



# Data Resources on Consumption Patterns for Specific Foods and for Specific Consumers

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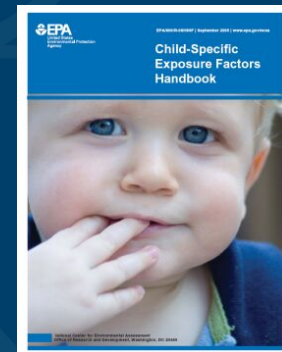
Susceptible Populations Workshop

Greenbelt, MD

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# Sources of Data

- Child-Specific Exposure Factors Handbook – 2002, updated September 2008
- Exposure Factors Handbook – 1989, 1997, updated External Review Draft October 2009



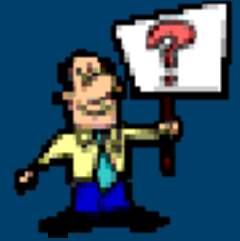
# *Exposure Factors Handbooks*

Compilation, summary,  
and evaluation of  
statistical data on  
factors necessary to  
assess exposures  
through various  
pathways

## *Topics Covered*

Variability and uncertainty  
**Water consumption**  
Non-Dietary exposures  
Inhalation rates  
Dermal factors  
Body weight  
**Food consumption**  
Human milk intake  
Consumer product use  
Activity data  
Life expectancy

# *Exposure Factors Handbook Research Questions*



- What exposure factors are most needed to assess exposure to environmental contaminants?
- How does exposure vary across life stages?
- How does exposure vary among various populations?

# *Susceptibility*

- Intrinsic factors
  - Life stage
  - Gender
  - Race/ethnicity
  - Genetic characteristics
  
- Extrinsic factors
  - Lifestyle
  - Disease status
  - Socioeconomic status
  - Nutritional status



# *Importance of Variability in Exposure Factors*

- Life Stage
  - Children may eat more of certain foods per unit of body weight (e.g., consumption of apples for children birth to < 1 yr is 11 times higher than adults 20 to < 50 yrs)
  - Older adults may have different consumption patterns than younger adults
  - Pregnant/lactating women may have different consumption patterns than other adults

## *Importance of Variability in Exposure Factors (cont.)*

- Gender
  - Assessing fish consumption for pregnant/lactating women and women of childbearing age may be important for some contaminants
- Race/ethnicity
  - Consumption of certain foods can be higher for some ethnic groups (e.g., fish consumption)

## *Importance of Variability in Exposure Factors (cont.)*

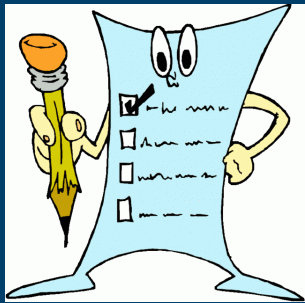
- Lifestyle
  - Fish consumption for recreational fishermen may be higher than the general population
  - Farmers and populations who homegrow foods may have higher consumption patterns than the general population
  - Vegetarians have different consumption patterns



## *Importance of Variability in Exposure Factors (cont.)*

- Disease status
  - Health status can have an impact on food choices (e.g., diabetics, hypertension)
- Socioeconomic characteristics
  - Can impact food choices (e.g., subsistence fishermen)

## *Food Consumption Data in the Handbooks*



- National data collected by USDA
  - Nationwide Food Consumption Surveys
  - Continuing Survey of Food Intake by Individuals (1994-1996, 1998)
- Future analysis of National Health and Nutrition Examination Survey (NHANES)
- Fish consumption – data from states and local governments

# *Data Examples*

- Age groups for children and adults
- Season (fall, spring, summer, winter)
- Urbanization (central city, non-metropolitan, suburban)
- Region (midwest, northeast, south, west)
- Race (Asian, Black, Native American, White, Other)
- Gender
- Socioeconomic status
- Per capita and consumers only
- Intake units (amount/day, amount/kg-day)

# *Children as Susceptible Populations*

## Age Groups <1 Year

birth to < 1 month

1 to < 3 months

3 to < 6 months

6 to < 12 months

## Age Groups >1 Year

1 to < 2 years

2 to < 3 years

3 to < 6 years

6 to < 11 years

11 to < 16 years

16 to < 21 years



## *Food Items Included*

- Intake of total fruits and vegetables
  - Individual fruits and vegetables
- Intake of total meats and dairy products
  - Intake of beef, pork, poultry
  - Intake of fluid milk, yogurt, milk desserts, cheese, eggs



## *Food Items Included (cont.)*



- Total fat intake
  - Animal fat, vegetable fat, top 10% of animal fat consumers
- Intake of grains
  - Cereal, rice, sweets, bread, snacks, breakfast foods, pasta
- Intake of fish and shellfish
  - General population
  - Marine recreational
  - Freshwater recreational
  - Native American
  - Asian Pacific Islander

## *Food Items Included (cont.)*

- Total food intake
  - Composition of individual's diet
- Intake of home-produced foods
  - Fruits, vegetables, meats, self caught fish
  - Based on analysis of USDA's NCFS 1987-1988 data
  - Households who garden, farm, hunt, raise animals
- Water intake
  - Community water
  - Bottled water



# Food Consumption Analyses



- *Analysis of Fat Intake (2007)*

- *Total fat*
- *Animal fat*



- *Analysis of Total Food Intake and Composition of Individual's Diet (2007)*

- *Percent of total food intake from each major food group for three groups (low-end, central, high-end consumers)*



Per Capita Intake of Total Foods and Major Food Groups, and Percent of Total Food Intake for Individuals with Low-end, Mid-range, and High-end Total Meat and Dairy Intake for >20 yrs (mg/kg-day)

Food Group	Low end		Mid range		High end	
	Intake	%	Intake	%	Intake	%
Total Foods	9	100.0%	14	100.0%	26	100.0%
Total Dairy	0	3.9%	2	15.2%	10	37.6%
Total Meats	1	6.8%	2	12.7%	3	10.4%
Total Fish	0	3.1%	0	1.4%	0	1.0%
Total Eggs	0	2.8%	0	2.1%	0	1.5%
Total Grains	1	14.5%	2	12.9%	3	9.8%
Total Vegetables	3	35.0%	4	29.9%	5	20.3%
Total Fruits	2	26.1%	3	18.1%	3	13.1%
Total Fats	0	5.1%	1	6.0%	1	5.1%

Table 9-1. Recommended Values for Intake of Fruits and Vegetables, As Consumed<sup>a</sup>

Age Group	Per Capita		Consumers Only		Multiple Percentiles	Source
	Mean	95 <sup>th</sup> Percentile	Mean	95 <sup>th</sup> Percentile		
	g/kg-day	g/kg-day	g/kg-day	g/kg-day		
Total Fruits						
Birth to 1 year	5.7	21.3	10.1	26.4	<div style="background-color: yellow; padding: 5px; display: inline-block;">Consumption varies with age</div> See Tables 9-3 and 9-4 Analysis of CSFII, 1994-96 and 1998, based on USDA (2000) and U.S. EPA (2000).	
1 to <2 years	6.2	18.5	6.9	19.0		
2 to <3 years	6.2	18.5	6.9	19.0		
3 to <6 years	4.6	14.4	5.1	15.0		
6 to <11 years	2.4	8.8	2.7	9.3		
11 to <16 years	0.8	3.5	1.1	3.7		
16 to <21 years	0.8	3.5	1.1	3.7		
20 to <50 years	0.9	3.9	1.2	4.4		
≥50 years	1.4	4.8	1.6	5.0		
Total Vegetables						
Birth to 1 year	4.5	14.8	6.2	16.1	See Tables 9-3 and 9-4 U.S. EPA Analysis of CSFII, 1994-96 and 1998, based on USDA (2000) and U.S. EPA (2000).	
1 to <2 years	6.9	17.1	6.9	17.1		
2 to <3 years	6.9	17.1	6.9	17.1		
3 to <6 years	5.9	14.7	5.9	14.7		
6 to <11 years	4.1	9.9	4.1	9.9		
11 to <16 years	2.9	6.9	2.9	6.9		
16 to <21 years	2.9	6.9	2.9	6.9		
20 to <50 years	2.9	6.8	2.9	6.8		
≥50 years	3.1	7.0	3.1	7.0		
Individual Fruits and Vegetables - See Tables 9-5 and 9-6						
<sup>a</sup> Analysis was conducted using slightly different childhood age groups than those recommended in <i>Guidance on Selecting Age Groups for Monitoring and Assessing Childhood Exposures to Environmental Contaminants</i> (U.S. EPA. 2005). Data were placed in the standardized age categories closest to those used in the analysis.						

Table 11-1. Recommended Values for Intake of Meats, Dairy Products, and Fats, As Consumed

Age Group	Per Capita		Consumers Only		Multiple Percentiles	Source
	Mean	95 <sup>th</sup> Percentile	Mean	95 <sup>th</sup> Percentile		
	g/kg-day	g/kg-day	g/kg-day	g/kg-day		
Total Meats <sup>a</sup>						
Birth to 1 year	1.2	6.7	3.0	9.2	See Tables 11-3	U.S. EPA Analysis of CSFII, 1994-96 and 1998 (1998)).
1 to <2 years	4.1	9.8	4.2	9.8		
2 to <3 years	4.1	9.8	4.2	9.8		
3 to <6 years	4.1	9.4	4.2	9.4		
6 to <11 years	2.9	6.5	2.9	6.5		
11 to <16 years	2.1	4.8	2.1	4.8		
16 to <21 years	2.1	4.8	2.1	4.8		
20 to <50 years	1.9	4.2	1.9	4.2		
50+ years	1.5	3.3	1.5	3.3		
Total Dairy Products <sup>a</sup>						
Birth to 1 year	12.6	48.7	15.9	57.5	See Tables 11-3 and 11-4	U.S. EPA Analysis of CSFII, 1994-96 and 1998, based on USDA (2000) and U.S. EPA (2000).
1 to <2 years	36.7	88.3	36.8	88.3		
2 to <3 years	36.7	88.3	36.8	88.3		
3 to <6 years	23.3	49.4	23.3	49.4		
6 to <11 years	13.6	31.5	13.6	31.5		
11 to <16 years	5.6	15.5	5.6	15.5		
16 to <21 years	5.6	15.5	5.6	15.5		
20 to <50 years	3.3	9.9	3.3	9.9		
50+ years	3.2	8.9	3.2	8.9		
Individual Meat and Dairy Products - See Tables 11-5 and 11-6						

Consumption varies with age



Table 10-5. Summary of Relevant Studies on Freshwater Recreational Fish Intake

Location	Population Group	Mean	95 <sup>th</sup> Percentile	Source
		g/day	g/day	
Alabama	Adults	44 <sup>a</sup>	-	ADEM, 1994
Clinch River	Adults who eat fish from study area	38 <sup>b</sup>	-	Campbell et al., 2002
	All Anglers	20 <sup>b</sup>	-	
Connecticut	Sports Fishers	51	-	Balcom et al., 1999
Lake Ontario	Adults	4.9 <sup>c</sup>	18	Connelly et al., 1996
Maine	All Anglers	5.0	21	Chemirisk, 1992; Ebert et al., 1993
	Consuming Anglers	6.4	26	
Michigan	1 to 5 years	5.6	-	Consumption varies with population and geographical area
	6 to 10 years	7.9	-	
	21 to 80 years	16 <sup>c</sup>	-	
	All ages	14	39	
Indiana	Active Consumers	20	60.5	Consumption varies with population and geographical area
	Potential & Active Consumers	16		
Minnesota	0 to 14 years	1.2 (50 <sup>th</sup> percentile)	15	Benson et al., 2001
	> 14 years (males)	4.5 (50 <sup>th</sup> percentile)	38	
	15 to 44 (females)	2.1 (50 <sup>th</sup> percentile)	25	
	> 44 (females)	3.6 (50 <sup>th</sup> percentile)	32	
North Dakota	0 to 14 years	1.7 (50 <sup>th</sup> percentile)	23	Benson et al., 2001
	> 14 years (males)	2.3 (50 <sup>th</sup> percentile)	28	
	15 to 44 (females)	4.3 (50 <sup>th</sup> percentile)	35	
	> 44 (females)	4.2 (50 <sup>th</sup> percentile)	36	
Savannah Rive	Adult Whites	38 <sup>b</sup>	-	Burger et al., 1999
	Adult Blacks	70 <sup>b</sup>	-	
Wisconsin	Sports Anglers	7.4	25	Fiore et al., 1989

<sup>a</sup> Based on the average of 2 methods.

<sup>b</sup> Calculated as amount eaten per year divided by 365 days per year..

<sup>c</sup> Based on average of multiple adult age groups.

Table 13-5. Consumer Only Intake of Homegrown Fruits (g/kg-day) - All Regions Combined

Population Group	Nc wgtd	Nc Unwgtd	% Consuming	Mean	SE	P1	P5	P10	P25	P50	P75	P90	P95	P99
Total	14,744,000	817	7.84	2.68	0.19	0.06	0.17	0.28	0.50	1.07	2.37	5.97	11.10	24.00
Age (years)														
1-2	360,000	23	6.32	8.74	3.10	0.96	1.09	1.30	1.64	3.48	7.98	19.30	60.60	60.60
3-5	550,000	34	6.79	4.07	1.48	0.01	0.01	0.36	0.98	1.92	2.73	6.02	8.91	48.30
6-11	1,044,000	75	6.25	3.59	0.50	0.00	0.17	0.27	0.47	1.31	3.08	11.80	15.80	32.20
12-19	1,189,000	67	5.80	1.94	0.50	0.00	0.17	0.27	0.47	0.66	2.35	6.76	8.34	18.50
20-39	3,163,000	164	5.13	1.95	0.50	0.00	0.17	0.27	0.47	0.70	1.77	4.17	6.84	16.10
40-69	5,633,000	309	9.93	2.66	0.50	0.00	0.17	0.27	0.47	1.03	2.33	5.81	13.00	23.80
≥ 70	2,620,000	134	16.50	2.25	0.23	0.04	0.22	0.38	0.61	1.18	2.35	5.21	8.69	11.70
Season														
Fall	3,137,000	108	6.58	1.57	0.16	0.26	0.30	0.39	0.57	1.04	1.92	3.48	4.97	10.60
Spring	2,963,000	301	6.42	1.58	0.14	0.09	0.20	0.25	0.42	0.86	1.70	4.07	5.10	8.12
Summer	4,356,000	145	9.58	3.86	0.64	0.01	0.09	0.16	0.45	1.26	3.31	10.90	14.60	53.30
Winter	4,288,000	263	8.80	3.08	0.34	0.04	0.17	0.27	0.56	1.15	2.61	8.04	15.30	24.90
Urbanization														
Central City			6.51	2.31	0.26	0.04	0.18	0.33	0.57	1.08	2.46	5.34	10.50	14.30
Non-Metropolitan			9.15	2.41	0.31	0.06	0.13	0.23	0.45	1.15	2.42	4.46	8.34	24.00
Suburban			9.97	3.07	0.32	0.13	0.23	0.30	0.49	0.99	2.33	7.26	15.20	37.00
Race														
Black	450,000	20	2.07	1.87	0.85	0.13	0.28	0.46	0.61	1.13	1.53	2.29	2.29	19.30
White	14,185,000	793	9.00	2.73	0.17	0.00	0.00	0.00	0.00	0.07	2.46	6.10	11.70	24.00
Questionnaire Response														
Households who garden	12,742,000	709	18.70	2.79	0.51	0.00	0.00	0.00	0.00	0.02	2.50	6.10	11.80	24.90
Households who farm	1,917,000	112	26.16	2.58	0.51	0.00	0.00	0.00	0.00	0.01	3.62	5.97	7.82	15.80

Percent consuming is higher for older adults

Racial differences

Percent consuming is higher for households who farm

SE = standard error.  
P = percentile of the distribution.  
Nc wgtd = weighted number of consumers.  
Nc unwgtd = unweighted number of consumers in survey.

Source: Moya and Phillips, 2001. (Based on EPA's analyses of the 1987-88 NFCS).

Recommended Values for Drinking Water Ingestion Rates <sup>a</sup> Consumers Only				
Age Group	Mean		95 <sup>th</sup> Percentile	
	mL/day	mL/kg-day	mL/day	mL/kg-day
Birth to <1 month	470 <sup>b</sup>	137 <sup>b</sup>	858 <sup>b</sup>	238 <sup>b</sup>
1 to <3 months	552	119	1,053 <sup>b</sup>	285 <sup>b</sup>
3 to <6 months	556	80	1,171 <sup>b</sup>	173 <sup>b</sup>
6 to <12 months	467	53	1,147	129
1 to <2 years	308	27	893	75
2 to <3 years	356	26	912	62
3 to <6 years	417	24	1,099	65
6 to <11 years	480	17	1,251	45
11 to <16 years	652	13	1,744	34
16 to <18 years	792	12	2,002 <sup>b</sup>	32 <sup>b</sup>
18 to <21 years	895	13	2,565 <sup>b</sup>	35 <sup>b</sup>
≥ 21 years	1,183	16	2,848	39
> 65 years <sup>c</sup>	1,242	18	2,604	37
All ages	1,000	17	2,601	44

**Infants specially susceptible**

See Tables 3-17 and 3-22

<sup>a</sup> Ingestion rates for combined direct and indirect water from community water supply.  
<sup>b</sup> The sample size does not meet minimum requirements as described in the *Third Report on Nutrition Monitoring in the United States* (LSRO, 1995).  
<sup>c</sup> U.S. EPA, 2004.

Source: Kahn, 2008 (Based on 1994-1996, 1998 USDA Continuing Survey of Food Intakes by Individuals (CSFII)).

## *Other Efforts on Susceptible Populations*

- Workshop on the Development of An Exposure Factors Handbook for the Aging (2007)
- Developing issue paper on physiological and behavioral differences in older adults
- Developing issue paper on physiological and behavioral differences in pregnant/lactating women
- Conducting analysis of fish intake using updated NHANES 1999-2006 food frequency questionnaire





# *Revised Exposure Factors Handbook*

## **Status**

- External Review Draft publicly released—October 2009
- Peer review panel meeting March, 2010
- Final – late fall 2010

[www.epa.gov/ncea](http://www.epa.gov/ncea)



## *Future Thoughts*

- Update contents of the handbooks to keep pace with the ever changing science of exposure assessment
- Incorporate information from ongoing efforts
- Improve the format and accessibility of the handbooks
- Make use of internet and web-based applications to publish future revisions of the handbooks
- Link to other tools and sources of information (e.g., fate and transport models, EPA's risk assessment portal)

## *Future Thoughts (continued)*

- Consolidate data from the handbooks into one “Life-stage Specific Exposure Factors Handbook” to include children, adults, pregnant/lactating women, aging
- Publishing a “highlights” document for the EFH
- Update document on sociodemographic data
- Expand the handbook to include data used in pharmacokinetic modeling and dose reconstruction from biomonitoring data.

## *Future Thoughts (continued)*

- Develop an interactive tool for using the handbook that includes search capabilities, link to references, and raw data if available
- Develop mechanism to communicate availability of updates and future plans
- Develop mechanism to conduct research and collaborate with other organizations to address data gaps



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