Schwermetalle in Muttermilch

Claudia Gundacker
Institut für Medizinische Genetik
Medizinische Universität Wien

INSTITUT FÜR MEDIZINISCHE GENETIK
INSTITUTE OF MEDICAL GENETICS
www.meduniwien.ac.at/medizinische-genetik

MEDICAL UNIVERSITY OF VIENNA

SCHWERMETALLE

Prioritäre Umweltschadstoffe

sind ubiquitär, persistieren, akkumulieren in Biota, wirken toxisch

- Blei (ZNS, Niere, blutbildendes System)
- Quecksilber (ZNS, Niere)
- Cadmium (Niere, Knochen)

Quellen der Bleibelastung

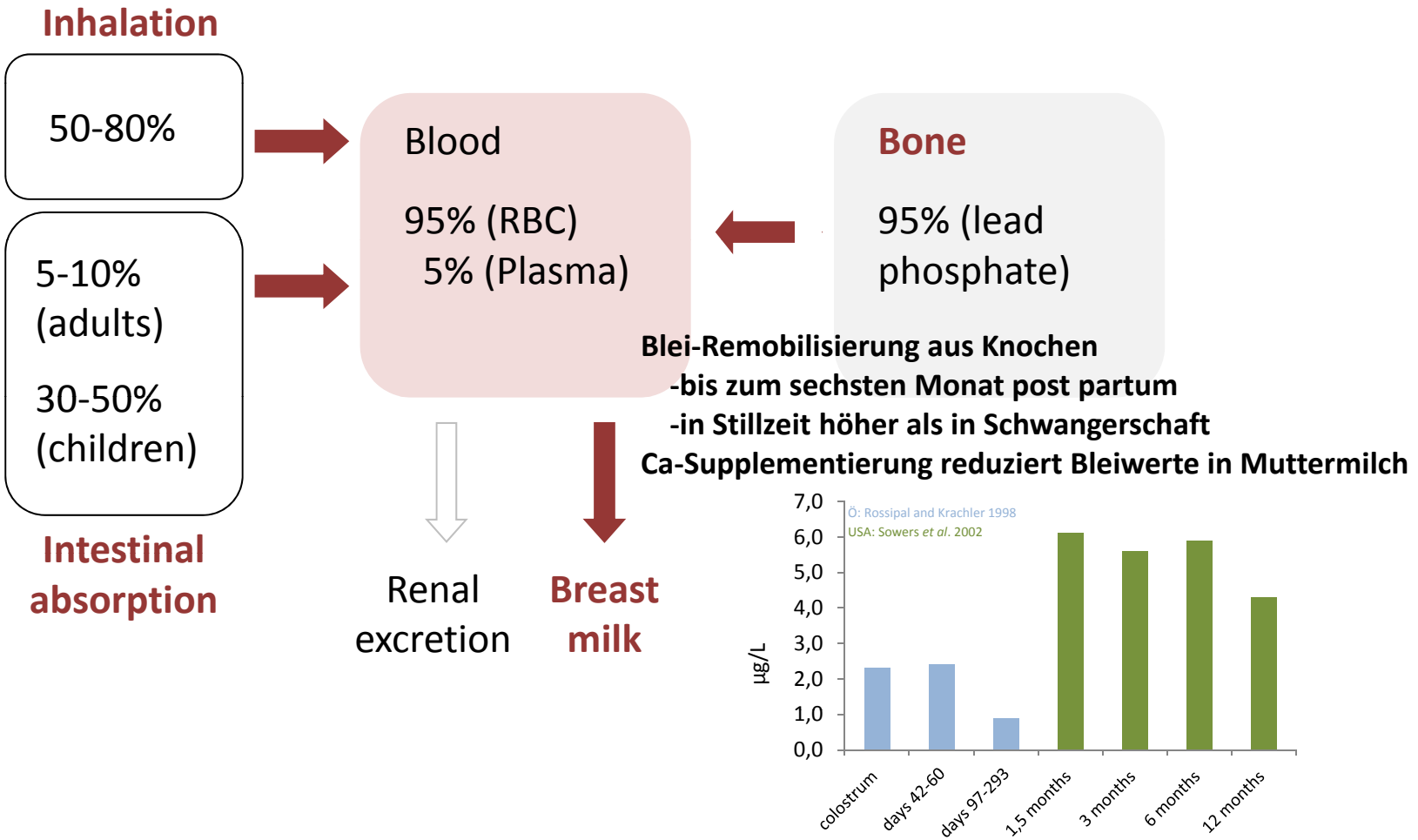
Einatmen kontaminierter Luft
Verzehr kontaminierter Nahrungsmittel
- Getreide (nicht Reis) und Getreideprodukte
- Kartoffel
- Blattgemüse
- Wild

Leitungswasser, Wein

Wöchentliche Bleiaufnahme aus der Nahrung
Frauen (20-40 Jahre): 2.7-9.0 µg/kg
PTWI (WHO/JECFA): 25 µg/kg

EFSA Panel on Contaminants in the Food Chain (CONTAM); Scientific Opinion on Lead in Food. EFSA Journal 2010; 8(4):1570. [147 pp.].

TOXIKOKINETIK BLEI



Gulson et al. 1998. Mobilization of lead from the skeleton during the postnatal period is larger than during pregnancy. J Lab Clin Med 131(4):324–329.
Ettinger et al. (2006). Influence of Maternal Bone Lead Burden and Calcium Intake on Levels of Lead in Breast Milk over the Course of Lactation. *American Journal of Epidemiology, 163(1), 48-56.*

BLEI IN DER MUTTERMILCH

- 60-80% an Casein gebunden
- Muttermilch: sehr niedriger Caseingehalt: niedrige Exkretionsrate -> 1-10% des mat. Blutbleigehaltes
- Muttermilchgehalte korrelieren mit Gehalten in mat. Blut, Patella, Nabelschnurblut und Blut der Säuglinge (1 Monat alt)

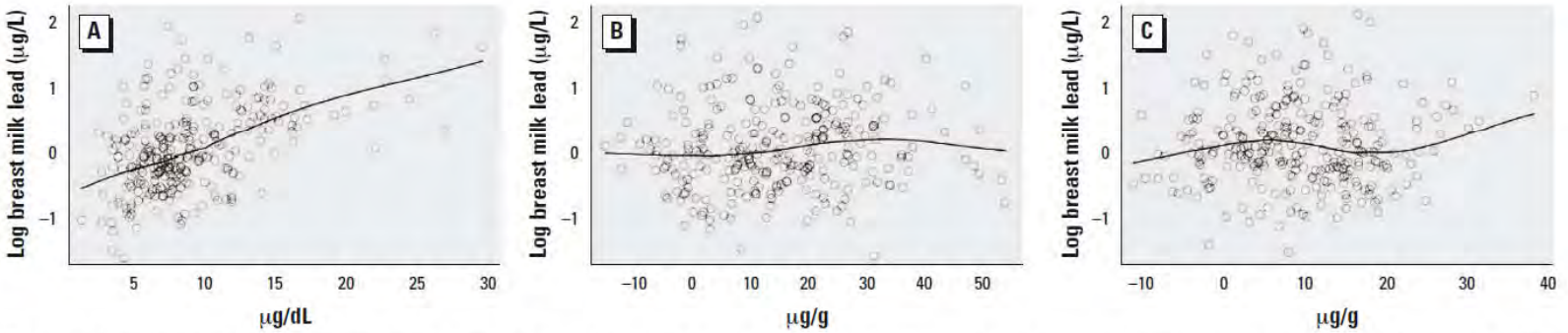
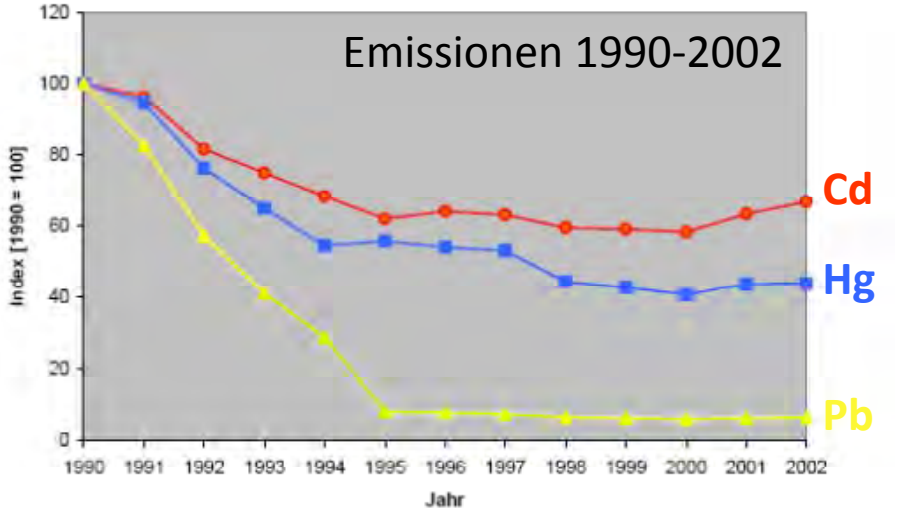


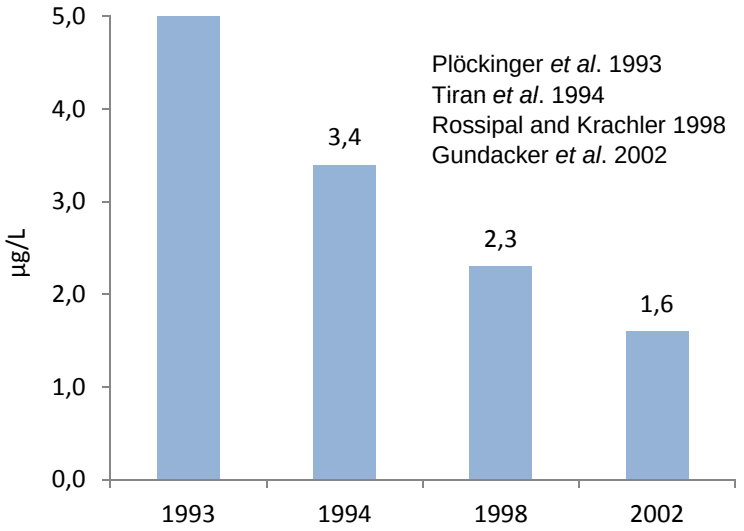
Figure 2. Smooth scatterplots (Lowess; bandwidth = 0.75) of breast milk lead by maternal lead biomarkers at 1 month postpartum: (*A*) blood lead; (*B*) patella lead; (*C*) tibia lead. Breast milk lead levels log(base-*e*) transformed.

Ettinger et al. (2004). Effect of breast milk lead on infant blood lead levels at 1 month of age. *Environ Health Perspect* 112(14):1381-5.
Ettinger et al. (2004). Levels of lead in breast milk and their relation to maternal blood and bone lead levels at one month postpartum. *Environ Health Perspect* 112(8): 926–931.

BLEIBELASTUNG IN ÖSTERREICH



UBA: LUFTGÜTEBERICHT 2004



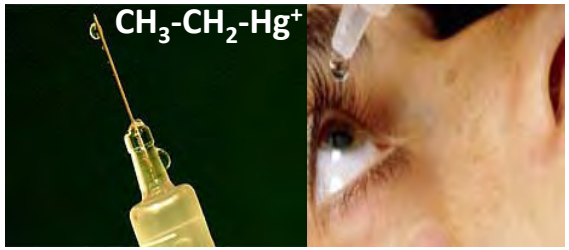
ÜBERSICHT BLEIGEHALTE MUTTERMILCH

country	µg/l Pb	SD/range	notes	mat B-Pb	authors
Australia	0.7	0.7		< 50	Gulson *et al.* 1998
Austria	35.8	15		37	Plöckinger *et al.* 1993
Austria	3.4	0-20.4			Tiran *et al.* 1994
Austria	2.30	2.9	colostrum (1-3 days pp)		Rossipal and Krachler 1998
	2.40	3.3	days 42-60		
	0.90	1.7	days 97-293		
Austria	1.6	1.7			Gundacker *et al.* 2002
China	4.7		non-exposed	132	Li *et al.* (2000)
	52.7		occupational exposure		
Croatia	7.3	8.3			Frkovic *et al.* 1997
Czechoslowakia	1.7	0-6.75			Zahradnicek *et al.* 1989
Egypt	30.6	0-158			Saleh *et al.* (1996)
Germany	9.1	2.5	rural		Sternowsky and Wessolowski 1985
	13.3	5.5	urban		
Great Britain	2.0	1.9-8.6	urban	101	Kovar *et al.* 1984
Greece	84.0	24	rural		Vavilis *et al.* (1997)
	90.0	29	urban		
Greece	20.0	5		149	Nashashibi *et al.* 1997
India	1.9	1.98			Tripathi *et al.* (1999)
Italy	45.6	0-425	rural		Guidi *et al.* 1992
	126.6	1-472	urban		
Italy	13.0	6			Coni *et al.* 2000
Malaysia	21.1		rural		Huat *et al.* 1983
	25.3		urban		
Mexico	24.7			459	Namihira *et al.* (1993)
Nigeria	67.0	46-1300			Vander Jagt *et al.* 2001
Saudi-Arabia	7.7	3.1-25			Younes *et al.* 1995
	5.2		women aged < 36		
	13.4		women aged > 36		
Slovakia	4.2				Ursinyova *et al.* 1995
Slovenia	2.6		colostrum		Krachler *et al.* 1999
Sweden	0.7	0.4		32	Palminger Hallen *et al.* 1995
USA	6.1		1,5 months pp		Sowers *et al.* (2002)
	5.6		3 months pp		
	5.9		6 months pp		
	4.3		12 months pp		

QUELLEN DER QUECKSILBER-BELASTUNG

Methyl-Hg: Fisch und Meeresfrüchte

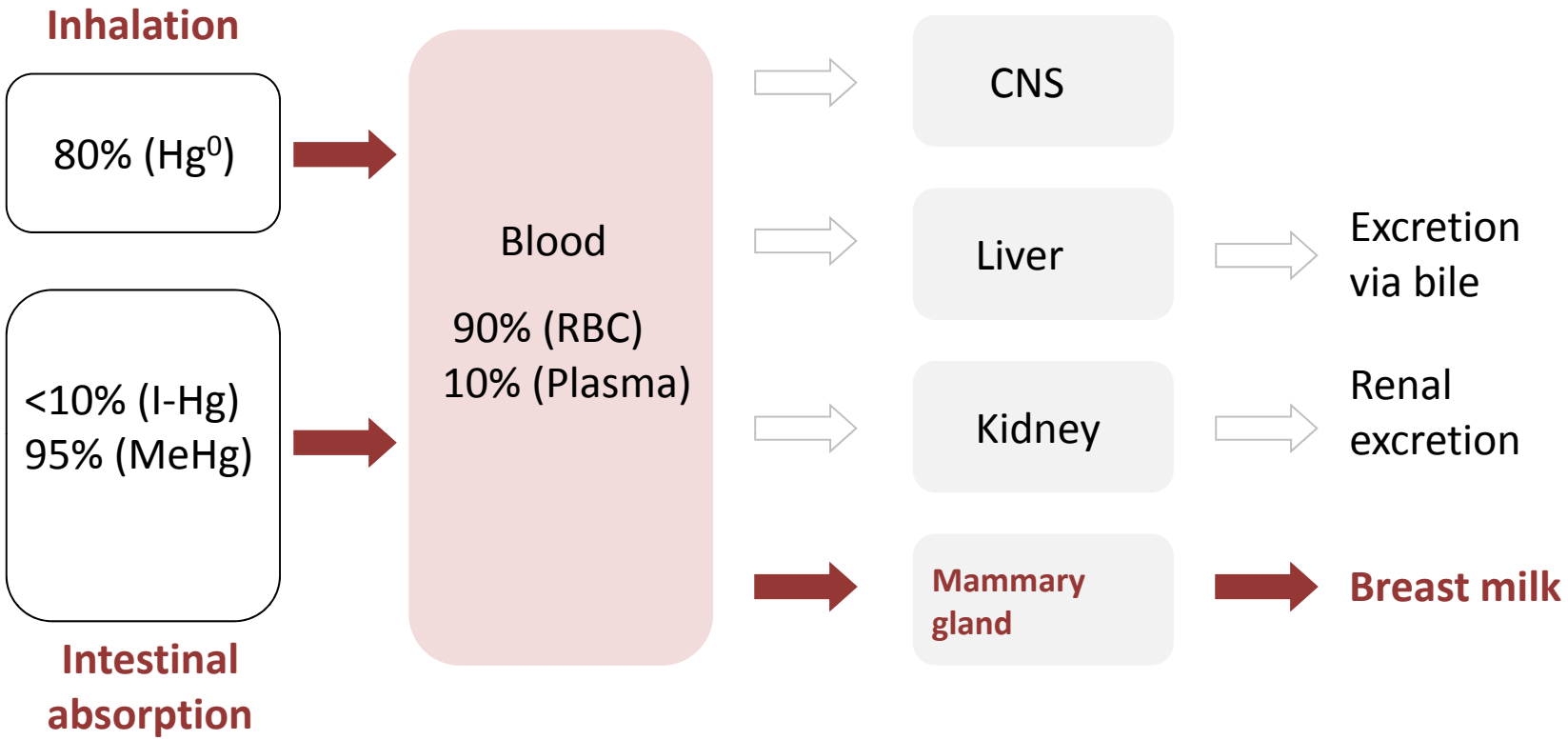
Hg^0: Amalgamfüllungen (50% Hg), berufliche Belastung



Ethyl-Hg: Impfstoffe, Arzneimittel

JECFA-PTWI: 1.6 µg/kg KG (MeHg)
5.0 µg/kg KG (T-Hg)

TOXIKOKINETIK QUECKSILBER



QUECKSILBER IN DER MUTTERMILCH

- Hauptsächlich an Serum-Albumin gebunden
- 30% der Gehalte in mat. Blut
- 20-60% MeHg
- MeHg in Muttermilch wird vom Säugling besser aufgenommen als I-Hg

Sundberg (1999). Protein binding of mercury in milk and plasma from mice and man - a comparison between methylmercury and inorganic mercury. *Toxicology, 137(3), 169-184.*
Oskarsson et al. (1996). Total and inorganic mercury in breast milk in relation to fish consumption and amalgam in lactating women. *Archives Of Environmental Health, 51(3), 234-241.*

QUECKSILBER IN DER MUTTERMILCH

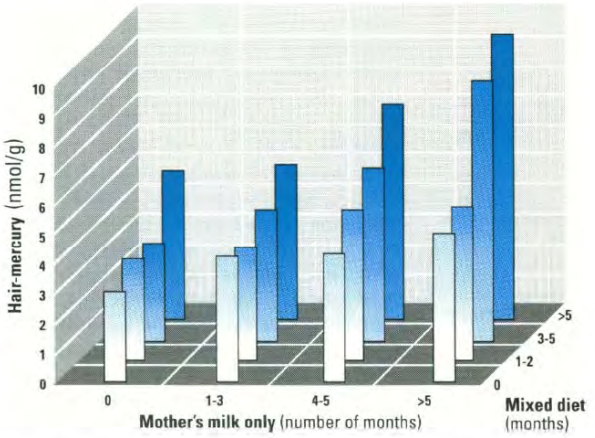


Figure 1. Mercury concentration in hair of 583 12-month-old infants in relation to the length of the nursing period. The mercury concentrations are given as geometric means. The duration of breast-feeding has been separated into the period where breast milk constituted the full diet (horizontal scale) and the period where the diet included other food (right-hand scale). Each of these periods has been split into four groups according to the quartiles.

Einjährige

Infants who reached milestone criteria (sitting, creeping and standing) **early had significantly higher mercury concentrations in the hair**. …if methylmercury exposure from human milk had any adverse effect on milestone development in these infants, the **effect was compensated for or overruled by advantages associated with nursing**

Siebenjährige

…**breastfeeding was associated with less benefits on neurobehavioral development than previously published** though **not associated with a deficit in neuropsychological performance**

Grandjean et al. (1995). Human milk as a source of methylmercury exposure in infants. *Env Health Perspect* 102(1):74-7.
Grandjean et al. (1995). Milestone development in infants exposed to methylmercury from human milk. *NeuroToxicology 16(1), 27-33.*
Jensen et al. (2005). Effects of breast feeding on neuropsychological development in a community with methylmercury exposure from seafood. *Journal Of Exposure Analysis And Environmental Epidemiology 15(5), 423-430.*

ÜBERSICHT QUECKSILBERGEHALTE MUTTERMILCH

country	µg/l Hg	SD/range	notes	mat B-Hg	authors
Austria	7.70	11	colostrum (1-3 days pp)		Rossipal and Krachler 1998
	0.85	1.23	days 42-60		
	< 0.52	< 0.52	days 97-293		
Austria	1.59	1.21			Gundacker *et al.* 2002
Brazil*	5.7	0-24.8			Boischio and Henshel 2000
Denmark	2.45				Grandjean *et al.* 1995b
Germany	4.58		day 1		Friedrich 1986
	1.55		day 3		
	1.16	0.81	day 5		
	0.5		after day 15		
Germany	1.9	1.58			Klemann *et al.* 1990
Germany	<0.2		no amalgam fillings		Drasch *et al.* 1998
	0.57		1-4 amalgam fillings		
	0.5		5-7 fillings		
	2.11		> 7 fillings		
Germany	1.37	0-20.3	1 week pp	0.65	Drexler and Schaller 1998
	0.64	0-11.7	2 months pp		
Iraq§		< 50-200	organic mercury	500-3250	Bakir *et al.* 1973
Iraq§		15-45	total mercury	50-2390	Amin-Zaki *et al.* 1974
Italy	<0.5	0-17.5			Clemente *et al.* 1982
Italy	13.9	1.6-52.5			Paccagnella and Riolfatti 1989
Slovenia*	11.8	1.2-37.4			Kosta *et al.* 1983
Phillippines*	36	18.2		24	Ramirez *et al.* 2000
Japan§	63				Fujita and Takabatake 1977
Japan*	0.21				Sakamoto *et al.* 2002b
Slovakia	1.6				Ursinyova *et al.* 1995
Sweden*	0.6			2.3	Oskarrson *et al.* 1995

QUELLEN DER CADMIUM-BELASTUNG

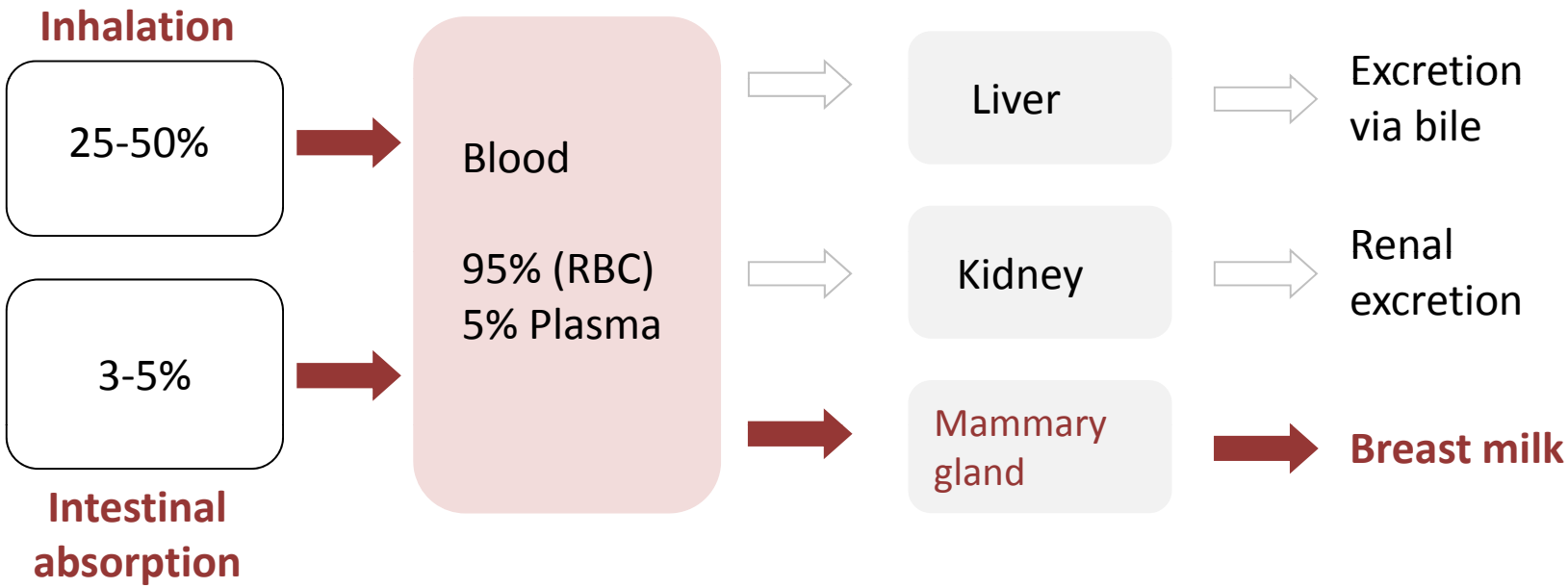
Rauchen

Getreide und Getreideprodukte, Gemüse, Nüsse, Hülsenfrüchte, Wurzeln, Kartoffel, Fleisch und Fleischprodukte
Hochkontaminierte Lebensmittel:
Algen, Schokolade, Knollensellerie, Pferdefleisch, Fisch, Muscheln (nicht Austern), Tintenfisch

Mittlere Wöchentliche Aufnahme: 2.3 µg/kg KG (1.9 to 3.0 µg/kg)

EFSA-PTWI: 2.5 µg/kg KG
[JECFA-PTMI: 25 µg/kg KG (PTWI: 7.0 µg/kg KG)]

TOXIKOKINETIK CADMIUM



CADMIUM IN DER MUTTERMILCH

Gebunden an Metallothionein 

10% der Gehalte in mat. Blut

Brustdrüse: Filterwirkung -> sehr niedrige Gehalte in MM

ÜBERSICHT CADMIUMGEHALTE MUTTERMILCH

country	µg/l Cd	SD/range	notes	mat B-Cd	authors
Austria	43	28-95			Maruna *et al.* 1976
Austria	1.30	1.2	colostrum (1-3 days pp)		Rossipal and Krachler 1998
	0.22	0.26	days 42-60		
	0.26	0.19	days 97-293		
Austria	0.09	0.09			Gundacker, unpublished data
Croatia	2.54	2.06			Frkovic *et al.* 1997
Czechoslowakia	0.31	0-1.08			Zahradnicek *et al.* 1989
Finland	2.00	1.7-3.1	1 month pp		Vuori *et al.* 1983
	1.50		3 months pp		
	1.60		6 months pp		
Finland	0.10		in 1987		Kantol and Vartiainen 2001
	0.06		1993-95		
Germany	0.27	0-1.13			Müller 1987
Germany	17.3	4.9	rural		Sternowsky and Wessolowski 1985
	24.6	7.3	urban		
Germany	0.07		non-smokers	0.5	Radisch *et al.* 1987
	0.16		smokers	1.5	
Great Britain	0.40		urban	0.7	Kovar *et al.* 1984
Italy	0.80	0.2			Coni *et al.* 2000
Japan	0.38	1.78	mat.age > 35		Nishijo *et al.* 2002
	0.26	1.81	mat age < 35		

RAUCHEN UND CADMIUMGEHALTE MUTTERMILCH

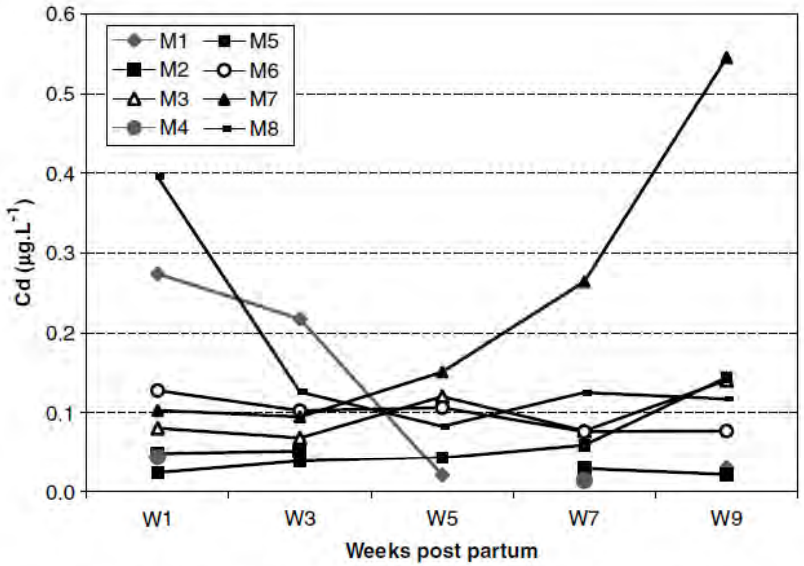


Figure 1. Cd milk concentrations during the first 2 months *post partum* observed in eight individuals (M1 = Mother 1 to M8 = Mother 8). One participant (M7) started to smoke during the study period (five cigarettes per day at week 5; 10 cigarettes per day at week 7 and week 9).

Gundacker et al. (2006). Smoking, cereal consumption, and supplementation affect cadmium content in breast milk. *J Expos Sci Environ Epidemiol, 17(1), 39-46.*

ZUSAMMENFASSUNG

	Blei	**Quecksilber**	**Cadmium**
Gehalte Österreich (µg/L)	1.63 ± 1.66	1.59 ± 1.21	0.086 ± 0.085
'Normal'-Werte[a]	2.0 - 5.0	1.4 - 1.7	< 1
Screening-Level[a]	20	3.5	5
% Gehalte rel. zu Mat-Bl	1-10%	30%	10%
Gehalte nehmen im Verlauf der Stillperiode ab	ab 3.-6. Monat	ab Tag 3-5	ab Tag 3-5
Postnatale Belastung über MM ist signifikant	ja	nein	nein
Präventionsmaßnahmen	Vermeidung rezenter Belastung (Ernährung) ↓Bleispeicherung in Knochen	Vermeidung rezenter Belastung (Amalgamfüllungen, Fisch)	Vermeidung rezenter Belastung (Rauchen, Ernährung)

[a] Abadin et al. 1997