

Occupational exposure to bisphenol A. Urinary biomonitoring

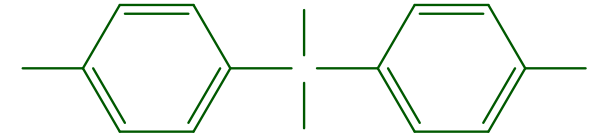
Sophie NDAW, INRS (France)

Symposium organised by the French National Research and Safety Institute (INRS) and the Chemistry section of the International Social Security Association (ISSA)

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What is Bisphenol A or BPA ?



Polycarbonate production

- Optical media
- Electronical & Electronics
- Construction
- Medical & Healthcare
- Bottles & Packaging
- Automotives

Epoxy production

- Protective Coatings
- Can Coating
- Composites
- Sea containers
- Flooring
- Adhesives
- Electrical & Electronics

Other products

- Other resins
- Thermal paper

BPA effects – human health trends

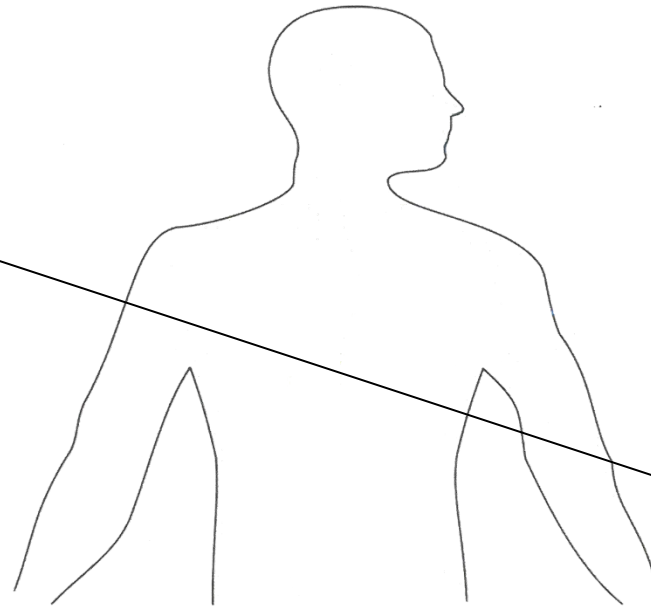
- Altered brain development and behavior
 - Hyperactivity
 - Abnormal behavior
- Endocrine disruption
 - Obesity
 - Type 2 diabetes
- Reproductive effects
 - Early sexual maturation
 - Miscarriage
- Cancer
 - Prostate
 - Breast

Controversial discussions
around the effects of BPA

Human exposure to BPA

- Diet
- Beverage
- Dust
- Thermal paper
- Medical devices
- Workplace exposure

- Inhalation route
- Oral route
- Dermal route



Increasing focus

- Thermal paper
- Dermal route
- Workplace exposure

Average exposure through diet
100 – 300 ng/kg/day (ANSES 2010)

ANSES 2013 – BPA risk assessment for human health

- Address the risks for human health of pregnant workers and consumers exposed to BPA through thermal paper they may handle
- Identify adverse effects for the unborn children's health on:
 - Vulnerability of the developing mammary gland
 - The brain and the behaviour
 - The metabolism and obesity
 - The female reproductive system
- Evaluation based on models and assumptions for the exposure to BPA



Évaluation
des risques
du bisphénol A (BPA)
pour la santé
humaine
Tome 1

Avis de l'Anses
Rapport d'expertise collective

Document scientifique

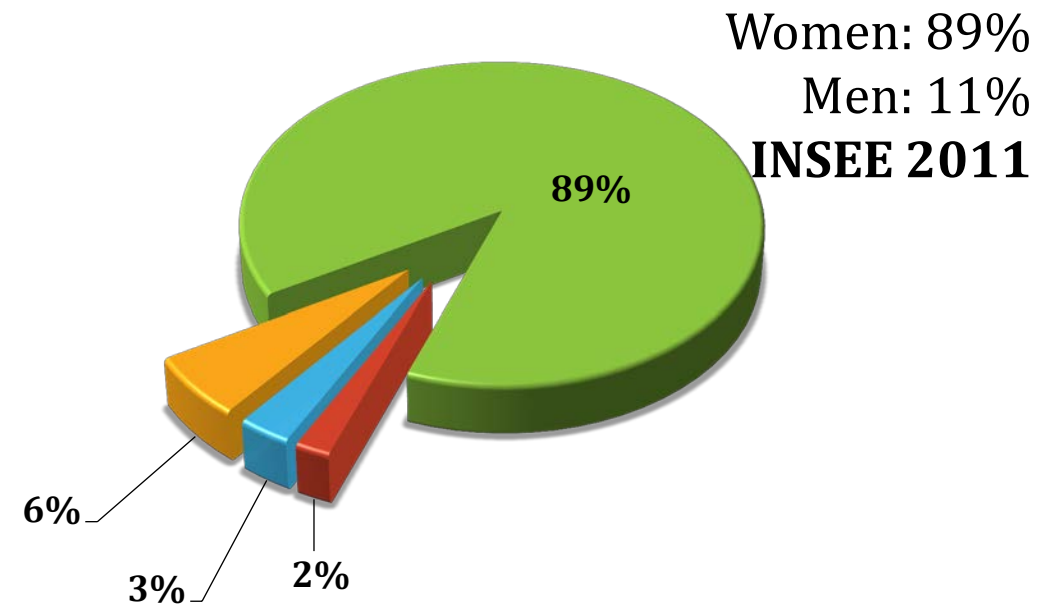


Occupational exposure to BPA through thermal paper

- Thermal paper manufacturers
- Printing companies workers
- Cashiers

186,000 French cashiers

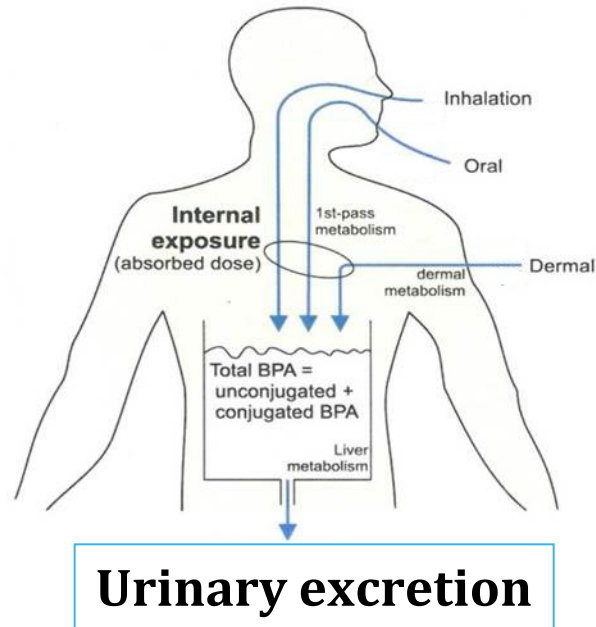
- Commerce
- Transport
- Hotel and Restaurant
- Others



Study design: 2013 - 2014

- BPA quantification in thermal paper
- Questionnaire
 - Job / work description
 - Food (canned food...)
 - Tobacco
 - DIY: paints...
- Urinary biomonitoring

Urinary excretion of BPA



Biomonitoring

- Free BPA in urine
- Total BPA (conjugated + unconjugated BPA) in urine
- Spot urine samples
 - Pre-shift
 - Post-shift
 - First morning void

- **Unconjugated BPA** (or BPA free form):
biologically active form for ERs
- **Conjugated BPA**: inactive forms



Exposure of cashiers to BPA

- 134 participants in 10 companies (restaurants, shops, ...)
- **90 cashiers** (69 women) aged 20-60 years (median 32 years)
- 10 to 1000 receipts/day (estimation)
- BPA in thermal paper: 1% - 1.8% (w/w)
- **44 controls**, aged 21-59 years (median 41 years)
 - Administrative staff
 - IT department
 - Supply staff

Urinary BPA levels of cashiers and controls

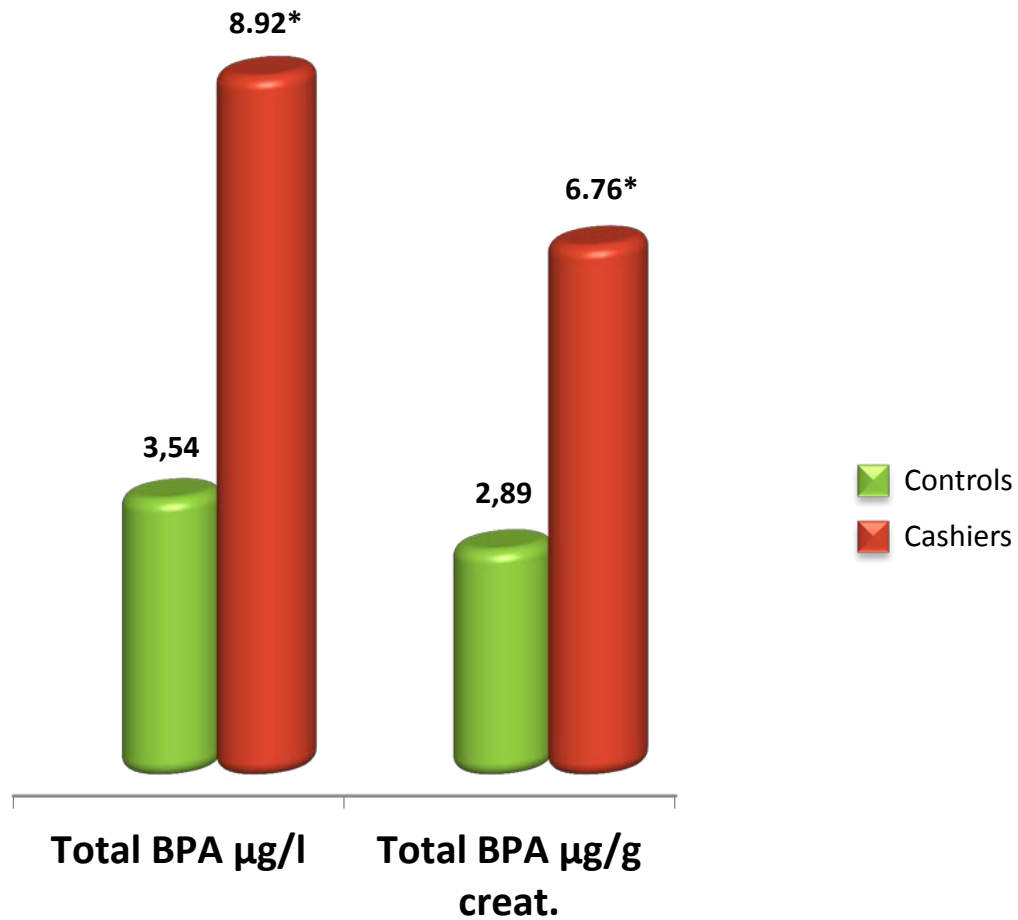
Distribution of BPA concentration

Total BPA µg/l					
	Nb samples	GM (GSD)	Median	95 th percentile	Range
Control N= 44	195	3,52 (2,35)	3,54	14,2	0,10 - 36,6
Exposed N= 90	390	8,58 (2,83)	8,92	44,0	0,54 - 1915

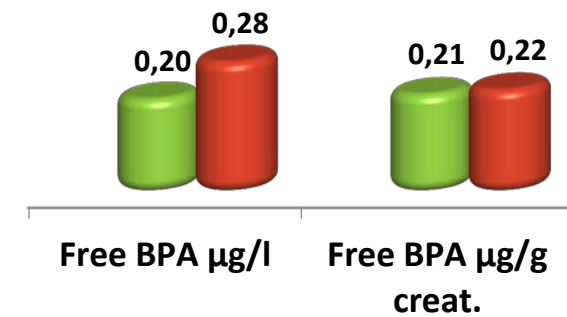
Free BPA µg/l					
	Nb samples	GM (GSD)	Median	95 th percentile	Range
Control N= 44	195	0,21 (2,33)	0,20	0,73	0,01 - 1,38
Exposed N= 90	390	0,28 (2,17)	0,28	0,88	0,01 - 16,2

Effect of exposure on BPA levels

Total BPA (median)



Free BPA (median)



Effect of other variables on BPA levels

- Sex: non significant difference between men and women
- Number of receipts handled
 - Estimation: 10 to 1000 receipts/day
 - No relationship between the number of receipts handled and total BPA concentration
- Age
- Length of service
- Tobacco
- Hand washes



Exposure of printing company workers

- 45 participants
- **30** occupationally exposed workers
- **15** non-occupationally exposed workers
- BPA in thermal paper: $\approx 0.6\%$ (w/w)

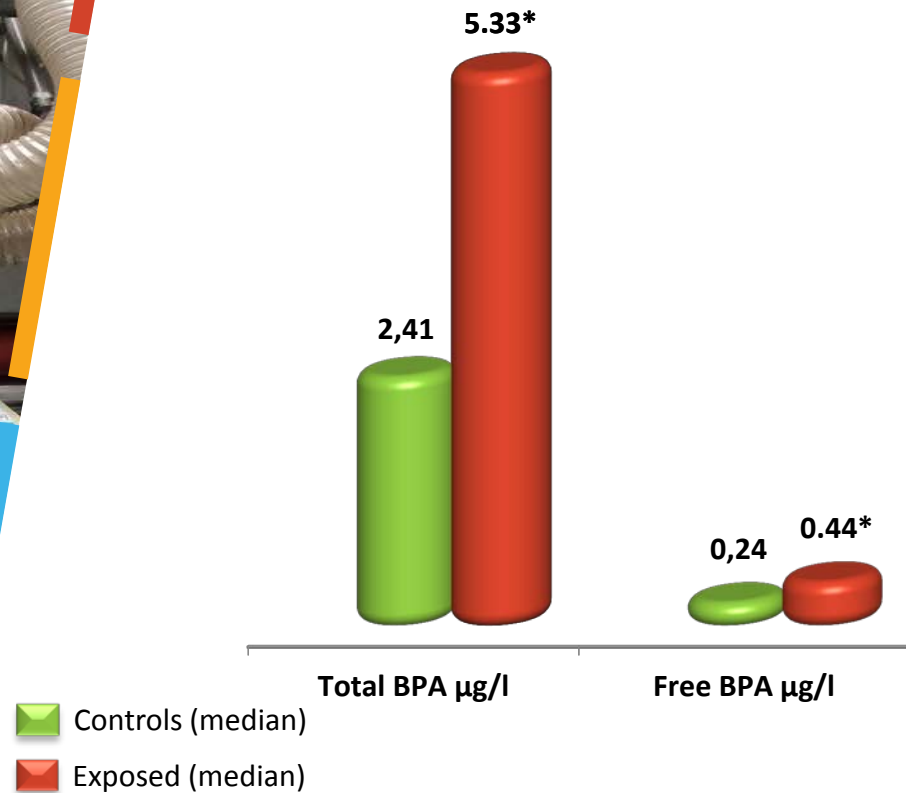
Urinary BPA levels of printing company workers

Distribution of BPA concentration

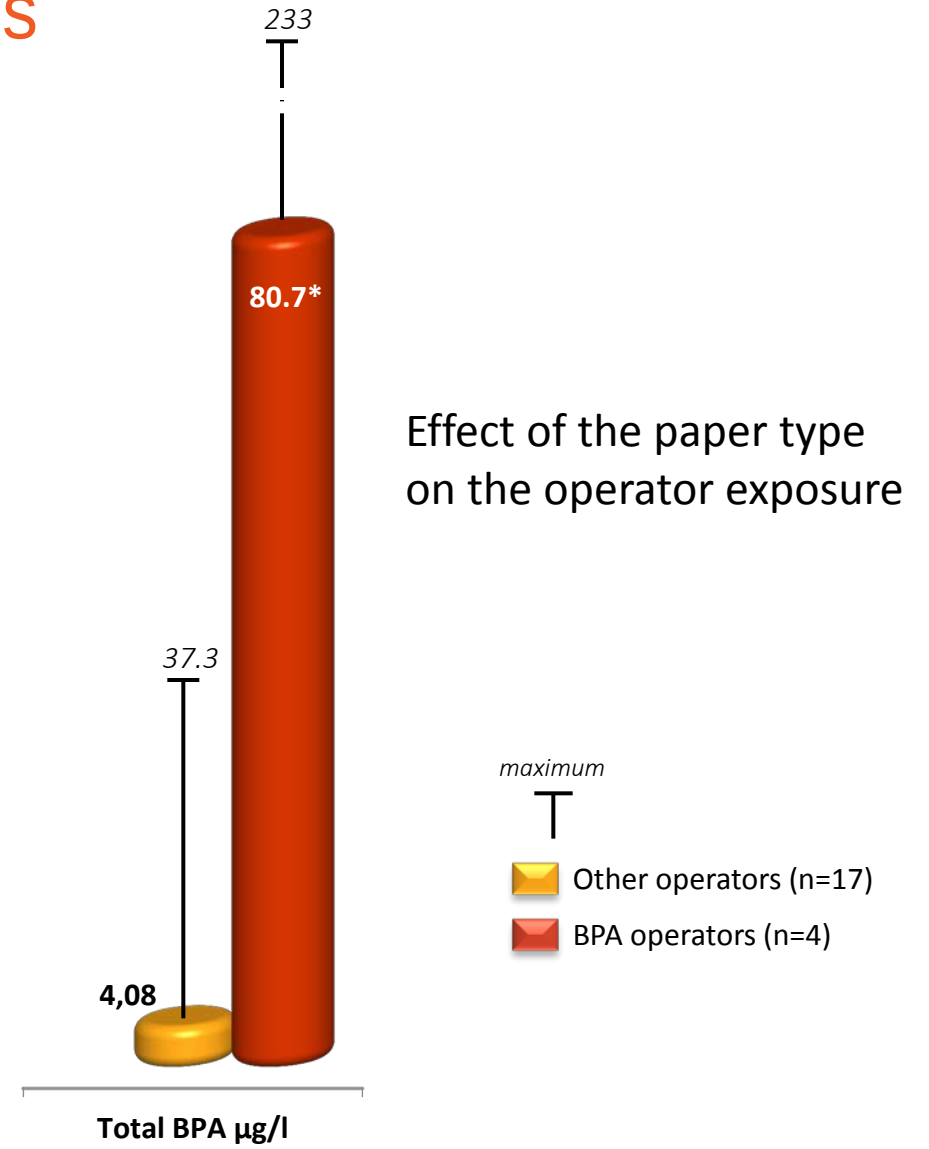
Total BPA µg/l					
	Nb samples	GM (GSD)	Median	95 th percentile	Range
Control N= 15	116	2,54 (2,40)	2,41	11,5	0,24 - 17,5
Exposed N= 30	225	7,23 (3,87)	5,33	108	0,30 - 233

Free BPA µg/l					
	Nb samples	GM (GSD)	Median	95 th percentile	Range
Control N= 15	116	0,24 (1,96)	0,24	0,63	0,07 - 0,93
Exposed N= 30	225	0,48 (2,09)	0,44	2,09	0,10 - 21,9

Effect of exposure on BPA levels



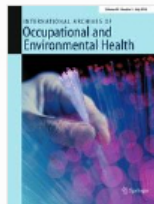
* $P < 0.05$



Thermal paper is a source of exposure to BPA for workers

- Previous data

- Thayer et al., 2015: total urinary BPA level
non-cashiers (n=21): 1.25 µg/g creatinine
cashiers (n=33): 2.76 µg/g creatinine



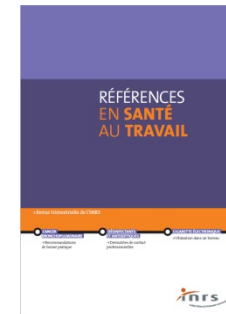
[International Archives of Occupational and Environmental Health](#)
pp 1-12

Occupational exposure of cashiers to Bisphenol A via thermal paper: urinary biomonitoring study

Sophie Ndaw ✉, Aurélie Remy, Danièle Jargot, Alain Robert

- INRS data

- Controls (n=44): 2.89 µg/g creatinine
- Cashiers (n=90): 6.76 µg/g creatinine



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Expositions professionnelles au bisphénol A lors de la manipulation de papier thermique

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EN
RÉSUMÉ

Restriction proposal submitted by ANSES (ECHA – 2014)

- Restriction regarding the use of BPA in thermal paper
 - Committee of Risk Assessment (RAC) opinion: june 2015
restriction is the most appropriate measure to address the identified risks
 - Committee for socio-economic analysis (SEAC): opinion september 2015
comparing the socio-economic benefits to the socio-economic costs, the proposed restriction is considered unlikely to be proportionate
 - Pending decision of the Commission

BPA alternatives in thermal paper

- Bisphenols: BPS, BPF and BPAP
- Phenolic substances: D8, D90, TGSA
- Urea-based substances: UU, Pergafast 201

Other occupations likely to be exposed to BPA:

Main use of BPA is in the production of polycarbonate plastics and epoxy resins (>90% of the total amount of BPA)

- Plastics industries: production of BPA based polycarbonate products
- Epoxy resin factories
- Liquid paint factories
- ...



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