



# BPA-RELATED RISKS

- **BPA scientific monitoring since May 2009: An overall assessment**
- **Key Findings from July to September 2012**

Réseau Environnement Santé

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## A/ BPA scientific monitoring since May 2009: An overall assessment

### Number of studies on humans and animals

#### Showing effects: 319 (94 %)

- On animals: 200 (49 of which are *in vivo* studies that used a BPA dose < ADI (EFSA))
- On humans: 119 (Health effects: 56 ; *In vitro* effects : 63)

#### Showing no effect: 21

- On animals: 11
- On humans: 10

## B/ BPA scientific monitoring from July to September 2012: A comprehensive overview

### EFFECTS ON HUMANS

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#### Adverse pathophysiological effects:

- Exposure to BPA is associated with increased blood pressure and decreased heart rate variability, which are risk factors of cardiovascular disorders.
- BPA exposure is higher in patients with severe coronary artery stenoses compared to those with no vessel disease.
- There is positive association between increasing levels of urinary BPA and measures of obesity (NHANES 2003-2008), which is consistently present across gender and race-ethnic groups.
- Urinary BPA concentration was significantly associated with obesity in a cross-sectional study of 2838 children and adolescents based on the 2003-2008 National Health and Nutrition Examination Surveys.
- BPA may alter reproductive function in susceptible women undergoing IVF.
- High body BPA burden may not be associated with an increased prevalence of type 2 diabetes in Korean adults.

#### In vitro effects:

- By comparing the effects of BPA and the local anesthetic mexiletine on wild type hNav1.5 the authors have demonstrated that BPA blocks the human heart sodium channel via the local anesthetic receptor.

### EFFECTS ON ANIMALS

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#### Rats:

- Prenatal exposure of rats to BPA (0.5 and 50µg/kg/day BPA) affects pituitary gonadotroph development in

females.

#### Mice:

- The study suggests that BPAF, a chemical structurally related to bisphenol A and used as a substitute for BPA, also has neurotoxic properties.

#### Monkey:

- Exposure to doses of BPA that yield circulating levels of BPA analogous to those reported in humans alters early oogenesis and follicle formation in the fetal ovary of the rhesus monkey.

#### Fish:

- There is strong and direct evidence for ascribing an antiandrogenic mechanisms of action to BPA in vertebrates.

## ENVIRONMENTAL EXPOSURE

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- Bisphenol A and nonylphenols were detected in drinking water samples from 35 major Italian cities and five popular Italian brands of bottled mineral water.

## INNOVATION - METHODOLOGY

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- A study which provides a wealth of tools and information that could be used for the development of BPA substitutes devoid of hormonal activity and more generally for environmental risk assessment.



# BPA-RELATED RISKS

**PEER-REVIEWED PAPERS (JULY-SEPTEMBER 2012)**  
**SOURCE: PubMed**

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## PAPER ANALYSES

### A. EFFECTS ON HUMANS

#### 1. ADVERSE PATHOPHYSIOLOGICAL EFFECTS:

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##### ➤ Cardiovascular disease

Bae S, Kim JH, Lim YH, Park HY, Hong YC. **Associations of bisphenol a exposure with heart rate variability and blood pressure.** Hypertension. 2012 Sep. Epub 2012 Jul 30. Department of Preventive Medicine, College of Medicine, Seoul National University, 103 Daehak-ro, Jongro-gu, Seoul 110-799, Republic of Korea.  
<http://www.ncbi.nlm.nih.gov/pubmed/22851732>

*The present study showed that exposure to BPA is associated with increased blood pressure and decreased heart rate variability, which are risk factors of cardiovascular disorders. The risk of hypertension also increased with increasing concentrations of BPA in participants who had not reported previous history of hypertension.*

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Melzer D, Gates P, Osborn NJ, Henley WE, Cipelli R, Young A, Money C, McCormack P, Schofield P, Mosedale D, Grainger D, Galloway TS. **Urinary bisphenol a concentration and angiography-defined coronary artery stenosis.** PLoS One. 2012. Epub 2012 Aug 15. Epidemiology and Public Health Group, Peninsula College of Medicine and Dentistry, University of Exeter, Exeter, United Kingdom.

<http://www.ncbi.nlm.nih.gov/pubmed/22916252>

*BPA exposure is higher in patients with severe coronary artery stenoses compared to those with no vessel disease.*

##### ➤ Obesity

Shankar A, Teppala S, Sabanayagam C. **Urinary bisphenol a levels and measures of obesity: results from the national health and nutrition examination survey 2003-2008.** ISRN Endocrinol. 2012. Epub 2012 Jul 18. Department of Community Medicine, West Virginia University School of Medicine, Robert C. Byrd Health Sciences Center, 1 Medical Center Drive, P.O. Box 9190, Morgantown, WV 26505-9190, USA.

<http://www.ncbi.nlm.nih.gov/pubmed/22852093>

*The results of this study based on the National Health and Nutritional Examination Survey (NHANES) 2003-2008 found a positive association between increasing levels of urinary BPA and measures of obesity, which is consistently present across gender and race-ethnic groups.*

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Trasande L, Attina TM, Blustein J. **Association between urinary bisphenol A concentration and obesity prevalence in children and adolescents.** JAMA. 2012 Sep 19. Department of Pediatrics, New York University School of Medicine, New York, NY 10016, USA.

<http://www.ncbi.nlm.nih.gov/pubmed/22990270>

*Urinary BPA concentration was significantly associated with obesity in a cross-sectional study of 2838 children and adolescents based on the 2003-2008 National Health and Nutrition Examination Surveys. Obesity was not associated with exposure to other environmental phenols commonly used in other consumer products*

➤ **Psychosocial behaviour**

Maserejian NN, Trachtenberg FL, Hauser R, McKinlay S, Shrader P, Tavares M, Bellinger DC. **Dental composite restorations and psychosocial function in children.** Pediatrics. 2012 Aug. Epub 2012 Jul 16. New England Research Institutes, Inc., 9 Galen St, Watertown, MA 02472.

<http://www.ncbi.nlm.nih.gov/pubmed/22802599>

*The results show that greater exposure to bisGMA-based dental composite restorations was associated with impaired psychosocial function in children.*

➤ **Reproduction / Hepatotoxicity**

Tarantino G, Valentino R, Somma CD, D'Esposito V, Passaretti F, Pizza G, Brancato V, Orio F, Formisano P, Colao A, Savastano S. **Bisphenol A in Polycystic Ovary Syndrome and its Association with Liver-Spleen Axis.** Clin Endocrinol (Oxf). 2012 Jul 16. [Epub ahead of print] Department of Clinical and Experimental Medicine, University Federico II of Naples, Italy.

<http://www.ncbi.nlm.nih.gov/pubmed/22805002>

*Increased serum bisphenol A levels contribute to low-grade chronic inflammation, hepatic steatosis, and hyperandrogenism in women with PCOS.*

➤ **Reproduction**

Ehrlich S, Williams PL, Missmer SA, Flaws JA, Ye X, Calafat AM, Petrozza JC, Wright D, Hauser R. **Urinary bisphenol A concentrations and early reproductive health outcomes among women undergoing IVF.** Hum Reprod. 2012 Sep 26. [Epub ahead of print] Department of Environmental Health, Harvard School of Public Health, 665 Huntington Avenue, Building I, 14th Floor, Boston, MA 02115, USA.

<http://www.ncbi.nlm.nih.gov/pubmed/23014629>

*The study shows that BPA may alter reproductive function in susceptible women undergoing IVF, notably because there was a significant linear dose-response association between increased urinary BPA concentrations and decreased number of oocytes, decreased number of normally fertilized oocytes and decreased E(2) levels.*

➤ **Diabetes**

Kim K, Park H. **Association between urinary concentrations of bisphenol A and type 2 diabetes in Korean adults: A population-based cross-sectional study.** Int J Hyg Environ Health. 2012 Aug 23. [Epub ahead of print] Department of Pharmacy, Keimyung University, Daegu, Republic of Korea.

<http://www.ncbi.nlm.nih.gov/pubmed/22921714>

*This cross-sectional study based on a Korean human biomonitoring survey suggests that a high body BPA burden may not be associated with an increased prevalence of type 2 diabetes in Korean adults.*

➤ Allergic asthma

Vaidya SV, Kulkarni H. **Association of urinary bisphenol a concentration with allergic asthma: results from the national health and nutrition examination survey 2005-2006.** J Asthma. 2012 Oct. Epub 2012 Sep 10. *Lata Medical Research Foundation , Nagpur , India.*

*This study based on the data from NHANES 2005-2006 shows that urinary BPA is significantly associated with allergic asthma in females.*

➤ Development

Maserejian NN, Hauser R, Tavares M, Trachtenberg FL, Shrader P, McKinlay S. **Dental Composites and Amalgam and Physical Development in Children.** J Dent Res. 2012 Sep 12. [Epub ahead of print] *New England Research Institutes, 9 Galen Street, Watertown, MA 02472, USA.*

<http://www.ncbi.nlm.nih.gov/pubmed/22972857>

*There are no significant differences in physical development over 5 years in children treated with dental composites or amalgam.*

## 2. IN VITRO EFFECTS:

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➤ Hormone metabolism

Demierre AL, Peter R, Oberli A, Bourqui-Pittet M. **Dermal penetration of bisphenol A in human skin contributes marginally to total exposure.** Toxicol Lett. 2012 Sep 18. Epub 2012 Jul 11. Federal Office of Public Health, Division of Chemicals, CH-3003 Berne, Switzerland.

<http://www.ncbi.nlm.nih.gov/pubmed/22796587>

*An in vitro test designed to determine the dermal penetration rate of BPA in human skin shows that the systemic exposure to BPA via the skin contributes in a negligible way to total systemic BPA exposure.*

➤ Cardiac function

O'Reilly AO, Eberhardt E, Weidner C, Alzheimer C, Wallace BA, Lampert A. **Bisphenol a binds to the local anesthetic receptor site to block the human cardiac sodium channel.** PLoS One. 2012. Epub 2012 Jul 27. Institute of Physiology and Pathophysiology, Friedrich-Alexander-Universität Erlangen-Nürnberg, Bavaria, Germany.

<http://www.ncbi.nlm.nih.gov/pubmed/22848561>

*This study investigated the interaction between BPA and hNav1.5, the predominant voltage-gated sodium channel subtype expressed in the human heart. By comparing the effects of BPA and the local anesthetic mexiletine on wild type hNav1.5 and the F1760A mutant, the authors have demonstrated that BPA blocks the human heart sodium channel via the local anesthetic receptor.*

➤ Modelling BPA interactions /Receptor ERRy

Babu S, Vellore NA, Kasibotla AV, Dwayne HJ, Stubblefield MA, Uppu RM. **Molecular docking of bisphenol A and its nitrated and chlorinated metabolites onto human estrogen-related receptor-gamma.** Biochem Biophys Res Commun. 2012 Sep 21. Epub 2012 Aug 23. United States.  
<http://www.ncbi.nlm.nih.gov/pubmed/22935422>

*The study shows that both BPA and its putative chlorinated and nitrated metabolites, formed by the oxidative biotransformation of BPA, have strong binding affinity for the human estrogen-related receptor-gamma (ERR $\gamma$ ) compared to estradiol.*

## B. EFFECTS ON ANIMALS

### a) RATS:

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#### ➤ Hormone metabolism

Ramirez MC, Bourguignon NS, Bonaventura MM, Lux-Lantos V, Libertun C, Becu-Villalobos D. **Neonatal xenoestrogen exposure alters growth hormone-dependent liver proteins and genes in adult female rats.** Toxicol Lett. 2012 Sep 18. Epub 2012 Jul 25. Instituto de Biología y Medicina Experimental, Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Vuelta de Obligado 2490, 1428 Buenos Aires, Argentina.  
<http://www.ncbi.nlm.nih.gov/pubmed/22842222>

*Pituitary GH content and liver IGF-I concentration were increased by neonatal BPA treatment of female rats from postnatal day 1 to 10. The findings indicate that perinatal exposure to BPA may compromise the sexually dimorphic capacity of the liver to metabolize drugs and steroids.*

#### ➤ Reproduction

Brannick KE, Craig ZR, Himes AD, Peretz JR, Wang W, Flaws JA, Raetzman LT. **Prenatal Exposure to Low Doses of Bisphenol A Increases Pituitary Proliferation and Gonadotroph Number in Female Mice Offspring at Birth.** Biol Reprod. 2012 Aug 8. [Epub ahead of print]  
<http://www.ncbi.nlm.nih.gov/pubmed/22875908>

*The study found that prenatal exposure of rats to BPA (0.5 and 50 $\mu$ g/kg/day BPA) affects pituitary gonadotroph development in females.*

#### ➤ Hepatotoxicity

Hassan ZK, Elobeid MA, Virk P, Omer SA, Elamin M, Daghestani MH, Alolayan EM. **Bisphenol A Induces Hepatotoxicity through Oxidative Stress in Rat Model.** Oxid Med Cell Longev. 2012. Epub 2012 Jul 24. Zoology Department, College of Science, King Saud University, Riyadh 11451, Saudi Arabia.  
<http://www.ncbi.nlm.nih.gov/pubmed/22888396>

*BPA exposure generates ROS and reduces the antioxidant gene expression which causes hepatotoxicity in Rat Model.*

#### ➤ Diabetes (*in vitro*)

Song L, Xia W, Zhou Z, Li Y, Lin Y, Wei J, Wei Z, Xu B, Shen J, Li W, Xu S. **Low-level Phenolic Estrogen Pollutants Impair Islets Morphology and  $\beta$ -Cells Function in Isolated Rat Islets.** J Endocrinol. 2012 Sep 3. [Epub ahead of print] *L Song, School of Public Health, Tongji Medical College, Ministry of Education Key Laboratory of Environment and Health, Wuhan, China.*

<http://www.ncbi.nlm.nih.gov/pubmed/22946080>

*Exposure to bisphenol A (BPA), octylphenol (OP) and nonylphenol (NP) can disrupt insulin secretion, pancreatic islets morphology and  $\beta$ -cells function in rat in vitro.*

#### ➤ Behavioral effects

Patisaul HB, Sullivan AW, Radford ME, Walker DM, Adewale HB, Winnik B, Coughlin JL, Buckley B, Gore AC. **Anxiogenic effects of developmental bisphenol a exposure are associated with gene expression changes in the juvenile rat amygdala and mitigated by soy.** PLoS One. 2012. Epub 2012 Sep 5. *Department of Biology, North Carolina State University, Raleigh, North Carolina, United States of America.*

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3434201/>

*Exposure to BPA from gestation through puberty induces behavioral effects (e.g. Anxiety) in rats which can manifest during adolescence, but wane in adulthood, and may be mitigated by diet (soy-based or soy-free).*

### b) MICE :

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#### ➤ Lung inflammation

Bauer S, Roy A, Emo J, Chapman T, Georas S, Lawrence P. **The Effects Of Maternal Exposure To Bisphenol A On Allergic Lung Inflammation Into Adulthood.** Toxicol Sci. 2012 Jul 21. [Epub ahead of print] *Department of Environmental Medicine.*

<http://www.ncbi.nlm.nih.gov/pubmed/22821851>

*Maternal exposure to BPA has subtle and qualitatively different effects on allergic lung inflammation but these persistent changes in adult offspring do not lead to significant differences in overall airway responsiveness, suggesting that early life exposure to BPA does not exacerbate allergic inflammation into adulthood.*

#### ➤ Reproduction

Xi W, Wan HT, Zhao YG, Wong MH, Giesy JP, Wong CK. **Effects of perinatal exposure to bisphenol A and di(2-ethylhexyl)-phthalate on gonadal development of male mice.** Environ Sci Pollut Res Int. 2011 Aug. Epub 2012 Jul 21. *Croucher Institute of Environmental Sciences, Department of Biology, Hong Kong Baptist University, Hong Kong, People's Republic of China.*

<http://www.ncbi.nlm.nih.gov/pubmed/22828881>

*This study shows that exposure of pregnant mice to BPA and DEHP induce negative influence on the development and functions of the reproductive system of male pups.*

#### ➤ Cancer

Lee HS, Pyo MY, Yang M. **Set, a putative oncogene, as a biomarker for prenatal exposure to bisphenol A.** Asian Pac J Cancer Prev. 2012. Research Center for Cell Fate Control, College of Pharmacy Sookmyung Women's University, Seoul, Korea E.

<http://www.ncbi.nlm.nih.gov/pubmed/22938446>

*Prenatal exposure to BPA up- or down-regulates various proteins. Among them, SET, a putative oncogene and inhibitor of phosphatase 2A, is significantly down- regulated in a BPA dose-dependent manner. SET can therefore be applied as a new biomarker for prenatal BPA exposure. BPA new mechanism of action includes CYP17 disruption via SET.*

➤ **Immunology / Inflammatory response**

Kuan YH, Huang FM, Li YC, Chang YC. **Proinflammatory activation of macrophages by bisphenol A-glycidyl-methacrylate involved NF $\kappa$ B activation via PI3K/Akt pathway.** Food Chem Toxicol. 2012 Aug 24. [Epub ahead of print] Department of Pharmacology, Chung Shan Medical University, Taichung, Taiwan.

<http://www.ncbi.nlm.nih.gov/pubmed/22939937>

*BisGMA, a BPA-based dental composite resin, induces nitric oxide, ROS, and inflammatory cytokines in murine macrophages. In addition, BisGMA may active macrophage via NF- $\kappa$ B activation, I $\kappa$ B degradation, and p-Akt activation.*

➤ **Reproduction / development**

Zhang GL, Zhang XF, Feng YM, Li L, Huynh E, Sun XF, Sun ZY, Shen W. **Exposure to bisphenol A results in a decline in mouse spermatogenesis.** Reprod Fertil Dev. 2012 Sep 4. [Epub ahead of print]

<http://www.ncbi.nlm.nih.gov/pubmed/22951085>

*Exposure of 3-day-old mice to BPA (0, 20 and 40  $\mu$ g kg $^{-1}$  day $^{-1}$ ) hampers spermatogenesis and the subsequent development of offspring.*

➤ **Brain development**

Viberg H, Lee I. **A single exposure to bisphenol A alters the levels of important neuroproteins in adult male and female mice.** Neurotoxicology. 2012 Sep 12. [Epub ahead of print] Department of Environmental Toxicology, Uppsala University, Uppsala, Sweden.

<http://www.ncbi.nlm.nih.gov/pubmed/22981971>

*A single neonatal exposure to bisphenol A during the peak of the brain growth spurt can alter the adult levels of proteins important for normal brain development. Neonatal exposure to bisphenol A can act as a developmental neurotoxicant.*

➤ **Neurotoxicity**

Lee S, Kim YK, Shin TY, Kim SH. **Neurotoxic Effects of Bisphenol AF on Calcium-Induced ROS and MAPKs.** Neurotox Res. 2012 Sep 21. [Epub ahead of print] CMRI, Department of Pharmacology, School of Medicine, Kyungpook National University, Daegu, 700-422, Republic of Korea.

<http://www.ncbi.nlm.nih.gov/pubmed/22996013>

*The study suggests that BPAF, a chemical structurally related to bisphenol A and used as a substitute for BPA, also has neurotoxic properties.*

➤ Contact Allergy and cytotoxicity

O'Boyle NM, Delaine T, Luthman K, Natsch A, Karlberg AT. **Analogues of the Epoxy Resin Monomer Diglycidyl Ether of Bisphenol F: Effects on Contact Allergenic Potency and Cytotoxicity.** Chem Res Toxicol. 2012 Sep 21. [Epub ahead of print]

<http://www.ncbi.nlm.nih.gov/pubmed/22998141>

*The allergenic effects of diglycidyl ethers of bisphenol F (DGEBF) depend on its terminal epoxide groups. In contrast, DGEBF cytotoxicity not only depends on the presence of epoxide groups, but also on other structural features.*

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C) MONKEY

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➤ Reproduction

Hunt PA, Lawson C, Gieske M, Murdoch B, Smith H, Marre A, Hassold T, Vandervoort CA. **Bisphenol A alters early oogenesis and follicle formation in the fetal ovary of the rhesus monkey.** Proc Natl Acad Sci U S A. 2012 Sep 24. [Epub ahead of print] School of Molecular Biosciences and Center for Reproductive Biology, Washington State University, Pullman, WA 99164.

<http://www.ncbi.nlm.nih.gov/pubmed/23012422>

*Exposure to doses of BPA that yield circulating levels of BPA analogous to those reported in humans alters early oogenesis and follicle formation in the fetal ovary of the rhesus monkey.*

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D) CHICKEN

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➤ Immune system

Tian J, Luo D, She R, Liu T, Ding Y, Yue Z, Xia K. **Effects of bisphenol A on the development of central immune organs of specific-pathogen-free chick embryos.** Toxicol Ind Health. 2012 Jul 10. [Epub ahead of print] Department of Veterinary Pathology, College of Veterinary Medicine, China Agricultural University, Beijing, China.

<http://www.ncbi.nlm.nih.gov/pubmed/22782708>

*Exposure of chick embryos to a very low-dose level of BPA induce toxic effect on the development of the central immune organs of specific-pathogen-free chick embryos.*

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E) FISH

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➤ Hormone metabolism

Ekman DR, Hartig PC, Cardon M, Skelton DM, Teng Q, Durhan EJ, Jensen KM, Kahl MD, Villeneuve DL, Gray LE Jr, Collette TW, Ankley GT. **Metabolite profiling and a transcriptional activation assay provide direct evidence of androgen receptor antagonism by bisphenol a in fish.** Environ Sci Technol. 2012 Sep. Epub 2012 Aug 22. Ecosystems Research Division, U.S. EPA, 960 College Station Rd., Athens, Georgia 30605,

*United States.*

<http://www.ncbi.nlm.nih.gov/pubmed/22846149>

*The results of this study carried out on fish (fathead minnows) provide strong and direct evidence for ascribing an antiandrogenic mechanisms of action to BPA in vertebrates.*

## C. ENVIRONMENTAL EXPOSURE

### HUMAN IMPREGNATION STUDIES:

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- **Belgian population**

Pirard C, Sagot C, Deville M, Dubois N, Charlier C. **Urinary levels of bisphenol A, triclosan and 4-nonylphenol in a general Belgian population.** Environ Int. 2012 Nov 1. Epub 2012 Aug 9.

<http://www.ncbi.nlm.nih.gov/pubmed/22885664>

*This study shows that the general Belgian population is extensively exposed to BPA and triclosan. Dietary intake would be the primary route of exposure to BPA.*

### ENVIRONMENTAL CONTAMINATION

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- **Drinking water**

Maggioni S, Balaguer P, Chiozzotto C, Benfenati E. **Screening of endocrine-disrupting phenols, herbicides, steroid estrogens, and estrogenicity in drinking water from the waterworks of 35 Italian cities and from PET-bottled mineral water.** Environ Sci Pollut Res Int. 2012 Jul 21. [Epub ahead of print] Istituto di Ricerche Farmacologiche "Mario Negri", via La Masa 19, 20156, Milan, Italy.

<http://www.ncbi.nlm.nih.gov/pubmed/22821279>

*Bisphenol A and nonylphenols were detected in drinking water samples from 35 major Italian cities and five popular Italian brands of bottled mineral water. Herbicides were found mainly in samples from cities in northern Italy.*

- **Water / restored stormwater pipes**

Ren DE, Smith JA. **Evaluation of Environmental Impacts of Two Common Restoration Methodologies for Pipes that Convey Stormwater Runoff.** Bull Environ Contam Toxicol. 2012 Sep. Epub 2012 Jul 22. Department of Civil and Environmental Engineering, University of Virginia, Charlottesville, VA, 22904-4742, USA.

<http://www.ncbi.nlm.nih.gov/pubmed/22820681>

*Neither BPA, nor phthalates (DEHP and BBP) were detected in water in contact with stormwater pipe-repair materials used by Ultraliner and Troliner technologies.*

- **Thermal paper**

Geens T, Goeyens L, Kannan K, Neels H, Covaci A. **Levels of bisphenol-A in thermal paper receipts from Belgium and estimation of human exposure.** Sci Total Environ. 2012 Oct 1. Epub 2012 Jul 28. *Toxicological Centre, University of Antwerp, Universiteitsplein 1, Antwerp, Belgium.*

<http://www.ncbi.nlm.nih.gov/pubmed/22846760>

*BPA was detected in all thermal paper samples collected in Belgium. An estimation of human exposure to BPA through thermal paper results in a median intake of 445ng BPA/day for the general population, which corresponds to an exposure of 6.4ng/kg bw/day for a person of 70kg. Occupational exposure can be much higher.*

#### ➤ Food-contact recycled-paper materials

Pérez-Palacios D, Fernández-Recio MÁ, Moreta C, Tena MT. **Determination of bisphenol-type endocrine disrupting compounds in food-contact recycled-paper materials by focused ultrasonic solid-liquid extraction and ultra performance liquid chromatography-high resolution mass spectrometry.** Talanta. 2012 Sep 15. Epub 2012 May 24. *Department of Chemistry, University of La Rioja, C/Madre de Dios 51, E-26006 Logroño (La Rioja), Spain.*

<http://www.ncbi.nlm.nih.gov/pubmed/22967537>

*The FUSLE and UPLC-ESI-QTOF-MS method was applied to the determination of bisphenol-type endocrine disrupting compounds in food-contact recycled-paper materials. The analysis of food-contact paper and cardboard samples confirmed the presence of for BPA, BPF, BADGE and BFDGE in these packaging.*

### D. METABOLISM AND BIOMONITORING

#### ➤ European biomonitoring: Assessment and methodology

Casas M, Chevrier C, Hond ED, Fernandez MF, Pierik F, Philippat C, Slama R, Toft G, Vandentorren S, Wilhelm M, Vrijheid M. **Exposure to brominated flame retardants, perfluorinated compounds, phthalates and phenols in European birth cohorts: ENRIECO evaluation, first human biomonitoring results, and recommendations.** Int J Hyg Environ Health. 2012 Jul 11. [Epub ahead of print] *Centre for Research in Environmental Epidemiology (CREAL), Barcelona, Spain; Hospital del Mar Research Institute (IMIM), Barcelona, Spain; Spanish Consortium for Research on Epidemiology and Public Health (CIBERESP), Spain.*

<http://www.ncbi.nlm.nih.gov/pubmed/22795704>

*As part of the ENRIECO project, the authors evaluated existing human biomonitoring data for BFRs, PFCs, phthalates and phenols in European birth cohorts and develop recommendations for more harmonized methods that will enable combination and comparison of cohort data in the future.*

### E. BPA: A GENERAL REVIEW

#### ➤ BPA in drinking water

Arnold SM, Clark KE, Staples CA, Klecka GM, Dimond SS, Caspers N, Hentges SG. **Relevance of drinking water as a source of human exposure to bisphenol A.** J Expo Sci Environ Epidemiol. 2012 Jul 18. doi: 10.1038/jes.2012.66. [Epub ahead of print] *The Dow Chemical Company, Midland, Michigan, USA.*

<http://www.ncbi.nlm.nih.gov/pubmed/22805988>

BPA in drinking water represents a minor component of overall human exposure. Human biomonitoring data indicate that ingestion of drinking water represents <2.8% of the total intake of BPA.

#### ➤ Exposure from food

Geens T, Aerts D, Berthot C, Bourguignon JP, Goeyens L, Lecomte P, Maghuin-Rogister G, Pironnet AM, Pussemier L, Scippo ML, Van Loco J, Covaci A. **A review of dietary and non-dietary exposure to bisphenol-A.** Food Chem Toxicol. 2012 Oct. Epub 2012 Aug 4. *Toxicological Centre, University of Antwerp, Universiteitsplein 1, Antwerp, Belgium; Belgian Superior Health Council, FPS Health, Food Chain Safety and Environment, Rue de l'Autonomie 4, 1070 Brussels, Belgium.*

<http://www.ncbi.nlm.nih.gov/pubmed/22889897>

*This review reports that food is the main source of BPA exposure and that the total exposure remains below the current tolerable daily intake of 50µg/kg/j.*

#### ➤ Effects on memory

Luine VN, Frankfurt M. [Epub ahead of print] **Estrogens facilitate memory processing through membrane mediated mechanisms and alterations in spine density.** Front Neuroendocrinol. 2012 Sep 7. *Department of Psychology, Hunter College of CUNY, New York, NY, USA.*

<http://www.ncbi.nlm.nih.gov/pubmed/22981654>

*This review documents rapid effects of estradiol on memory which enhances memory consolidation within 1h in rats. Bisphenol-A, rapidly antagonizes enhancements in memory in both sexes possibly through actions on spines. In conclusion, estradiol and related compounds exert rapid alterations in cognition through non-genomic mechanisms.*

#### ➤ Epigenetic effects

Singh S, Li SS. **Epigenetic effects of environmental chemicals bisphenol a and phthalates.** Int J Mol Sci. 2012. Epub 2012 Aug 15. *Department of Life Science, College of Science, National Taiwan Normal University, Taipei 116, Taiwan.*

<http://www.ncbi.nlm.nih.gov/pubmed/22949852>

*In vitro and in vivo studies show that in utero exposure to environmental toxicants such as BPA and phthalates causes epigenetic modifications that can induce alterations in gene expression that may persist throughout life and over several generations.*

## F. INNOVATION - METHODOLOGY

#### ➤ Risk assessment / BPA substitutes

Delfosse V, Grimaldi M, Pons JL, Boulahouf A, le Maire A, Cavailles V, Labesse G, Bourguet W, Balaguer P. **Structural and mechanistic insights into bisphenols action provide guidelines for risk assessment and discovery of bisphenol A substitutes.** Proc Natl Acad Sci U S A. 2012 Sep 11. Epub 2012 Aug 27. *Centre de Biochimie Structurale, Institut National de la Santé et de la Recherche Médicale U1054, Centre National de*

*la Recherche Scientifique, Unité Mixte de Recherche 5048, Universités Montpellier 1 and 2, 34090 Montpellier, France.*

<http://www.ncbi.nlm.nih.gov/pubmed/22927406>

*This study provides a wealth of tools and information that could be used for the development of BPA substitutes devoid of hormonal activity and more generally for environmental risk assessment.*

➤ European biomonitoring: Assessment and methodology

Casas M, Chevrier C, Hond ED, Fernandez MF, Pierik F, Philippat C, Slama R, Toft G, Vandendorren S, Wilhelm M, Vrijheid M. **Exposure to brominated flame retardants, perfluorinated compounds, phthalates and phenols in European birth cohorts: ENRIECO evaluation, first human biomonitoring results, and recommendations.** *Int J Hyg Environ Health.* 2012 Jul 11. [Epub ahead of print] Centre for Research in Environmental Epidemiology (CREAL), Barcelona, Spain; Hospital del Mar Research Institute (IMIM), Barcelona, Spain; Spanish Consortium for Research on Epidemiology and Public Health (CIBERESP), Spain.

<http://www.ncbi.nlm.nih.gov/pubmed/22795704>

*As part of the ENRIECO project, the authors evaluated existing human biomonitoring data for BFRs, PFCs, phthalates and phenols in European birth cohorts and develop recommendations for more harmonized methods that will enable combination and comparison of cohort data in the future.*

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