

**Environmental exposure assessment in European birth cohorts:  
results from the ENRIECO project**

**Additional Material**

Ulrike Gehring<sup>1</sup>, Maribel Casas<sup>2,3,4</sup>, Bert Brunekreef<sup>1,5</sup>, Anna Bergström<sup>6</sup>, Jens Peter Bonde<sup>7</sup>, Jérémie Botton<sup>2,3,4</sup>, Cecile Chevrier<sup>8</sup>, Sylvaine Cordier<sup>8</sup>, Joachim Heinrich<sup>9</sup>, Cynthia Hohmann<sup>10</sup>, Thomas Keil<sup>10</sup>, Jordi Sunyer<sup>2,3,4,11</sup>, Christina G. Tischer<sup>9</sup>, Gunnar Toft<sup>12</sup>, Magnus Wickman<sup>6</sup>, Martine Vrijheid<sup>2,3,4</sup>, Mark Nieuwenhuijsen<sup>2,3,4</sup>

**Affiliations**

- <sup>1</sup> Institute for Risk Assessment Sciences, Utrecht University, Utrecht, The Netherlands
- <sup>2</sup> Centre for Research in Environmental Epidemiology (CREAL), Barcelona, Spain
- <sup>3</sup> Hospital del Mar Research Institute (IMIM), Barcelona, Spain
- <sup>4</sup> Spanish Consortium for Research on Epidemiology and Public Health (CIBERESP), Spain
- <sup>5</sup> Julius Center for Health Sciences and Primary Care, University Medical Center Utrecht, The Netherlands
- <sup>6</sup> Institute of Environmental Medicine, Karolinska Institutet, Sweden
- <sup>7</sup> Department of Occupational and Environmental Medicine, Bispebjerg University Hospital, Copenhagen NV, Denmark
- <sup>8</sup> INSERM U1085 - IRSET, University of Rennes I, France
- <sup>9</sup> Helmholtz Zentrum, München & German Research Centre for Environmental Health, Institute of Epidemiology I, Neuherberg, Germany
- <sup>10</sup> Institute of Social Medicine, Epidemiology and Health Economics, Charité University Medical Center Berlin, Germany
- <sup>11</sup> Universitat Pompeu Fabra (UPF), Spain
- <sup>12</sup> Department of Occupational Medicine, Aarhus University Hospital, Denmark

**Table S1.** Experts who participated in the different working groups.

<b>Exposure</b>	<b>WG-group leader</b>	<b>Participants<sup>a</sup></b>
Outdoor air pollution	Ulrike Gehring <a href="mailto:u.gehring@uu.nl">u.gehring@uu.nl</a>	Ferran Ballester, Bert Brunekreef, Ann Colles, Vicky Patelarou, Frank Pierik, Kinga Polanska
Water contamination	Mark Nieuwenhuijsen <a href="mailto:mnieuwenhuijsen@creal.cat">mnieuwenhuijsen@creal.cat</a>	J�r�mie Botton, Maribel Casas, Sylvaine Cordier, Vicky Patelarou,
Allergens & microbial agents	Joachim Heinrich <a href="mailto:joachim.heinrich@helmholtz-muenchen.de">joachim.heinrich@helmholtz-muenchen.de</a>	Chih-Mei Chen, Ulrike Gehring, Christina Tischer, Constantine Vardavas
Metals	Jordi Sunyer <a href="mailto:jsunyer@creal.cat">jsunyer@creal.cat</a>	Ferran Ballester, Maribel Casas, Kinga Polanska, Constantine Vardavas, Michael Wilhelm
Pesticides	Cecile Chevrier <a href="mailto:cecile.chevrier@rennes.inserm.fr">cecile.chevrier@rennes.inserm.fr</a>	Sylvaine Cordier, Claire Petit, Frank Pierik, Stephanie Vandentorren
Persistent organic pollutants	Gunnar Toft <a href="mailto:gunttoft@rm.dk">gunttoft@rm.dk</a>	Jens Peter Bonde, Merete Eggersb�, Hannu Kiviranta, Vicky Patelarou, Greet Schoeters, Remy Slama, Stephanie Vandentorren, Michael Wilhelm
Other chemical exposures	Martine Vrijheid <a href="mailto:mvrijheid@creal.cat">mvrijheid@creal.cat</a>	Maribel Casas, Elly Den Hond, Ilias Kavouras, Frank Pierik, St�phanie Vandentorren, Gunnar Vase Toft, Michael Wilhelm
Radiations	Martine Vrijheid <a href="mailto:mvrijheid@creal.cat">mvrijheid@creal.cat</a>	Elisabeth Cardis, Maribel Casas, Payam Dadvand, Mark Nieuwenhuijsen  External experts: Anke Huss, Roel Vermeulen
Smoking and second hand tobacco smoke	Magnus Wickman <a href="mailto:magnus.wickman@ki.se">magnus.wickman@ki.se</a>	Anna Bergstr�m, Ulrike Gehring, Eva Hallner, Cynthia Hohmann, Thomas Keil, �sa Neuman, Mattias �berg, G�ran Pershagen
Noise	Thomas Keil <a href="mailto:thomas.keil@charite.de">thomas.keil@charite.de</a>	Maria Pia Fantini, Cynthia Hohmann, Yvonne de Kluizenaar, Lorenza Luciano, Frank Pierik
Occupational exposures	Sylvaine Cordier <a href="mailto:sylvaine.cordier@univ-rennes1.fr">sylvaine.cordier@univ-rennes1.fr</a>	Jens Peter Bonde, Lex Burdorf, Merete Eggesb�, Ana Maria Garcia, Regina Gra�ulevi�ien�, Manolis Kogevinas, Mark Nieuwenhuijsen, Anne-Marie Nybo-Andersen, Vicky Patelarou, Frank Pierik, Ana Cristina Santos, Claudia Snijder, Martine Vrijheid, Tanja Vrijkotte  External experts : Jo�lle F�votte, Hans Kromhout, Nel Roeleveld, Martie Van Tongeren

<sup>a</sup> in alphabetic order

**Table S2.** Modelling of outdoor air pollution in European birth cohorts.

Cohort	NO <sub>2</sub>	NO <sub>x</sub> /NO	PM <sub>2.5</sub>	PM <sub>coarse</sub>	PM <sub>10</sub>	“Soot”	SSE	Others	N <sup>a,b</sup>	Timing <sup>b</sup>
ABCD	●◇	◇	◇	◇	◇	◇	◇		~ 7,600	Pregnancy & birth
BAMSE	●◇	◇▲	●◇	◇	◇▲	●◇	◇	▲ SO <sub>2</sub>	~3,700	1yr, 4-8 yrs
BiB	◇	◇								
DNBC	◇▲	◇▲	◇	◇	◇	◇	◇	▲ Ozone	~18,000	0-1.5 yrs
EDEN	●◇▲	◇			▲			Δ Benzene	700-1,000	Pregnancy
ELFE	△	△	△		△			△ Ozone		
GAPS II	●▲	●▲	▲		▲	▲		▲ Ozone	581-708	Birth-4 yrs
Generation R	◇▲	◇	◇	◇	◇▲	◇△	◇		~9,000	All ages
GINIplus	●◇	◇	●◇△	◇	◇	●◇	◇		3,878-5,991	Birth, 1, 2, 4, 6 yrs
INMA old										
Granada	●◇	●◇							220	4 yrs
Menorca	○	○								
INMA new										
Asturias	●◇	◇	○		○			● Benzene; ○ TEX	478	Pregnancy
Gipuzkoa	●◇	◇						● Benzene	597	Pregnancy
Sabadell	●◇	●◇						● BTEX	608	Pregnancy & any age
Valencia	●◇	◇	◇	◇	◇	◇	◇	○ BTEX	785	Pregnancy
KANC	◇	◇▲	◇▲	◇	◇▲	◇	◇		4,000	Pregnancy & birth
Leicester	○	○			○▲				~1,000	1 and 4 yrs
LISAplus	●◇	◇	●◇	◇	◇	●◇	◇		1,314-2,357	0, 2, 6 yrs
MOBA	◇	◇	◇	◇	◇	◇	◇			
NINFEA	◇	◇	◇	◇	◇	◇	◇			
PARIS	◇	▲	◇		◇					All ages
PIAMA	●◇	◇	●◇	◇	◇	●◇	◇		3,953	Pregnancy & birth
RHEA	◇	◇	◇	◇	◇	◇	◇			Pregnancy & birth

<sup>a</sup> number of children with exposure information

<sup>b</sup> only for work that has been done already

● Land-use regression (LUR) done (outside ESCAPE); ○ LUR planned (outside ESCAPE); ◇ LUR ongoing work within ESCAPE; ▲ Dispersion modelling done; Δ Dispersion modelling planned

PM<sub>coarse</sub> = PM<sub>10</sub>-PM<sub>2.5</sub>; Soot = reflectance of PM<sub>2.5</sub> filters or elemental carbon; (B)TEX = (benzene, ) toluene, ethylbenzene, xylenes; SO<sub>2</sub> = Sulfur dioxide;

SSE = “source specific” elements from X-ray fluorescence

mo = months, yrs = yrs

**Table S3.** Assessment of exposure to allergens and microbial agents by means of environmental monitoring in European birth cohorts.

	Component measured (time point <sup>a</sup> )					N (time point) <sup>b</sup>
	Cat	Dog	House dust mite	Mould	Bacteria	
BAMSE	Fel d1 (2 mo, 7 yrs)	Can f1 (2 mo)	Der p1 & Der f1 (2 mo, 7 yrs)	$\beta$ (1,3) glucan, EPS <i>Asp/Pen</i> (7 yrs)	Endotoxin (7 yrs)	533 (2 mo), 358 (7 yrs)
ELFE				Alternaria, Aspergillus, Cladosporium, Penicillium, Stachybotrys chartarum		0-1 yr *
GINIplus	Fel d1		Der p1 & Der f1	$\beta$ (1,3) glucan, EPS <i>Asp/Pen</i>	Endotoxin	219 (5-6 yrs)
INMA old						
Menorca	Fel d1		Der p1			482 (3 mo), 11 yrs*
INMA new						
Asturias	Fel d1		Der p1		Pollen	4 yrs*
Sabadell	Fel d1		Der p1		Pollen	14 and 30 mo.*
Kraków	Fel d1	Can f1	Der p1 & Der f1			336 (3 yr), 250 (5 yr)
LISApplus	Fel d1 (3 mo, 5-6 & 10 yrs)		Der p1 & Der f1 (3 mo, 5-6 yrs)	$\beta$ (1,3) glucan, EPS <i>Asp/Pen</i> (5-6 & 10 yrs)	Endotoxin (3 mo, 5-6 & 10 yrs)	2,166 (3 mo), 138 (5-6 yrs), 100 (10 yrs)
LUKAS	Fel d1		Der p1 & Der f1	EPS <i>Asp/Pen</i>	Endotoxin	~350 (2 mo, 1yr, 3 yrs, 6 yrs)
MAS	Fel d1	Can f1	Der p1			1,000 (3mo), 800 (18 mo), 600 (3 yrs)
PARIS			Der p1 & Der f1	Alternaria, Aspergillus, Cladosporium, Penicillium	Endotoxin	Pollen 162-196 (1 mo), 157-196 (6 or 9 mo)
PIAMA	Fel d1 (pregnancy, 3 mo, 1, 4, 5-6 & 8 yrs)	Can f1 (pregnancy, 3 mo, 1, 4, 5-6 & 8 yrs)	Der p1 & Der f1 (pregnancy, 3 mo, 1, 4, 5-6 & 8 yrs)	$\beta$ (1,3) glucan, EPS <i>Asp/Pen</i> (pregnancy, 3 mo, 1 & 5-6 yrs)	Endotoxin (pregnancy, 3 mo, 1 & 5-6 yrs)	Allergens/mould,bacteria: 700/200 (pregnancy), 1,750/700 (3 mo.), 200/100 (1 yr), 1,000 (4 yrs), 350 (5-6 yrs), 100 (8 yrs)

\* planned/ongoing

<sup>a</sup> if components were measured at different time points

<sup>b</sup> N = number of children with exposure information; only for work that has been done already; excluding ongoing/planned work

Can f = Canis familiaris; Der p = Dermatophagoides pteronyssinus; Der f = Dermatophagoides farinae; Fel d = Felis domesticus;

EPS *Asp/Pen* = Extracellular polysaccharides from *Aspergillus* and *Penicillium spp.*

mo = months, yrs = yrs

**Table S4.** Biological and environmental monitoring for assessment of exposure to smoking and second hand tobacco smoke in European birth cohorts.

Cohort	Component	Medium	Timing <sup>a</sup> (N <sup>a,b</sup> )
<b>Biological monitoring</b>			
ALSPAC	Cotinine	B	7 yrs (7,000, child), 15 yrs (3,500, child)
BAMSE	Cotinine	U	4 yrs (990, child)
Czech	Cotinine	B	Birth (293, mother)
		U	3-5 yrs (523, child), 6 yrs (980, child), 10 yrs (940, child)
Duisburg	Cotinine *	U	
	Nicotine *	U	
EDEN	Cotinine *	U	
ELFE	Cotinine *	U	
GINIplus	Cotinine	U	5-6 yrs (199, child)
<b>INMA old</b>			
Granada	Cotinine	U	4-5 yrs (174, child)
Ribera Ebre	Cotinine *	U	
<b>INMA new</b>			
Asturias	Cotinine *	U	
Gipuzkoa	Cotinine *	U	
Sabadell	Cotinine *	U	
Valencia	Cotinine *	U	
INUENDO	Cotinine *	B	
Kraków	Cotinine	B	Pregnancy (467, mother)
		C	Birth (484)
		U	3 yrs (219, child)
LISAplus	Cotinine	U	5-6 yrs (119, child)
REPRO_PL	Cotinine	S	Pregnancy (1,800, mother)
RHEA	Cotinine	H	Pregnancy (500-600, mother)
		U	6-24 mo.(300, child)
		U	Pregnancy (150, mother)
<b>Environmental monitoring</b>			
BAMSE	Nicotine	A	5-9 yrs (356)
GINIplus	Nicotine	A	5-6 yrs (215)
LISA	Nicotine	A	5-6 yrs (137)
PARIS	Nicotine	A	1-6 mo (196), 9-12 mo (196)
PIAMA	Nicotine	A	1-2 yrs (90), 5-6 yrs (341)

\* planned;

<sup>a</sup> only for work that has been done already

<sup>b</sup> number of children with exposure information, mother/child indicates that sample was taken from the mother /the child

A=air; B = blood/serum; C = cord blood; H = hair; S = saliva, U = urine

NNAL = 4-methylnitrosoamino)-1-(3-pyridyl)-1-butanol

mo = months, yrs = years

**Table S5.** Assessment of exposure to water contaminants in European birth cohorts.

<b>Cohort</b>	<b>DBPs</b>	<b>Metals</b>	<b>Nitrates</b>	<b>Pesticides</b>	<b>Endocrine disruptors</b>	<b>Others</b>	<b>Timing<sup>a</sup></b>
BiB	B,E,Q						Pregnancy
Duisburg	Q*						8 yrs
EDEN	E*,Q*						
ELFE	E*,Q*						
HUMIS						E (not determined)	
INMA old							
Granada	B,E,Q	E			E		Pregnancy, 4-5 yrs
Ribera Ebre				E			
INMA new							
Asturias	E,Q					E(Chlorine, physical parameters)	Pregnancy, birth, 1 yr, 4yrs
Gipuzkoa	E,Q	E,Q	E				Pregnancy, birth, 1 yr, 4 yrs
Sabadell	E,Q	E	E				Pregnancy, 1 yr, 4 yrs
Valencia	E,Q						Pregnancy, 1 yr., 4 yrs
KANC	E,Q	E,Q					Pregnancy
KOALA	Q						3 mo., 1 yr, 2 yrs, 5 yrs
MoBa	Q						Pregnancy
PARIS						Q* (Swimming pool water)	
PÉLAGIE	B,E,Q		E	B,E			Pregnancy
RHEA	E,Q						Pregnancy

<sup>a</sup> only for work that has been done already

\* planned

DBP = Disinfection-by-products

B = biomonitoring ; E = environmental monitoring (routine monitoring companies or newly collected water concentration); Q = questionnaire

**Table S6.** Percentage <sup>a,b</sup> of cohort participants with biomonitoring data for water contaminants, metals, persistent organic pollutants (POPs), and other chemicals.

Cohort	No. of children at birth	Exposure			
		Water contaminin.	Metals	POPs	Other chemicals <sup>d</sup>
ABCD	7,863				
ALSPAC	14,062		20-33%		3%
ArcRisk-Norway	430		66%	12-100%	
BIB	13,000	<1%			≤1%
DNBC	96,986			≤2%	
Duisburg	234		50-94%	35-96%	36-48%
EDEN	1,899		16-48%		10%
Faroese					
Cohort I	1,022		83-100%	44-100%	
Cohort II	182		90-100%	91-96%	
Cohort III	656		80-100%	76-100%	88%
FLEHS	1,196		100%	100%	
Generation R	9,778				1%
HUMIS	2,500			1-19%	15-16%
INMA old					
Granada	668	33%	15-17%	46-48%	4-7%
Menorca	482		62%	19-99%	19-51%
Ribera Ebre	102		70%	56-71%	
INMA new					
Asturias	485		71-99%	5%	6-11%
Gipuzkoa	611		83-100%	18-100%	5-18%
Sabadell	622		78-82%	4-100%	5-79%
Valencia	787		3-70%	22-69%	4-22%
INUENDO	1,322		30%	38-76%	27-38%
Kraków	505		48-91%	90-97%	
LUKAS	442		29%	17-29%	29%
MoBa	107,000				<1%
PCB cohort	1,134		9%	22-98%	18%
PELAGIE	3,421	18%	15%	17%	3-17%
REPRO_PL	1,800		17-78%	11%	
RHEA	1,500		3%		

<sup>a</sup> based on number of children at birth; <sup>b</sup> not including work that is planned; <sup>c</sup> brominated flame retardants, perfluorinated compounds, phthalates and phenols