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ACRONYMS AND ABBREVIATIONS

| | | |
|-----------------|---|---|
| AAP | = | American Academy of Pediatrics |
| ADD | = | Average Daily Dose |
| AF | = | Adherence Factor |
| AIR | = | Acid Insoluble Residue |
| ANOVA | = | Analysis of Variance |
| ARS | = | Agricultural Research Service |
| ATSDR | = | Agency for Toxic Substances and Disease Registry |
| ATUS | = | American Time Use Study |
| BI | = | Bootstrap Interval |
| BMD | = | Benchmark Dose |
| BMI | = | Body Mass Index |
| BMR | = | Basal Metabolic Rate |
| BTM | = | Best Tracer Method |
| C | = | Contaminant Concentration |
| CARB | = | California Air Resources Board |
| CATI | = | Computer Assisted Telephone Interviewing |
| CDC | = | Centers for Disease Control and Prevention |
| CDS | = | Child Development Supplement |
| CHAD | = | Consolidated Human Activity Database |
| CI | = | Confidence Interval |
| cm ² | = | Square Centimeter |
| cm ³ | = | Cubic Centimeter |
| CNRC | = | Children's Nutrition Research Center |
| CRITFC | = | Columbia River Inter-Tribal Fish Commission |
| CSFII | = | Continuing Survey of Food Intake by Individuals |
| CTFA | = | Cosmetic, Toiletry, and Fragrance Association |
| CV | = | Coefficient of Variation |
| DARLING | = | Davis Area Research on Lactation, Infant Nutrition and Growth |
| DIY | = | Do-it-yourself |
| DLW | = | Doubly Labeled Water |
| DONALD | = | Dortmund Nutritional and Anthropometric Longitudinally Designed |
| E or EE | = | Energy Expenditure |
| EBF | = | Exclusively Breastfed |
| ECG | = | Energy Cost of Growth |
| ED | = | Exposure Duration |
| EI | = | Energy Intake |
| EPA | = | Environmental Protection Agency |
| f _B | = | Breathing Frequency |
| FCID | = | Food Commodity Intake Database |
| FITS | = | Feeding Infant and Toddler Study |
| FQPA | = | Food Quality Protection Act |
| F/S | = | Food/Soil |
| g | = | Gram |

| | | |
|--------|---|--|
| GAF | = | General Assessment Factor |
| GLM | = | General Linear Model |
| H | = | Oxygen Uptake Factor |
| HEC | = | Human Equivalent Exposure Concentrations |
| HPV | = | High Production Volume |
| HR | = | Heart Rate |
| I | = | Tabulated Intake Rate |
| I_A | = | Adjusted Intake Rate |
| ICRP | = | International Commission on Radiological Protection |
| IEUBK | = | Integrated Exposure and Uptake Biokinetic Model |
| IFS | = | Iowa Fluoride Study |
| IOM | = | Institute of Medicine |
| IPCS | = | International Programme on Chemical Safety |
| IR | = | Intake Rate |
| IR_p | = | Intake Rate Percentile |
| IRIS | = | Integrated Risk Information System |
| KJ | = | Kilo Joules |
| KS | = | Kolmogorov-Smirnov |
| kg | = | Kilogram |
| L_1 | = | Cooking or Preparation Loss |
| L_2 | = | Post-cooking Loss |
| LADD | = | Lifetime Average Daily Dose |
| LTM | = | Limiting Tracer Method |
| m^2 | = | Square Meter |
| m^3 | = | Cubic Meter |
| mg | = | Milligram |
| MJ | = | Mega Joules |
| mL | = | Milliliter |
| METS | = | Metabolic Equivalents of Work |
| MSA | = | Metropolitan Statistical Area |
| N | = | Number of Subjects or Respondents |
| N_c | = | Weighted Number of Individuals Consuming Homegrown Food Item |
| N_T | = | Weighted Total Number of Individuals Surveyed |
| NAS | = | National Academy of Sciences |
| NCEA | = | National Center for Environmental Assessment |
| NCHS | = | National Center for Health Statistics |
| NERL | = | National Exposure Research Laboratory |
| NFCS | = | Nationwide Food Consumption Survey |
| NHANES | = | National Health and Nutrition Examination Survey |
| NHAPS | = | National Human Activity Pattern Survey |
| NHES | = | National Health Examination Survey |
| NHEXAS | = | National Human Exposure Assessment Survey |
| NIS | = | National Immunization Survey |
| NOAEL | = | No-observed-adverse-effect-level |
| NRC | = | National Research Council |

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| | | |
|-----------------|---|---|
| OPP | = | Office of Pesticide Programs |
| ORD | = | Office of Research and Development |
| PBPK | = | Physiologically-Based Pharmacokinetic |
| PDIR | = | Physiological Daily Inhalation Rate |
| PSID | = | Panel Study of Income Dynamics |
| RAGS | = | Risk Assessment Guidance for Superfund |
| RDD | = | Random Digit Dial |
| RfD | = | Reference Dose |
| RfC | = | Reference Concentration |
| RME | = | Reasonable Maximum Exposure |
| RQ | = | Respiratory Quotient |
| RTF | = | Ready to Feed |
| SA | = | Surface Area |
| SA/BW | = | Surface Area to Body Weight Ratio |
| SCS | = | Soil Contact Survey |
| SD | = | Standard Deviation |
| SDA | = | Soaps and Detergent Association |
| SE | = | Standard Error |
| SEM | = | Standard Error of the Mean |
| SES | = | Socioeconomic Status |
| SPC | = | Science Policy Council |
| SPS | = | Statistical Processing System |
| SRD | = | Source Ranking Database |
| TDEE | = | Total Daily Energy Expenditure |
| TFEI | = | Total Food Energy Intake |
| USDA | = | United States Department of Agriculture |
| USDL | = | United States Department of Labor |
| USDHHS | = | United States Department of Health and Human Services |
| UV | = | Ultraviolet |
| VO ₂ | = | Oxygen Consumption Rate |
| VQ | = | Ventilatory Equivalent |
| VR | = | Ventilation Rate |
| W | = | Weight |
| w_i | = | Sample Weight Assigned to Observation x_i . |
| WHO | = | World Health Organization |
| WIC | = | USDA's Women, Infants, and Children Program |
| x_i | = | i^{th} observation |

PREFACE

The Exposure Factors Program of the U.S. Environmental Protection Agency's (U.S. EPA's) Office of Research and Development (ORD) has three main goals: (1) provide updates to the *Exposure Factors Handbook* and the *Child-Specific Exposure Factors Handbook*; (2) identify exposure factors data gaps and needs in consultation with clients; and (3) develop companion documents to assist clients in the use of exposure factors data. The activities under each goal are supported by and respond to the needs of the various program offices.

The National Center for Environmental Assessment (NCEA) of the U.S. EPA's ORD has prepared this handbook to provide information on various physiological and behavioral factors commonly used in assessing children's exposure to environmental chemicals. Children have different exposure circumstances than do adults. Understanding these differences is key for evaluating potential for environmental hazards from pollutants. They consume more of certain foods and water and have higher inhalation rates per unit of body weight than adults. Young children play close to the ground and come into contact with contaminated soil outdoors and with contaminated dust on surfaces and carpets indoors. Ingestion of breast milk is another potential pathway of exposure for infants and young children.

NCEA published the *Exposure Factors Handbook* in 1997. That document includes exposure factors and related data on children, as well as adults. However, the U.S. EPA Program Offices identified the need to prepare a document specifically for children's exposure factors. The *Child-Specific Exposure Factors Handbook* is intended to fulfill this need.

This handbook was first offered to the public in 2002. Since that time, the U.S. EPA has incorporated updated data and revised the recommendations for several exposure factors and developed a standardized set of age categories to be used for children's exposure assessment. Where possible, the U.S. EPA has used this standard set of age categories to permit easier comparison of data among multiple sources and to allow consistency between different types of exposure factors.

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EXECUTIVE SUMMARY

This *Child-Specific Exposure Factors Handbook* has been prepared to focus on various factors used in assessing exposure, specifically for children ages 0 to <21 years old. This handbook provides nonchemical-specific data on exposure factors for the U.S. EPA recommended set of childhood age groups in the following areas:

- ingestion of water and other select liquids (Chapter 3);
- non-dietary ingestion factors (Chapter 4);
- ingestion of soil and dust (Chapter 5);
- inhalation rates (Chapter 6);
- dermal exposure factors such as surface area and adherence (Chapter 7);
- body weight (Chapter 8);
- intake of fruits and vegetables (Chapter 9);
- intake of fish and shellfish (Chapter 10);
- intake of meat, dairy products, and fats (Chapter 11);
- intake of grain products (Chapter 12);
- intake of home-produced foods (Chapter 13);
- total food intake (Chapter 14);
- human milk intake (Chapter 15);
- activity factors (Chapter 16); and
- consumer products (Chapter 17).

The *Child-specific Exposure Factors Handbook* was first published in 2002. Subsequently, recognizing that exposures among infants, toddlers, adolescents, and teenagers can vary significantly, the U.S. EPA published its *Guidance on Selecting Age Groups for Monitoring and Assessing Childhood Exposures to Environmental Contaminants* (U.S. EPA, 2005). To the extent possible, source data for the independent studies cited in the earlier version of this handbook were obtained and re-analyzed to conform to the standard age categories. This update and revision of the 2002 interim final *Child-specific Exposure Factors Handbook* is designed specifically to complement the U.S. EPA's recommended set of childhood age groups:

- Less than 12 months old: birth to <1 month, 1 to <3 months, 3 to <6 months, and 6 to <12 months.
- Greater than 12 months old: 1 to <2 years, 2 to <3 years, 3 to <6 years, 6 to <11 years, 11 to <16 years, and 16 to <21 years.

The data presented in this handbook have been compiled from various sources, which include the U.S. EPA's *Exposure Factor Handbook* (U.S. EPA, 1997), government reports, and information presented in the scientific literature. The data presented are the result of analyses by the individual study authors. However, in some cases the U.S. EPA has conducted analysis of published primary data to present results for the recommended age groups. Studies presented in this handbook were chosen because they were seen as useful and appropriate for estimating exposure factors based on the following considerations: (1) soundness (adequacy of approach and minimal or defined bias); (2) applicability and utility (focus on the exposure factor of interest, representativeness of the population, currency of the information, and adequacy of the data collection period); (3) clarity and completeness (accessibility, reproducibility, and quality assurance); (4) variability and uncertainty (variability in the population and uncertainty in the results); and (5) evaluation and review (level of peer review and number and agreement of studies). Overall confidence ratings of high, medium, or low were derived for the various exposure factors based on the evaluation of the elements described above.

Many scientific studies were reviewed for possible inclusion in this handbook. The handbook contains summaries of selected studies published through July 2008. Generally, studies were designated as "key" or "relevant" studies. Key studies were considered the most useful for deriving recommendations; while relevant studies provided applicable or pertinent data, but not necessarily the most important for a variety of reasons (e.g., data were outdated, limitations in study design). The recommended values for exposure factors are based on the results of key studies. The U.S. EPA's procedure for developing recommendations was as follows:

1. Key studies were evaluated in terms of both quality and relevance to specific populations (general U. S. population, age groups, gender, etc.). The criteria for assessing the quality of studies are described in Section 1.5.
 2. If only one study was classified as key for a particular factor, the mean value from that study was selected as the recommended central tendency value for that population. If multiple key studies with reasonably equal quality, relevance, and study design information were available, a weighted mean (if appropriate, considering sample size and other statistical factors) of the studies was chosen as the recommended mean value. If the key studies were judged to be unequal in quality, relevance, or study design, the range of means is presented and the user of this handbook should employ judgment in selecting the most appropriate value for the lifestage or local population of interest. Recommendations for upper percentiles, when multiple studies were available, were calculated as the midpoint of the range of upper percentile values of the studies for each age group where data were available.
 3. Aspects of exposure factors variability have been discussed. This document attempts to characterize the variability of each of the factors. Variability refers to true heterogeneity or diversity in a population. Differences among individuals in a population are referred to as inter-individual variability, differences for one individual over time is referred to as intra-individual variability. Since most of the studies used to derive exposure factors data are short term in nature, they present the variability in short term exposures across a population sample and often do not allow analysis of either inter-temporal variability within individuals nor inter-individual variability of long term average exposures. Inter-individual variability in this handbook is characterized in one or more of the following ways: (1) as a table with various percentiles or ranges of values; (2) as analytical distributions with specified parameters; and/or (3) as a qualitative discussion.
 4. Uncertainties were discussed in terms of data limitations, the range of circumstances over which the estimates were (or were not) applicable, possible biases in the values themselves, a statement about parameter uncertainties (measurement error, sampling error) and model or scenario uncertainties if models or scenarios were used to derive the recommended value.
 5. The U.S. EPA assigned a confidence rating of low, medium or high to each recommended value. This rating is not intended to represent an uncertainty analysis; rather, it represents the U.S. EPA's judgment on the quality of the underlying data used to derive the recommendation.
 6. Finally, the U.S. EPA developed a table for each exposure factor to summarize the recommended values for that factor. Table ES-1 summarizes key recommended values for the exposure factors included in this handbook. Additional recommendations and detailed supporting information can be found in the individuals chapters that address these factors.
- In the providing recommendations for the various exposure factors, an attempt was made to present percentile values that are consistent with the exposure estimators defined in *Guidelines for Exposure Assessment* (U.S. EPA, 1992) (i.e., mean, 50th, 90th, 95th, 98th, and 99.9th percentile). However, this was not always possible, because the data available were limited for some factors, or the authors of the study did not provide such information. It is important to note, however, that these percentiles

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were discussed in the guidelines within the context of risk descriptors and not individual exposure factors. For example, the guidelines state that the assessor may derive a high-end estimate of exposure by using maximum or near maximum values for one or more sensitive exposure factors, leaving others at their mean value. The term “upper percentile” is used throughout this handbook, and it is intended to represent values in the upper tail (i.e., between 90th and 99.9th percentile) of the distribution of values for a particular exposure factor.

Most of the data presented in this handbook are derived from studies that target (1) the general population (e.g., USDA food consumption surveys) or (2) a sample population from a specific area or group (e.g., soil ingestion study using children from the three-city area in southeastern Washington State). The decision as to whether to use site-specific or national values for an assessment may depend on the quality of the competing data sets as well as on the purpose of the specific assessment.

It is important to note that the recommended values were derived solely from the U.S. EPA’s interpretation of the available data. Different values may be appropriate for the user in consideration of policy, precedent, strategy, or other factors (e.g., more up-to-date data of better quality and more representative of the population of concern).

U.S. EPA. (1992) Guidelines for exposure assessment. Washington, DC: Office of Research and Development, Office of Health and Environmental Assessment. EPA/600/Z-92/001.

U.S. EPA. (1997) Exposure factors handbook. Washington, DC: National Center for Environmental Assessment, Office of Research and Development. EPA/600/P-95/002Fa,b,c.

U.S. EPA. (2005) Guidance on selecting age groups for monitoring and assessing childhood exposures to environmental contaminants (2005). U.S. Environmental Protection Agency, Washington, D.C., EPA/630/P-03/003F.

| Table ES-1. Summary of Recommended Exposure Factors for Children | | | | | | | | | | | |
|--|-------------|--------------|--------------|---------------|--------------|--------------|--------------|---------------|----------------|----------------|----------------|
| Age Group | 0 to <1 mo. | 1 to <3 mos. | 3 to <6 mos. | 6 to <12 mos. | 1 to <2 yrs. | 2 to <3 yrs. | 3 to <6 yrs. | 6 to <11 yrs. | 11 to <16 yrs. | 16 to <18 yrs. | 18 to <21 yrs. |
| Ingestion of Drinking Water (mL/day) - See Chapter 3 | | | | | | | | | | | |
| Mean per capita | 184 | 227 | 362 | 360 | 271 | 317 | 380 | 447 | 606 | 731 | 826 |
| 95 th percentile per capita | 839 | 896 | 1,056 | 1,055 | 837 | 877 | 1,078 | 1,235 | 1,727 | 1,983 | 2,540 |
| Mean consumer only | 470 | 552 | 556 | 467 | 308 | 356 | 417 | 480 | 652 | 792 | 895 |
| 95 th percentile consumer only | 858 | 1,053 | 1,171 | 1,147 | 893 | 912 | 1,099 | 1,251 | 1,744 | 2,002 | 2,565 |
| Ingestion of Drinking Water (mL/kg-day) - See Chapter 3 | | | | | | | | | | | |
| Mean per capita | 52 | 48 | 52 | 41 | 23 | 23 | 22 | 16 | 12 | 11 | 12 |
| 95 th percentile per capita | 232 | 205 | 159 | 126 | 71 | 60 | 61 | 43 | 34 | 31 | 35 |
| Mean consumer only | 137 | 119 | 80 | 53 | 27 | 26 | 24 | 17 | 13 | 12 | 13 |
| 95 th percentile consumer only | 238 | 285 | 173 | 129 | 75 | 62 | 65 | 45 | 34 | 32 | 35 |
| Ingestion of Water while Swimming (mL/hour) - See Chapter 3 | | | | | | | | | | | |
| Mean | - | - | - | - | - | - | - | - | 50 | - | 20 |
| Upper percentile | - | - | - | - | - | - | - | - | 100 | - | 70 |
| Hand-to-mouth Frequency (contacts/hour) - See Chapter 4 | | | | | | | | | | | |
| Indoor | - | 28 | 19 | 20 | 20 | 13 | 15 | 7 | - | - | - |
| 95 th percentile | - | 65 | 52 | 63 | 63 | 37 | 54 | 21 | - | - | - |
| Outdoor | - | - | 15 | 14 | 14 | 5 | 9 | 3 | - | - | - |
| 95 th percentile | - | - | 47 | 47 | 42 | 20 | 36 | 12 | - | - | - |
| Object-to-mouth Frequency (contacts/hour) - See Chapter 4 | | | | | | | | | | | |
| Mean | - | - | - | 20 | - | - | - | 1 | - | - | - |
| 95 th percentile | - | - | - | - | - | - | - | - | - | - | - |
| Object-to-mouth Duration (minutes/hour) - See Chapter 4 | | | | | | | | | | | |
| Mean | - | - | 11 | 8 | 13 | 13 | - | - | - | - | - |
| 95 th percentile | - | - | 26 | 22 | 16 | 16 | - | - | - | - | - |

| Table ES-1. Summary of Recommended Exposure Factors for Children (Continued) | | | | | | | | | | | |
|--|-----------------------------|--------------|--------------|---------------|--------------|--------------|--------------|---------------|----------------|----------------|----------------|
| Age Group | 0 to <1 mos. | 1 to <3 mos. | 3 to <6 mos. | 6 to <12 mos. | 1 to <2 yrs. | 2 to <3 yrs. | 3 to <6 yrs. | 6 to <11 yrs. | 11 to <16 yrs. | 16 to <18 yrs. | 18 to <21 yrs. |
| Soil/dust Ingestion (mg/day) - See Chapter 5 | | | | | | | | | | | |
| Soil | - | - | - | 30 | - | - | - | 50 | - | - | - |
| Dust | - | - | - | 30 | - | - | - | 60 | - | - | - |
| Soil + Dust | - | - | - | 60 | - | - | - | 100 | - | - | - |
| Soil pica | - | - | - | - | - | - | - | 1,000 | - | - | - |
| Geophagy | - | - | - | - | - | - | - | 50,000 | - | - | - |
| Inhalation Rate - Long-term (m³/day) - See Chapter 6 | | | | | | | | | | | |
| Mean | 3.6 | - | 4.1 | 5.4 | 8.0 | 9.5 | 10.9 | 12.4 | 15.1 | 16.5 | - |
| 95 th percentile | 7.1 | - | 6.1 | 8.1 | 12.8 | 15.9 | 16.2 | 18.7 | 23.5 | 27.6 | - |
| Inhalation Rate - Short-term (m³/minute) - See Chapter 6 | | | | | | | | | | | |
| Sleep/nap | Mean | 3.0E-03 | 4.5E-03 | 4.6E-03 | 4.5E-03 | 4.6E-03 | 4.3E-03 | 4.5E-03 | 5.0E-03 | 4.9E-03 | - |
| | 95 th percentile | 4.6E-03 | 6.4E-03 | 6.4E-03 | 6.4E-03 | 6.4E-03 | 5.8E-03 | 6.3E-03 | 7.4E-03 | 7.1E-03 | - |
| Sedentary | Mean | 3.1E-03 | 4.7E-03 | 4.8E-03 | 4.7E-03 | 4.8E-03 | 4.8E-03 | 4.8E-03 | 5.4E-03 | 5.3E-03 | - |
| | 95 th percentile | 4.7E-03 | 7.6E-03 | 6.5E-03 | 6.5E-03 | 6.5E-03 | 5.8E-03 | 6.4E-03 | 7.5E-03 | 7.2E-03 | - |
| Light | Mean | 1.1E-02 | 1.6E-02 | 1.6E-02 | 1.2E-02 | 1.2E-02 | 1.1E-02 | 1.1E-02 | 1.3E-02 | 1.2E-02 | - |
| | 95 th percentile | 1.4E-02 | 2.1E-02 | 2.1E-02 | 1.6E-02 | 1.6E-02 | 1.4E-02 | 1.5E-02 | 1.7E-02 | 1.6E-02 | - |
| Moderate | Mean | 2.3E-02 | 3.8E-02 | 3.8E-02 | 2.9E-02 | 2.9E-02 | 2.7E-02 | 2.9E-02 | 3.4E-02 | 3.7E-02 | - |
| | 95 th percentile | 4.1E-02 | 5.2E-02 | 5.2E-02 | 4.5E-02 | 4.5E-02 | 4.3E-02 | 4.2E-02 | 4.9E-02 | 4.9E-02 | - |
| Heavy | Mean | 3.0E-03 | 4.6E-03 | 4.6E-03 | 4.5E-03 | 4.6E-03 | 4.3E-03 | 4.5E-03 | 5.0E-03 | 4.9E-03 | - |
| | 95 th percentile | 4.6E-03 | 6.4E-03 | 6.4E-03 | 6.4E-03 | 6.4E-03 | 5.8E-03 | 6.3E-03 | 7.4E-03 | 7.1E-03 | - |
| Skin Surface Area - Total (m²) - See Chapter 7 | | | | | | | | | | | |
| Total Body | Mean | 0.29 | 0.33 | 0.38 | 0.45 | 0.53 | 0.76 | 1.08 | 1.59 | 1.84 | - |
| | 95 th | 0.34 | 0.38 | 0.44 | 0.51 | 0.61 | 0.95 | 1.48 | 2.06 | 2.33 | - |

| Table ES-1. Summary of Recommended Exposure Factors for Children (Continued) | | | | | | | | | | | |
|--|-----------------------------|--------------|--------------|---------------|---|--------------|--------------|---------------|----------------|----------------|----------------|
| Age Group | 0 to <1 mo. | 1 to <3 mos. | 3 to <6 mos. | 6 to <12 mos. | 1 to <2 yrs. | 2 to <3 yrs. | 3 to <6 yrs. | 6 to <11 yrs. | 11 to <16 yrs. | 16 to <18 yrs. | 18 to <21 yrs. |
| Skin Surface Area - Body Parts (m²) - See Chapter 7 | | | | | | | | | | | |
| Head | Mean | 0.053 | 0.060 | 0.069 | 0.082 | 0.087 | 0.104 | 0.136 | 0.149 | 0.144 | |
| | 95 th percentile | 0.062 | 0.069 | 0.080 | 0.093 | 0.101 | 0.130 | 0.186 | 0.194 | 0.182 | |
| Trunk | Mean | 0.104 | 0.118 | 0.136 | 0.161 | 0.188 | 0.241 | 0.375 | 0.536 | 0.592 | |
| | 95 th percentile | 0.121 | 0.136 | 0.157 | 0.182 | 0.217 | 0.301 | 0.514 | 0.694 | 0.750 | |
| Arms | Mean | 0.040 | 0.045 | 0.052 | 0.062 | 0.069 | 0.108 | 0.137 | 0.205 | 0.282 | |
| | 95 th percentile | 0.047 | 0.052 | 0.060 | 0.070 | 0.079 | 0.135 | 0.188 | 0.266 | 0.356 | |
| Hands | Mean | 0.015 | 0.017 | 0.020 | 0.024 | 0.030 | 0.045 | 0.054 | 0.084 | 0.099 | |
| | 95 th percentile | 0.018 | 0.020 | 0.023 | 0.027 | 0.035 | 0.056 | 0.074 | 0.109 | 0.126 | |
| Legs | Mean | 0.060 | 0.068 | 0.078 | 0.093 | 0.122 | 0.207 | 0.301 | 0.498 | 0.592 | |
| | 95 th percentile | 0.070 | 0.078 | 0.091 | 0.105 | 0.141 | 0.162 | 0.259 | 0.413 | 0.750 | |
| Feet | Mean | 0.019 | 0.021 | 0.025 | 0.029 | 0.033 | 0.043 | 0.078 | 0.119 | 0.131 | |
| | 95 th percentile | 0.022 | 0.025 | 0.029 | 0.033 | 0.038 | 0.050 | 0.107 | 0.155 | 0.165 | |
| Adherence of Solids to Skin (means; mg/cm²) - See Chapter 7 for specific activities and age groups represented by these values | | | | | | | | | | | |
| Residential indoor | | | | | 0.0041 (arms); 0.011 (hands); 0.0035 (legs); 0.010 (feet) | | | | | | |
| Daycare (in & outdoors) | | | | | 0.024 (arms); 0.099 (hands); 0.020 (legs); 0.071 (feet) | | | | | | |
| Outdoor sports | | | | | 0.012 (face); 0.011 (arms); 0.11 (hands); 0.031 (legs) | | | | | | |
| Indoor sports | | | | | 0.0019 (arms); 0.0063 (hands); 0.0020 (legs); 0.0022 (feet) | | | | | | |
| Activities with soil | | | | | 0.054 (face); 0.046 (arms); 0.17 (hands); 0.051 (legs); 0.20 (feet) | | | | | | |
| Playing in mud | | | | | 11 (arms); 47 (hands); 23 (legs); 15 (feet) | | | | | | |
| Playing in sediment | | | | | 0.040 (face); 0.17 (arms); 0.49 (hands); 0.70 (legs); 21 (feet) | | | | | | |
| Body Weight (kg) - See Chapter 8 | | | | | | | | | | | |
| Mean | 4.8 | 5.6 | 7.4 | 9.2 | 11.4 | 13.8 | 18.6 | 31.8 | 56.8 | 71.6 | |
| Total Fruit Intake (g/kg-day)^a - See Chapter 9 | | | | | | | | | | | |
| Mean per capita | | 5.7 | | | 6.2 | | 4.6 | 2.4 | | 0.8 | |
| 95 th percentile per capita | | 21 | | | 19 | | 14 | 8.8 | | 3.5 | |
| Mean consumer only | | 10 | | | 6.9 | | 5.1 | 2.7 | | 1.1 | |
| 95 th percentile consumer | | 26 | | | 19 | | 15 | 9.3 | | 3.8 | |

| Table ES-1. Summary of Recommended Exposure Factors for Children (Continued) | | | | | | | | | | | |
|--|-------------|--------------|--------------|---------------|--------------|--------------|--------------|---------------|----------------|----------------|----------------|
| Age Group | 0 to <1 mo. | 1 to <3 mos. | 3 to <6 mos. | 6 to <12 mos. | 1 to <2 yrs. | 2 to <3 yrs. | 3 to <6 yrs. | 6 to <11 yrs. | 11 to <16 yrs. | 16 to <18 yrs. | 18 to <21 yrs. |
| Total Vegetable Intake (g/kg-day)^a - See Chapter 9 | | | | | | | | | | | |
| Mean per capita | | 4.5 | | | 6.9 | | 5.9 | 4.1 | | 2.9 | |
| 95 th percentile per capita | | 15 | | | 17 | | 15 | 9.9 | | 6.9 | |
| Mean consumer only | | 6.2 | | | 6.9 | | 5.9 | 4.1 | | 2.9 | |
| 95 th percentile consumer | | 16 | | | 17 | | 15 | 9.9 | | 6.9 | |
| Fish and Shellfish Intake (g/kg-day)^a - See Chapter 10 | | | | | | | | | | | |
| General Population | | | | | | | | | | | |
| Total Fish | | | | | | | | | | | |
| Mean per capita | - | | | | | | 0.43 | 0.28 | 0.23 | 0.16 | - |
| 95 th percentile per capita | - | | | | | | 3.0 | 1.9 | 1.5 | 1.3 | - |
| Mean consumer only | - | | | | | | 4.2 | 3.2 | 2.2 | 2.1 | - |
| 95 th consumer | - | | | | | | 10 | 8.7 | 6.2 | 6.6 | - |
| Marine | | | | | | | | | | | |
| Mean per capita | - | | | | | | 0.31 | 0.20 | 0.15 | 0.10 | - |
| 95 th percentile per capita | - | | | | | | 2.3 | 1.5 | 1.3 | 0.46 | - |
| Mean consumer only | - | | | | | | 3.7 | 2.8 | 2.0 | 2.0 | - |
| 95 th percentile consumer | - | | | | | | 9.3 | 8.0 | 5.2 | 6.5 | - |
| Freshwater | | | | | | | | | | | |
| Mean per capita | - | | | | | | 0.12 | 0.08 | 0.08 | 0.07 | - |
| 95 th percentile per capita | - | | | | | | 0.71 | 0.35 | 0.48 | 0.29 | - |
| Mean consumer only | - | | | | | | 2.3 | 1.8 | 1.3 | 1.4 | - |
| 95 th percentile consumer | - | | | | | | 7.2 | 6.2 | 4.4 | 3.3 | - |
| Recreational Marine - No age-specific recommendations; see Chapter 10. | | | | | | | | | | | |
| Recreational Freshwater - No age-specific recommendations; see Chapter 10. | | | | | | | | | | | |
| Native American - No age-specific recommendations; see Chapter 10. | | | | | | | | | | | |

| Table ES-1. Summary of Recommended Exposure Factors for Children (Continued) | | | | | | | | | | | |
|--|-------------|--------------|--------------|---------------|--------------|--------------|--------------|---------------|----------------|----------------|----------------|
| Age Group | 0 to <1 mo. | 1 to <3 mos. | 3 to <6 mos. | 6 to <12 mos. | 1 to <2 yrs. | 2 to <3 yrs. | 3 to <6 yrs. | 6 to <11 yrs. | 11 to <16 yrs. | 16 to <18 yrs. | 18 to <21 yrs. |
| Total Meat Intake (g/kg-day)^a - See Chapter 11 | | | | | | | | | | | |
| Mean per capita | | | 1.2 | | 4.1 | | 4.1 | 2.9 | | 2.1 | |
| 95 th percentile per capita | | | 6.7 | | 9.8 | | 9.4 | 6.5 | | 4.8 | |
| Mean consumer only | | | 3.0 | | 4.2 | | 4.2 | 2.9 | | 2.1 | |
| 95 th percentile consumer | | | 9.2 | | 9.8 | | 9.4 | 6.5 | | 4.8 | |
| Total Dairy Intake (g/kg-day)^a - See Chapter 11 | | | | | | | | | | | |
| Mean per capita | | | 13 | | 37 | | 23 | 14 | | 5.6 | |
| 95 th percentile per capita | | | 49 | | 88 | | 49 | 32 | | 16 | |
| Mean consumer only | | | 16 | | 37 | | 23 | 14 | | 5.6 | |
| 95 th percentile consumer | | | 58 | | 88 | | 49 | 32 | | 16 | |
| Total Fat Intake (g/kg-day)^a - See Chapter 11 | | | | | | | | | | | |
| Mean per capita | 5.2 | 4.5 | 4.1 | 3.7 | 4.0 | 3.6 | 3.4 | 2.6 | 1.6 | 1.3 | |
| 95 th percentile per capita | 16 | 11 | 8.2 | 7.0 | 7.1 | 6.4 | 5.8 | 4.2 | 3.0 | 2.7 | |
| Mean consumer only | 7.8 | 6.0 | 4.4 | 3.7 | 4.0 | 3.6 | 3.4 | 2.6 | 1.6 | 1.3 | |
| 95 th percentile consumer | 16 | 12 | 8.3 | 7.0 | 7.1 | 6.4 | 5.8 | 4.2 | 3.0 | 2.7 | |
| Total Grain Intake (g/kg-day)^a - See Chapter 12 | | | | | | | | | | | |
| Mean per capita | | | 2.5 | | 6.4 | | 6.3 | 4.3 | | 2.5 | |
| 95 th percentile per capita | | | 8.6 | | 12 | | 12 | 8.2 | | 5.1 | |
| Mean consumer only | | | 3.6 | | 6.4 | | 6.3 | 4.3 | | 2.5 | |
| 95 th percentile consumer | | | 9.2 | | 12 | | 12 | 8.2 | | 5.1 | |

Table ES-1. Summary of Recommended Exposure Factors for Children (Continued)

| Age Group | 0 to <1 mo. | 1 to <3 mos. | 3 to <6 mos. | 6 to <12 mos. | 1 to <2 yrs. | 2 to <3 yrs. | 3 to <6 yrs. | 6 to <11 yrs. | 11 to <16 yrs. | 16 to <18 yrs. | 18 to <21 yrs. |
|--|-------------|--------------|--------------|---------------|--------------|--------------|--------------|---------------|----------------|----------------|----------------|
| Home-produced Food Intake (g/kg-day)^b - See Chapter 13 | | | | | | | | | | | |
| Fruits | | | | | | | | | | | |
| Mean | - | - | - | - | 8.7 | - | 4.1 | 3.6 | 1.9 | | |
| 95 th percentile | - | - | - | - | 60.6 | - | 8.9 | 15.8 | 8.3 | | |
| Vegetables | | | | | | | | | | | |
| Mean | - | - | - | - | 5.2 | - | 2.5 | 2.0 | 1.5 | | |
| 95 th percentile | - | - | - | - | 19.6 | - | 7.7 | 6.2 | 6.0 | | |
| Meats | | | | | | | | | | | |
| Mean | - | - | - | - | 3.7 | - | 3.6 | 3.7 | 1.7 | | |
| 95 th percentile | - | - | - | - | 10.0 | - | 9.1 | 14.0 | 4.3 | | |
| Fish | | | | | | | | | | | |
| Mean | - | - | - | - | - | - | - | 2.8 | 1.5 | | |
| 95 th percentile | - | - | - | - | - | - | - | 7.1 | 4.7 | | |
| Total Food Intake (g/kg-day) - See Chapter 14 | | | | | | | | | | | |
| Mean per capita | 20 | 16 | 28 | 56 | 90 | 74 | 61 | 40 | 24 | 18 | |
| 95 th percentile per capita | 61 | 40 | 65 | 134 | 161 | 126 | 102 | 70 | 45 | 35 | |
| Human Milk Intake (mL/day) - See Chapter 15 | | | | | | | | | | | |
| Mean | 510 | 690 | 770 | 620 | | | | NA | | | |
| Upper percentile | 950 | 980 | 1,000 | 1,000 | | | | NA | | | |
| Human Milk Intake (mL/kg-day) - See Chapter 15 | | | | | | | | | | | |
| Mean | 150 | 140 | 110 | 83 | | | | NA | | | |
| Upper percentile | 220 | 190 | 150 | 130 | | | | NA | | | |
| Lipid Intake from Human Milk (mL/day) - See Chapter 15 | | | | | | | | | | | |
| Mean | 20 | 27 | 30 | 25 | | | | NA | | | |
| Upper percentile | 38 | 40 | 42 | 42 | | | | NA | | | |

| Table ES-1. Summary of Recommended Exposure Factors for Children (Continued) | | | | | | | | | | | |
|--|-------------|--------------|--------------|---------------|--------------|--------------|--------------|---------------|----------------|----------------|----------------|
| Age Group | 0 to <1 mo. | 1 to <3 mos. | 3 to <6 mos. | 6 to <12 mos. | 1 to <2 yrs. | 2 to <3 yrs. | 3 to <6 yrs. | 6 to <11 yrs. | 11 to <16 yrs. | 16 to <18 yrs. | 18 to <21 yrs. |
| Lipid Intake from Human Milk (mL/kg-day) - See Chapter 15 | | | | | | | | | | | |
| Mean | 6.0 | 5.5 | 4.2 | 3.3 | | | | NA | | | |
| Upper percentile | 8.7 | 8.0 | 6.0 | 5.2 | | | | NA | | | |
| Activity Factors - See Chapter 16 | | | | | | | | | | | |
| Mean (minutes/day) | | | | | | | | | | | |
| Indoors, total | 1,440 | 1,432 | 1,414 | 1,301 | 1,353 | 1,316 | 1,278 | 1,244 | 1,260 | 1,248 | |
| Outdoors, total | 0 | 8 | 26 | 139 | 36 | 76 | 107 | 132 | 100 | 102 | |
| Indoors, at residence | | | | | | | | | | | |
| Mean | 1,108 | 1,065 | 1,065 | 979 | 979 | 979 | 957 | 893 | 889 | 833 | |
| 95th | 1,440 | 1,440 | 1,440 | 1,296 | 1,296 | 1,296 | 1,355 | 1,275 | 1,315 | 1,288 | |
| Showering | 15 | 20 | - | 22 | 22 | 22 | 17 | 18 | 18 | 20 | |
| Mean | - | - | - | 44 | 44 | 44 | 34 | 41 | 40 | 45 | |
| Bathing | 19 | 23 | 23 | 23 | 23 | 23 | 24 | 24 | 25 | 33 | |
| Mean | 30 | 32 | 30 | 45 | 45 | 45 | 60 | 46 | 43 | 60 | |
| 95th | 18 | 43 | 53 | 53 | 53 | 53 | 60 | 67 | 67 | 83 | |
| Playing on sand/gravel | - | 121 | 121 | 121 | 121 | 121 | 121 | 121 | 121 | - | |
| Mean | 52 | 68 | 62 | 79 | 79 | 79 | 73 | 73 | 75 | 60 | |
| 95th | - | 121 | 121 | 121 | 121 | 121 | 121 | 121 | 121 | - | |
| Playing on grass | 33 | 56 | 47 | 63 | 63 | 63 | 63 | 63 | 49 | 30 | |
| Mean | - | 121 | 121 | 121 | 121 | 121 | 121 | 121 | 120 | - | |
| 95th | - | - | - | - | - | - | - | - | - | - | |
| Mean (minutes/month) | | | | | | | | | | | |
| Swimming | 96 | 105 | 116 | 137 | 139 | 145 | 181 | 181 | 181 | 181 | 181 |
| Mean | - | - | - | - | - | - | - | - | - | - | - |
| 95th | - | - | - | - | - | - | - | - | - | - | - |

Table ES-1. Summary of Recommended Exposure Factors for Children (Continued)

| Age Group | 0 to <1 mo. | 1 to <3 mos. | 3 to <6 mos. | 6 to <12 mos. | 1 to <2 yrs. | 2 to <3 yrs. | 3 to <6 yrs. | 6 to <11 yrs. | 11 to <16 yrs. | 16 to <18 yrs. | 18 to <21 yrs. |
|--|---|--------------|--------------|---------------|--------------|--------------|--------------|---------------|----------------|----------------|----------------|
| Consumer Products - See Chapter 17 | | | | | | | | | | | |
| No age-specific recommendations; see Chapter 17. | | | | | | | | | | | |
| ^a | Analysis was conducted using slightly different 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 recommended age categories closest to those used in the analysis. | | | | | | | | | | |
| ^b | Analysis was conducted prior to Agency's issuance of <i>Guidance on Selecting Age Groups for Monitoring and Assessing Childhood Exposures to Environmental Contaminants</i> (U.S. EPA, 2005). Thus, age groups in the original study are slightly different than those presented here. See chapter for details. | | | | | | | | | | |
| - | No data available and/or no recommendation made. | | | | | | | | | | |
| NA | Not applicable. | | | | | | | | | | |

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