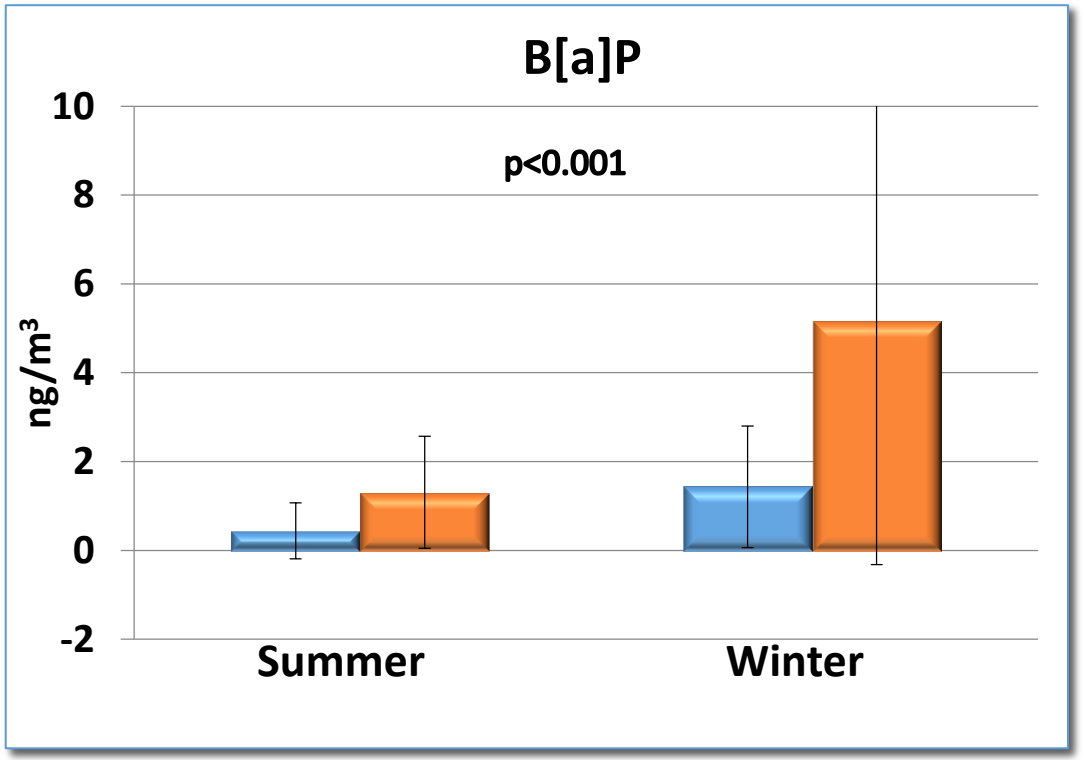






EXPOSURE TO PM 2.5 AND B[a]P





Ceske Budejovice

Karvina

PAHs IN DIET – CHEMICAL ANALYSIS

- ¼ of consumed diet
- Daily intake : 1.58 kg

C90 – 30.8.2013

C90 – 31.8.2013

C90 – 1.9.2013

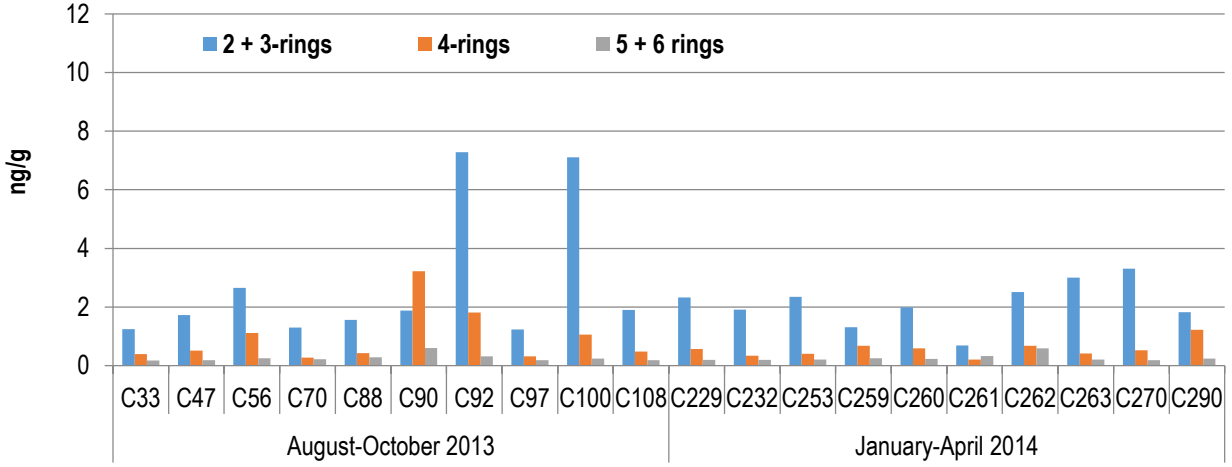
C90 – 2.9.2013

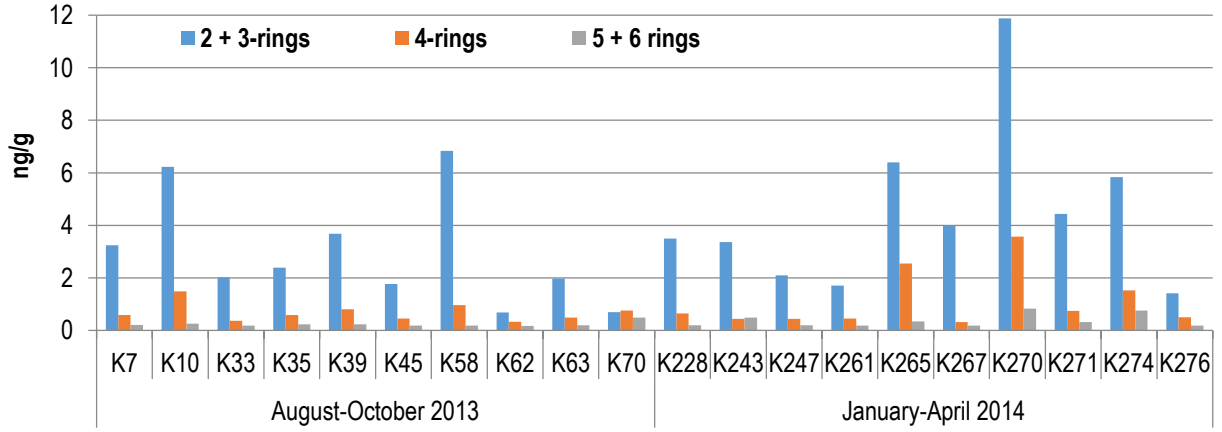
C90 – 3.9.2013

C90 – 4.9.2013

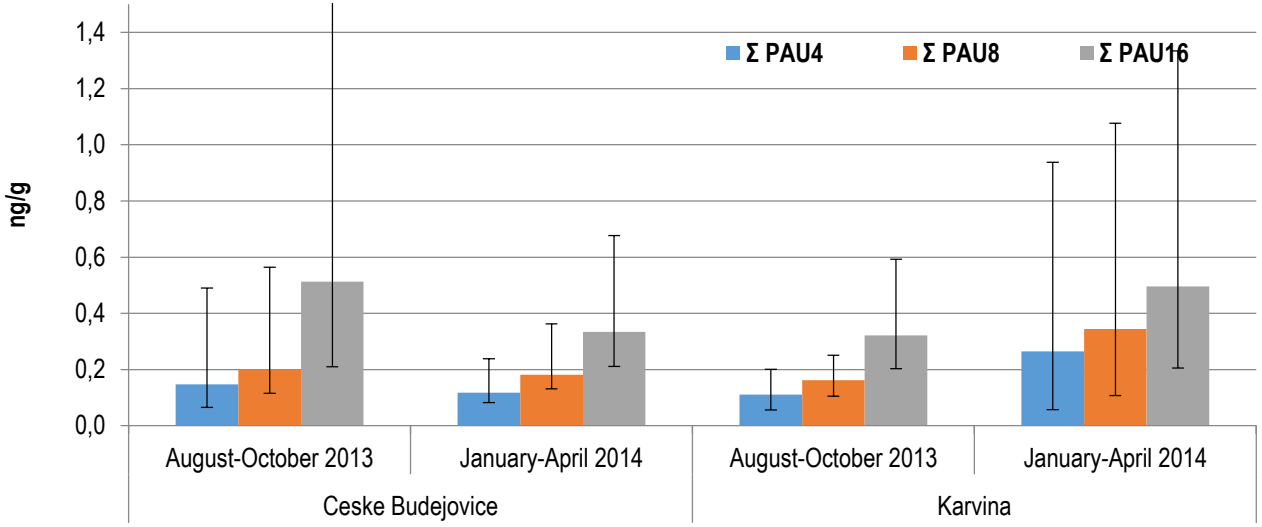
C90 – 5.9.2013

PAHs in diet

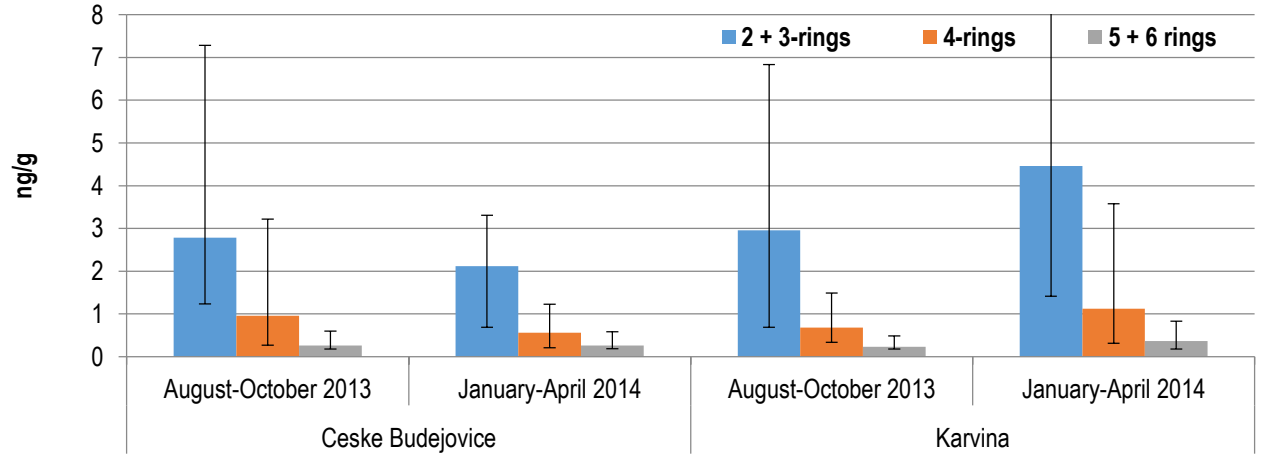




Σ PAH4: BaP, CHR, BaA, BbF
Σ PAH8: PAH4 ,BkFA, BghiP, DBahA, IP



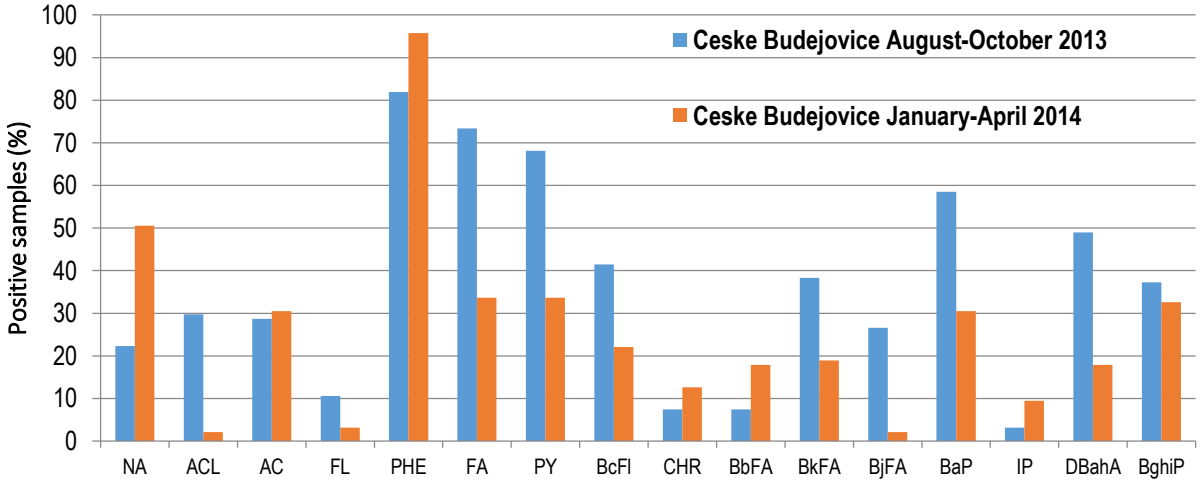
2 + 3-rings PAHs: NA, AC, ACL, FL, PHE, AN
4-rings PAHs: FA, PY, BaA, CHR, BcF, 5MC
5 + 6-rings PAHs: BbFA, BkFA, BjFA, BaP, DBahA, IP, BghiP, CPP, DBalP, DBaeP, DBaiP, DBahP

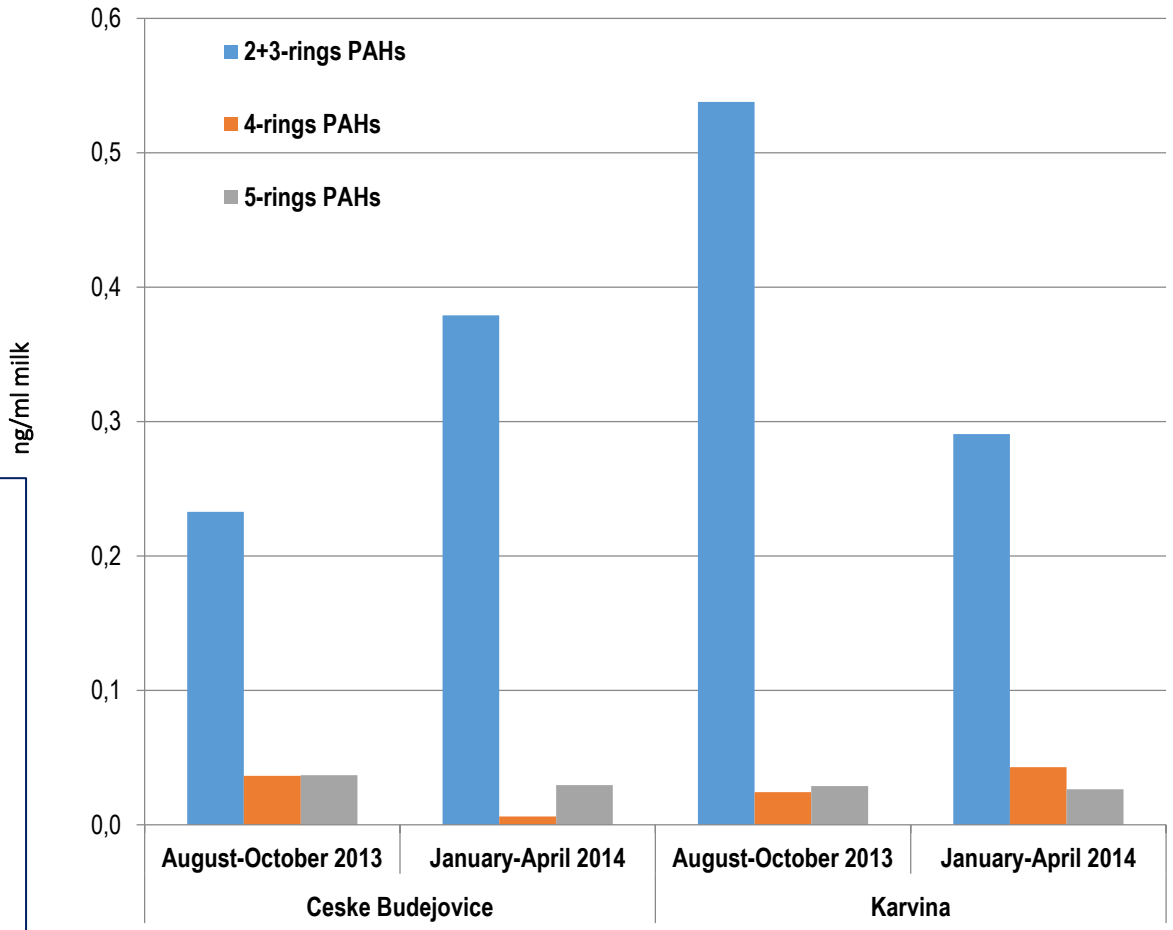


** Error bars indicate minimum and maximum concentration*

PAHs in human breast milk

2 + 3-rings PAHs: NA, AC, ACL, FL, PHE, AN
4-rings PAHs: FA, PY, BaA, CHR, BcF, 5MC
5 + 6-rings PAHs: BbFA, BkFA, BjFA, BaP, DBahA, IP, BghiP, CPP, DBalP, DBaeP, DBaiP, DBahP





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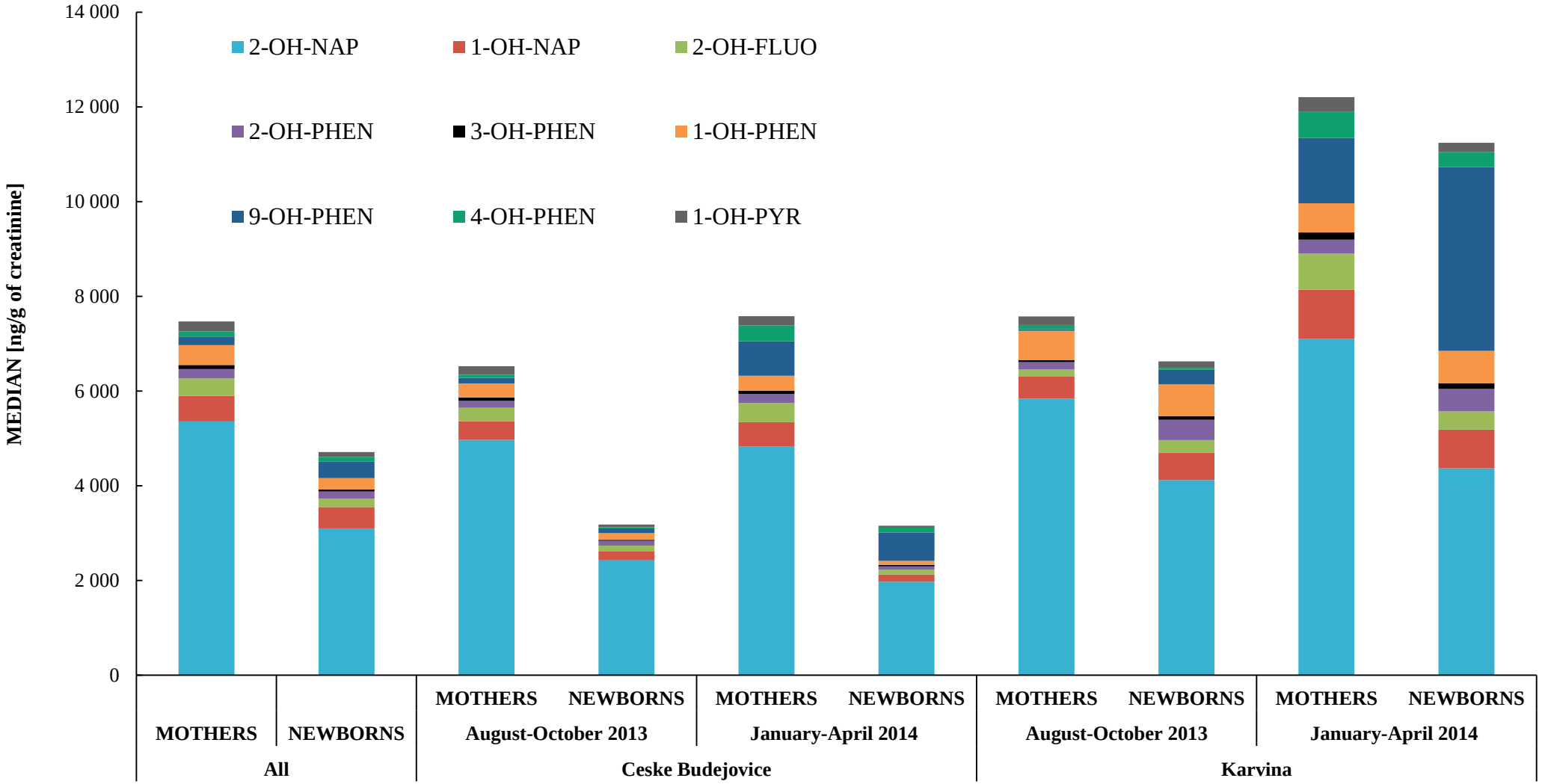
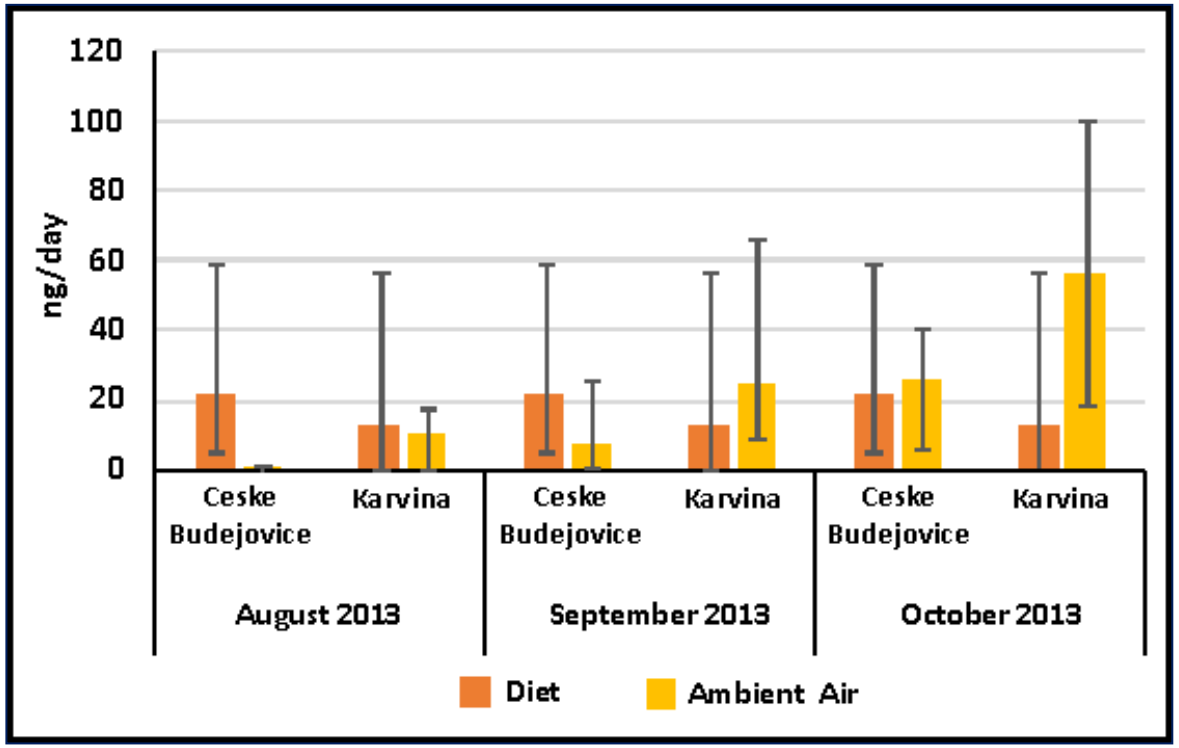
Relationship between atmospheric pollution in the residential area and concentrations of polycyclic aromatic hydrocarbons (PAHs) in human breast milk

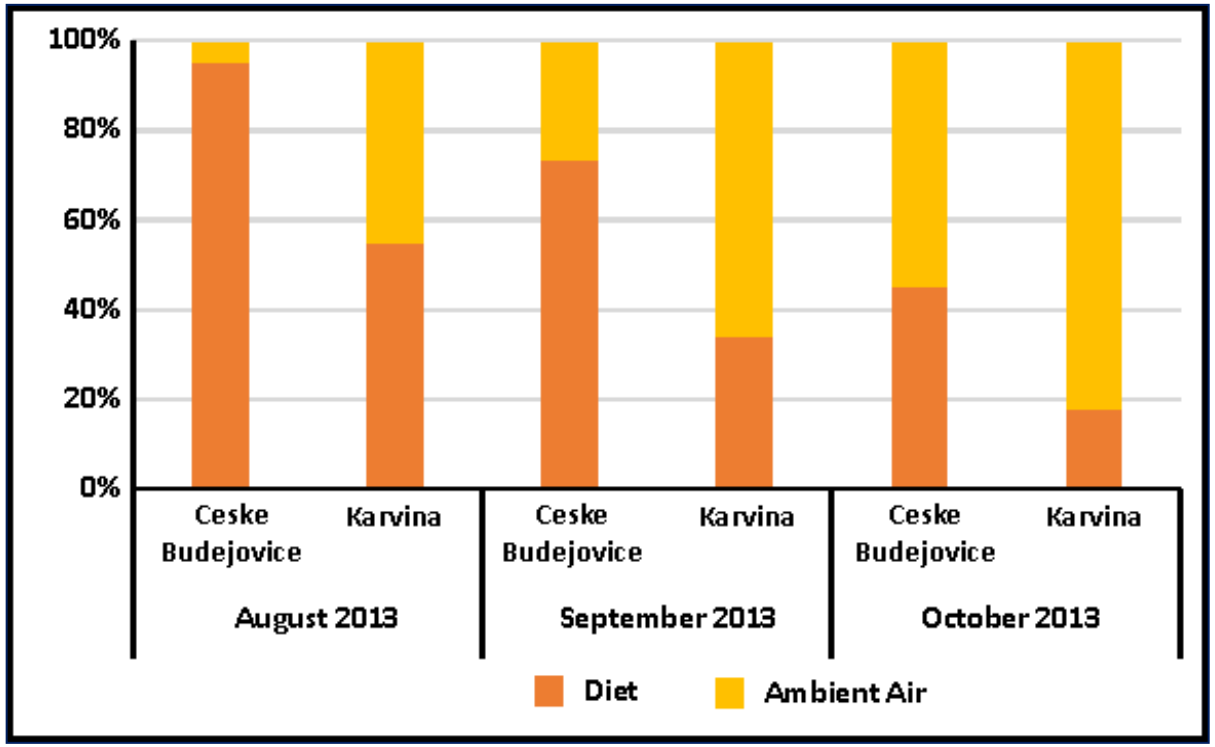
Jana Pulkrabova [a,*], Michal Stupak [a], Andrea Svarcova [a], Pavel Rossner [b], Andrea Rossnerova [b], Antonin Ambroz [b], Radim Sram [b], Jana Hajslova [a]

[*] University of Chemistry and Technology, Prague, Faculty of Food and Biochemical Technology, Department of Food Analysis and Nutrition, Technicka 3, 166 28 Prague 6, Czech Republic


MEDIAN [ng/g of creatinine]
14 000
12 000
10 000
8 000
6 000
4 000
2 000
0
2-OH-NAP
1-OH-NAP
2-OH-FLUO
2-OH-PHEN
3-OH-PHEN
1-OH-PHEN
9-OH-PHEN
4-OH-PHEN
1-OH-PYR
MOTHERS
NEWBORNS
MOTHERS
NEWBORNS
MOTHERS
NEWBORNS
MOTHERS
NEWBORNS
MOTHERS
NEWBORNS
MOTHERS
NEWBORNS
August-October 2013
January-April 2014
August-October 2013
January-April 2014
All
Ceske Budejovice
Karvina

INTAKE OF B[a]P FROM AMBIENT AIR AND DIET





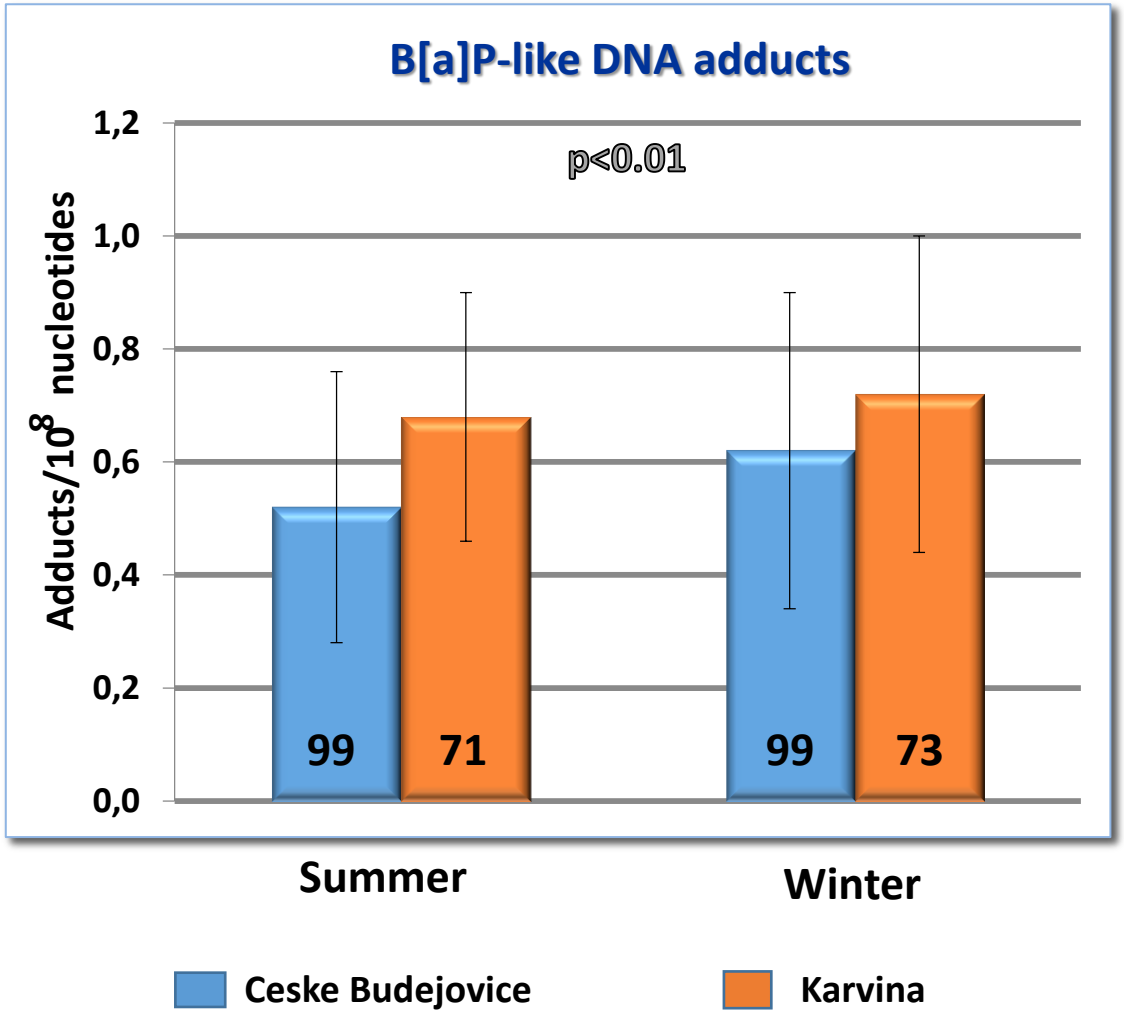
R.J. Sram, 2018

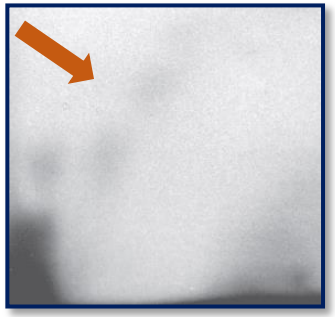
CONCLUSIONS

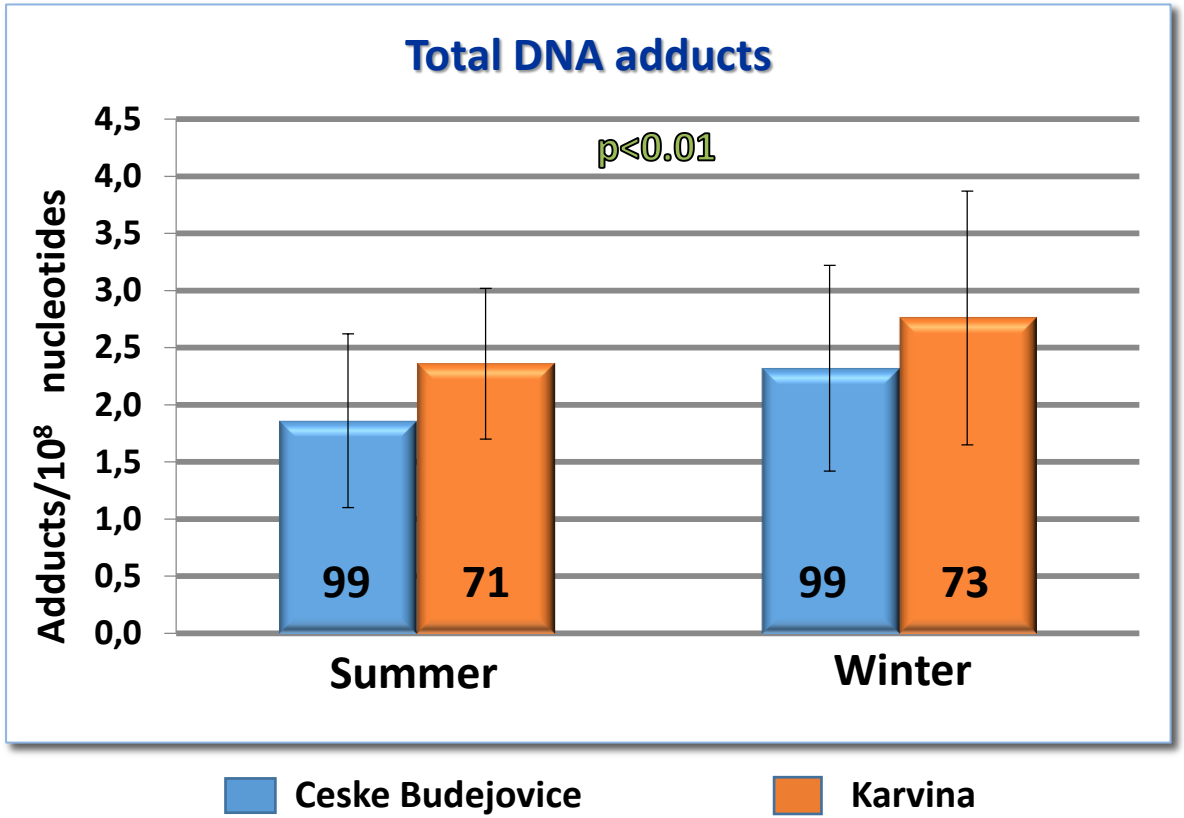
- The first such complex study on the assessment of human exposure to PAHs in the Czech Republic
- The first data on the levels of OH-PAHs in urine of the Czech population
  - Approximately 2x higher median ΣOH-PAHs in urine from winter period in Karvina compared to Ceske Budejovice

- HUMAN EXPOSURE
  - The importance to monitor both the dietary intake together with exposure via inhalation was documented
  - In summer period the major part of exposure (60 – 90%) is via diet while in winter more than 60% is via inhalation
  - Newborns – milk contribute by about 20 – 50% of the total exposure depending on the season

DNA ADDUCTS IN NEWBORNS

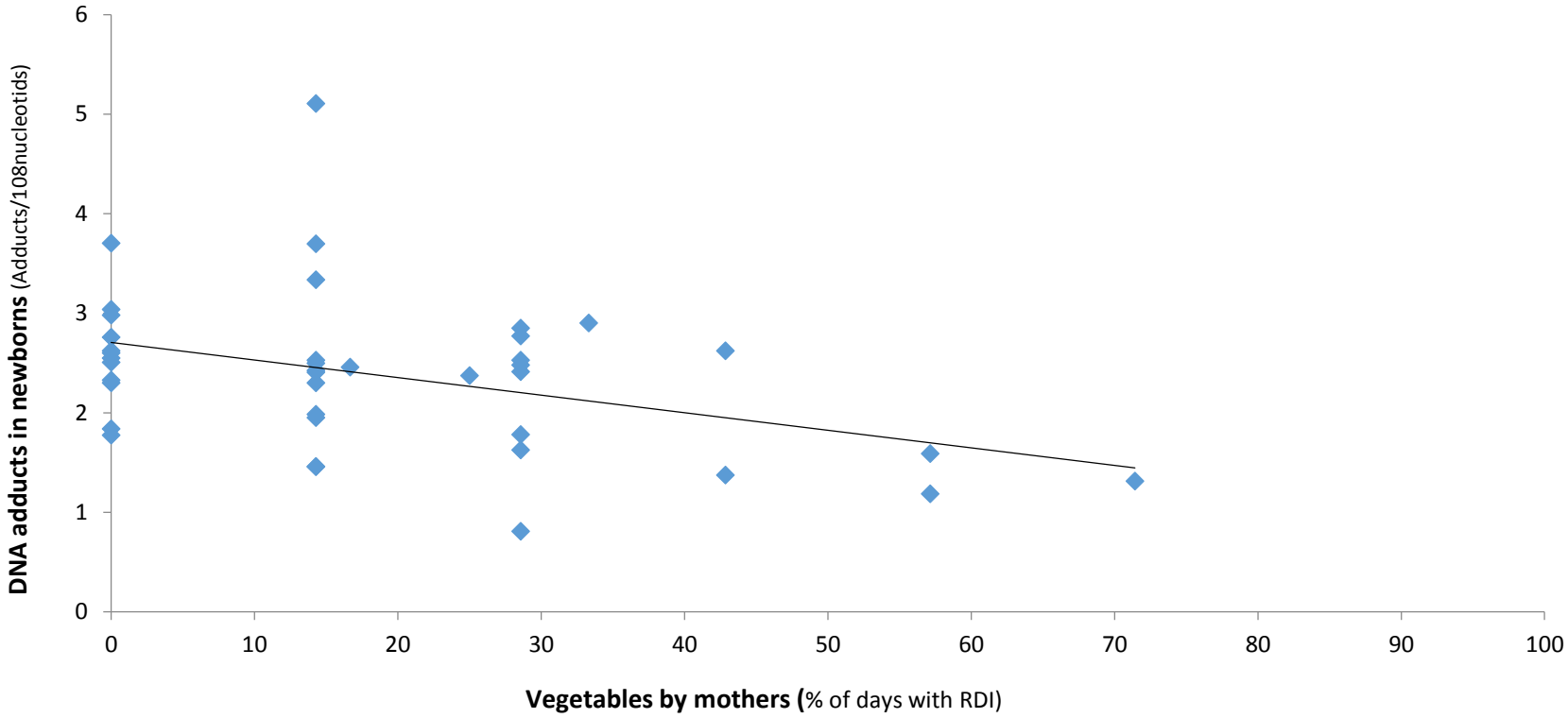






R.J. Sram, 2018

DNA adducts in newborns vs. vegetables intake by mothers



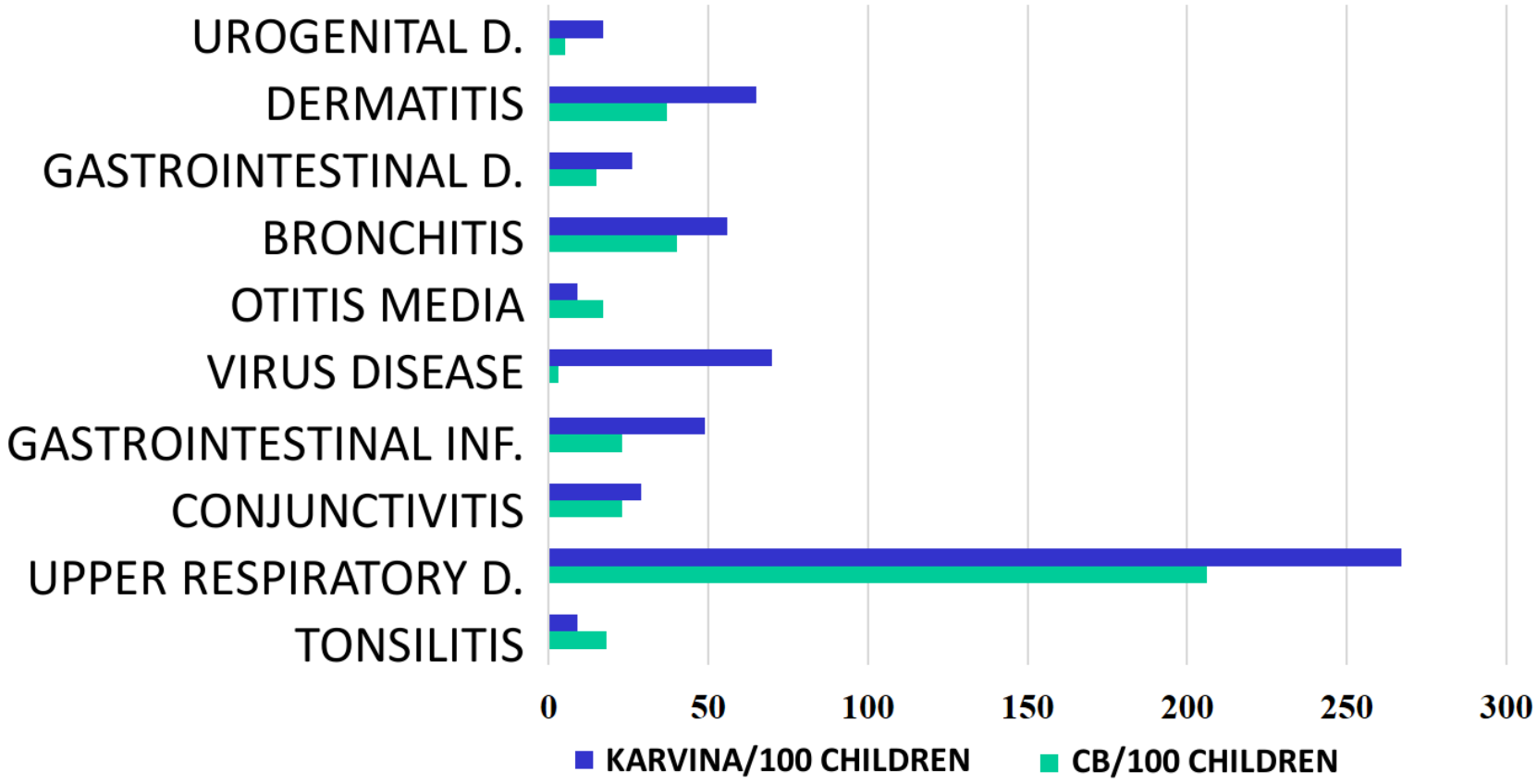
OXIDATIVE STRESS IN NEWBORNS

8- oxodG mmol/mmol creatinine

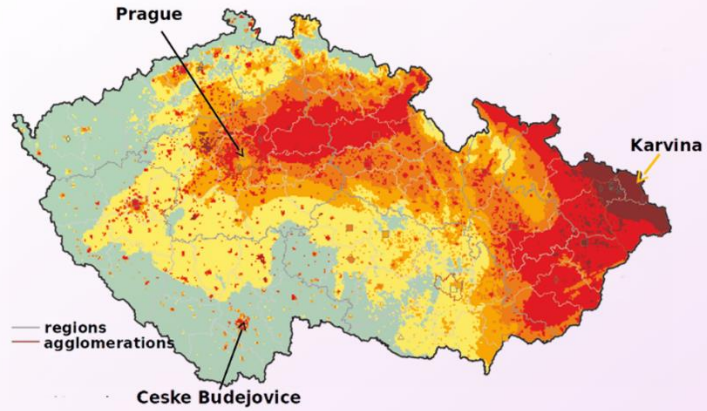
		N	
SUMMER	Ceske Budejovice	99	4.7 ± 1.4
	Karvina	71	4.7 ± 2.4
WINTER	Ceske Budejovice	99	4.2 ± 1.5
	Karvina	73	5.7 ± 2.9 ***

*** p<0.001

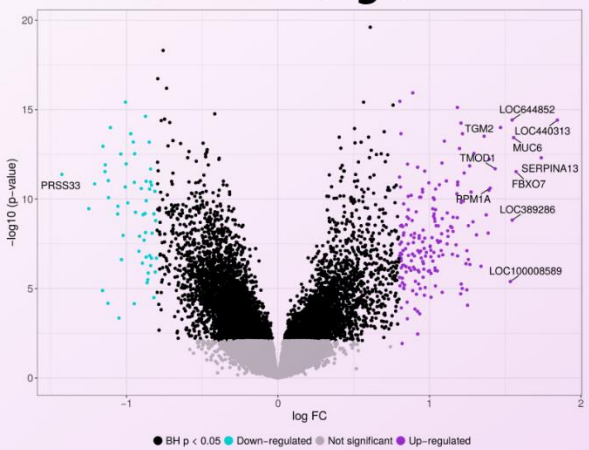
MORBIDITY OF CHILDREN AT 2 YS OF AGE



Comparison of locality and season



Karvina winter genes



MUC6 ↑
inflammatory
immune response

SERPINA13 ↑
blood coagulation
inflammation
Parkinson disease

FBOX7 ↑
oxidative stress in
neuron
Parkinson disease

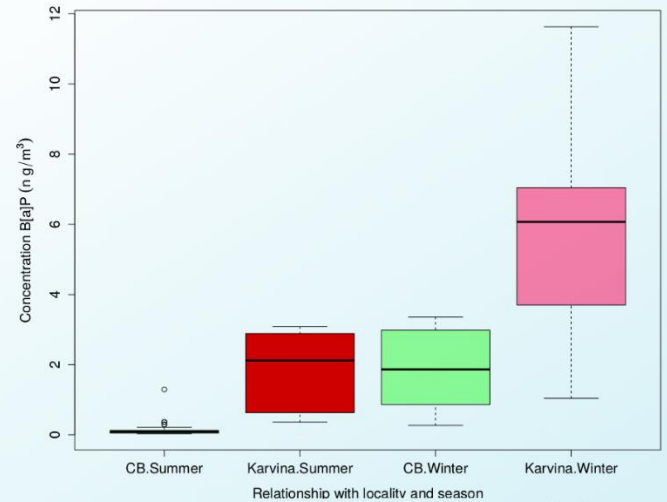
Karvina winter pathways

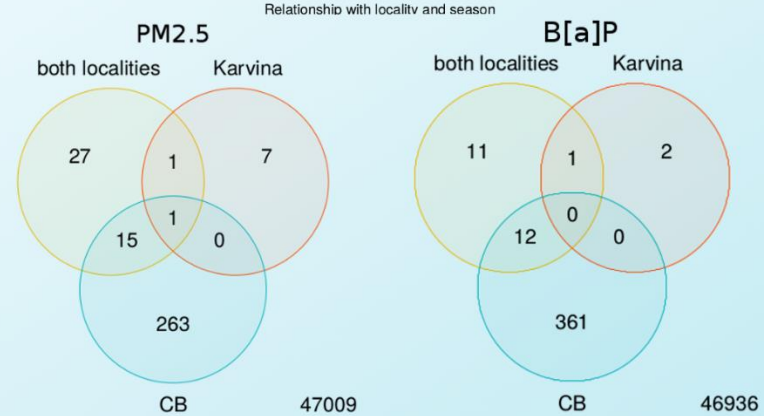
porphyrin and chlorophyll metabolism
heme synthesis, transportation, and metabolism

NRF2 pathway
cellular defense against oxidative stress

Neurotrophin signaling pathway
brain development processes

Influence of B[a]P and PM2.5





Karvina

TAF15 neurological disease (B[a]P)
FBXO41 immune system (PM2.5)

CB

The most of genes were correlated
in control locality.

CONCLUSIONS

1) Exposure to B[a]P represents a significant health risk for the population of the Czech Republic (62 % living in regions with the exposure > 1 ng/m3/year)
2) PM2.5 and B[a]P concentrations were higher in Karvina in both seasons
3) DNA adducts were significantly higher in newborns from Karvina in both seasons
4) DNA oxidative damage in newborns was higher in Karvina during winter
5) Increased concentrations of PAHs metabolites in children urine were associated with decreased birth length, birth weight and head circumference
6) Diet may be a significant source of PAHs exposure, especially when their concentrations in ambient air are lower
7) Morbidity of children at 2 ys of age was higher in a more polluted district

CONCLUSIONS

DUE TO A HIGH AIR POLLUTION CZECH REPUBLIC SEEMS TO BE A PARADISE TO STUDY THE IMPACT OF PM2.5 AND PAHs EXPOSURE TO HUMAN HEALTH, ESPECIALLY TO CHILD DEVELOPMENT

ACKNOWLEGEMENT

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Thank you for your attention

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QUALITAS
Kvalitní život
ve zdraví i nemoci

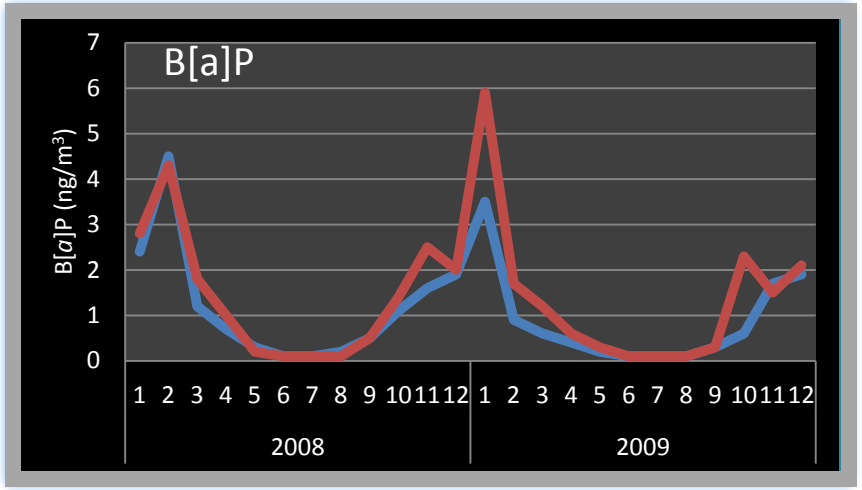
Akademie věd
České republiky
Strategie AV21
Špičkový výzkum ve veřejném zájmu

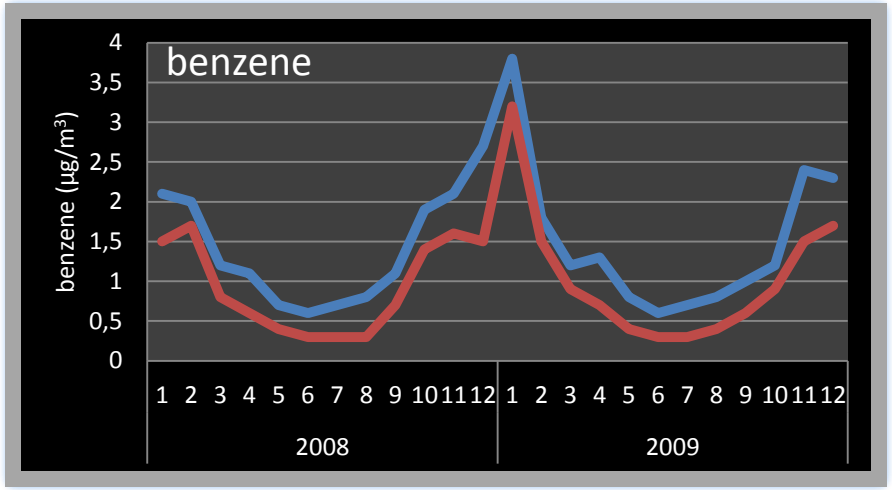
CHANGES
IN THE TRANSCRIPTOME
OF PREGNANT MOTHERS

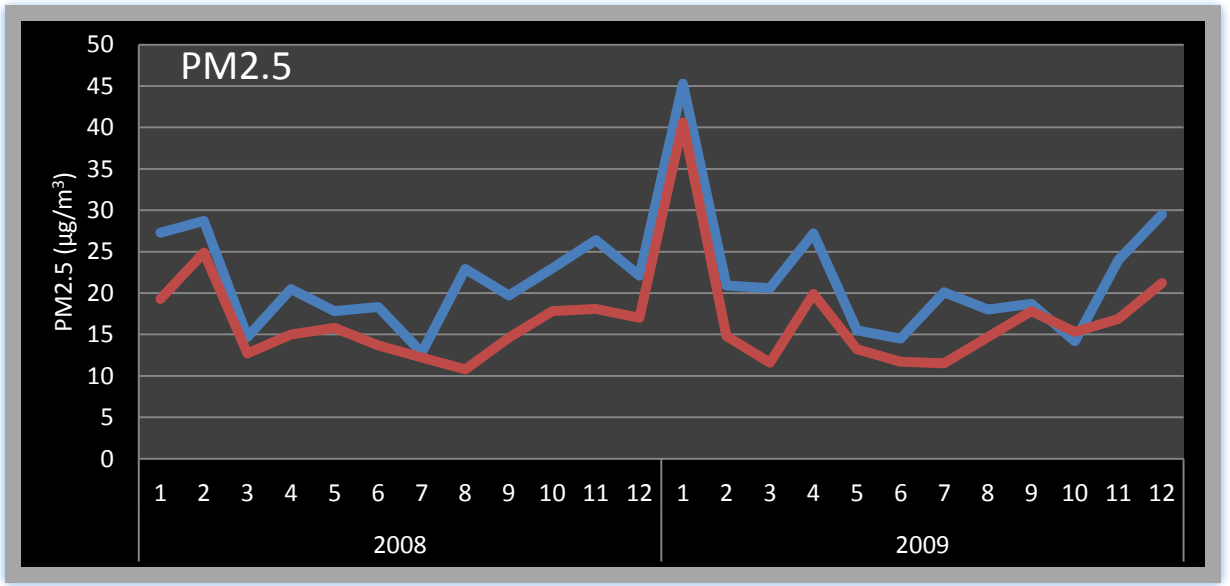
R. J. Sram 2018

CONCENTRATIONS OF POLLUTANTS
(months)

Prague Ceske Budejovice







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DNA ADDUCTS IN MOTHERS AND NEWBORNS
(^{32}P-postlabeling)

(Prague vs. Ceske Budejovice)

Adducts/10^8 nucl.	N	Peripheral blood mothers		Cord blood		Placenta	
		Average ± S.D.		Average ± S.D.		Average ± S.D.	
		B[a]P-like	Total	B[a]P-like	Total	B[a]P-like	Total
Prague	80	0.24±0.18	1.23±1.09	0.23±0.18	0.98±0.89	0.24±0.18	1.15±1.06
Ces. Budejovice	76	0.44*±0.39	1.59*±1.46	0.41*±0.41	1.40*±1.31	0.54*±0.48	1.94* #±1.46

R. J. Sram 2018

OXIDATIVE DAMAGE

Lipid peroxidation (15-F_{2t}-isoprostane)

		Peripheral blood mothers	*Cord blood*
pg/ml of plasma	*N*	mean ± S.D.	mean ± S.D.
Prague	*80*	192.9 ± 121.4	304.7 ± 211.9
Ceske Budejovice	*76*	129.8 ± 118.7	147.0 ±125.0*

MICRONUCLEI IN NEWBORNS

PRAGUE
(86)
2.17 MN/1000 BC

CESKE BUDEJOVICE
(92)
3.82 MN/1000 BC

TOWN
(40)
3.45 MN/1000 BC

VILLAGES
(52)
4.11 MN/1000 BC

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DEREGULATION OF GENES

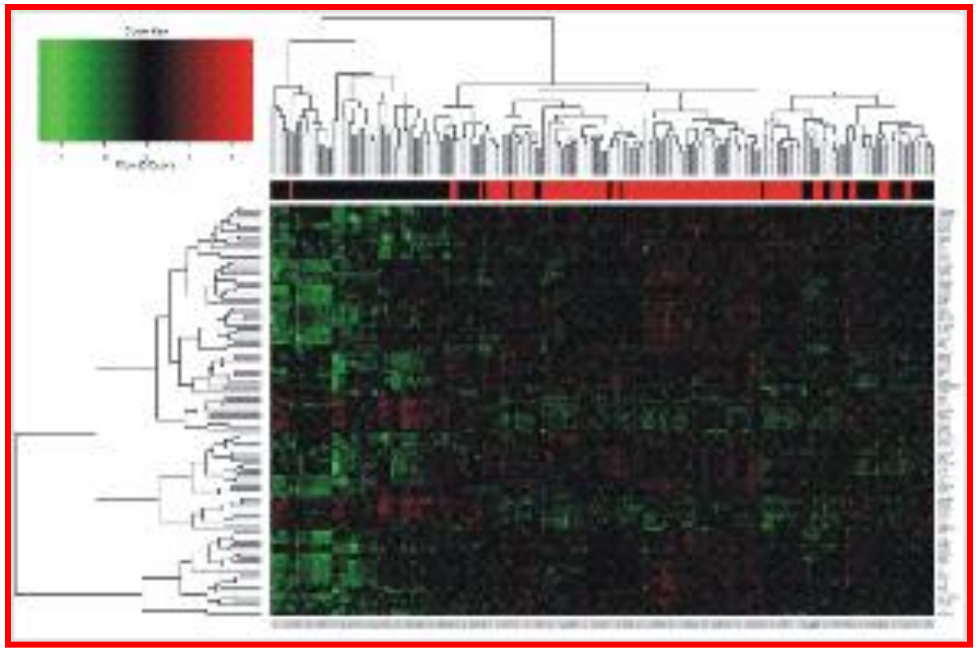
Cord blood

Change: 104 genes

37 ↑

67 ↓

CB



Increased expression in CB:
genes related to metabolism of xenobiotics

Decreased expression in CB
genes related to immune response and autoimmune diseases

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CONCLUSIONS

- Studies of transcriptome indicate a new knowledge about a possible effect of air pollution to children health
- Surprisingly, the monthly exposure to B[a]P > 2.8 ng/m^3 increased IUGR as well as the deregulation of genes in newborns
- We should try to learn what is the impact of those data for the child development, specifically the effect of c-PAHs and PM2.5 exposures to respiratory morbidity

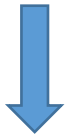
R. J. Sram 2018

AIR POLLUTION

CNS

N.D. Saenen et al.

In Utero Fine Particle Air Pollution and Placental Expression of Genes in the Brain-Derived Neurotrophic Factor Signaling Pathway: An ENVIR*ON*AGE Birth Cohort Study EHP 123:834-840 (2015)



PM2.5 15-19 $\mu g/m^3$

deregulation of genes *BDNF* and *SYN1* in placenta

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PAHs & BDNF

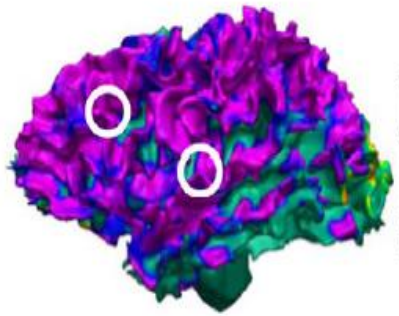
D. Tang et al. Molecular and neurodevelopmental benefits to children of closure of a coal burning power plant in China. PlOS One 9(2014)e91966

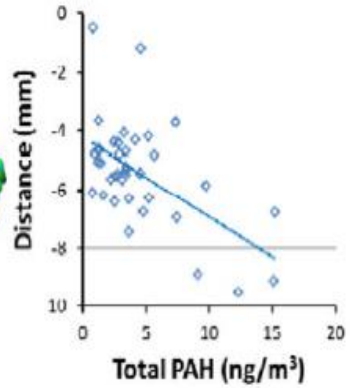
	2002(N=110)	2005(N=107)
PAH-DNA adducts	0.324±0.139	0.204±0.081*
BDNF, ug/dL	752.9±463.1	1266.6±619.8*
Gesell Scores Average	99.4±10.7	100.3±7.2
Motor	97.5±11.5	97.8±7.8
Adaptive	98.7±14.9	101.2±11.0
Language	102.1±12.8	100.5±9.8*
Social	99.4±11.8	101.8±6.8

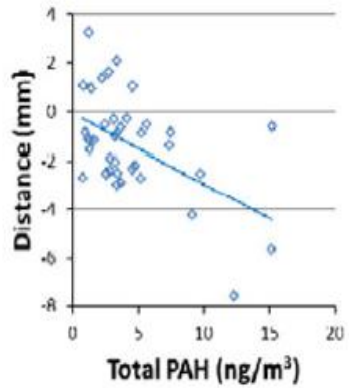
*$p < 0.05$

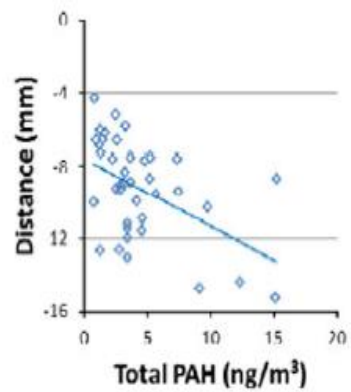
Correlations with Prenatal PAH Level

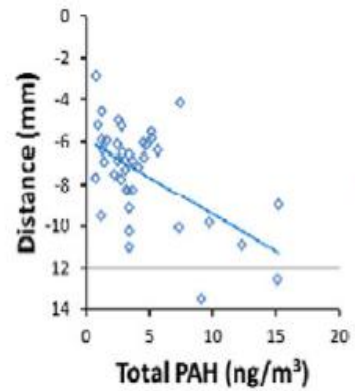
left lateral



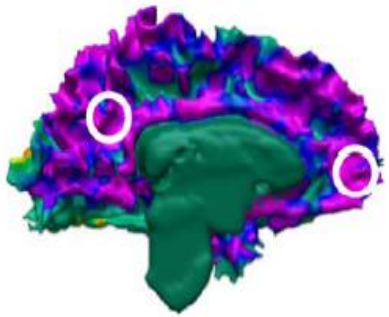






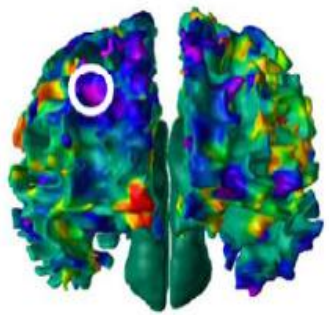


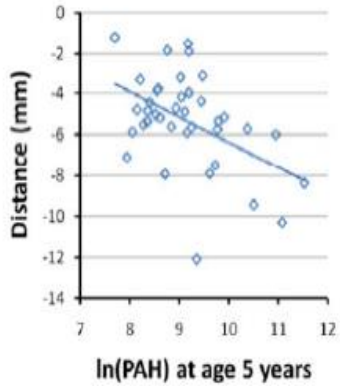
left mesial

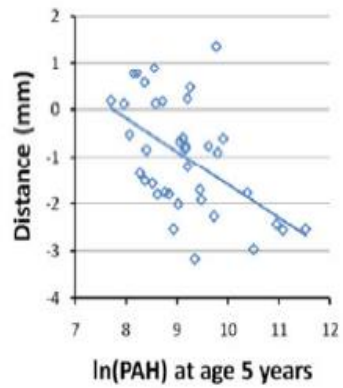


Correlations with Postnatal PAH Levels

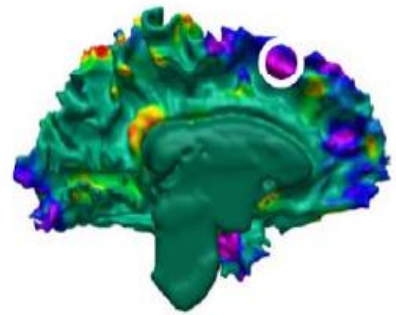
anterior







left mesial



MMR study

1) Increased prenatal exposure to PAHs reduced left hemisphere white matter
2) Reduced white matter measures of the left hemisphere were associated with significantly higher scores for externalizing problems of the CBCL (child behavior checklist), as well as externalizing symptoms that included ADHD symptoms and conduct disorder problems.
3) Higher prenatal PAH exposure was associated with reduced processing speed during intelligence testing

PAHs and cognitive functions

W.A.Jedrychowski et al. Prenatal exposure to polycyclic aromatic hydrocarbons and cognitive dysfunction in children. Environ Sci Pollut Res 22 (2015) 3631-3639

- 170 children in Cracow
- Exposure: PAH-DNA adducts, prenatal PAHs 43.0±55.3 ng/m3
- At age 7 ys Wechsler Inteligence Scale for Children
- Depressed verbal IQ index, cord blood adducts RR=3.0 (95%CI: 1.3, 6.8)
- Breast feeding 6 months – protective effect RR=0.3 (95%CI: 0.1, 0.9)
- Conclusion: PAHs are harmful to the developing fetal brain

CONCLUSIONS

Zvýšené koncentrace PM2.5 zvyšují výskyt:

- **autismu**
- **poruch kognitivních funkcí u dětí**
- **onemocnění depresí**
- **incidence demence**
- **Parkinsonovy choroby**
- **ovlivňují koncentraci proteinu BDNF**

ZÁVĚRY

Zvýšené koncentrace PAHs :

- **ovlivňují hladinu BDNF**
- **redukují bílou hmotu mozku**
- **snižují kognitivní funkce u dětí**
- **zvyšují výskyt ADHD**

CONCLUSIONS

DUE TO A HIGH AIR POLLUTION CZECH REPUBLIC

SEEMS TO BE A PARADISE TO STUDY THE IMPACT

OF PM2.5 AND PAHs EXPOSURE TO HUMAN HEALTH

AIR POLLUTION

IMPACT ON SPERM

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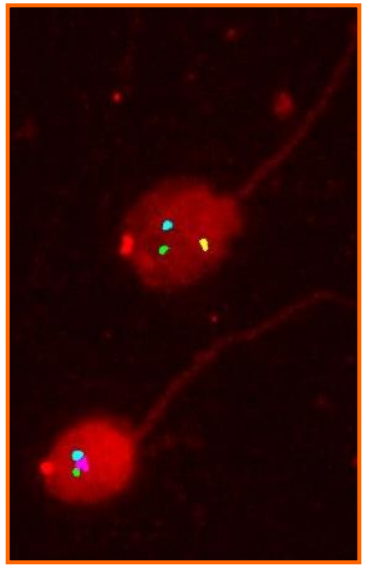
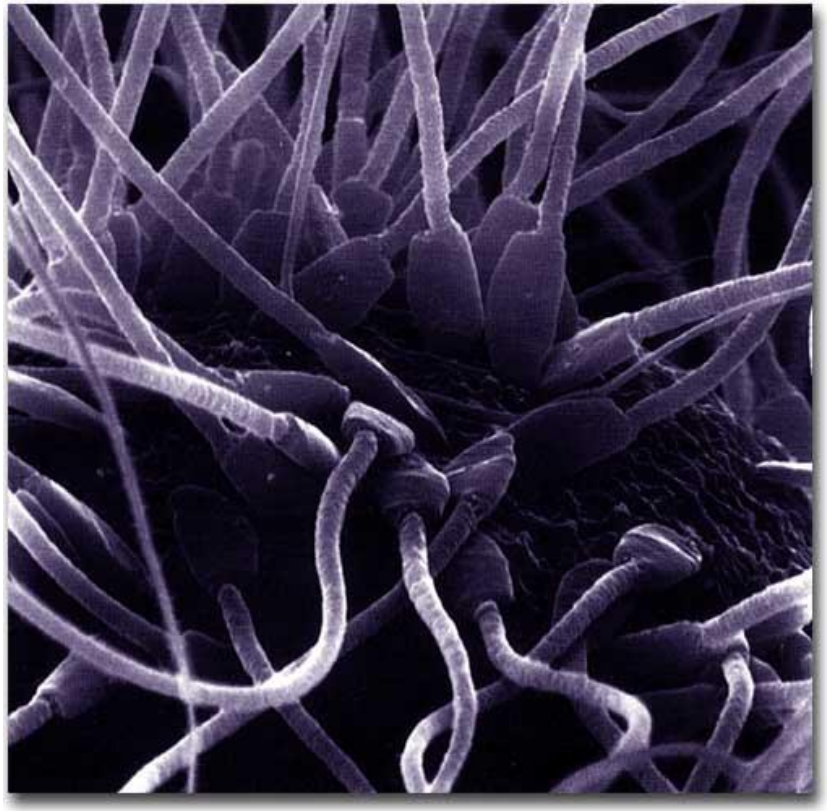
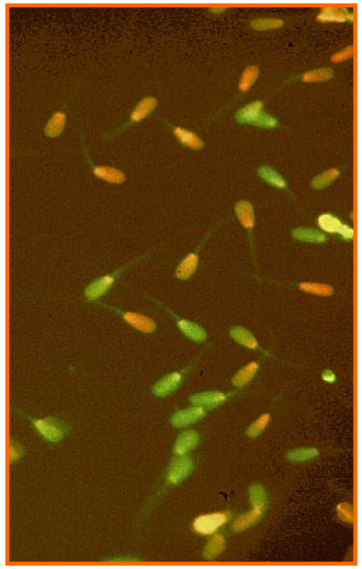
DNA adducts

chromosomes

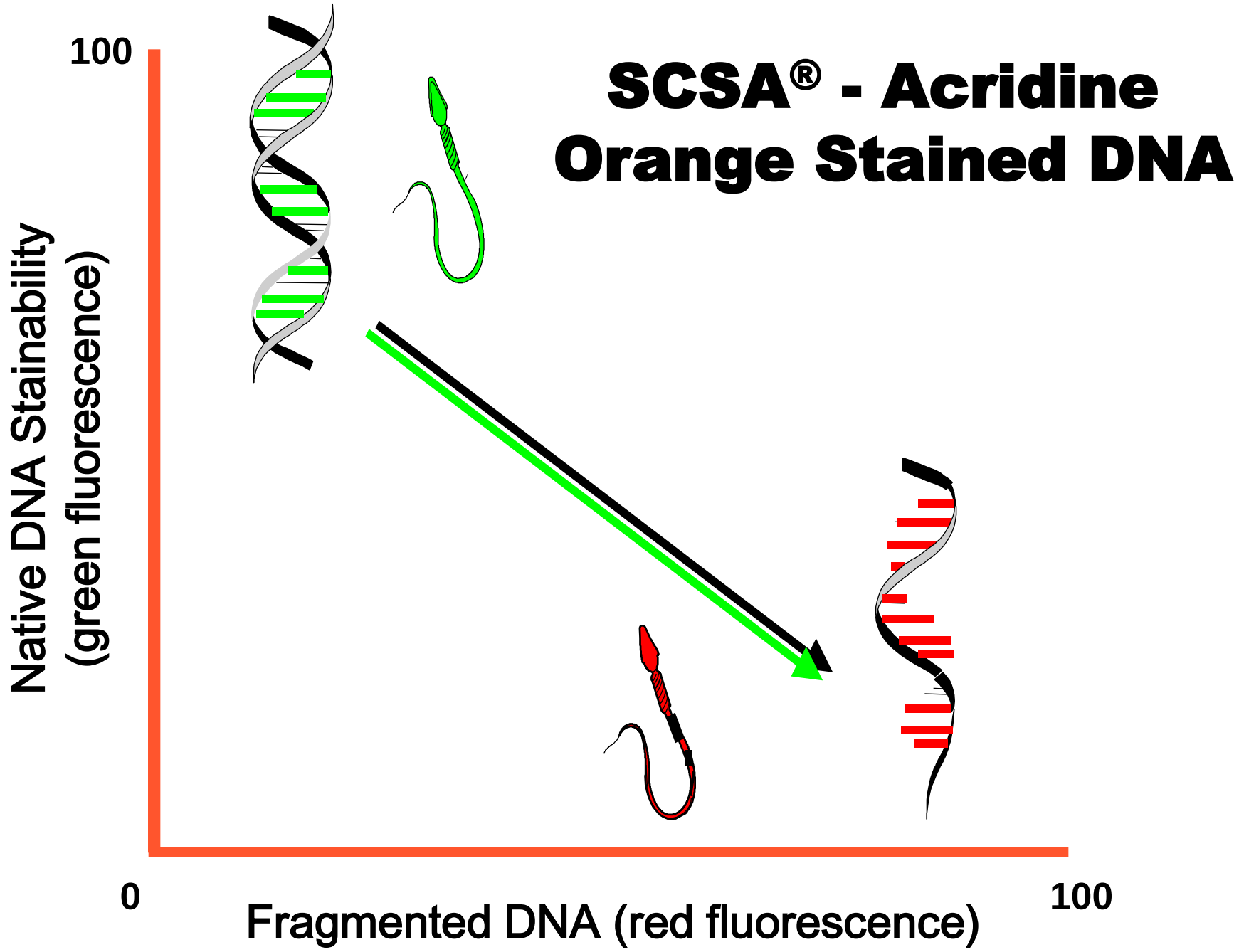




chromatine

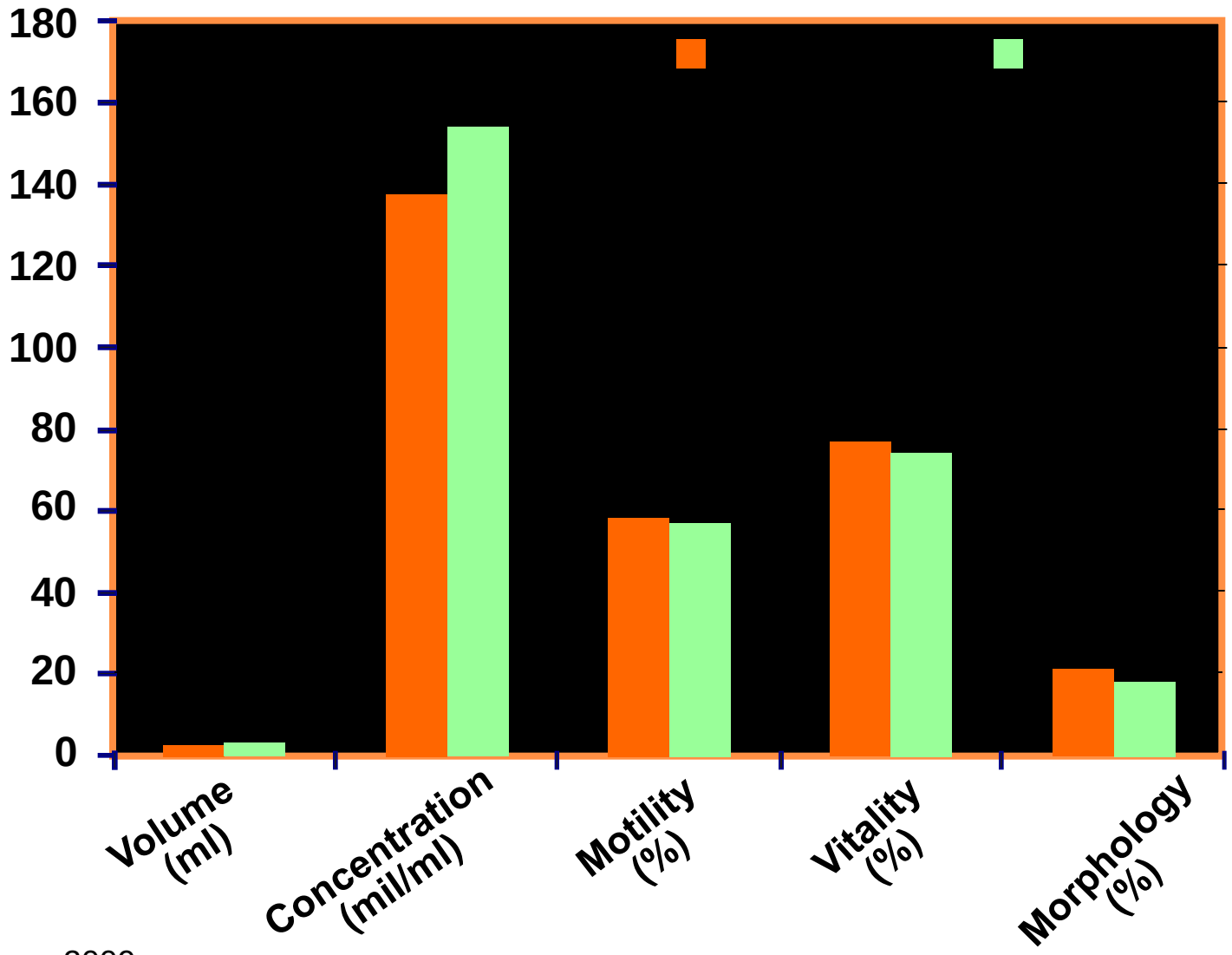


R. J. Sram 2009


SCSA® - Acridine Orange Stained DNA
100
Native DNA Stainability (green fluorescence)
0
100
Fragmented DNA (red fluorescence)

R. J. Sram 2009

Sperm analysis



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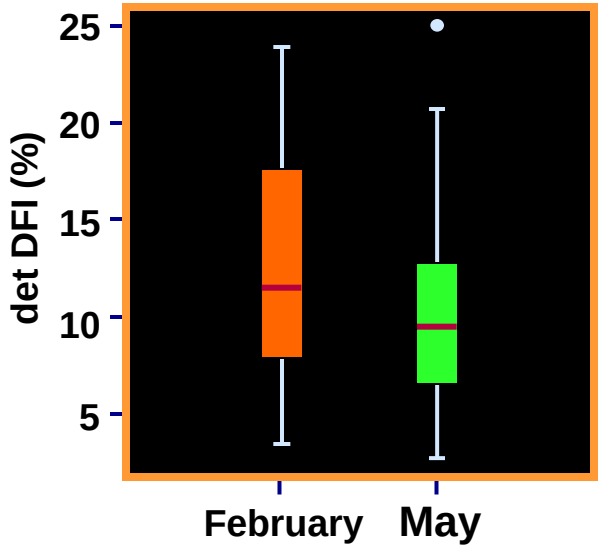
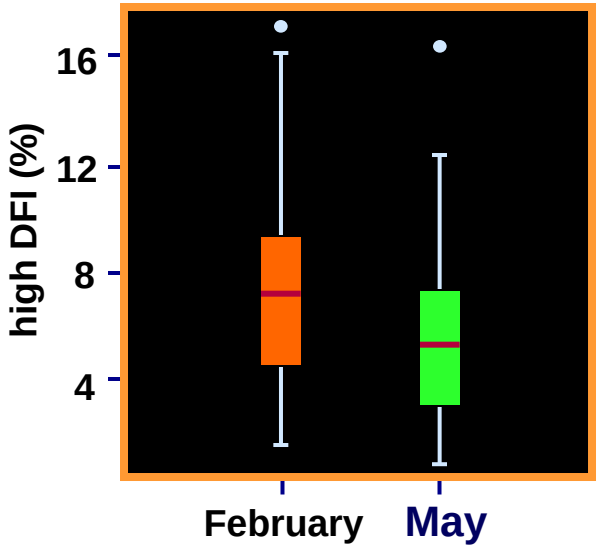
Policemen patrolling the streets in Prague centre with heavy traffic

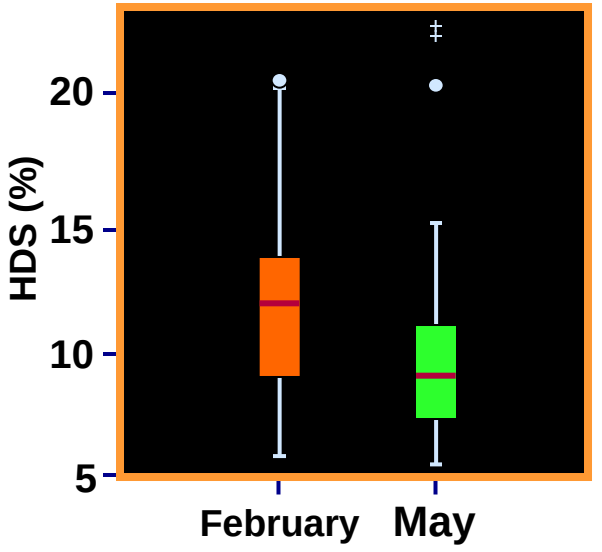
The level of air pollution will be assessed on the basis of information from two source:
-data from stationary measuring stations AIM Prague
-for 48 h using personal sampling devices (URG Corp, USA)



P≤0.001



P≤0.001



P≤0.001

N=46

dDFI	< 15%	Feb 30	May 42
dDFI	15 – 30%	Feb 16	May 4
dDFI	>30%	Feb 2	May 2
HDS	>15%	Feb 10	May 4

R. J. Sram 2009