Rigshospitalet
VÆKST REPRODUKTION

Menneskers optag af UV-filtre fra tøj

Hanne Frederiksen

Afdeling for Vækst og Reproduktion, Rigshospitalet

Center for Hormonforstyrrende Stoffer, Informationsdag 31. Oktober 2017

UV-filtres hormonforstyrrende egenskaber

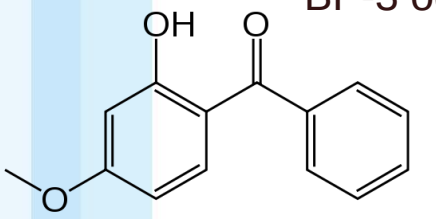
- Nogle UV-filtre har vist østrogene, anti-androgene og anti-thyroide egenskaber og påvirker i dyreforsøg udvikling af pubertet, skjoldbruskkirtel og reproduktive funktioner (Foster et al. 1983, Schlumpf et al. 2008, Krause et al. 2012, Kim og Choi 2014, Watanabe et al. 2015).
- Benzophenone-3 (BP-3) eksponering af zebrafisk ændre kønsratioen → færre hanner, flere hunner (Kinnberg et al. 2015).
- Præ- og perinatal eksponering af rotter viser anti-androgene effekter → nedsat antal spermatocytter hos afkom (Nakamura et al. 2015).
- In vitro-studier har vist, at nogle UV-filtre (bl.a. BP-3, 4-MBP, 4-MBC, 3-BC) kan aktivere den sædspecifikke CatSper-kanal (kationkanal i sædceller) og derved ”snyde” sædcellerne til for tidlig at igangsætte den hyper-mobilitet, som er nødvendig for at befrugte ægget (Rehfeld et al. 2016, Schiffer et al. 2014)

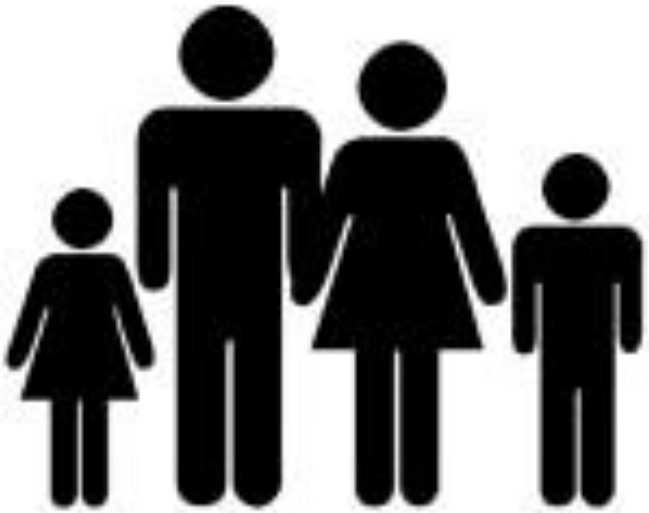
4-methylbenzophenon (4-MBP), 3- (4-methylbenzyliden)-camphor (4-MBC), 3-benzylidencamphor (3-BC) og benzophenon-3 (BP-3)

Rigshospitalet
VÆKST REPRODUKTION

Human Biomonitering

BP-3 og andre UV-filtre

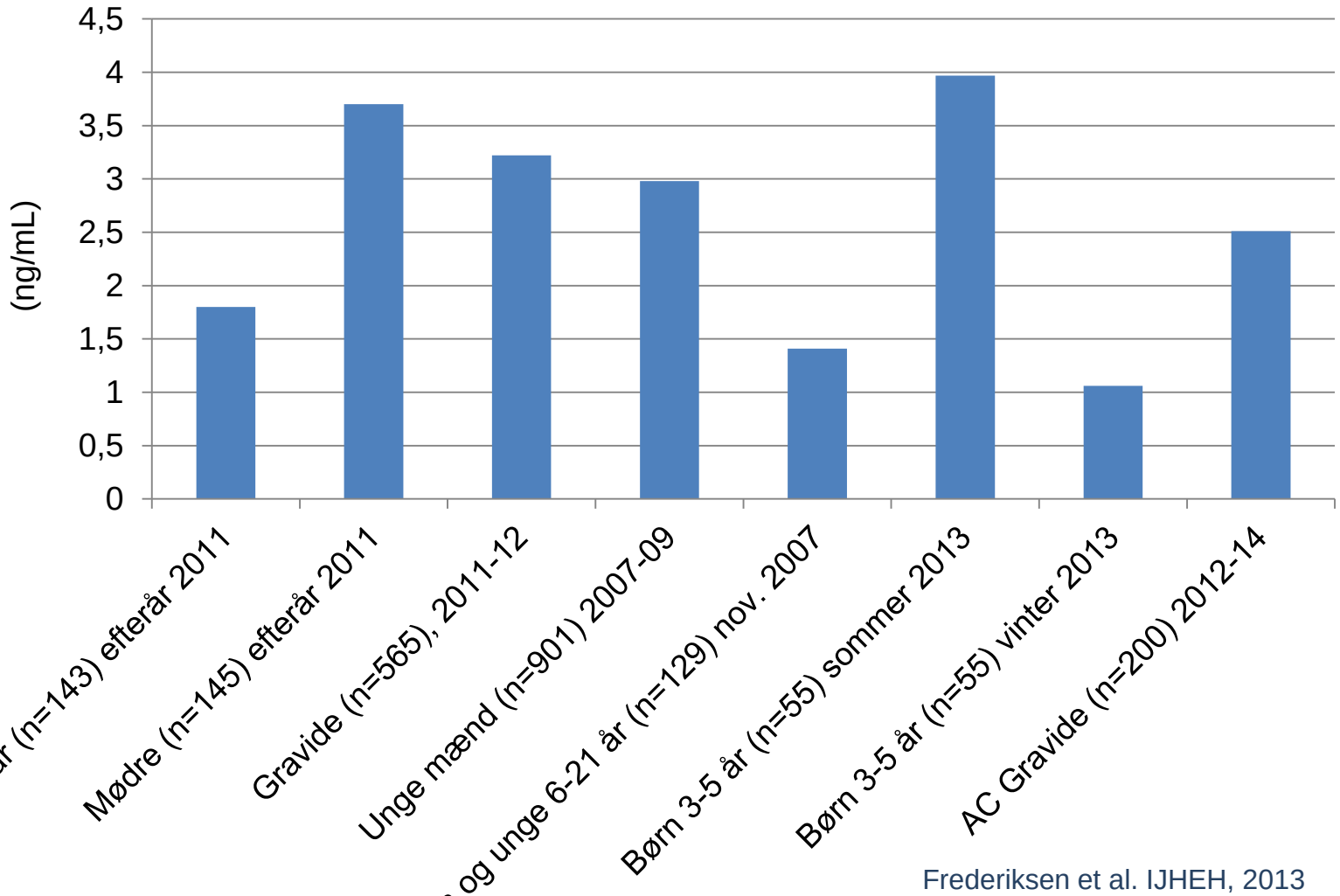




- Fedt (hjerne- og brystvæv)
- Sædvæske
- Fostervand
- Serum
- Urin

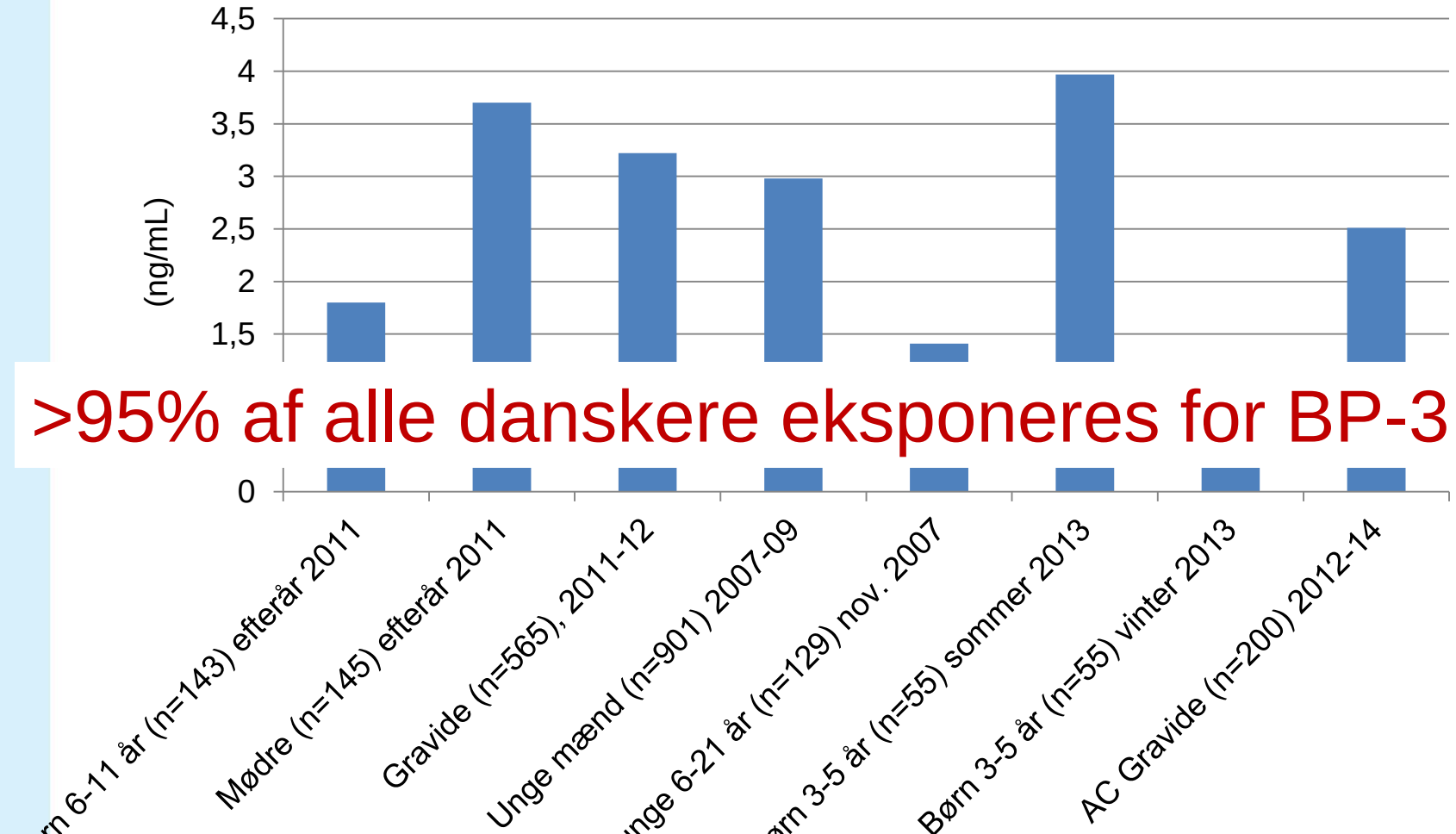
BP-3 eller metabolitter (BP-1)
udskilles i urin (4-24 timer)

BP-3 målt i danskeres urin



Frederiksen et al. IJHEH, 2013
Frederiksen et al. Reproduction, 2014
Krause et al. Environ Int, 2017a
Krause et al. Environ Int, 2017b

BP-3 målt i danskeres urin



>95% af alle danskere eksponeres for BP-3

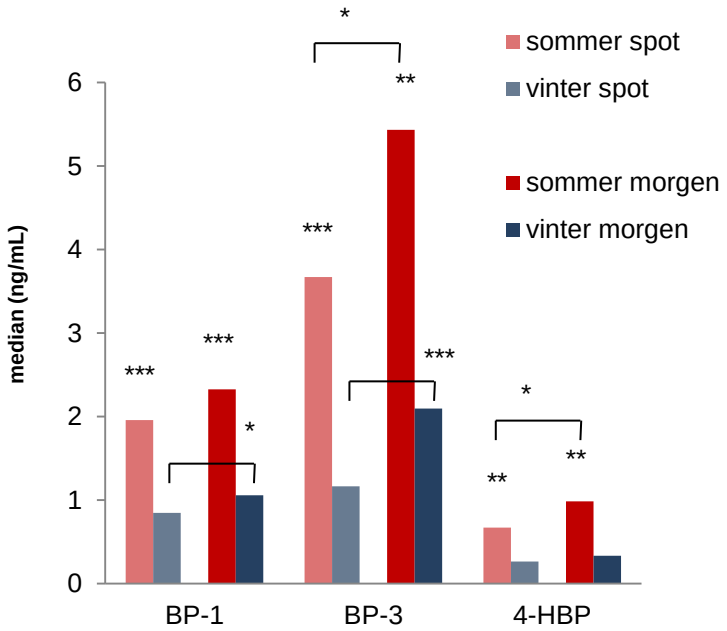
Frederiksen et al. IJHEH, 2013
Frederiksen et al. Reproduction, 2014
Krause et al. Environ Int, 2017a
Krause et al. Environ Int, 2017b

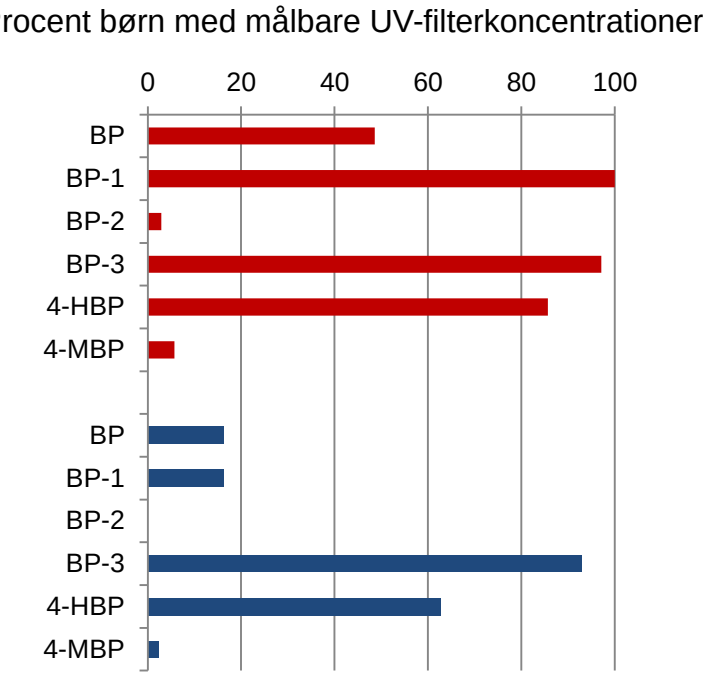
BP-3 målt i danskeres urin

>95% af alle danskere eksponeres for BP-3

Frederiksen et al. IJHEH, 2013
Frederiksen et al. Reproduction, 2014
Krause et al. Environ Int, 2017a
Krause et al. Environ Int, 2017b

UV-filtre i danske børnehave-børn

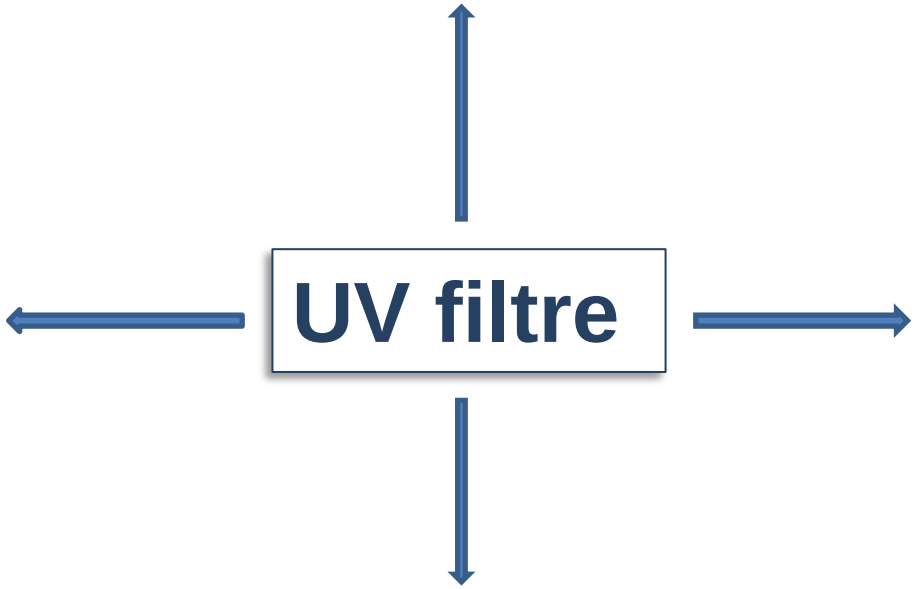




- Børn eksponeres for nogle UV-filtre året rundt
- Nogle UV-filtre bruges også som absorbere i forbrugerprodukter

Krause et al. Environ Int, 2017, 99, 177-184

Kilder til eksponering



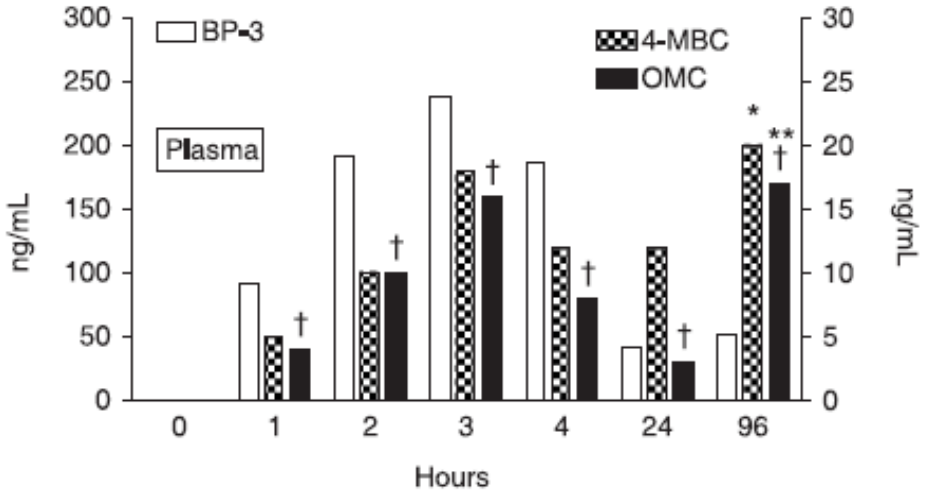
(Miljø- og Fødevareministeriet, rapport nr. 142, 2015, Greve et al. 2010)

Kemiske UV-filtre / absorbere optages gennem huden

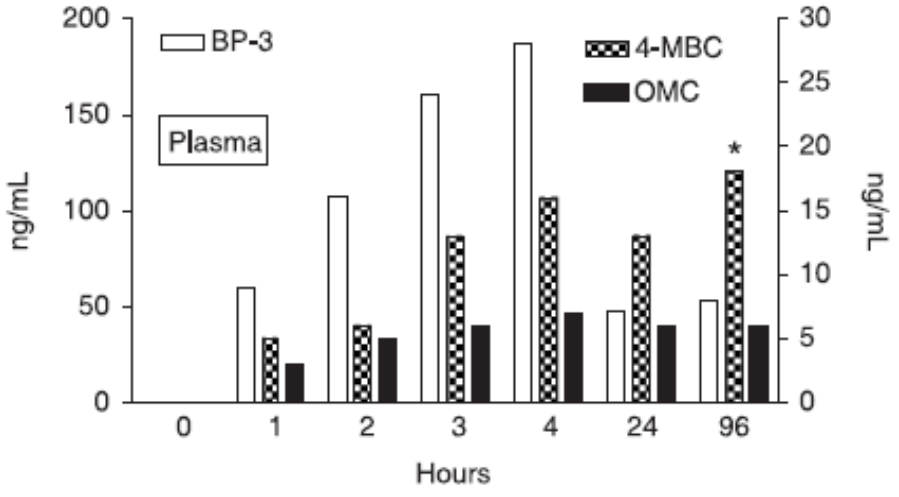
- Smøring af hele kroppen,
- 2 mg creme per cm^2 hud
- Cremen indeholdt 10% (w/w) af hver tre UV-filter:

Benzophenone-3 (BP-3)
Octyl-methoxycinnamate (OMC)
3-(4-methylbenzylidene) camphor (4-MBC)

Mænd, N=15



Kvinder, N=17



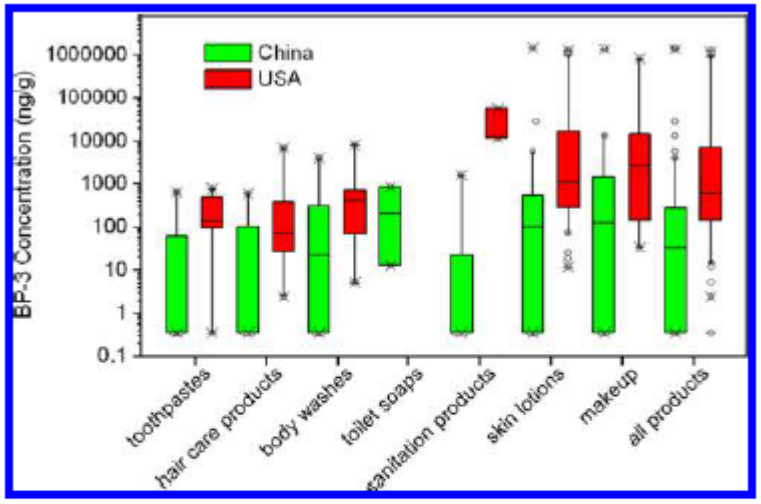
Janjua et al, JEADV 2008, 22, 456–461

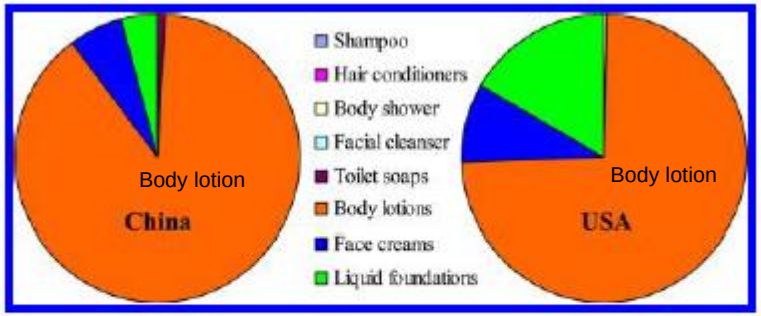
BP-3 i plejeprodukter i Kina og USA (ikke solcremer)

Table 1. Concentrations (ng/g Product Weight) and Detection Rates (%) of BP-3 in Personal Care Products from China and the United States[a]

	n	GM	fifth percentile	median	95th percentile	range	detection rate (%)
toothpastes	17	10.0	0.354	43.6	679	nd–786	58.8
hair care products	32	20.5	0.354	42.5	886	nd–6810	71.9
Body shampoo	31	61.0	0.354	92.1	5440	nd–8190	80.6
toilet soaps	3	132	32.3	205	788	13.1–853	100
sanitation products	9	18.1	0.354	0.562	38 300	nd–56 100	55.6
Body lotion	107	548	0.354	530	973 000	nd–1 480 000	88.8
makeup	32	284	0.354	221	391 000	nd–1 370 000	84.4
China	117	20.1	0.354	32.7	3860	nd–1 480 000	64.1
USA	114	1200	16.9	628	923 000	nd–1 290 000	99.1
all products	231	151	0.354	184	825 000	nd–1 480 000	81.4

[a]GM = geometric mean; nd = not detected.





Liao and Kannan, Environ. Sci. Technol. 2014, 48, 4103−4109

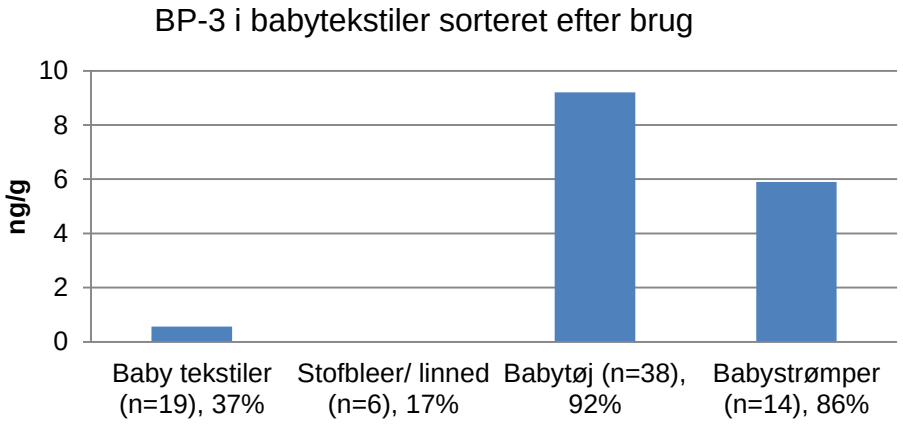
Bisphenoler og benzophenoner i tekstiler og babytøj

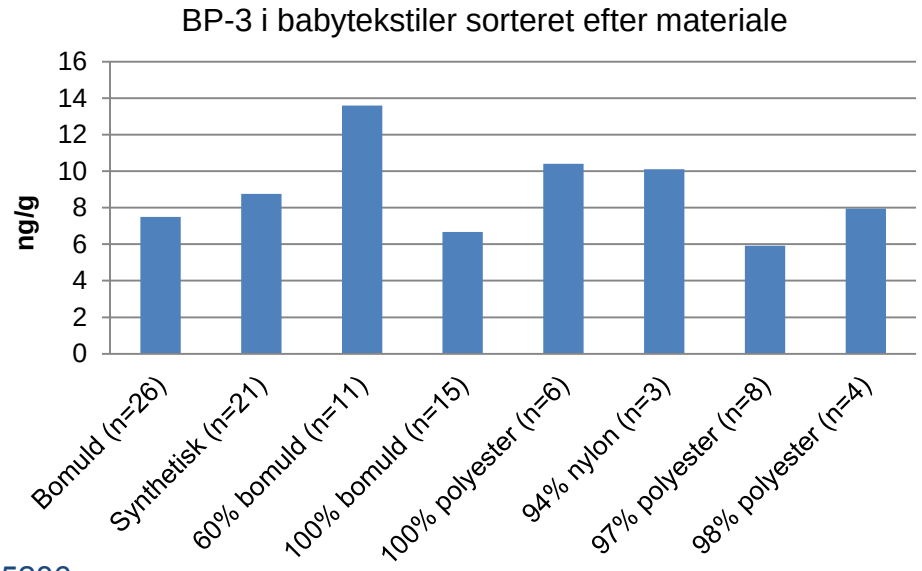
77 stykker tøj produceret i Sydøstasien og El Salvador

Table 1. Overall Concentrations (ng/g) of Bisphenols, Benzophenones, Bisphenol A Diglycidyl Ether (BADGE), and Their Derivatives in Textiles (n = 77) Collected from Albany, New York, USA[a]

n = 77	DR (%)	mean	SD	median	range
BPA	82	366	1690	10.7	<2.21−13300
BPS	53	15.0	58.9	1.02	<0.74−394
BPF	5.2	6.70	25.3	0.32	<14.7−194
BPP	5.2	0.23	0.99	0.004	<0.74−7.96
BP3	70	11.3	19.9	5.94	<2.21−157
4-OH-BP	7.8	0.41	1.01	0.10	<1.47−7.66
BP1	1.3	n.a.	n.a.	n.a.	<1.10−1.21
BADGE·$2H_2O$	22	1.92	2.84	0.82	<1.47−13.1
BADGE	7.8	0.23	0.62	0.04	<0.74−4.37
BADGE·HCl·H_2O	16	7.32	11.9	2.88	<1.47−62.9
BFDGE	29	13.6	27.2	2.44	<1.47−132
BFDGE·$2H_2O$	1.3	n.a.	n.a.	n.a.	<3.68−79.0
3R-NOGE	25	13.3	30.4	1.47	<0.74−174
4R-NOGE	12	1.77	3.54	0.64	<2.94−27.2

[a]DR = detection rate; SD = standard deviation; n.a. = not available.





Xue et al. Environ. Sci. Technol. 2017, 51, 5279−5286

Kan BP-3 i tøj optages gennem huden?

BP-3 kan måles i indendørs luft (Wan et al., 2015), er målt i nyt tøj (Xue et al., 2017) og forventes også at være i tøj, der er i brug.

Hypothese: Dermal BP-3 optagelse fra tøj bidrager væsentligt til den samlede BP-3 eksponering.

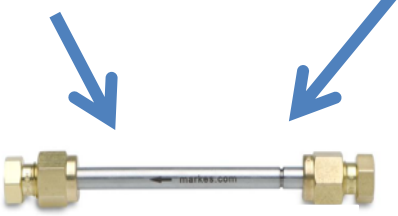
Morrison et al. Environ. Sci. Technol. 2017

Rigshospitalet
VÆKST REPRODUKTION

Studie design

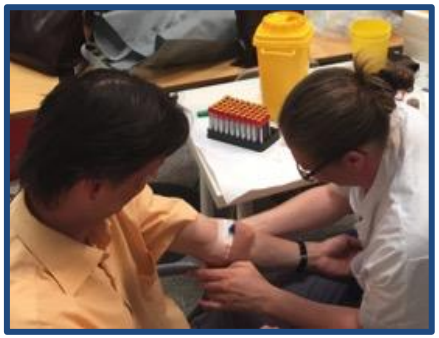
Forseglet prepareringskammer - Bomulds T-shirt eksponeret for BP-3 gennem 32 dage

3 timers personeksponering i et særligt eksponeringsrum



Luftprøver

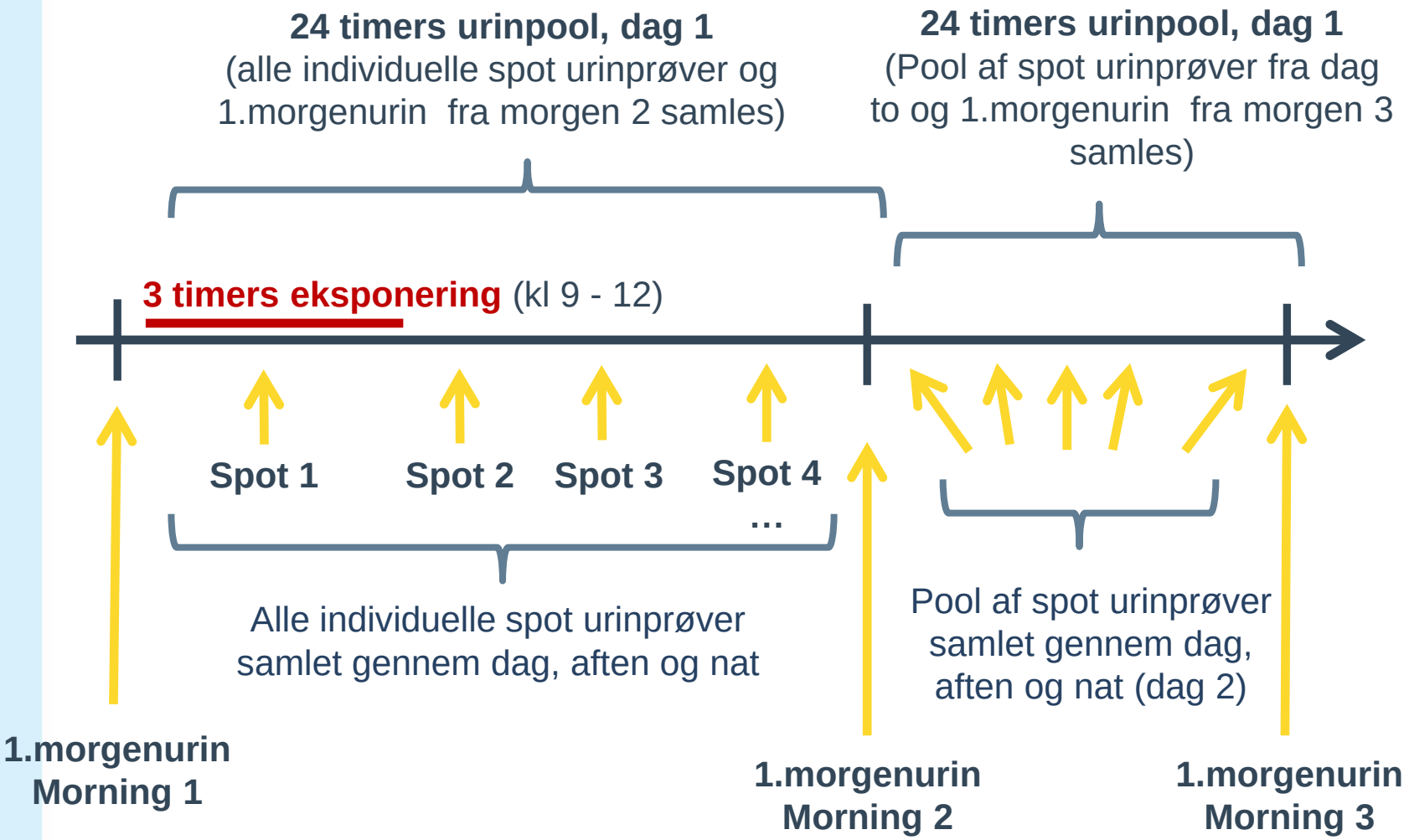
Blod



Urin

Morrison et al. Environ. Sci. Technol. 2017

Studie design



Morrison et al. Environ. Sci. Technol. 2017

Forsøgsdeltagere

	Person 1	Person 2	Person 3
Alder (år)	27	36	51
Vægt (kg)	73	71	84
Højde (m)	1.8	1.8	1.84
BMI (kg/m^2)	22.5	21.9	24.8
BSA (m^2)	1.92	1.89	2.08

Morrison et al. Environ. Sci. Technol. 2017, 51, 11371−11379

Analyser

- Blod (serum) og urin: Turboflow væskekromatografi-tandem massespektrometri (LC-MS/MS)
- Luft: Termisk desorptions-gaskromatografi massespektrometri (TD-GC/MS)
- T-shirts: Ekstraktion og HPLC-UV

Morrison et al. Environ. Sci. Technol. 2017, 51, 11371−11379

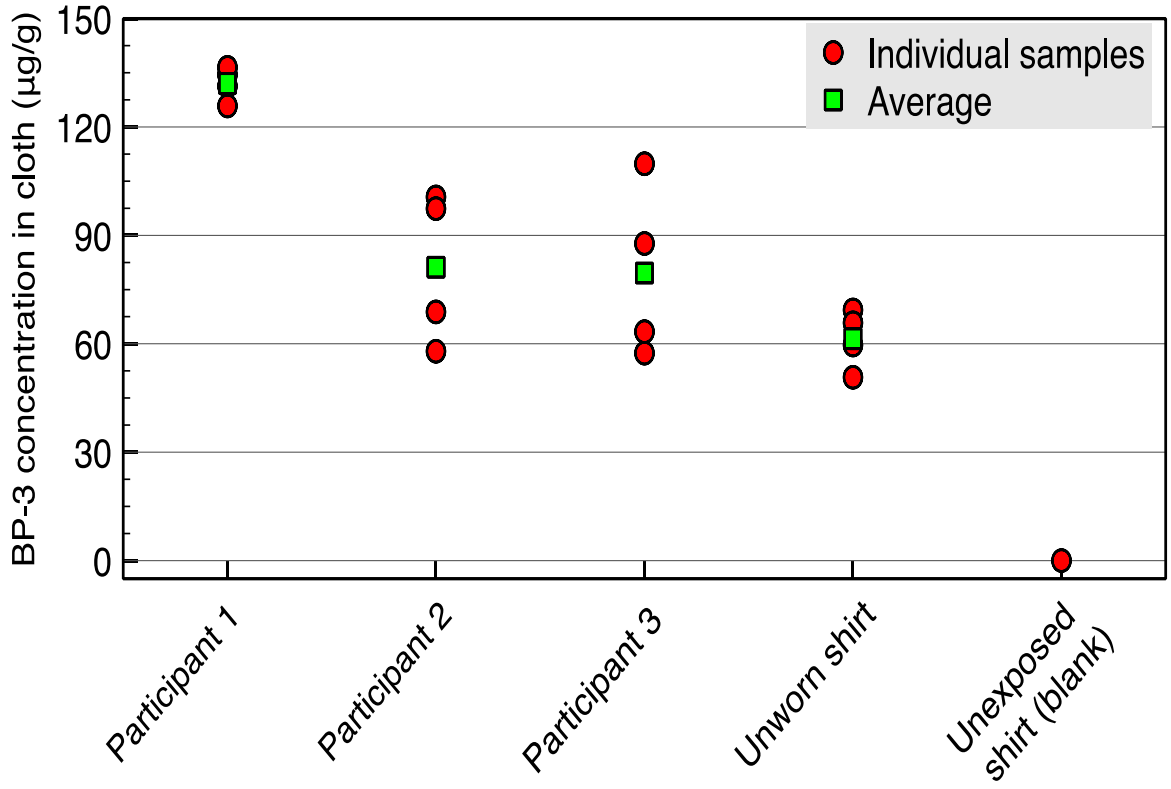
Luftmålinger

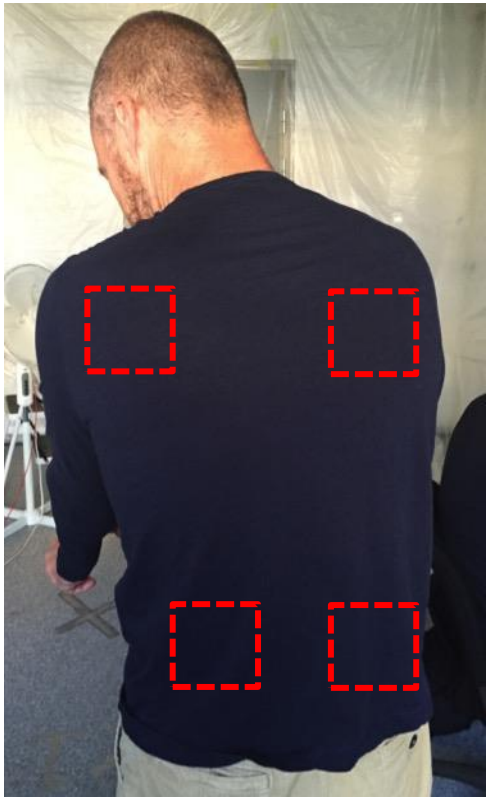
Forseglet prepareringskammer:
Efter 32 dage var BP-3 koncentrationen
i kammeret = 4,4 mg/m^3

Eksponeringsrum:
Luft nær vejrtrækningszone
BP-3 koncentration <LOQ (0,3 mg/m^3)
Indåndingsestimat <0,3 mg

Morrison et al. Environ. Sci. Technol. 2017, 51, 11371−11379

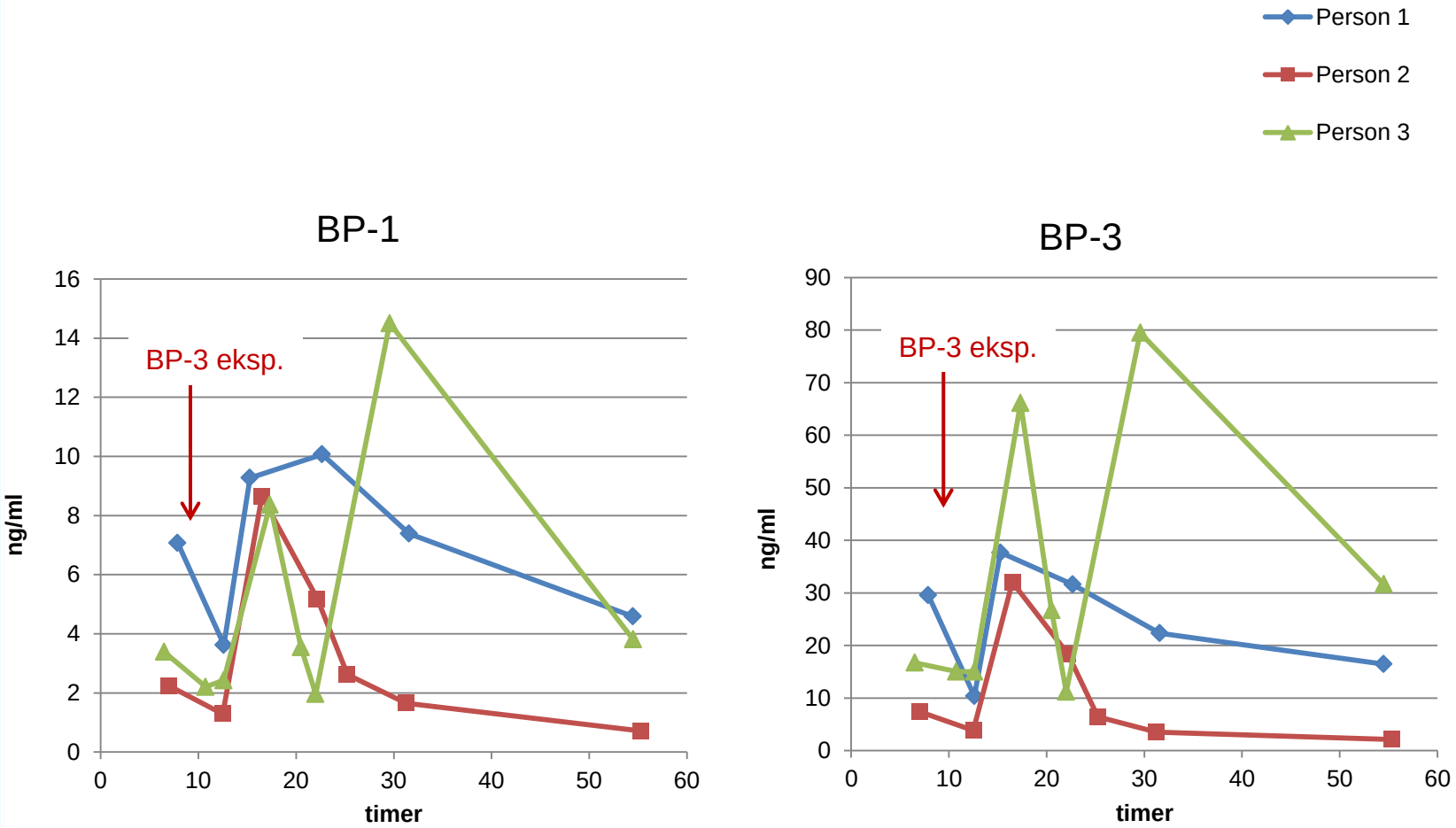
BP-3 koncentration i T-shirts





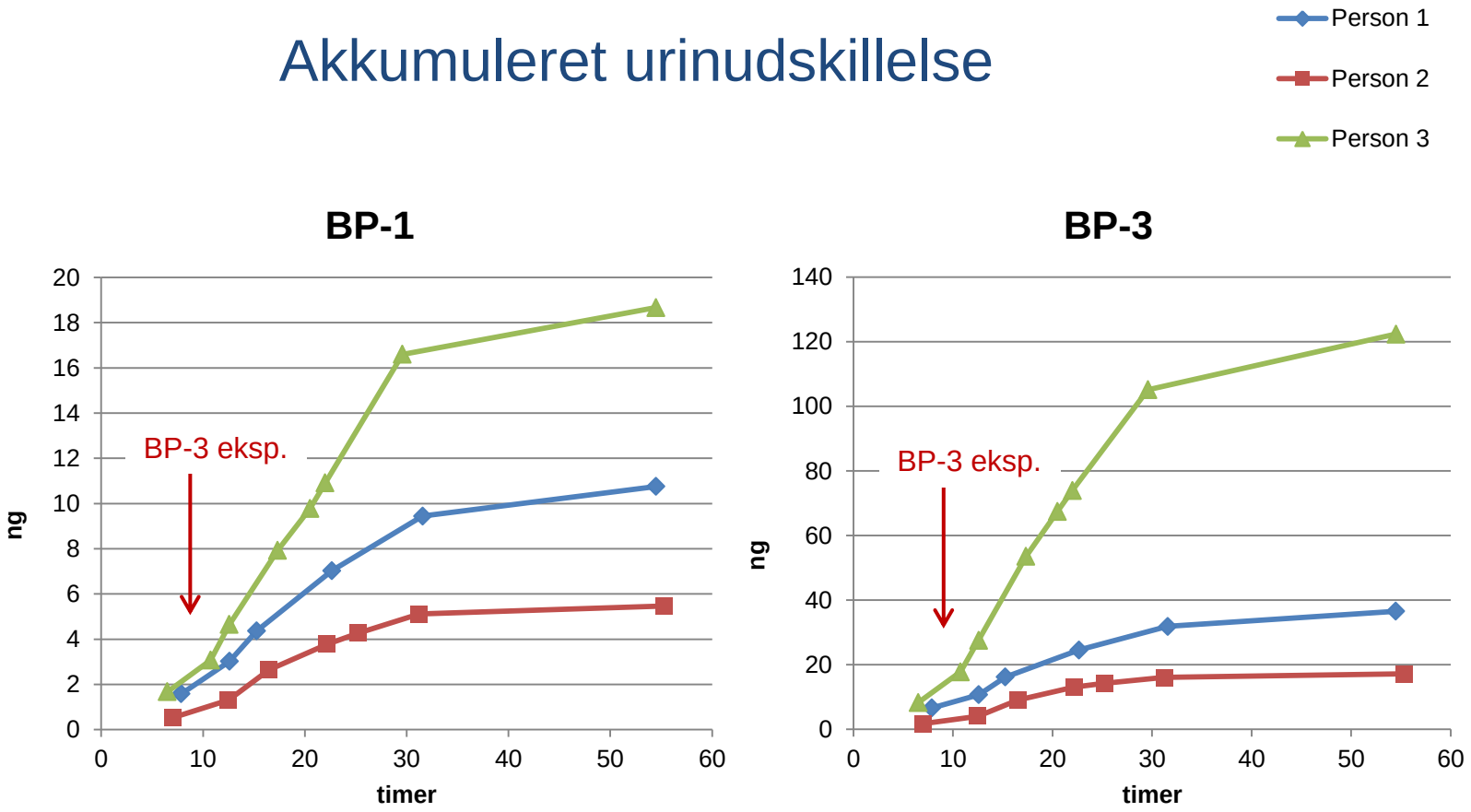
Morrison et al. Environ. Sci. Technol. 2017, 51, 11371−11379

BP-1 og BP-3 koncentration målt i urin



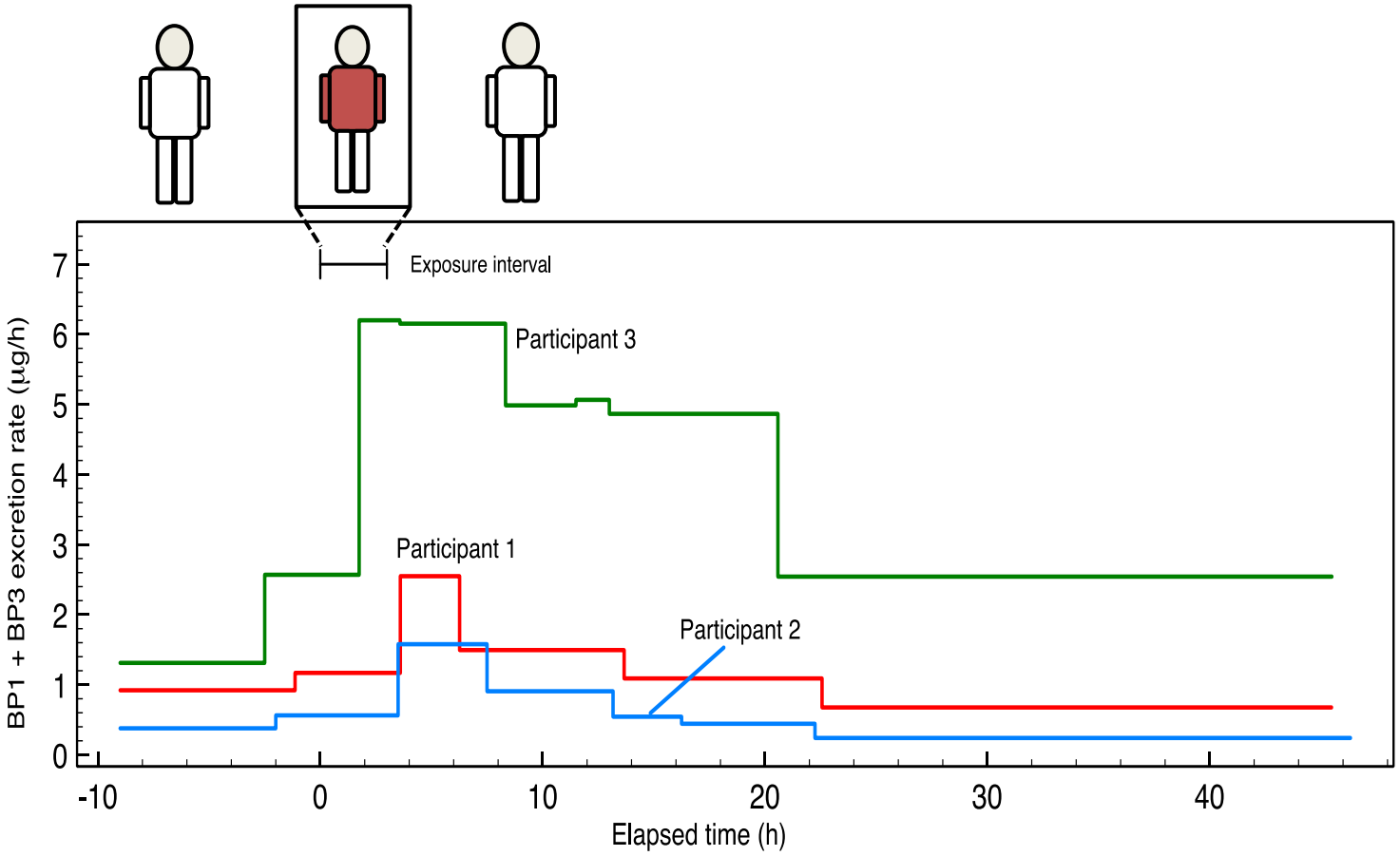
Morrison et al. Environ. Sci. Technol. 2017, 51, 11371−11379

Akkumuleret urinudskillelse



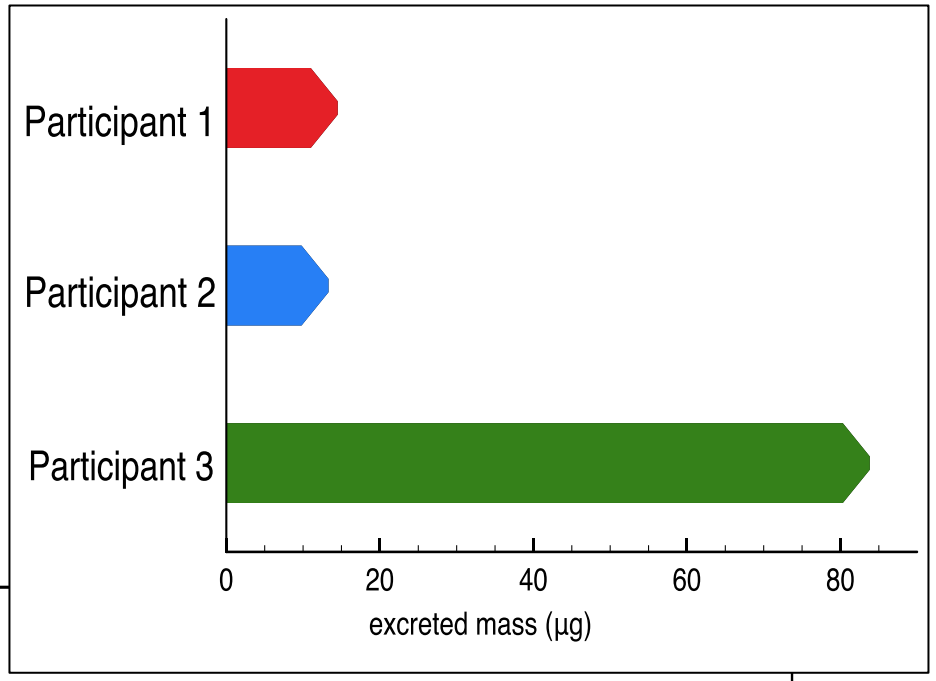
Morrison et al. Environ. Sci. Technol. 2017, 51, 11371−11379

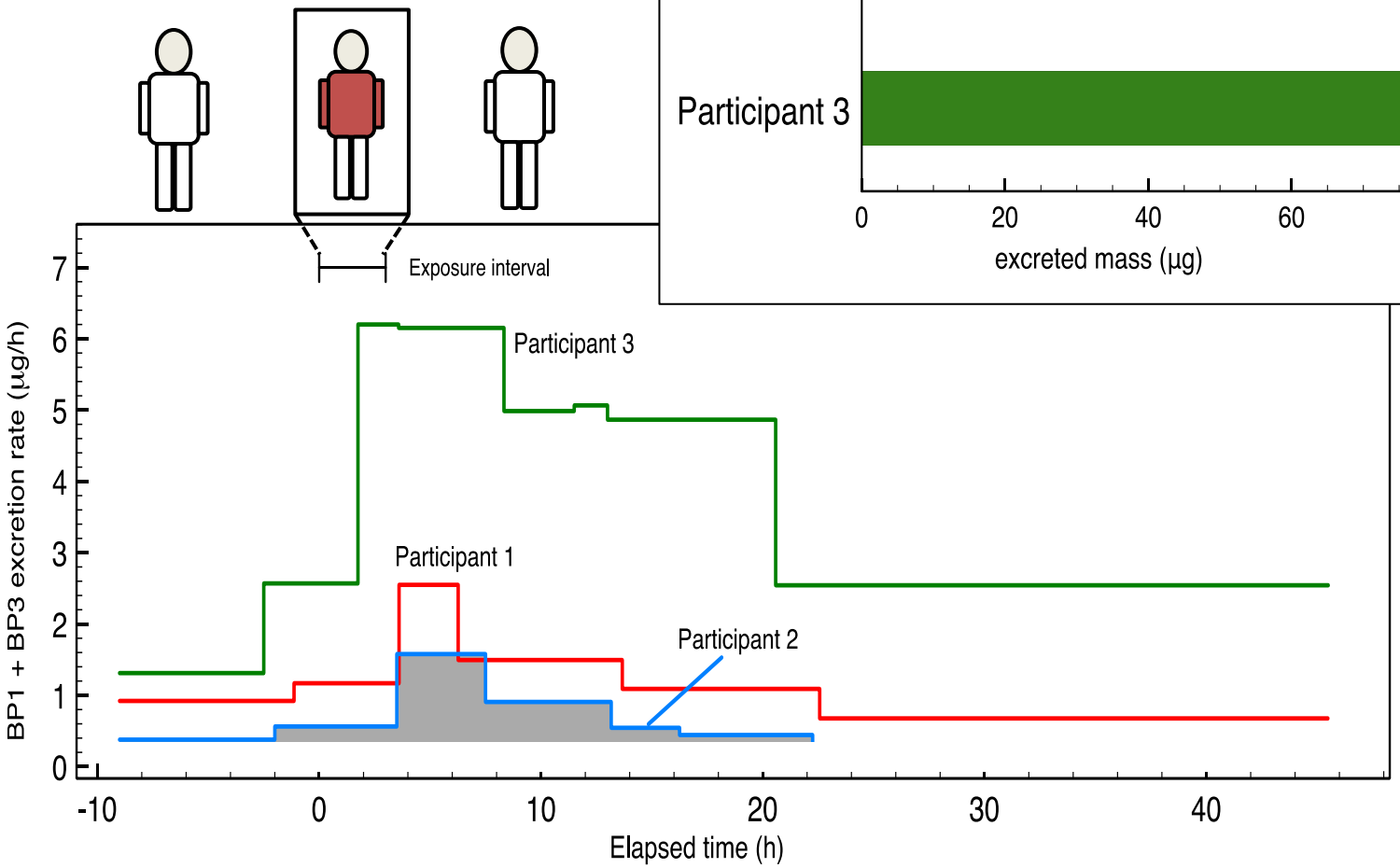
Udskillelseshastigheden i urin – sum af BP-1 og BP-3



Morrison et al. Environ. Sci. Technol. 2017, 51, 11371−11379

Samlet udskillelse





Morrison et al. Environ. Sci. Technol. 2017, 51, 11371−11379

Estimering af den samlede daglige eksponering - sum BP-3 + BP-1

		Daglig eksponering ng/kg/dag	
USA	Kvinder	532	Calafat et al. 2008
	Mænd	245	
Kina		33	Gao et al. 2015
Belgien	kun BP-3	22	Dewalque et al. 2014
Danmark	Sommer børn	212	Krause et al 2017
	Vinter børn	56	

Anslået optagelse fra tøj i dette studie: **9 - 35 ng/kg/dag**

Modellering baseret på:
Weschler og Nazaroff 2012 (permeabilitetsmetode)
Morrison et al. 2016 (optagelse fra tøj)
Wan et al. 2015 (luft koncentration i amerikanske bygninger)

Morrison et al. Environ. Sci. Technol. 2017, 51, 11371−11379

Konklusion

- BP-3 kan optages gennem huden fra eksponeret tøj, måles i blodet, metaboliseres og udskilles i urin som hhv. BP-3 og BP-1
- En deltager absorberede ~ 8 gange mere end andre deltagere → Forskelle i hudpermeabilitet?
- Dermal optagelse fra luft og tøj bidrager sandsynligvis til den samlede BP-3 eksponering.

Morrison et al. Environ. Sci. Technol. 2017, 51, 11371−11379

Environmental Science & Technology
Article
pubs.acs.org/est

Dermal Uptake of Benzophenone-3 from Clothing

Glenn C. Morrison,[*,†] Gabriel Bekö,[‡] Charles J. Weschler,[‡,§] Tobias Schripp,[∥,⊥] Tunga Salthammer,[∥] Jonathan Hill,[†] Anna-Maria Andersson,[#,▽] Jørn Toftum,[‡] Geo Clausen,[‡] and Hanne Frederiksen[#,▽]

[†]Civil, Architectural and Environmental Engineering, Missouri University of Science and Technology, Rolla, Missouri 65409, United States

[‡]International Centre for Indoor Environment and Energy, Department of Civil Engineering, Technical University of Denmark, Lyngby, 2800 Denmark

[§]Environmental and Occupational Health Sciences Institute, Rutgers University, Piscataway, New Jersey 08901, United States

[∥]Department of Material Analysis and Indoor Chemistry, Fraunhofer WKI, Braunschweig 38108, Germany

[⊥]Institute of Combustion Technology, German Aerospace Center, Stuttgart, 70569, Germany

[#]Department of Growth and Reproduction and [▽]International Center for Research and Research Training in Endocrine Disruption of Male Reproduction and Child Health (EDMaRC), Rigshospitalet, University of Copenhagen, Copenhagen 2100, Denmark

Supporting Information

ABSTRACT: Benzophenone-3 (also known as BP-3 or oxybenzone) is added to sunscreens, plastics, and some coatings to filter UV radiation. The suspected endocrine disruptor BP-3 has been detected in the air and settled dust of homes and is expected to redistribute from its original sources to other indoor compartments, including clothing. Given its physical and chemical properties, we hypothesized that dermal uptake from clothing could contribute to the body burden of this compound. First, cotton shirts were exposed to air at an elevated concentration of BP-3 for 32 days; the final air concentration was 4.4 $\mu g/m^3$. Next, three participants wore the exposed shirts for 3 h. After 3 h of exposure, participants wore their usual clothing during the collection of urine samples for the next 48 h. Urine was analyzed for BP-3, a metabolite (BP-1), and six other UV filters. The rate of urinary excretion of the sum of BP-1 and BP-3 increased for all participants during and following the 3 h of exposure. The summed mass of BP-1 and BP-3 excreted during the first 24 h attributable to wearing exposed t-shirts were 12, 9.9, and 82 μg for participants 1, 2, and 3, respectively. Analysis of these results, coupled with predictions of steady-state models, suggest that dermal uptake of BP-3 from clothing could meaningfully contribute to overall body burden.

Rigshospitalet
VÆKST REPRODUKTION

Mange tak til

- Stine E. Andersen, *Afdeling for Vækst og Reproduktion, Rigshospitalet*
- Anna-Maria Andersson, *Afdeling for Vækst og Reproduktion, Rigshospitalet*
- Glenn Morrison, Environmental Science and Engineering, University of North Carolina
- Charles Weschler, Environmental and Occupational Health Sciences Institute, Rutgers University, Piscataway, NJ
- Gabriel Bekö, Department of Civil Engineering, International Centre for Indoor Environment and Energy, Technical University of Denmark,

Tak for økonomisk støtte fra:

- Otto Mønsted Guest Professorship of the Technical University of Denmark
- International Center for Research and Research Training in Endocrine Disruption of Male Reproduction and Child Health (EDMaRC), Rigshospitalet,
- the National Science Foundation under grant no. 1336807.

Tak for anden økonomisk støtte til:

- Velux Fondene
- Lundbeck Fonden
- Augustinus Fonden
- Svend Andersens Fond

? ? ?

Rigshospitalet
VÆKST REPRODUKTION

Niveauerne af UV-filtre hos gravide

Hanne Frederiksen

Afdeling for Vækst og Reproduktion, Rigshospitalet

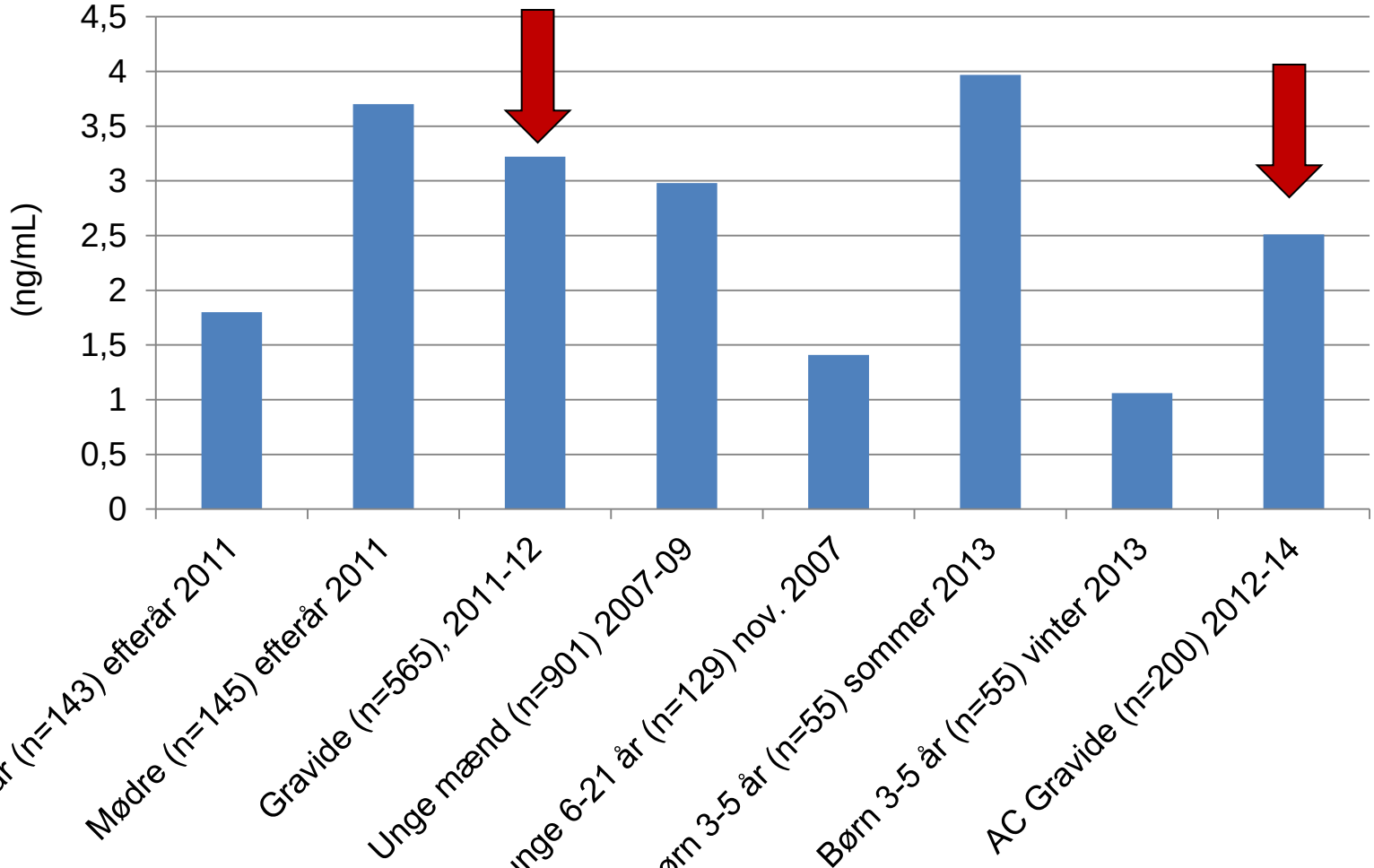
Center for Hormonforstyrrende Stoffer, Informationsdag 31. Oktober 2017

UV-filtres hormonforstyrrende egenskaber

- Nogle UV-filtre har vist østrogene, anti-androgene og anti-thyroide egenskaber og påvirker i dyreforsøg udvikling af pubertet, skjoldbruskkirtel og reproduktive funktioner (Foster et al. 1983, Schlumpf et al. 2008, Krause et al. 2012, Kim og Choi 2014, Watanabe et al. 2015).
- Benzophenone-3 (BP-3) eksponering af zebrafisk ændre kønsratioen → færre hanner, flere hunner (Kinnberg et al. 2015).
- Præ- og perinatal eksponering af rotter viser anti-androgene effekter → nedsat antal spermatocytter hos afkom (Nakamura et al. 2015).
- In vitro-studier har vist, at nogle UV-filtre (bl.a. BP-3, 4-MBP, 4-MBC, 3-BC) kan aktivere den sædspecifikke CatSper-kanal (kationkanal i sædceller) og derved ”snyde” sædcellerne til for tidlig at igangsætte den hyper-mobilitet, som er nødvendig for at befrugte ægget (Rehfeld et al. 2016, Schiffer et al. 2014)

4-methylbenzophenon (4-MBP), 3- (4-methylbenzyliden)-camphor (4-MBC), 3-benzylidencamphor (3-BC) og benzophenon-3 (BP-3)

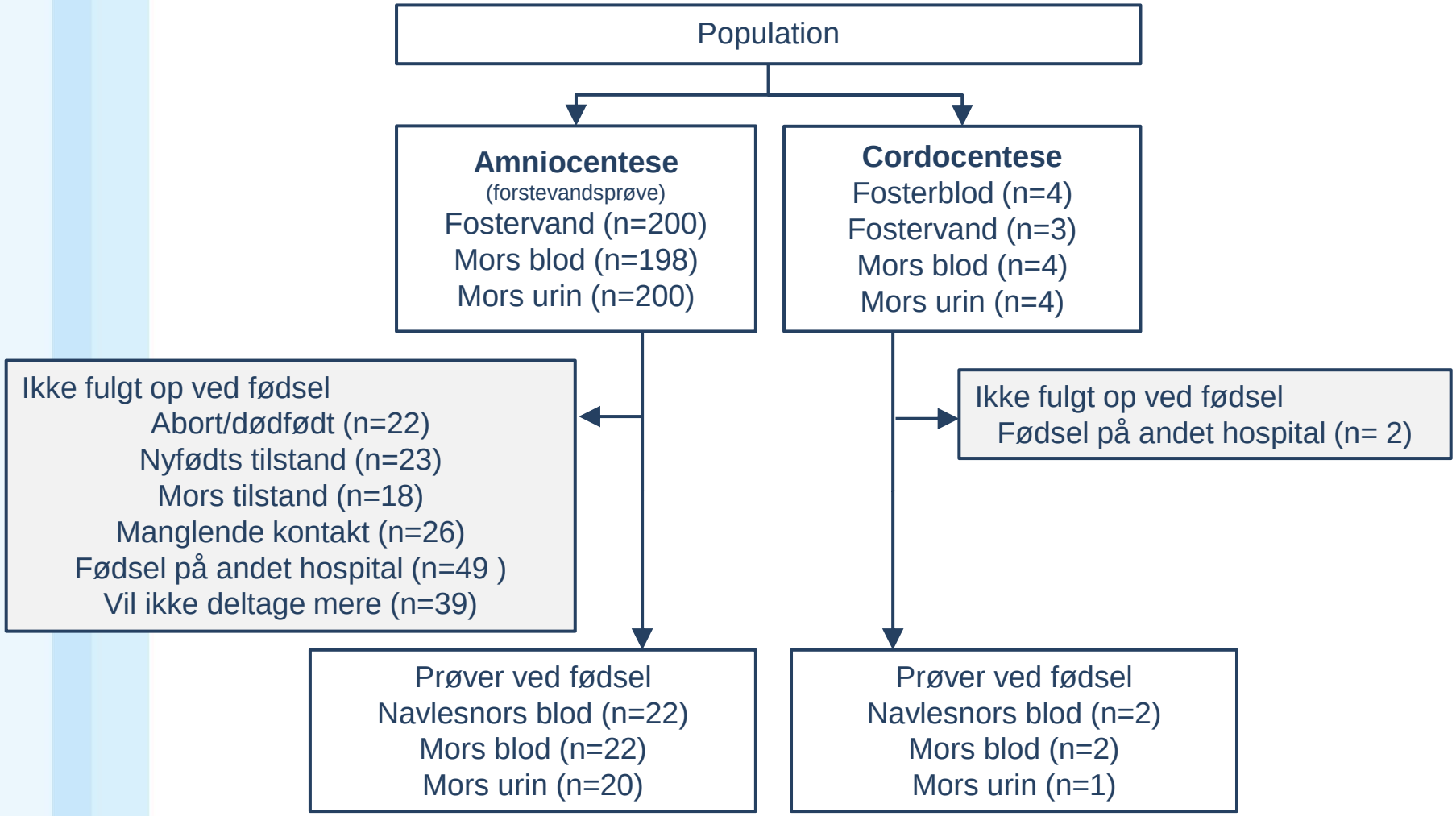
BP-3 målt i danskeres urin



Frederiksen et al. IJHEH, 2013
Frederiksen et al. Reproduction, 2014
Krause et al. Environ Int, 2017a
Krause et al. Environ Int, 2017b

Eksponeres et foster for sin mors UV-filtre?

Studie design



Krause et al. Environ Int, 2017, *in press*

Gravide i amniocentese projekt (n=200)

		Group 1 n=51 (26%)	Group 2 n=78 (39%)	Group 3 n=71 (35%)	In total n=200 (100%)	p-value
Age (n)		51	78	69	198	
	median (min-max)	37 (27-44)	34 (21-42)	33 (21-44)	35 (21-44)	0.000
Education (n)		51	78	69	198	
	high	37 (72)	50 (64)	50 (72)	137 (69)	
	middel	9 (18)	16 (21)	8 (12)	33 (17)	0.526
	low	5 (10)	12 (15)	11 (16)	28 (14)	
Body mass index (BMI) (n)		47	77	70	194	
	BMI: ≤ 20: underweight	7 (15)	22 (28)	10 (14)	39 (20)	
	BMI: >20-25: normal	33 (70)	30 (39)	42 (61)	105 (54)	0.006
	BMI > 25: overweight	7 (15)	26 (33)	17 (25)	50 (26)	
Conception (n)		50	75	69	194	
	Natural conception	46 (92)	65 (87)	63 (91)	169 (85)	0.542
	Fertility treatment	4 (8)	10 (13)	6 (9)	20 (10)	
Sunscren use (n)		49	72	66	187	
	Used over 2 days ago	42 (86)	51 (71)	60 (91)	153 (82)	
	Used during last 2 days	1 (2)	2 (3)	1 (1.5)	4 (2)	0.054
	Used during last day	2 (4)	10 (14)	1 (1.5)	13 (7)	
	Used during last 2 hours*	4 (8)	9 (13)	4 (6)	17 (9)	

* Including personal care products other than sunscreens known to contain UV filters.

Group 1: amniocentesis performed due to maternal request only as both ultrasound scan and karyotype of fetus was normal
Group 2: amniocentesis performed due to calculated increased risk of having an abnormal fetus, but ultrasound scan was without any malformations and karyotype results turn out to be normal.
Group 3: amniocentesis performed due to malformations on ultrasound scan and or fetuses with abnormal karyotype.

Krause et al. Environ Int, 2017, *in press*

Rigshospitalet
VÆKST REPRODUKTION

UV-filtre i fostervand, urin og serum ved Amniocentese

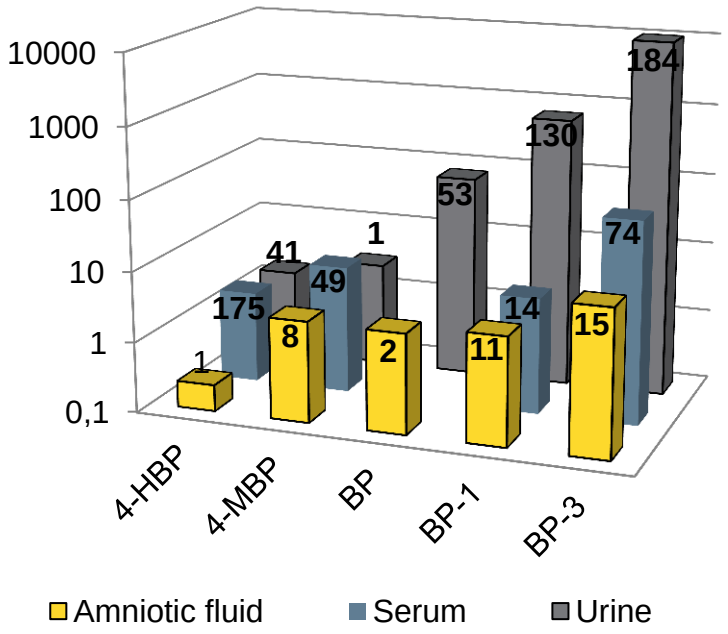
Koncentration (ng/ml) i maternal serum (n=198), urin (n=200) og fostervand (n=200) indsamlet ved amniocentese, graviditetsuge 12-36

	Benzophenone	LOD*	n >LOD (%)	Min.	Percentile 50	75	90	Max.
Serum	BP-1	0.13	14 (7)				<LOD	4.37
	BP-2	0.08	0					<LOD
	BP-3	0.12	74 (37)		<LOD	0.39	0.79	71.8
	BP-7	0.24	3 (2)				<LOD	0.68
	4-HBP	0.18	175 (88)	<LOD	0.63	0.92	1.22	1.96
	4-MBP	0.27	49 (25)			<LOD	0.65	6.37
Urin	BP	2.35	53 (27)			<LOD	5.98	74.5
	BP-1	0.25	130 (65)	<LOD	0.46	2.44	16.1	665
	BP-2	0.41	3(2)				<LOD	2.94
	BP-3	0.28	184 (92)	<LOD	2.59	10.4	96.2	10034
	BP-7	0.44	0					<LOD
	4-HBP	0.23	41 (21)			<LOD	0.35	1.67
	4-MBP	0.45	1 (1)				<LOD	2.94
Fostervand	BP	2.35	2 (1)				<LOD	2.6
	BP-1	0.25	11 (6)				<LOD	3.38
	BP-2	0.41	0					<LOD
	BP-3	0.28	15 (8)				<LOD	11.6
	BP-7	0.44	0					<LOD
	4-HBP	0.23	1 (1)				<LOD	0.24
	4-MBP	0.45	8 (4)				<LOD	2.7

*** LOD: detektionsgrænse**

BP: benzophenone (na i serum);
BP-1: benzophenone-1
BP-2: benzophenone-2
BP-3: benzophenone-3
BP-7: 5 chloro-2-hydroxybenzophenone
4-HBP: 4-hydroxy-benzophenone
4-MBP: 4-methyl-benzophenone

Max koncentrationer ved amniocentese



Krause et al. Environ Int, 2017, *in press*

Rigshospitalet
VÆKST REPRODUKTION

UV-filtre i urin, serum og navlesnorsblod ved fødsel

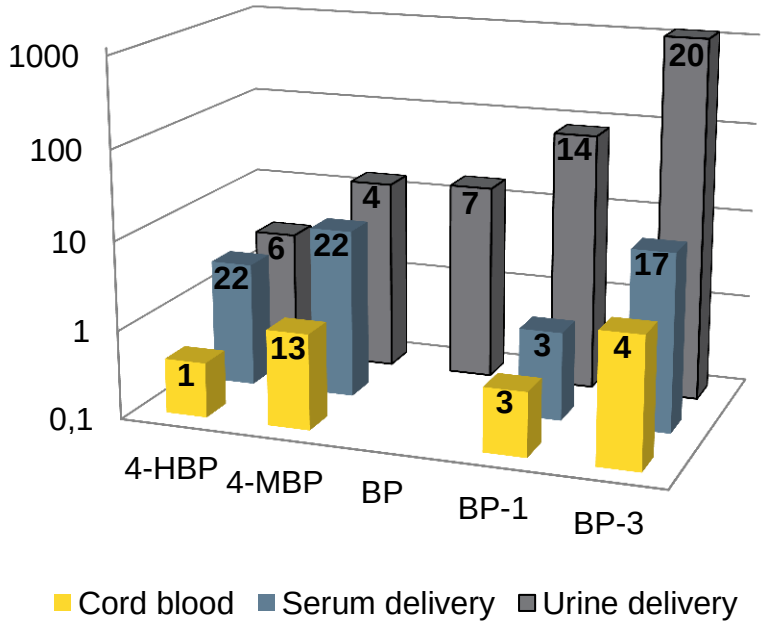
Koncentration (ng/ml) i maternal serum (n=22), urin (n=20) og navlesnorsblod (n=22) indsamlet ved fødslen fra 23 kvinder

	Benzophenone	LOD*	n >LOD (%)	Min.	Percentile 50	75	90	Max.
Serum	BP-1	0.13	3 (14)			<LOD	0.33	0.99
	BP-2	0.08	0					<LOD
	BP-3	0.12	17 (77)	<LOD	0.27	0.64	1.96	10.1
	BP-7	0.24	1 (5)				<LOD	0.28
	4-HBP	0.18	22 (100)	0.77	1.57	1.96	2.34	2.55
	4-MBP	0.27	22 (100)	0.3	0.92	1.35	1.77	8.01
Urin	BP	2.35	7 (35)	<LOD	1.66	3.17	7.43	16.5
	BP-1	0.25	14 (70)	<LOD	1.04	5.3	21.8	81.4
	BP-2	0.41	0					<LOD
	BP-3	0.28	20 (100)	0.42	6.89	38.9	329	1162
	BP-7	0.44	0					<LOD
	4-HBP	0.23	6 (30)		<LOD	0.44	1.21	2.84
	4-MBP	0.45	4 (20)			<LOD	1.57	14.6
Fostervand	BP	2.35	3 (14)			<LOD	0.29	0.53
	BP-1	0.25	0					<LOD
	BP-2	0.41	4 (18)			<LOD	0.85	2.93
	BP-3	0.28	0					<LOD
	BP-7	0.44	1 (5)				<LOD	0.43
	4-HBP	0.23	13 (59)	<LOD	0.35	0.43	0.9	1.2
	4-MBP	0.45	3 (14)			<LOD	0.33	0.99

*** LOD: detektions grænse**

BP: benzophenone (na i serum);
BP-1: benzophenone-1
BP-2: benzophenone-2
BP-3: benzophenone-3
BP-7: 5 chloro-2-hydroxybenzophenone
4-HBP: 4-hydroxy-benzophenone
4-MBP: 4-methyl-benzophenone

Max koncentrationer ved fødsel

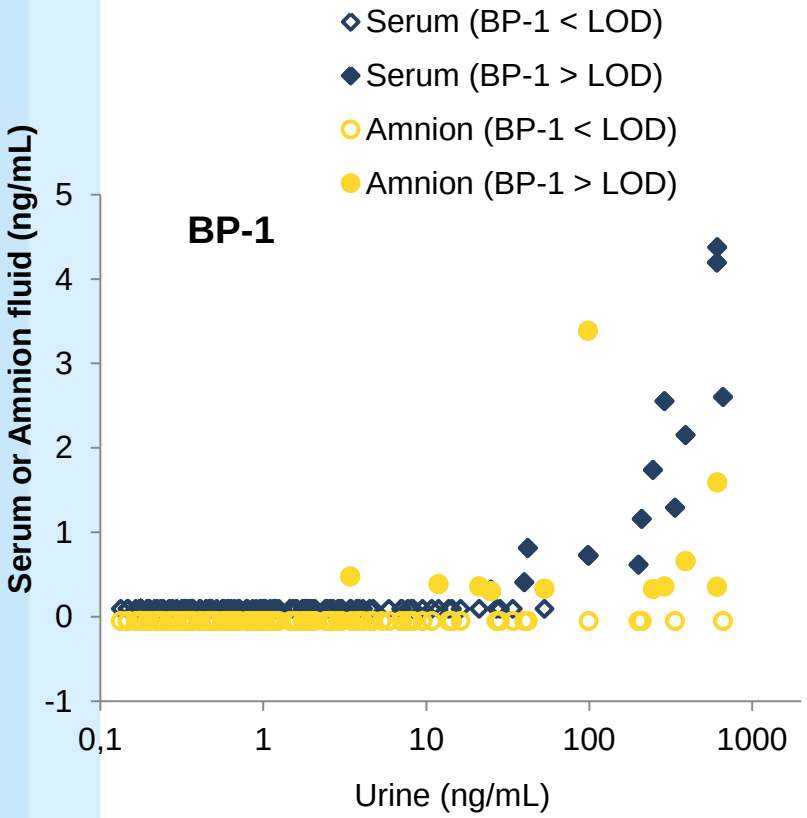


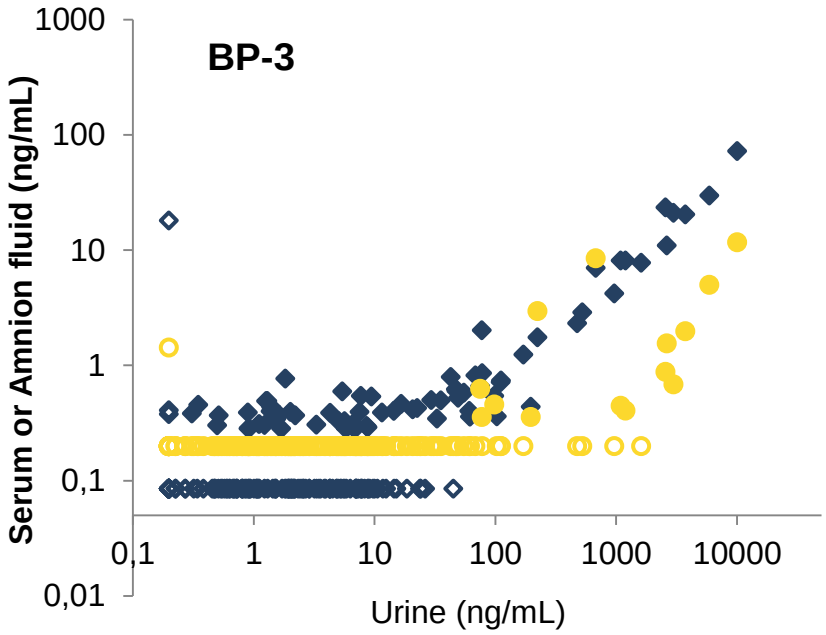
Krause et al. Environ Int, 2017, *in press*

Rigshospitalet
VÆKST REPRODUKTION

Korrelation mellem UV-filter konc. i parrede maternale og føtale prøver ved amniocentese

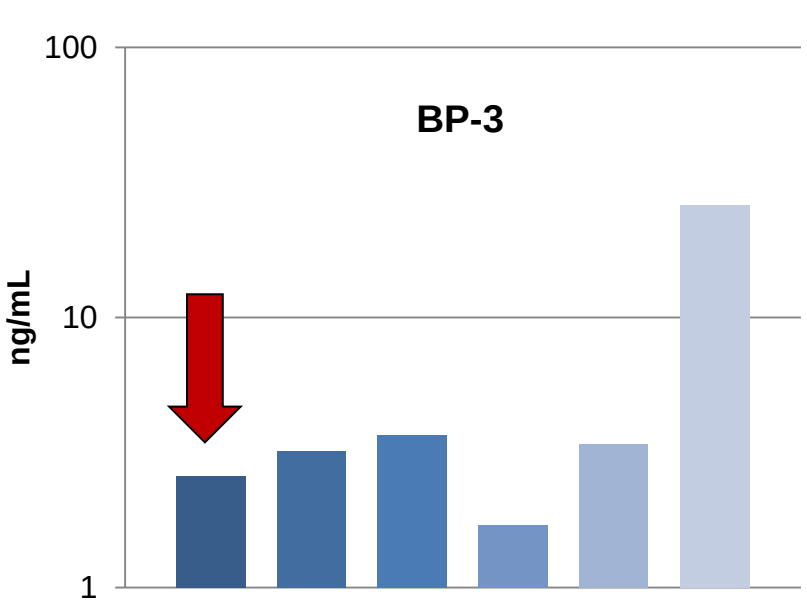
	Antal parrede prøver	Spearman coefficient	p- value
Urin vs. serum			
BP-1	14	0.921	0.000**
BP-3	71	0.774	0.000**
4-HBP	27	-0.029	0.887
Urin vs. fostervand			
BP-1	11	0.127	0.709
BP-3	14	0.604	0.022*
Serum vs. fostervand			
BP-1	7	0.321	0.482
BP-3	15	0.571	0.026*
Serum vs. navlesnorsblod			
4-MBP	13	-0.137	0.655





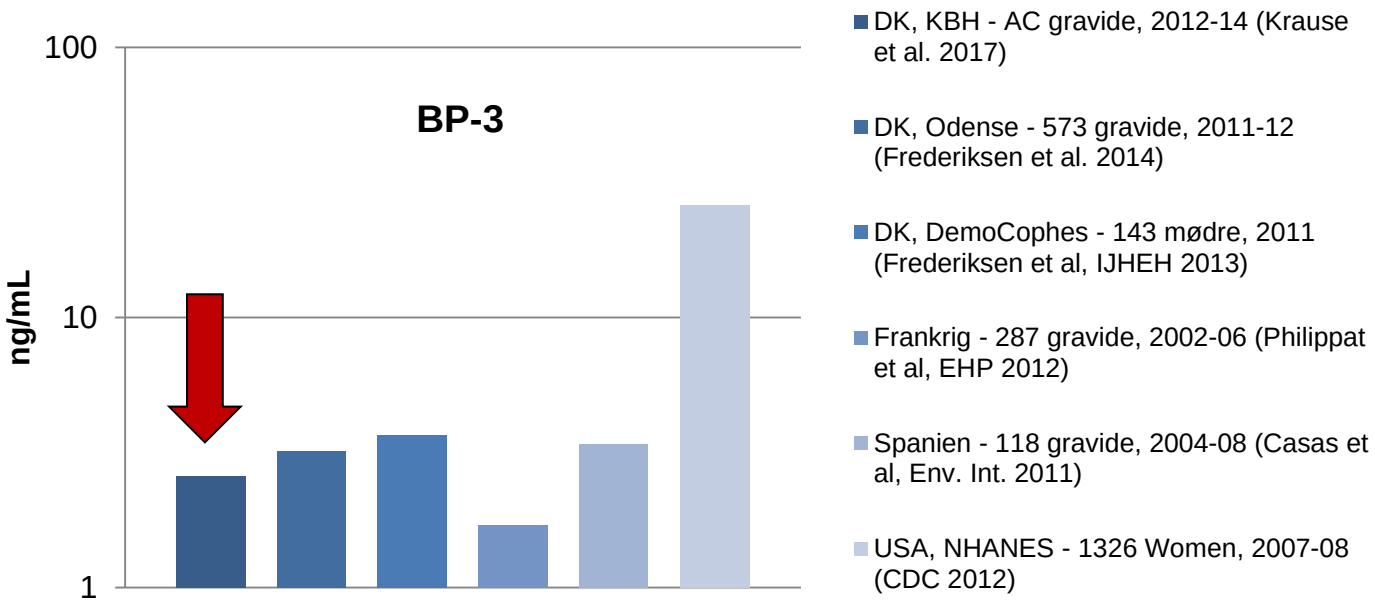
Krause et al. Environ Int, 2017, *in press*

Kvinder i Europa og USA



- DK, KBH - AC gravide, 2012-14 (Krause et al. 2017)
- DK, Odense - 573 gravide, 2011-12 (Frederiksen et al. 2014)
- DK, DemoCophes - 143 mødre, 2011 (Frederiksen et al, IJHEH 2013)
- Frankrig - 287 gravide, 2002-06 (Philippat et al, EHP 2012)
- Spanien - 118 gravide, 2004-08 (Casas et al, Env. Int. 2011)
- USA, NHANES - 1326 Women, 2007-08 (CDC 2012)

Kvinder i Europa og USA



Vægt : 60 kg
Urin: 2 L/dag
Urin udskillelses faktor ?

x sikkerhedsfaktor 100

	BP-1	BP-3
200 gravide kvinder		
Middel (median) eksponering (ug/L)	0.46	2.59
Højest eksponerede gavide (ug/L)	665	10034
Estimeret dagligt indtag (mg/kg/dag)	0.02	0.33
DI * SF (mg/kg/dag)	2.22	33.45
NOALS* i rotte studier		
Tox (mg/kg/dag)	236	200
Reprotox (mg/kg/dag)	100	700

*no observed adverse effect levels

Konklusion

- BP-1, BP-3, 4-MBP og 4-HBP blev målt i fostervand ved amniocentese og navlesnorsblod ved fødsel
- BP-1, BP-3 og 4-MBP blev målt i føtalblod ved cordocentese

- BP-1 og BP-3 koncentrationen i føtal- og navlesnorsblod var ca. 10 gange lavere end i maternal serum og 1000 gange lavere end i maternal urin.
- BP-1 og BP-3 kunne kun måles i den føtale cirkulationen når moderen var var udsat for en høj eksponering, hvilket indikerer en vis beskyttelse af fostret.
- 4-MBP passerer tilsyneladende lettere end andre UV-filtre til føtal- og navlesnorsblod (ratio 1: 3 mellem navlesnorsblod og maternal serumniveau)

- Niveauet af BP-3 i fostervand og maternal urin korrelerede og den gravide kvindes eksponering for BP-3 kan således være en gyldig proxy for fostrets eksponering.

Krause et al. Environ Int, 2017, *in press*

Environment International xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Environment International

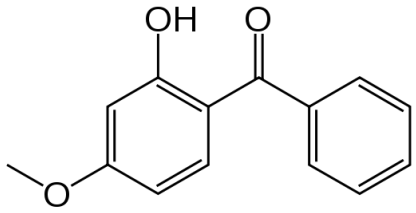
journal homepage: www.elsevier.com/locate/envint

Presence of benzophenones commonly used as UV filters and absorbers in paired maternal and fetal samples

M. Krause[a,b], H. Frederiksen[a,b], K. Sundberg[c], F.S. Jørgensen[d], L.N. Jensen[c], P. Nørgaard[d], C. Jørgensen[c], P. Ertberg[d], A. Juul[a,b], K.T. Drzewiecki[e], N.E. Skakkebaek[a,b], A.M. Andersson[a,b,*,1]

[a] Department of Growth and Reproduction, Rigshospitalet, University of Copenhagen, Denmark
[b] International Center for Research and Research Training in Endocrine Disruption of Male Reproduction and Child Health (EDMaRC), Rigshospitalet, University of Copenhagen, Denmark
[c] Center of Fetal Medicine and Pregnancy, Department of Obstetrics, Rigshospitalet, University of Copenhagen, Denmark
[d] Fetal Medicine Unit, Department of Obstetrics and Gynecology, Copenhagen University Hospital Hvidovre, Denmark
[e] Department of Plastic Surgery, Breast Surgery and Burns Treatment, Rigshospitalet, University of Copenhagen, Denmark

Perspektiver: Hvad betyder den føtale UV-filter eksponering for den senere udvikling?



Rigshospitalet
VÆKST REPRODUKTION

Mange tak til

- **Marianna Krause**
- Anna-Maria Andersson
- Stine E. Andersen
- Ole Nielsen
- Niels Erik Skakkebaek
- A. Juul

Afdeling for Vækst og Reproduktion, Rigshospitalet

- Krzysztof. T. Drzewiecki

Department of Plastic Surgery, Breast Surgery and Burns Treatment, Rigshospitalet

- Karin Sundberg
- L.N. Jensen
- C. Jørgensen

Center of Fetal Medicine and Pregnancy, Department of Obstetrics, Rigshospitalet

- Finn Stener Jørgensen
- P. Nørgaard
- P. Ertberg

Fetal Medicine Unit, Department of Obstetrics and Gynecology, Copenhagen University Hospital Hvidovre

Tak for økonomisk støtte til:

CEHOS

EDMaRC
Endocrine Disruption of Male Reproduction and Child Health

- Velux Fondene
- Lundbeck Fonden
- Augustinus Fonden
- Svend Andersens Fond