

Indoor air quality in Belgian dwellings during early life

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Context

- Air pollution is a trigger for health
- Epidemiologic studies analyse the impact of **outdoor air** pollution on **general population**
- Babies spent most of their time indoor
- Babies are vulnerable to air pollution



Objectives

- State of exposure to indoor air pollutants at home during early life
- Individual exposure data > future cohort follow up
- Awareness of indoor air quality around birth
- The link between indoor and outdoor NO₂/VOC

Methods

- Data gathering
 - Indoor air sampling and analysis
 - Survey
- Data analysis
 - Statistics
 - Health risk assessment

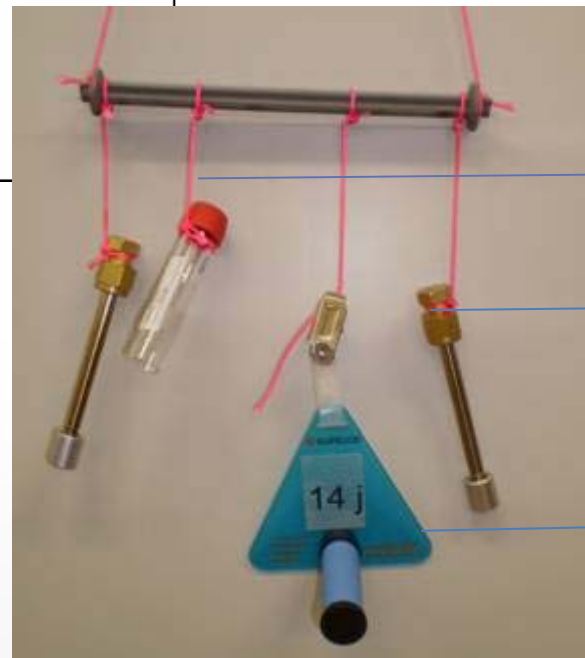
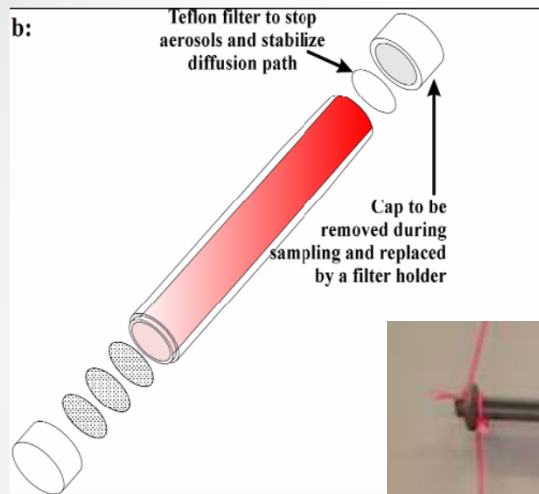
Methods

Wich pollutants ?

- Benzene, toluene, ethylbenzene, xylenes
- Formaldehyde, acetaldehyde
- NO₂

Methods

Air sampling



NO₂

BTEX

ALDEHYDES

2 weeks

Passive sampling

212 newborn homes

January 2014 – August 2015

Methods

Air analysis

NO₂

EN WD 264097

Aldehydes

ISO 16000-4 :2011 : Indoor air

Part 4: Determination of formaldehyde - Diffusive sampling method

BTEX

EN ISO 16017-2:2003 :

Indoor, ambient and workplace air

"Sampling and analysis of volatile organic compounds by sorbent tube/thermal desorption/capillary gas chromatography – Part 2: Diffusive sampling

Methods

Surveys

- Sources of pollutants
 - Air fresheners, incense candles
 - Renovation works
 - New furniture
 - Ventilation, windows opening
 - Heat system, stove system
 - Location of the garage, fuel oil tank
 - House environment (urban/rural, etc)
- Last 6 months
- Binary answer

Results

Decriptive statistics

Compound	MIN	P5	P25	P50	P75	P95	MAX
Formaldehyde	4,9	8,9	12,0	16,6	21,3	30,8	48,9
Acetaldehyde	0,9	2,0	3,4	5,0	6,8	10,8	22,0
NO2	0,4	6,5	9,8	11,8	16,0	26,7	92,5
Benzene	0,2	0,5	0,9	1,3	2,1	6,6	94,0
Toluene	0,1	1,4	3,3	6,0	12,5	83,8	463,4
Ethylbenzene	0,0	0,3	0,5	1,0	1,9	7,7	43,5
Xylenes_total	0,0	0,8	2,0	3,7	8,6	38,6	234,8

Spearman correlations :

- NO2 – BTEX or Aldehydes : 0
- Aldehydes – BTEX : 0,3
- BTEX : 0,6-0,9

Results

Formaldehyde

effects on lung function, cancer

	MIN	P5	P25	P50	P75	P95	MAX
Formaldehyde	4,9	8,9	12,0	16,6	21,3	30,8	48,9

USUAL Concentration ($\mu\text{g}/\text{m}^3$)

Outdoor : 5 – 30

Indoor : 10 - 100

Guidelines indoor ($\mu\text{g}/\text{m}^3$)

France & Flanders : 10

Results

Benzene

Leukemia, genotoxicity

	MIN	P5	P25	P50	P75	P95	MAX
Benzene	0,2	0,5	0,9	1,3	2,1	6,6	94,0

USUAL Concentration ($\mu\text{g}/\text{m}^3$)

Indoor : 1,5

Outdoor Regional P50: 0,49

Guidelines ($\mu\text{g}/\text{m}^3$)

WHO indoor : unit risk

France indoor: 2

UE Legal standard outdoor : 5

Results

NO₂

airways inflammation, decrease immune defence, leading to susceptibility to respiratory infection

Compound	MIN	P5	P25	P50	P75	P95	MAX
NO ₂	0,4	6,5	9,8	11,8	16,0	26,7	92,5

USUAL Concentration ($\mu\text{g}/\text{m}^3$)

Indoor (no gas stove): 15

Outdoor Regional P50: 18

Guidelines INDOOR ($\mu\text{g}/\text{m}^3$)

WHO : no evidence for threshold

40 (annual) = Legal standard UE OUTDOOR

Results

Surveys

Correlations (mann-withney test)

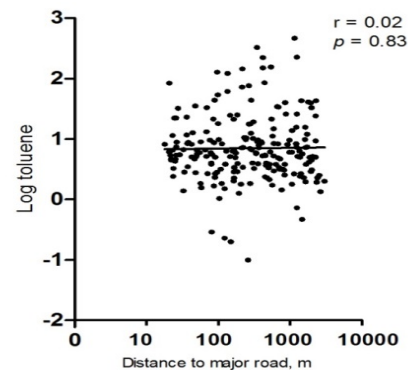
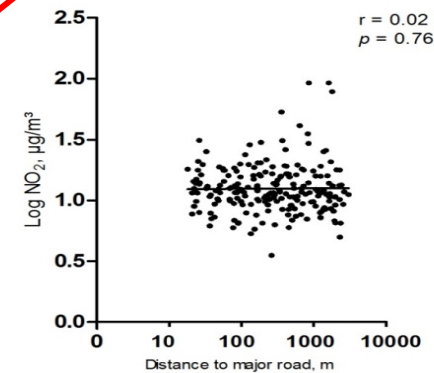
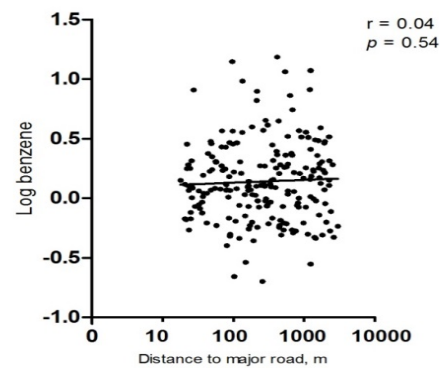
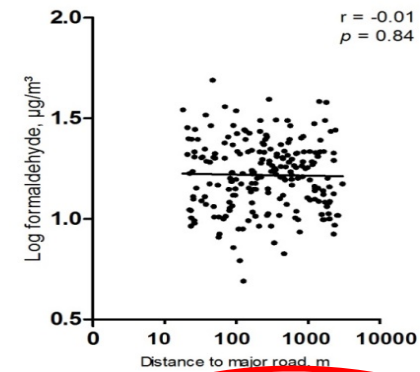
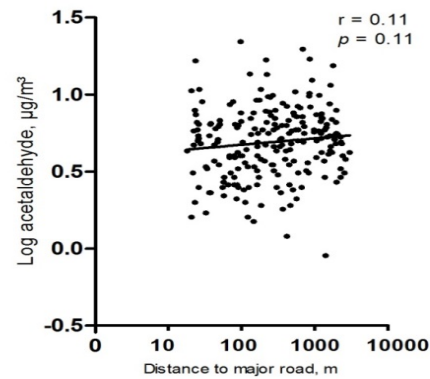
- Acetaldehyde – NO₂ > urban environment
- NO₂ > gaz cooker, candles, incense
- Benzene – toluene > coal stove (2%)
- Toluene – xylene – ethylbenzene > attached garage
- Formaldehyde > floor, walls renovation works
- Aldehydes - toluene < ventilation
- BTEX < ??? renovation works

Results

Surveys

Descriptive statistics

- Daily window opening 52% (80% in baby room)
- Renovation works 50% (41% baby room)
- Air fresheners 53%
- Gas stove 6%
- New furniture baby room 29%



NO₂ / distance to major road
 No link

Health Risk Assessment

Individual Cancer risk (ICR) : $ICR = C_{air} \times URE$

	Carcinogenic classification (WHO/USEPA)	Unit Risk Estimate (URE) ($\mu\text{g}/\text{m}^3$) ⁻¹ OEHHA	ICR (P50)
Benzene	1/A	2.9*E-5	3,8E-05
Ethylbenzene	2B /D	2,5*E-6	2,5E-06
Formaldehyde	2A/B1	6*E-6	1,0E-04
Acetaldehyde	2B/B2	2,7*E-6	1,4E-05

WHO : "acceptable " excess risk for cancer : $< 1/10.000$

Carcinogenic risk $> 10^{-4}$ in 50% of the homes

Conclusions

- BTEX, aldehydes and NO₂ were measurable in each house
- Concentrations were in the same trend as in other surveys in Europe
- Large distribution of concentrations were found > exposure is unequal
- Concentrations are below / above guidelines for individual pollutant
- Nevertheless cancer excess risk is higher than 1/10,000 in more than 50% of newborn homes
- Action to reduce levels of carcinogen are to be strengthened since newborn spend most of their time at home
- Most of the parents open the windows daily. On the other hand the period around birth is a renovation period with subsequently VOC emission

Thanks for your attention

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For more information on the project

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