



**TABLE OF CONTENTS**

|          |  |       |
|----------|--|-------|
| 12       | INTAKE OF GRAIN PRODUCTS .....                           | 12-1  |
| 12.1     | INTRODUCTION .....                                       | 12-1  |
| 12.2     | RECOMMENDATIONS .....                                    | 12-2  |
| 12.3     | INTAKE STUDIES .....                                     | 12-6  |
| 12.3.1   | Key Grain Intake Study .....                             | 12-6  |
| 12.3.1.1 | U.S. EPA Analysis of CSFII 1994-96, 1998 .....           | 12-6  |
| 12.3.2   | Relevant Grain Intake Studies .....                      | 12-7  |
| 12.3.2.1 | USDA, 1999 .....   | 12-7  |
| 12.3.2.2 | Smiciklas-Wright et al., 2002 .....                      | 12-8  |
| 12.3.2.3 | Fox et al., 2004 .....                                   | 12-8  |
| 12.3.2.4 | Ponza et al., 2004 .....                                 | 12-9  |
| 12.3.2.5 | Mennella et al., 2006 .....                              | 12-9  |
| 12.3.2.6 | Fox et al., 2006 .....                                   | 12-10 |
| 12.4     | CONVERSION BETWEEN WET AND DRY WEIGHT INTAKE RATES ..... | 12-10 |
| 12.5     | REFERENCES FOR CHAPTER 12 .....                          | 12-10 |
|          | APPENDIX 12A .....                                       | 12A-1 |



**LIST OF TABLES**

|              |   |       |
|--------------|---|-------|
| Table 12-1.  | Recommended Values for Intake of Grains, As Consumed . . . . .  | 12-3  |
| Table 12-2.  | Confidence in Recommendations for Intake of Grain Products . . . . .  | 12-4  |
| Table 12-3.  | Per Capita Intake of Total Grains (g/kg-day as consumed) . . . . .  | 12-12 |
| Table 12-4.  | Consumer Only Intake of Total Grains (g/kg-day as consumed) . . . . .   | 12-12 |
| Table 12-5.  | Per Capita Intake of Individual Grain Products (g/kg-day as consumed) . . . . .   | 12-13 |
| Table 12-6.  | Consumer Only Intake of Individual Grain Products (g/kg-day as consumed) . . . . .  | 12-13 |
| Table 12-7.  | Mean Quantities of Grain Products Consumed Daily by Sex and Age, Per Capita (g/day) . . .   | 12-14 |
| Table 12-8.  | Percentage of Individuals Consuming Grain Products, by Sex and Age (%) . . . . .  | 12-15 |
| Table 12-9.  | Quantity (as consumed) of Grain Products Consumed Per Eating Occasion and<br>Percentage of Individuals Using These Foods in Two Days . . . . .          | 12-16 |
| Table 12-10. | Characteristics of the FITS Sample Population . . . . .   | 12-17 |
| Table 12-11. | Percentage of Infants and Toddlers Consuming Different Types of Grain Products . . . . .  | 12-18 |
| Table 12-12. | Characteristics of WIC Participants and Nonparticipants (Percentages) . . . . .   | 12-19 |
| Table 12-13. | Food Choices for Infants and Toddlers by WIC Participation Status . . . . .   | 12-20 |
| Table 12-14. | Percentage of Hispanic and Non-Hispanic Infants and Toddlers Consuming Different<br>Types of Grain Products on A Given Day . . . . .                    | 12-21 |
| Table 12-15. | Average Portion Sizes Per Eating Occasion of Grain Products Commonly Consumed<br>by Infants from the 2002 Feeding Infants and Toddlers Study . . . . .  | 12-22 |
| Table 12-16. | Average Portion Sizes Per Eating Occasion of Grain Products Commonly Consumed<br>by Toddlers from the 2002 Feeding Infants and Toddlers Study . . . . . | 12-22 |
| Table 12-17. | Mean Moisture Content of Selected Grain Products Expressed as Percentages<br>of Edible Portions . . . . .   | 12-23 |
| Table 12A-1. | Food Codes and Definitions Used in Analysis of the 1994-96, 1998 USDA CSFII Data . . .  | 12A-2 |



---

**Chapter 12 - Intake of Grain Products**

---

**12 INTAKE OF GRAIN PRODUCTS****12.1 INTRODUCTION**

The American food supply is generally considered to be one of the safest in the world. Nevertheless, grain products may become contaminated with toxic chemicals by several different pathways. Ambient air pollutants may be deposited on or absorbed by the plants, or dissolved in rainfall or irrigation waters that contact the plants. Pollutants may also be absorbed through plant roots from contaminated soil and ground water. The addition of pesticides, soil additives, and fertilizers may also result in contamination of grain products. To assess exposure through this pathway, information on ingestion rates of grain products are needed.

Children's exposure from contaminated foods may differ from that of adults because of differences in the type and amounts of food eaten. Also, for many foods, the intake per unit body weight is greater for children than for adults. Common grain products eaten by children include milled rice, oats, and wheat flour (Goldman, 1995).

A variety of terms may be used to define intake of grain products (e.g., consumer-only intake, per capita intake, total grain intake, as-consumed intake, dry weight intake). As described in Chapter 9, Intake of Fruits and Vegetables, consumer-only intake is defined as the quantity of grain products consumed by children during the survey period. These data are generated by averaging intake across only the children in the survey who consumed these food items. Per capita intake rates are generated by averaging consumer-only intakes over the entire population of children (including those children that reported no intake). In general, per capita intake rates are appropriate for use in exposure assessment for which average dose estimates for children are of interest because they represent both children who ate the foods during the survey period and children who may eat the food items at some time, but did not consume them during the survey period. Per capita intake, therefore, represents an average across the entire population of interest, but does so at the expense of underestimating consumption for the subset of the population that consumed the food in question. Total grain intake refers to the sum of all grain products consumed in a day.

Intake rates may be expressed on the basis of the as-consumed weight (e.g., cooked or prepared) or on the uncooked or unprepared weight. As-consumed intake rates are based on the weight of the food in the form that it is consumed and should be used in assessments where the basis for the contaminant concentrations in foods is also indexed to the as-consumed weight. The food ingestion values provided in this chapter are expressed as as-consumed intake rates because this is the fashion in which data were reported by survey respondents. This is of importance because concentration data to be used in the dose equation are often measured in uncooked food samples. It should be recognized that cooking can either increase or decrease food weight. Similarly, cooking can increase the mass of contaminant in food (due to formation reactions, or absorption from cooking oils or water) or decrease the mass of contaminant in food (due to vaporization, fat loss or leaching). The combined effects of changes in weight and changes in contaminant mass can result in either an increase or decrease in contaminant concentration in cooked food. Therefore, if the as-consumed ingestion rate and the uncooked concentration are used in the dose equation, dose may be under-estimated or over-estimated. Ideally, after-cooking food concentrations should be combined with the as-consumed intake rates. In the absence of data, it is reasonable to assume that no change in contaminant concentration occurs after cooking. It is important for the assessor to be aware of these issues and choose intake rate data that best match the concentration data that are being used. For more information on cooking losses and conversions necessary to account for such losses, the reader is referred to Chapter 13 of this handbook.

Sometimes contaminant concentrations in food are reported on a dry weight basis. When these data are used in an exposure assessment, it is recommended that dry-weight intake rates also be used. Dry-weight food concentrations and intake rates are based on the weight of the food consumed after the moisture content has been removed. For information on converting the intake rates presented in this chapter to dry weight intake rates, the reader is referred to Section 12.4.

The purpose of this chapter is to provide intake data for grain products among children. The recommendations for ingestion rates of grain



products are provided in the next section, along with a summary of the confidence ratings for these recommendations. The recommended values are based on the key study identified by U.S. EPA for this factor. Following the recommendations, the key study on ingestion of grain products is summarized. Relevant data on ingestion of grain products are also provided. These data are presented to provide the reader with added perspective on the current state-of-knowledge pertaining to ingestion of grain products among children.

and Nutrition Survey (NHANES) will be incorporated as the data become available and are analyzed.

## **12.2 RECOMMENDATIONS**

Tables 12-1 presents a summary of the recommended values for per capita and consumers-only intake of grain products, on an as consumed basis. Confidence ratings for the grain intake recommendations for general population children are provided in Table 12-2.

The U.S. EPA analysis of data from the 1994-96 and 1998 Continuing Survey of Food Intake among Individuals (CSFII) was used in selecting recommended intake rates for general population children. The U.S. EPA analysis was conducted using age groups that differed slightly from U.S. EPA's *Guidance on Selecting Age Groups for Monitoring and Assessing Childhood Exposures to Environmental Contaminants* (U.S. EPA, 2005). However, for the purposes of the recommendations presented here, data were placed in the standardized age categories closest to those used in the analysis. Also, the CSFII data on which the recommendations are based are short-term survey data and may not necessarily reflect the long-term distribution of average daily intake rates. However, for broad categories of food (i.e., total grains), because they are eaten on a daily basis throughout the year with minimal seasonality, the short term distribution may be a reasonable approximation of the long-term distribution, although it will display somewhat increased variability. This implies that the upper percentiles shown here will tend to overestimate the corresponding percentiles of the true long-term distribution. It should also be noted that because these recommendations are based on 1994-96 and 1998 CSFII data, they may not reflect the most recent changes that may have occurred in consumption patterns. More current data from the National Health



**Chapter 12 - Intake of Grain Products**

| Table 12-1. Recommended Values for Intake of Grains, 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 Grains  |            |                             |                |                             |                                |   |
| Birth to 1 year   | 2.5        | 8.6                         | 3.6            | 9.2                         |                                |   |
| 1 to <2 years   | 6.4        | 12                          | 6.4            | 12                          |                                |   |
| 2 to <3 years   | 6.4        | 12                          | 6.4            | 12                          |                                |   |
| 3 to <6 years   | 6.3        | 12                          | 6.3            | 12                          | See Tables<br>12-3 and<br>12-4 | U.S. EPA<br>Analysis of<br>CSFII,<br>1994-96 and<br>1998. |
| 6 to <11 years  | 4.3        | 8.2                         | 4.3            | 8.2                         |                                |   |
| 11 to <16 years   | 2.5        | 5.1                         | 2.5            | 5.1                         |                                |   |
| 16 to <21 years   | 2.5        | 5.1                         | 2.5            | 5.1                         |                                |   |
| Individual Grain Products - See Tables 12-5 and 12-6  |            |                             |                |                             |                                |   |
| <sup>a</sup> 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 standardized age categories closest to those used in the analysis. |            |                             |                |                             |                                |   |



Table 12-2. Confidence in Recommendations for Intake of Grain Products

| General Assessment Factors   | Rationale   | Rating |
|--|---|--------|
| <p><b>Soundness</b></p> <p><i>Adequacy of Approach</i></p> <p><i>Minimal (or defined) Bias</i></p>   | <p>The survey methodology and data analysis was adequate. The survey sampled more than 11,000 individuals up to age 18 years. An analysis of primary data was conducted.</p> <p>No physical measurements were taken. The method relied on recent recall of grain products eaten.</p>  | High   |
| <p><b>Applicability and Utility</b></p> <p><i>Exposure Factor of Interest</i></p> <p><i>Representativeness</i></p> <p><i>Currency</i></p> <p><i>Data Collection Period</i></p> | <p>The key study was directly relevant to grain intake.</p> <p>The data were demographically representative of the U.S. population (based on stratified random sample).</p> <p>Data were collected between 1994 and 1998.</p> <p>Data were collected for two non-consecutive days.</p>  | Medium |
| <p><b>Clarity and Completeness</b></p> <p><i>Accessibility</i></p> <p><i>Reproducibility</i></p> <p><i>Quality Assurance</i></p>   | <p>The CSFII data are publicly available.</p> <p>The methodology used was clearly described; enough information was included to reproduce the results.</p> <p>Quality assurance of the CSFII data was good; quality control of the secondary data analysis was not well described.</p>  | High   |
| <p><b>Variability and Uncertainty</b></p> <p><i>Variability in Population</i></p> <p><i>Minimal Uncertainty</i></p>  | <p>Full distributions were provided for total grains. Means were provided for individual grain products.</p> <p>Data collection was based on recall for a 2-day period; the accuracy of using these data to estimate long-term intake (especially at the upper percentiles) is uncertain. However, use of short-term data to estimate chronic ingestion can be assumed for broad categories of foods such as total grains. Uncertainty is likely to be greater for individual grain products.</p> | Medium |



**Chapter 12 - Intake of Grain Products**

| Table 12-2. Confidence in Recommendations for Intake of Grain Products (continued) |  |   |
|--|--|---|
| General Assessment Factors   | Rationale  | Rating  |
| <b>Evaluation and Review</b>   |  | Medium  |
| <i>Peer Review</i>   | The USDA CSFII survey received a high level of peer review. The U.S. EPA analysis of these data has not been peer reviewed outside the Agency. |   |
| <i>Number and Agreement of Studies</i>   | There was 1 key study.   |   |
| <b>Overall Rating</b>  |  | <b>High</b> confidence in the averages;<br><b>Low</b> confidence in the long-term upper percentiles |



**12.3 INTAKE STUDIES**

The primary source of recent information on consumption rates of grain products among children is the U.S. Department of Agriculture's (USDA) CSFII. Data from the 1994-96 CSFII and the 1998 Children's supplement to the 1994-96 CSFII have been used in various studies to generate children's consumer-only and per capita intake rates for both individual grain products and total grains. The CSFII is a series of surveys designed to measure the kinds and amounts of foods eaten by Americans. The CSFII 1994-96 was conducted between January 1994 and January 1997 with a target population of non-institutionalized individuals in all 50 states and Washington, D.C. In each of the 3 survey years, data were collected for a nationally representative sample of individuals of all ages. The CSFII 1998 was conducted between December 1997 and December 1998 and surveyed children 9 years of age and younger. It used the same sample design as the CSFII 1994-96 and was intended to be merged with CSFII 1994-96 to increase the sample size for children. The merged surveys are designated as CSFII 1994-96, 1998. Additional information on these surveys can be obtained at <http://www.ars.usda.gov/Services/docs.htm?docid=14531>.

The CSFII 1994-96, 1998 collected dietary intake data through in-person interviews on 2 non-consecutive days. The data were based on 24-hour recall. A total of 21,662 individuals provided data for the first day; of those individuals, 20,607 provided data for a second day. Over 11,000 of the sample persons represented children up to 18 years of age. The 2-day response rate for the 1994-1996 CSFII was approximately 76 percent. The 2-day response rate for CSFII 1998 was 82 percent.

The CSFII 1994-96, 98 surveys were based on a complex multistage area probability sample design. The sampling frame was organized using 1990 U.S. population census estimates, and the stratification plan took into account geographic location, degree of urbanization, and socioeconomic characteristics. Several sets of sampling weights are available for use with the intake data. By using appropriate weights, data for all four years of the surveys can be combined. USDA recommends that all 4 years be combined in order to provide an adequate sample size for children.

**12.3.1 Key Grain Intake Study**

**12.3.1.1 U.S. EPA Analysis of CSFII 1994-96, 1998**

For many years, the U.S. EPA's Office of Pesticide Programs (OPP) has used food consumption data collected by the U.S. Department of Agriculture (USDA) for its dietary risk assessments. Most recently, OPP, in cooperation with USDA's Agricultural Research Service (ARS), used data from the 1994-96, 1998 CSFII to develop the Food Commodity Intake Database (FCID). CSFII data on the foods people reported eating were converted to the quantities of agricultural commodities eaten. "Agricultural commodity" is a term used by U.S. EPA to mean plant (or animal) parts consumed by humans as food; when such items are raw or unprocessed, they are referred to as "raw agricultural commodities." For example, an apple pie may contain the commodities apples, flour, fat, sugar and spices. FCID contains approximately 553 unique commodity names and 8-digit codes. The FCID commodity names and codes were selected and defined by U.S. EPA and were based on the U.S. EPA Food Commodity Vocabulary (<http://www.epa.gov/pesticides/foodfeed/>).

The grain items/groups selected for the U.S. EPA analysis included total grains, and individual grain products such as cereal and rice. Appendix 12A presents the food codes and definitions used to determine the various grain products used in the analysis. Intake rates for these food items/groups represent intake of all forms of the product (e.g., both home produced and commercially produced). Children who provided data for two days of the survey were included in the intake estimates. Individuals who did not provide information on body weight or for whom identifying information was unavailable were excluded from the analysis. Two-day average intake rates were calculated for all individuals in the database for each of the food items/groups. These average daily intake rates were divided by each individual's reported body weight to generate intake rates in units of grams per kilogram of body weight per day (g/kg-day). The data were weighted according to the four-year, two-day sample weights provided in the 1994-96, 1998 CSFII to adjust the data for the sample population to reflect the national population.

Summary statistics were generated on both





---

**Chapter 12 - Intake of Grain Products**

---

a per capita and a consumer only basis. For per capita intake, both users and non-users of the food item were included in the analysis. Consumer-only intake rates were calculated using data for only those individuals who ate the food item of interest during the survey period. Intake data from the CSFII are based on as-consumed (i.e., cooked or prepared) forms of the food items/groups. Summary statistics, including: number of observations, percentage of the population consuming the grain product being analyzed, mean intake rate, and standard error of the mean intake rate were calculated for total grains and selected individual grain products. Percentiles of the intake rate distribution (i.e., 1st, 5th, 10th, 25th, 50th, 75th, 90th, 95th, 99th, and 100th percentile were also provided for total grains. Data were provided for the following age groups of children: birth to <1 year, 1 to <2 years, 3 to <5 years, 6 to <12 years, and 13 to <19 years. Because these data were developed for use in U.S. EPA's pesticide registration program, the age groups used are slightly different than those recommended in U.S. EPA's *Guidance on Selecting Age Groups for Monitoring and Assessing Childhood Exposures to Environmental Contaminants* (U.S. EPA, 2005).

Tables 12-3 presents as-consumed per capita intake data for total grains in g/kg-day; as-consumed consumer only intake data for total grains in g/kg-day are provided in Table 12-4. Table 12-5 provides per capita intake data for individual grain products and Table 12-6 provides consumer only intake data for individual grain products.

It should be noted that the distribution of average daily intake rates generated using short-term data (e.g., 2-day) do not necessarily reflect the long-term distribution of average daily intake rates. The distributions generated from short-term and long-term data will differ to the extent that each individual's intake varies from day to day; the distributions will be similar to the extent that individuals' intakes are constant from day to day. However, for broad categories of foods (e.g., total grains) that are eaten on a daily basis throughout the year, the short-term distribution may be a reasonable approximation of the true long-term distribution, although it will show somewhat more variability. In this chapter, distributions are provided only for total grains. Because of the increased variability of the short-term

distribution, the short-term upper percentiles shown here may overestimate the corresponding percentiles of the long-term distribution. For individual grains, only the mean, standard error, and percent consuming are provided.

The strengths of U.S. EPA's analysis are that it provides distributions of intake rates for various age groups of children, normalized by body weight. The analysis uses the 1994-96, 1998 CSFII data set which was designed to be representative of the U.S. population. The data set includes four years of intake data combined, and is based on a two-day survey period. As discussed above, short-term dietary data may not accurately reflect long-term eating patterns and may under-represent infrequent consumers of a given food. This is particularly true for the tails (extremes) of the distribution of food intake. Also, the analysis was conducted using slightly different age groups than those recommended in U.S. EPA's *Guidance on Selecting Age Groups for Monitoring and Assessing Childhood Exposures to Environmental Contaminants* (U.S. EPA, 2005). However, given the similarities in the age groups used, the data should provide suitable intake estimates for the age groups of interest.

### **12.3.2 Relevant Grain Intake Studies**

#### **12.3.2.1 USDA, 1999 - Food and Nutrient Intakes by Children 1994-96, 1998, Table Set 17**

USDA (1999) calculated national probability estimates of food and nutrient intake by children based on all 4 years of the CSFII (1994-96 and 1998) for children age 9 years and under, and on CSFII 1994-96 only for individuals age 10 years and over. Sample weights were used to adjust for non-response, to match the sample to the U.S. population in terms of demographic characteristics, and to equalize intakes over the 4 quarters of the year and the 7 days of the week. A total of 503 breast-fed children were excluded from the estimates, but both consumers and non-consumers were included in the analysis.

USDA (1999) provided data on the mean per capita quantities (grams) of various food products/groups consumed per individual for one day, and the percent of individuals consuming those foods in one day of the survey. Tables 12-7 and 12-8 present data on the mean quantities (grams) of grain products consumed per individual for one day, and the



percentage of survey individuals consuming grain products that survey day. Data on mean intakes or mean percentages are based on respondents' day-1 intakes.

The advantages of USDA (1999) study is that it uses the 1994-96, 98 CSFII data set, which includes four years of intake data, combined, and includes the supplemental data on children. These data are expected to be generally representative of the U.S. population and they include data on a wide variety of grain products. The data set is one of a series of USDA data sets that are publicly available. One limitation of this data set is that it is based on a one-day, and short-term dietary data may not accurately reflect long-term eating patterns. Other limitations of this study are that it only provides mean values of food intake rates, consumption is not normalized by body weight, and presentation of results is not consistent with U.S. EPA's recommended age groups.

**12.3.2.2 *Smiciklas-Wright et al., 2002 - Foods Commonly Eaten in the United States: Quantities Consumed per Eating Occasion and in a Day, 1994-1996***

Using data gathered in the 1994-96 USDA CSFII, Smiciklas-Wright et al. (2002) calculated distributions for the quantities of grain products consumed per eating occasion by members of the U.S. population (i.e., serving sizes). The estimates of serving size are based on data obtained from 14,262 respondents, ages 2 and above, who provided 2 days of dietary intake information. A total of 4,939 of these respondents were children, ages 2 to 19 years of age. Only dietary intake data from users of the specified food were used in the analysis (i.e., consumers only data).

Table 12-9 presents serving size data for selected grain products. These data are presented on an as-consumed basis (grams) and represent the quantity of grain products consumed per eating occasion. These estimates may be useful for assessing acute exposures to contaminants in specific foods, or other assessments where the amount consumed per eating occasion is necessary. Only the mean and standard deviation serving size data and percent of the population consuming the food during the 2-day survey period are presented in this handbook. Percentiles of serving sizes

of the foods consumed by these age groups of the U.S. population can be found in Smiciklas-Wright et al. (2002).

The advantages of using these data are that they were derived from the USDA CSFII and are representative of the U.S. population. The analysis conducted by Smiciklas-Wright et al. (2002) accounted for individual foods consumed as ingredients of mixed foods. Mixed foods were disaggregated via recipe files so that the individual ingredients could be grouped together with similar foods that were reported separately. Thus, weights of foods consumed as ingredients were combined with weights of foods reported separately to provide a more thorough representation of consumption. However, it should be noted that since the recipes for the mixed foods consumed were not provided by the respondents, standard recipes were used. As a result, the estimates of quantity consumed for some food types are based on assumptions about the types and quantities of ingredients consumed as part of mixed foods. This study used data from the 1994 to 1996 CSFII; data from the 1998 children's supplement were not included.

**12.3.2.3 *Fox et al., 2004 - Feeding Infants and Toddlers study: What Foods Are Infants and Toddlers Eating***

Fox et al. (2004) used data from the Feeding Infants and Toddlers study (FITS) to assess food consumption patterns in infants and toddlers. The FITS was sponsored by Gerber Products Company and was conducted to obtain current information on food and nutrient intakes of children, ages 4 to 24 months old, in the 50 states and the District of Columbia. The FITS is described in detail in Devaney et al. (2004). FITS was based on a random sample of 3,022 infants and toddlers for which dietary intake data were collected by telephone from their parents or caregivers between March and July 2002. An initial recruitment and household interview was conducted, followed by an interview to obtain information on intake based on 24-hour recall. The interview also addressed growth, development and feeding patterns. A second dietary recall interview was conducted for a subset of 703 randomly selected respondents. The study over-sampled children in the 4 to 6 and 9 to 11 months age groups; sample weights were adjusted for non-response,



---

**Chapter 12 - Intake of Grain Products**

---

over sampling, and under coverage of some subgroups. The response rate for the FITS was 73 percent for the recruitment interview. Of the recruited households, there was a response rate of 94 percent for the dietary recall interviews (Devaney et al., 2004). The characteristics of the FITS study population is shown in Table 12-10.

Fox et al. (2004) analyzed the first set of 24-hour recall data collected from all study participants. For this analysis, children were grouped into six age categories: 4 to 6 months, 7 to 8 months, 9 to 11 months, 12 to 14 months, 15 to 18 months, and 19 to 24 months. Table 12-11 provides the percentage of infants and toddlers consuming different types of grains or grain products at least once in a day. The percentages of children eating any type of grain or grain product ranged from 65.8 percent for 4 to 6 month olds to 99.2 percent for 19 to 24 month olds.

The advantages of this study were that the study population represents the U.S. population and the sample size was large. One limitation of the analysis done by Fox et al. (2004) is that only frequency data were provided; no information on actual intake rates was included. In addition, Devaney et al (2004) noted several limitations associated with the FITS data. For the FITS, a commercial list of infants and toddlers was used to obtain the sample used in the study. Since many of the household could not be located and did not have children in the target population, a lower response rate than would have occurred in a true national sample was obtained (Devaney et al., 2004). In addition, the sample was likely from a higher socioeconomic status when compared with all U.S. infants in this age group (4 to 24 months old) and the use of a telephone survey may have omitted lower-income households without telephones (Devaney et al., 2004).

**12.3.2.4 Ponza et al., 2004 - Nutrient Food Intakes and Food Choices of Infants and Toddlers Participating in WIC**

Ponza et al. (2004) conducted a study using selected data from the FITS to assess feeding patterns, food choices and nutrient intake of infants and toddlers participating in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). Ponza et al. (2004) evaluated FITS data for the following age groups: 4 to 6 months (N = 862), 7 to 11

months (N = 1,159) and 12 to 24 months (N= 996). The total sample size described by WIC participants and non-participants is shown in Table 12-12.

The foods consumed were analyzed by tabulating the percentage of infants who consumed specific foods/food groups per day (Ponza et al., 2004). Weighted data were used in all of the analyses used in the study (Ponza et al., 2004). Table 12-12 presents the demographic data for WIC participants and non-participants. Table 12-13 provides information on the food choices for the infants and toddlers studied. In general, there was little difference in grain product choices among WIC participants and non-participants, except for the 7 to 11 months age category (Table 12-13). Nonparticipants, ages 7 to 11 months, were more likely to eat non-infant cereals than WIC participants.

An advantage of this study is that it had a relatively large sample size and was representative of the U.S. general population of infants and children. A limitation of the study is that intake values for foods were not provided. Other limitations are those associated with the FITS data, as described previously in Section 12.3.2.3.

**12.3.2.5 Mennella et al., 2006 - Feeding Infants and Toddlers Study: The Types of Foods Fed to Hispanic Infants and Toddlers**

Menella et al. (2006) investigated the types of food and beverages consumed by Hispanic infants and toddlers in comparison to the non-Hispanic infants and toddlers in the United States. The FITS 2002 data for children between 4 and 24 months of age were used for the study. The data represent a random sample of 371 Hispanic and 2,367 non-Hispanic infants and toddlers (Menella et al., 2006). Menella et al. (2006) grouped the infants as follows: 4 to 5 months (N = 84 Hispanic; 538 non-Hispanic), 6 to 11 months (N = 163 Hispanic and 1,228 non-Hispanic), and 12 to 24 months (N = 124 Hispanic and 871 non-Hispanic) of age.

Table 12-14 provides the percentage of Hispanic and non-Hispanic infants and toddlers consuming grain products. In most instances the percentages consuming the different types are similar. However, 6 to 11 month old Hispanic children were more likely to eat rice and pasta than non-Hispanic children in this age groups.

The advantage of the study is that it



Chapter 12 - Intake of Grain Products

provides information on food preferences for Hispanic and non-Hispanic infants and toddlers. A limitation is that the study did not provide food intake data, but provided frequency of use data instead. Other limitations are those noted previously in Section 12.3.2.3 for the FITS data.

**12.3.2.6 Fox et al., 2006 - Average Portion of Foods Commonly Eaten by Infants and Toddlers in the United States**

Fox et al. (2006) estimated average portion sizes consumed per eating occasion by children 4 to 24 months of age who participated in the FITS. The FITS is a cross-sectional study designed to collect and analyze data on feeding practices, food consumption, and usual nutrient intake of U.S. infants and toddlers and is described in Section 12.3.2.3 of this chapter. It included a stratified random sample of 3,022 children between 4 and 24 months of age.

Using the 24-hour recall data, Fox et al. (2006) derived average portion sizes for six major food groups, including breads and grains. Average portion sizes for select individual foods within these major groups were also estimated. For this analysis, children were grouped into six age categories: 4 to 5 months, 6 to 8 months, 9 to 11 months, 12 to 14 months, 15 to 18 months, and 19 to 24 months. Tables 12-15 and 12-16 present the average portion sizes for grain products for infants and toddlers, respectively.

**12.4 CONVERSION BETWEEN WET AND DRY WEIGHT INTAKE RATES**

The intake data presented in this chapter are reported in units of wet weight (i.e., as-consumed or uncooked weight of grain products consumed per day or per eating occasion). However, data on the concentration of contaminants in grain products may be reported in units of either wet or dry weight.(e.g., mg contaminant per gram dry-weight of grain products.) It is essential that exposure assessors be aware of this difference so that they may ensure consistency between the units used for intake rates and those used for concentration data (i.e., if the contaminant concentration is measured in dry weight of grain products, then the dry weight units should be used for their intake values).

If necessary, wet weight (e.g., as

consumed) intake rates may be converted to dry weight intake rates using the moisture content percentages presented in Table 12-17 and the following equation:

$$IR_{dw} = IR_{ww} \left[ \frac{100 - W}{100} \right] \quad (\text{Eqn. 12-1})$$

where:

- IR<sub>dw</sub> = dry weight intake rate;
- IR<sub>ww</sub> = wet weight intake rate; and
- W = percent water content

Alternatively, dry weight residue levels in grain products may be converted to wet weight residue levels for use with wet weight (e.g., as-consumed) intake rates as follows:

$$C_{ww} = C_{dw} \left[ \frac{100 - W}{100} \right] \quad (\text{Eqn. 12-2})$$

where:

- C<sub>ww</sub> = wet weight intake rate;
- C<sub>dw</sub> = dry weight intake rate; and
- W = percent water content.

The moisture data presented in Table 12-17 are for selected grain products taken from USDA (2007).

**12.5 REFERENCES FOR CHAPTER 12**

Devaney, B.; Kalb, L.; Briefel, R.; Zavitsky-Novak, T.; Clusen, N.; Ziegler, P. (2004) Feeding infants and toddlers study: overview of the study design. J Am Diet Assoc 104(Suppl 1): S8-S13.

Fox, M.K.; Pac, S.; Devaney, B.; Jankowski, L. (2004) Feeding Infants and Toddlers Study: what foods are infants and toddlers eating. J Am Diet Assoc 104 (Suppl): S22-S30.

Fox, M.K.; Reidy, K.; Karwe, V.; Ziegler, P. (2006) Average portions of foods commonly eaten by infants and toddlers in the United States. J Am Diet Assoc 106 (Suppl 1): S66-S76.

Goldman, L. (1995) Children - unique and vulnerable. Environmental risks facing children and



---

*Chapter 12 - Intake of Grain Products*

---

- recommendations for response. Environ Health Perspect 103(6):13-17.
- Mennella, J.; Ziegler, P.; Briefel, R.; Novak, T. (2006) Feeding Infants and Toddlers Study: the types of foods fed to Hispanic infants and toddlers. J Am Diet Assoc 106 (Suppl 1): S96.
- Ponza, M.; Devaney, B.; Ziegler, P.; Reidy, K.; Squatrito, C. (2004) Nutrient intakes and food choices of infants and toddlers participating in WIC. J Am Diet Assoc 104 (Suppl): S71-S79.
- Smiciklas-Wright, H.; Mitchell, D.C.; Mickle, S.J.; Cook, A.J.; Goldman, J.D. (2002) Foods commonly eaten in the United States: Quantities consumed per eating occasion and in a day, 1994-1996. U.S. Department of Agriculture NFS Report No. 96-5, pre-publication version, 252 pp.
- USDA. (1999) Food and nutrient intakes by children 1994-96, 1998: Table Set 17. Beltsville, MD: Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture.
- USDA. (2007) USDA National Nutrient Database for Standard Reference, Release 20. Agricultural Research Service, Nutrient Data Laboratory Home Page, <http://www.ars.usda.gov/ba/bhnrc/ndl>
- U.S. EPA. (2005) Guidance on Selecting Age Groups for Monitoring and Assessing Childhood Exposures to Environmental Contaminants. U.S. Environmental Protection Agency, Washington, D.C., EPA/630/P-03/003F.



Table 12-3. Per Capita Intake of Total Grains (g/kg-day as consumed)

| Age Group       | N     | Percent Consuming  | Mean | SE   | Percentiles     |                 |                  |                  |                  |                  |                  |                  |                  |                   |
|-----------------|-------|--|------|------|-----------------|-----------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|
|                 |       |  |      |      | 1 <sup>st</sup> | 5 <sup>th</sup> | 10 <sup>th</sup> | 25 <sup>th</sup> | 50 <sup>th</sup> | 75 <sup>th</sup> | 90 <sup>th</sup> | 95 <sup>th</sup> | 99 <sup>th</sup> | 100 <sup>th</sup> |
| Birth to 1 year | 1,486 | 70.5   | 2.5  | 0.1  | 0.0             | 0.0             | 0.0              | 0.0              | 1.6              | 3.8              | 6.2              | 8.6              | 12.7             | 26.3              |
| 1 to 2 years    | 2,096 | 99.8   | 6.4  | 0.1  | 1.1             | 2.1             | 2.8              | 4.2              | 5.9              | 7.9              | 10.4             | 12.1             | 16.8             | 31.6              |
| 3 to 5 years    | 4,391 | 100.0  | 6.3  | 0.1  | 1.8             | 2.6             | 3.2              | 4.3              | 5.9              | 7.8              | 9.9              | 11.5             | 15.6             | 27.0              |
| 6 to 12 years   | 2,089 | 100.0  | 4.3  | 0.1  | 0.9             | 1.7             | 2.0              | 2.8              | 4.0              | 5.4              | 7.0              | 8.2              | 11.1             | 17.2              |
| 13 to 19 years  | 1,222 | 100.0  | 2.5  | 0.05 | 0.4             | 0.8             | 1.1              | 1.5              | 2.3              | 3.1              | 4.4              | 5.1              | 7.9              | 12.4              |
| N               |       | = Sample size.   |      |      |                 |                 |                  |                  |                  |                  |                  |                  |                  |                   |
| SE              |       | = Standard error.  |      |      |                 |                 |                  |                  |                  |                  |                  |                  |                  |                   |
| Source:         |       | Based on unpublished U.S. EPA analysis of 1994-96, 1998 CSFII. |      |      |                 |                 |                  |                  |                  |                  |                  |                  |                  |                   |

Table 12-4. Consumer Only Intake of Total Grains (g/kg-day as consumed)

| Age Group       | N     | Mean   | SE   | Percentiles     |                 |                  |                  |                  |                  |                  |                  |                  |                   |  |
|-----------------|-------|--|------|-----------------|-----------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|--|
|                 |       |  |      | 1 <sup>st</sup> | 5 <sup>th</sup> | 10 <sup>th</sup> | 25 <sup>th</sup> | 50 <sup>th</sup> | 75 <sup>th</sup> | 90 <sup>th</sup> | 95 <sup>th</sup> | 99 <sup>th</sup> | 100 <sup>th</sup> |  |
| Birth to 1 year | 1,048 | 3.6  | 0.1  | 0.1             | 0.3             | 0.6              | 1.4              | 2.8              | 4.8              | 7.4              | 9.2              | 13.4             | 26.3              |  |
| 1 to 2 years    | 2,092 | 6.4  | 0.1  | 1.2             | 2.1             | 2.8              | 4.2              | 5.9              | 7.9              | 10.4             | 12.1             | 16.8             | 31.6              |  |
| 3 to 5 years    | 4,389 | 6.3  | 0.1  | 1.8             | 2.6             | 3.2              | 4.3              | 5.9              | 7.8              | 9.9              | 11.5             | 15.6             | 27.0              |  |
| 6 to 12 years   | 2,089 | 4.3  | 0.1  | 0.9             | 1.7             | 2.0              | 2.8              | 4.0              | 5.4              | 7.0              | 8.2              | 11.1             | 17.2              |  |
| 13 to 19 years  | 1,222 | 2.5  | 0.05 | 0.4             | 0.8             | 1.1              | 1.5              | 2.3              | 3.1              | 4.4              | 5.1              | 7.9              | 12.4              |  |
| N               |       | = Sample size.   |      |                 |                 |                  |                  |                  |                  |                  |                  |                  |                   |  |
| SE              |       | = Standard error.  |      |                 |                 |                  |                  |                  |                  |                  |                  |                  |                   |  |
| Source:         |       | Based on unpublished U.S. EPA analysis of 1994-96, 1998 CSFII. |      |                 |                 |                  |                  |                  |                  |                  |                  |                  |                   |  |



*Chapter 12 - Intake of Grain Products*

| Table 12-5. Per Capita Intake of Individual Grain Products (g/kg-day as consumed) |       |                   |      |      |                   |      |      |
|---|-------|-------------------|------|------|-------------------|------|------|
| Age Group   | N     | Cereal            |      |      | Rice              |      |      |
|   |       | Percent Consuming | Mean | SE   | Percent Consuming | Mean | SE   |
| Birth to 1 year   | 1,486 | 74.6              | 4.0  | 0.14 | 60.2              | 0.74 | 0.04 |
| 1 to 2 years  | 2,096 | 99.8              | 8.4  | 0.08 | 86.4              | 0.57 | 0.03 |
| 3 to 5 years  | 4,391 | 100.0             | 8.7  | 0.07 | 87.9              | 0.50 | 0.03 |
| 6 to 12 years   | 2,089 | 100.0             | 6.2  | 0.06 | 88.0              | 0.35 | 0.02 |
| 13 to 19 years  | 1,222 | 100.0             | 4.1  | 0.06 | 85.8              | 0.27 | 0.02 |

N = Sample size.  
SE = Standard error.

Source: Based on unpublished U.S. EPA analysis of 1994-96, 1998 CSFII .

| Table 12-6. Consumer Only Intake of Individual Grain Products (g/kg-day as consumed) |        |      |      |       |      |      |
|--|--------|------|------|-------|------|------|
| Age Group  | Cereal |      |      | Rice  |      |      |
|  | N      | Mean | SE   | N     | Mean | SE   |
| Birth to 1 year  | 1,116  | 5.4  | 0.16 | 900   | 1.23 | 0.07 |
| 1 to 2 years   | 2,092  | 8.4  | 0.08 | 1,819 | 0.67 | 0.04 |
| 3 to 5 years   | 4,389  | 8.7  | 0.07 | 3,869 | 0.57 | 0.03 |
| 6 to 12 years  | 2,089  | 6.2  | 0.06 | 1,847 | 0.40 | 0.02 |
| 13 to 19 years   | 1,222  | 4.1  | 0.06 | 1,038 | 0.31 | 0.03 |

N = Sample size.  
SE = Standard error.

Source: Based on unpublished U.S. EPA analysis of 1994-96, 1998 CSFII .



Table 12-7. Mean Quantities of Grain Products Consumed Daily by Sex and Age, Per Capita (g/day)

| Age Group   | Sample Size | Total | Yeast, breads, and rolls | Cereals and Pasta |                      |      | Quick breads, pancakes, French toast | Cakes, cookies, pastries, pies | Crackers, popcorn, pretzels, corn chips | Mixtures, mainly grain |       |
|---|-------------|-------|--------------------------|-------------------|----------------------|------|--------------------------------------|--------------------------------|---|------------------------|-------|
|   |             |       |                          | Total             | Ready-to-eat cereals | Rice |                                      |                                |   |                        | Pasta |
| Males and Females   |             |       |                          |                   |                      |      |                                      |                                |   |                        |       |
| Under 1 year  | 1,126       | 56    | 2                        | 2                 | 1                    | 2    | 1 <sup>a</sup>                       | 1                              | 3                                       | 1                      | 20    |
| 1 year  | 1,016       | 192   | 16                       | 16                | 11                   | 9    | 9                                    | 9                              | 16                                      | 7                      | 87    |
| 2 years   | 1,102       | 219   | 26                       | 26                | 16                   | 15   | 12                                   | 12                             | 22                                      | 9                      | 87    |
| 1 to 2 years  | 2,118       | 206   | 21                       | 21                | 13                   | 12   | 11                                   | 11                             | 19                                      | 8                      | 87    |
| 3 years   | 1,831       | 242   | 30                       | 30                | 19                   | 13   | 12                                   | 16                             | 23                                      | 11                     | 98    |
| 4 years   | 1,859       | 264   | 36                       | 36                | 22                   | 15   | 11                                   | 17                             | 30                                      | 13                     | 102   |
| 5 years   | 884         | 284   | 41                       | 41                | 24                   | 17   | 11                                   | 15                             | 33                                      | 13                     | 107   |
| 3 to 5 years  | 4,574       | 264   | 36                       | 36                | 22                   | 15   | 11                                   | 16                             | 29                                      | 12                     | 102   |
| 5 years and under   | 7,818       | 219   | 27                       | 27                | 16                   | 13   | 10                                   | 12                             | 22                                      | 9                      | 87    |
| Males   |             |       |                          |                   |                      |      |                                      |                                |   |                        |       |
| 6 to 9 years  | 787         | 310   | 45                       | 77                | 28                   | 18   | 15                                   | 23                             | 39                                      | 16                     | 109   |
| 6 to 11 years   | 1,031       | 318   | 46                       | 80                | 31                   | 16   | 18                                   | 23                             | 40                                      | 15                     | 115   |
| 2 to 19 years   | 737         | 406   | 54                       | 82                | 29                   | 27   | 17                                   | 26                             | 49                                      | 19                     | 175   |
| Females   |             |       |                          |                   |                      |      |                                      |                                |   |                        |       |
| 6 to 9 years  | 704         | 284   | 43                       | 61                | 21                   | 12   | 15                                   | 18                             | 42                                      | 13                     | 107   |
| 6 to 11 years   | 969         | 280   | 43                       | 62                | 20                   | 14   | 15                                   | 19                             | 42                                      | 14                     | 101   |
| 12 to 19 years  | 732         | 306   | 40                       | 67                | 17                   | 19   | 22                                   | 15                             | 37                                      | 15                     | 132   |
| Males and Females   |             |       |                          |                   |                      |      |                                      |                                |   |                        |       |
| 9 years and under   | 9,309       | 250   | 34                       | 64                | 20                   | 14   | 12                                   | 16                             | 30                                      | 12                     | 96    |
| 19 years and under  | 11,287      | 298   | 40                       | 69                | 22                   | 17   | 15                                   | 18                             | 36                                      | 14                     | 120   |
| <sup>a</sup> Estimate is not statistically reliable due to small sample size reporting intake.<br>Note: Consumption amounts shown are representative of the first day of each participant's survey response.<br>Source: USDA, 1999. |             |       |                          |                   |                      |      |                                      |                                |   |                        |       |





Table 12-8. Percentage of Individuals Consuming Grain Products, by Sex and Age (%)

| Age Group   | Sample Size | Total             | Yeast, breads, and rolls | Cereals and Pasta |                      |      | Quick breads, pancakes, French toast | Cakes, cookies, pastries, pies | Crackers, popcorn, pretzels, corn chips | Mixtures, mainly grain |       |
|---|-------------|-------------------|--------------------------|-------------------|----------------------|------|--------------------------------------|--------------------------------|---|------------------------|-------|
|   |             |                   |                          | Total             | Ready-to-eat cereals | Rice |                                      |                                |   |                        | Pasta |
| Males and Females   |             |                   |                          |                   |                      |      |                                      |                                |   |                        |       |
| Under 1 year  | 1,126       | 70.6              | 10.9                     | 62.8              | 9.1                  | 3.4  | 2.1                                  | 4.4                            | 16.5                                    | 10.3                   | 15.0  |
| 1 year  | 1,016       | 98.2 <sup>a</sup> | 48.4                     | 70.6              | 45.3                 | 11.3 | 9.4                                  | 23.0                           | 47.0                                    | 39.0                   | 47.8  |
| 2 years   | 1,102       | 99.0 <sup>a</sup> | 58.7                     | 71.1              | 51.9                 | 14.4 | 9.4                                  | 27.5                           | 46.6                                    | 37.9                   | 45.3  |
| 1 to 2 years  | 2,118       | 98.7              | 53.7                     | 70.9              | 48.7                 | 12.9 | 9.4                                  | 25.3                           | 46.8                                    | 38.4                   | 46.5  |
| 3 years   | 1,831       | 99.4 <sup>a</sup> | 64.1                     | 69.7              | 53.3                 | 11.1 | 8.6                                  | 28.8                           | 46.1                                    | 38.5                   | 49.0  |
| 4 years   | 1,859       | 99.5 <sup>a</sup> | 67.0                     | 69.1              | 54.8                 | 11.4 | 7.1                                  | 28.6                           | 52.3                                    | 39.4                   | 46.2  |
| 5 years   | 884         | 99.9 <sup>a</sup> | 69.2                     | 70.4              | 54.9                 | 11.4 | 6.8                                  | 25.2                           | 52.4                                    | 32.1                   | 47.4  |
| 3 to 5 years  | 4,574       | 99.6 <sup>a</sup> | 66.8                     | 69.7              | 54.3                 | 11.3 | 7.5                                  | 27.5                           | 50.3                                    | 36.7                   | 47.5  |
| 5 years and under   | 7,818       | 95.8              | 55.5                     | 69.3              | 46.9                 | 10.9 | 7.5                                  | 24.0                           | 45.0                                    | 34.1                   | 43.3  |
| Males   |             |                   |                          |                   |                      |      |                                      |                                |   |                        |       |
| 6 to 9 years  | 787         | 98.9 <sup>a</sup> | 69.8                     | 62.6              | 50.8                 | 10.5 | 7.4                                  | 28.1                           | 52.5                                    | 36.0                   | 44.5  |
| 6 to 11 years   | 1,031       | 99.0 <sup>a</sup> | 69.1                     | 64.0              | 52.4                 | 9.7  | 8.1                                  | 27.1                           | 52.3                                    | 33.8                   | 45.3  |
| 12 to 19 years  | 737         | 98.2 <sup>a</sup> | 62.7                     | 44.6              | 33.2                 | 10.0 | 5.9                                  | 24.4                           | 41.3                                    | 27.2                   | 46.2  |
| Females   |             |                   |                          |                   |                      |      |                                      |                                |   |                        |       |
| 6 to 9 years  | 704         | 99.7 <sup>a</sup> | 71.5                     | 61.2              | 47.6                 | 9.0  | 7.9                                  | 26.3                           | 57.1                                    | 38.3                   | 48.0  |
| 6 to 11 years   | 969         | 99.3 <sup>a</sup> | 71.0                     | 59.3              | 45.6                 | 9.4  | 7.1                                  | 27.1                           | 55.0                                    | 37.1                   | 45.7  |
| 12 to 19 years  | 732         | 97.6 <sup>a</sup> | 60.9                     | 45.9              | 30.3                 | 8.6  | 9.3                                  | 19.8                           | 40.6                                    | 30.9                   | 46.1  |
| Males and Females   |             |                   |                          |                   |                      |      |                                      |                                |   |                        |       |
| 9 years and under   | 9,309       | 97.2              | 61.6                     | 66.4              | 47.9                 | 10.5 | 7.6                                  | 25.3                           | 48.9                                    | 35.3                   | 44.4  |
| 19 years and under  | 11,287      | 97.6              | 62.4                     | 57.6              | 41.7                 | 9.9  | 7.6                                  | 24.2                           | 46.1                                    | 32.5                   | 45.1  |
| <sup>a</sup> Estimate is not statistically reliable due to small sample size reporting intake.<br>Note: Percentages shown are representative of the first day of each participant's survey response.<br>Source: USDA, 1999. |             |                   |                          |                   |                      |      |                                      |                                |   |                        |       |



Table 12-9. Quantity (as consumed) of Grain Products Consumed Per Eating Occasion and Percentage of Individuals Using These Foods in Two Days

| Food category               | Quantity consumed per eating occasion (grams) |      |              |                                |      |     |                   |                  |                 |                     |                  |                 |
|-----------------------------|---|------|--------------|--------------------------------|------|-----|-------------------|------------------|-----------------|---------------------|------------------|-----------------|
|                             | 2 to 5 years                                  |      |              | 6 to 11 years                  |      |     | 12 to 19 years    |                  |                 |                     |                  |                 |
|                             | Male and Female<br>(N = 2,109)                |      |              | Male and Female<br>(N = 1,432) |      |     | Male<br>(N = 696) |                  |                 | Female<br>(N = 702) |                  |                 |
|                             | PC  | Mean | SEM          | PC                             | Mean | SEM | PC                | Mean             | SEM             | PC                  | Mean             | SEM             |
| White bread                 | 66.9  | 34   | <sup>a</sup> | 67.1                           | 42   | 1   | 61.3              | 56               | 1               | 57.9                | 47               | 1               |
| Whole grain and wheat bread | 24.3  | 37   | 1            | 20.5                           | 44   | 1   | 14.5              | 60               | 2               | 17.6                | 53               | 2               |
| Rolls                       | 40.0  | 39   | 1            | 53.5                           | 48   | 1   | 61.9              | 69               | 2               | 48.8                | 51               | 1               |
| Biscuits                    | 8.3   | 38   | 2            | 9.7                            | 48   | 3   | 12.2              | 72               | 4               | 10.3                | 55               | 4               |
| Tortillas                   | 14.6  | 32   | 2            | 16.4                           | 47   | 2   | 22.9              | 76               | 5               | 20.1                | 56               | 3               |
| Quickbreads and muffins     | 9.6   | 55   | 4            | 9.6                            | 67   | 5   | 11.0              | 125              | 12              | 11.0                | 79               | 10              |
| Doughnuts and sweet rolls   | 11.3  | 59   | 2            | 13.4                           | 69   | 2   | 17.3              | 102              | 12              | 13.8                | 78               | 5               |
| Crackers                    | 25.4  | 17   | 1            | 17.2                           | 26   | 2   | 10.6              | 39               | 5               | 14.2                | 26               | 3               |
| Cookies                     | 51.0  | 28   | 1            | 46.7                           | 37   | 2   | 29.0              | 53               | 3               | 31.8                | 42               | 2               |
| Cake                        | 14.6  | 70   | 3            | 19.7                           | 79   | 4   | 15.1              | 99               | 9               | 15.5                | 85               | 8               |
| Pie                         | 2.9   | 76   | 8            | 5.6                            | 116  | 8   | 6.6               | 188              | 15              | 4.8                 | 138 <sup>b</sup> | 12 <sup>b</sup> |
| Pancake and waffles         | 19.1  | 49   | 1            | 21.5                           | 77   | 3   | 13.5              | 96               | 6               | 8.2                 | 74               | 5               |
| Cooked cereal               | 16.8  | 211  | 10           | 9.0                            | 245  | 14  | 5.2               | 310 <sup>b</sup> | 29 <sup>b</sup> | 6.0                 | 256 <sup>b</sup> | 31 <sup>b</sup> |
| Oatmeal                     | 10.4  | 221  | 9            | 5.7                            | 256  | 19  | 2.4               | 348 <sup>b</sup> | 45 <sup>b</sup> | 2.3                 | 321 <sup>b</sup> | 40 <sup>b</sup> |
| Ready-to-eat cereal         | 72.9  | 33   | 1            | 67.3                           | 47   | 1   | 45.6              | 72               | 3               | 46.3                | 52               | 2               |
| Corn Flakes                 | 11.2  | 33   | 2            | 13.1                           | 42   | 2   | 10.4              | 62               | 4               | 8.7                 | 49               | 4               |
| Toasted Oat Rings           | 20.6  | 30   | 1            | 12.5                           | 45   | 2   | 7.3               | 62               | 5               | 8.1                 | 42               | 3               |
| Rice                        | 29.6  | 84   | 3            | 24.6                           | 124  | 6   | 24.2              | 203              | 10              | 28.8                | 157              | 10              |
| Pasta                       | 49.4  | 90   | 3            | 41.4                           | 130  | 5   | 33.4              | 203              | 9               | 37.8                | 155              | 9               |
| Macaroni and cheese         | 17.8  | 159  | 8            | 13.2                           | 217  | 13  | 7.5               | 408              | 46              | 10.7                | 260              | 30              |
| Spaghetti with tomato sauce | 16.8  | 242  | 11           | 11.5                           | 322  | 18  | 10.1              | 583              | 46              | 8.5                 | 479              | 51              |
| Pizza                       | 23.7  | 86   | 3            | 32.8                           | 108  | 6   | 39.6              | 205              | 13              | 30.5                | 143              | 8               |
| Corn chips                  | 19.6  | 29   | 2            | 25.6                           | 33   | 2   | 26.9              | 58               | 5               | 25.1                | 44               | 3               |
| Popcorn                     | 11.6  | 20   | 1            | 12.7                           | 31   | 2   | 7.8               | 54               | 5               | 10.5                | 37               | 4               |

<sup>a</sup> Indicates a SEM value that is greater than 0 but less than 0.5.  
<sup>b</sup> Indicates a statistic that is potentially unreliable because of small sample size or large coefficient of variation.  
 PC = Percent consuming at least once in 2 days.  
 SEM = Standard error of the mean.

Source: Smiciklas-Wright et al., 2002 (based on 1994-1996 CSFII data).



**Chapter 12 - Intake of Grain Products**

| Table 12-10. Characteristics of the FITS Sample Population                     |             |                      |
|--|-------------|----------------------|
|  | Sample Size | Percentage of Sample |
| <b>Gender</b>  |             |                      |
| Male   | 1,549       | 51.3                 |
| Female   | 1,473       | 48.7                 |
| <b>Age of Child</b>  |             |                      |
| 4 to 6 months  | 862         | 28.5                 |
| 7 to 8 months  | 483         | 16.0                 |
| 9 to 11 months   | 679         | 22.5                 |
| 12 to 14 months  | 374         | 12.4                 |
| 15 to 18 months  | 308         | 10.2                 |
| 19 to 24 months  | 316         | 10.4                 |
| <b>Child's Ethnicity</b>   |             |                      |
| Hispanic or Latino   | 367         | 12.1                 |
| Non-Hispanic or Latino   | 2,641       | 87.4                 |
| Missing  | 14          | 0.5                  |
| <b>Child's Race</b>  |             |                      |
| White  | 2,417       | 80.0                 |
| Black  | 225         | 7.4                  |
| Other  | 380         | 12.6                 |
| <b>Urbanicity</b>  |             |                      |
| Urban  | 1,389       | 46.0                 |
| Suburban   | 1,014       | 33.6                 |
| Rural  | 577         | 19.1                 |
| Missing  | 42          | 1.3                  |
| <b>Household Income</b>  |             |                      |
| Under \$10,000   | 48          | 1.6                  |
| \$10,000 to \$14,999   | 48          | 1.6                  |
| \$15,000 to \$24,999   | 221         | 7.3                  |
| \$25,000 to \$34,999   | 359         | 11.9                 |
| \$35,000 to \$49,999   | 723         | 23.9                 |
| \$50,000 to \$74,999   | 588         | 19.5                 |
| \$75,000 to \$99,999   | 311         | 10.3                 |
| \$100,000 and Over   | 272         | 9.0                  |
| Missing  | 452         | 14.9                 |
| <b>Receives WIC</b>  |             |                      |
| Yes  | 821         | 27.2                 |
| No   | 2,196       | 72.6                 |
| Missing  | 5           | 0.2                  |
| <b>Sample Size (Unweighted)</b>  | 3,022       | 100.0                |
| WIC = Special Supplemental Nutrition Program for Women, Infants, and Children. |             |                      |
| Source: Devaney et al., 2004.  |             |                      |



Table 12-11. Percentage of Infants and Toddlers Consuming Different Types of Grain Products

| Food Group/Food                   | Percentage of Infants and Toddlers Consuming at Least Once in a Day            |               |                |                 |                 |                 |
|-----------------------------------|--|---------------|----------------|-----------------|-----------------|-----------------|
|                                   | 4 to 6 months  | 7 to 8 months | 9 to 11 months | 12 to 14 months | 15 to 18 months | 19 to 24 months |
| <b>Any Grain or Grain Product</b> | 65.8   | 91.5          | 97.5           | 97.8            | 98.6            | 99.2            |
| Infant Cereals                    | 64.8   | 81.2          | 63.8           | 23.9            | 9.2             | 3.1             |
| Noninfant Cereals <sup>a</sup>    | 0.6  | 18.3          | 44.3           | 58.9            | 60.5            | 51.9            |
| Not Pre-sweetened                 | 0.5  | 17.0          | 37.0           | 44.5            | 40.6            | 31.9            |
| Pre-sweetened <sup>b</sup>        | 0.0  | 1.8           | 9.0            | 17.7            | 26.4            | 22.7            |
| Breads and Rolls <sup>c</sup>     | 0.6  | 9.9           | 24.5           | 47.3            | 52.7            | 53.1            |
| Crackers, Pretzels, Rice Cakes    | 3.0  | 16.2          | 33.4           | 45.2            | 46.4            | 44.7            |
| Cereal or Granola Bars            | 0.0  | 1.1           | 3.4            | 9.8             | 10.0            | 9.7             |
| Pancakes, Waffles, French Toast   | 0.1  | 0.8           | 7.5            | 15.1            | 16.1            | 15.4            |
| Rice and Pasta <sup>d</sup>       | 2.3  | 4.5           | 18.2           | 26.2            | 39.0            | 35.9            |
| Other                             | 0.2  | 0.1           | 2.7            | 2.8             | 2.5             | 4.5             |
| <b>Grains in Mixed Dishes</b>     | 0.4  | 5.3           | 24.1           | 48.3            | 52.0            | 55.1            |
| Sandwiches                        | 0.0  | 1.1           | 8.6            | 21.5            | 25.8            | 25.8            |
| Burrito, Taco, Enchilada, Nachos  | 0.0  | 0.0           | 1.0            | 4.5             | 2.8             | 2.1             |
| Macaroni and Cheese               | 0.2  | 1.6           | 4.9            | 14.6            | 15.0            | 15.0            |
| Pizza                             | 0.1  | 0.7           | 2.2            | 6.8             | 9.0             | 9.4             |
| Pot Pie/Hot Pocket                | 0.0  | 0.9           | 0.5            | 2.0             | 1.0             | 1.8             |
| Spaghetti, Ravioli, Lasagna       | 0.1  | 1.8           | 9.9            | 15.3            | 12.1            | 8.8             |
| <sup>a</sup>                      | Includes both ready-to-eat and cooked cereals.                                 |               |                |                 |                 |                 |
| <sup>b</sup>                      | Defined as cereals with more than 21.1 g sugar per 100 g.                      |               |                |                 |                 |                 |
| <sup>c</sup>                      | Does not include bread in sandwiches. Sandwiches are included in mixed dishes. |               |                |                 |                 |                 |
| <sup>d</sup>                      | Does not include rice or pasta in mixed dishes.                                |               |                |                 |                 |                 |
| Source:                           | Fox et al., 2004.  |               |                |                 |                 |                 |



Chapter 12 - Intake of Grain Products

Table 12-12. Characteristics of WIC Participants and Nonparticipants<sup>a</sup> (Percentages)

|  | Infants 4 to 6 months |                 | Infants 7 to 11 months |                 | Toddlers 12 to 24 months |                 |
|--|-----------------------|-----------------|------------------------|-----------------|--------------------------|-----------------|
|  | WIC Participant       | Non-participant | WIC Participant        | Non-participant | WIC Participant          | Non-participant |
| <b>Gender</b>                          |                       |                 |                        |                 |                          |                 |
| Male                                   | 55                    | 54              | 55                     | 51              | 57                       | 52              |
| Female                                 | 45                    | 46              | 45                     | 49              | 43                       | 48              |
| <b>Child's Ethnicity</b>               |                       | **              |                        | **              |                          | **              |
| Hispanic or Latino                     | 20                    | 11              | 24                     | 8               | 22                       | 10              |
| Non-Hispanic or Latino                 | 80                    | 89              | 76                     | 92              | 78                       | 89              |
| <b>Child's Race</b>                    |                       | **              |                        | **              |                          | **              |
| White                                  | 69                    | 84              | 63                     | 86              | 67                       | 84              |
| Black                                  | 15                    | 4               | 17                     | 5               | 13                       | 5               |
| Other                                  | 22                    | 11              | 20                     | 9               | 20                       | 11              |
| <b>Child In Day Care</b>               |                       |                 |                        | **              |                          | *               |
| Yes                                    | 39                    | 38              | 34                     | 46              | 43                       | 53              |
| No                                     | 61                    | 62              | 66                     | 54              | 57                       | 47              |
| <b>Age of Mother</b>                   |                       | **              |                        | **              |                          | **              |
| 14 to 19                               | 18                    | 1               | 13                     | 1               | 9                        | 1               |
| 20 to 24                               | 33                    | 13              | 38                     | 11              | 33                       | 14              |
| 25 to 29                               | 29                    | 29              | 23                     | 30              | 29                       | 26              |
| 30 to 34                               | 9                     | 33              | 15                     | 36              | 18                       | 34              |
| 35 or Older                            | 9                     | 23              | 11                     | 21              | 11                       | 26              |
| Missing                                | 2                     | 2               | 1                      | 1               | 0                        | 1               |
| <b>Mother's Education</b>              |                       | **              |                        | **              |                          | **              |
| 11 <sup>th</sup> Grade or Less         | 23                    | 2               | 15                     | 2               | 17                       | 3               |
| Completed High School                  | 35                    | 19              | 42                     | 20              | 42                       | 19              |
| Some Postsecondary                     | 33                    | 26              | 32                     | 27              | 31                       | 28              |
| Completed College                      | 7                     | 53              | 9                      | 51              | 9                        | 48              |
| Missing                                | 2                     | 1               | 2                      | 0               | 1                        | 2               |
| <b>Parent's Marital Status</b>         |                       | **              |                        | **              |                          | **              |
| Married                                | 49                    | 93              | 57                     | 93              | 58                       | 88              |
| Not Married                            | 50                    | 7               | 42                     | 7               | 41                       | 11              |
| Missing                                | 1                     | 1               | 1                      | 0               | 1                        | 1               |
| <b>Mother or Female Guardian Works</b> |                       |                 |                        | **              |                          | *               |
| Yes                                    | 46                    | 51              | 45                     | 60              | 55                       | 61              |
| No                                     | 53                    | 48              | 54                     | 40              | 45                       | 38              |
| Missing                                | 1                     | 1               | 1                      | 0               | 0                        | 1               |
| <b>Urbanicity</b>                      |                       | **              |                        | **              |                          | **              |
| Urban                                  | 34                    | 55              | 37                     | 50              | 35                       | 48              |
| Suburban                               | 36                    | 31              | 31                     | 34              | 35                       | 35              |
| Rural                                  | 28                    | 13              | 30                     | 15              | 28                       | 16              |
| Missing                                | 2                     | 1               | 2                      | 1               | 2                        | 2               |
| <b>Sample Size (Unweighted)</b>        | 265                   | 597             | 351                    | 808             | 205                      | 791             |

<sup>a</sup> X<sup>2</sup> test were conducted to test for statistical significance in the differences between WIC participants and non-participants within each age group for each variable. The results of X<sup>2</sup> test are listed next to the variable under the column labeled non-participants for each of the three age groups. \*P<0.05; \*\*P>0.01; non-participants significantly different from WIC participants on the variable.

WIC =Special Supplemental Nutrition Program for Women, Infants, and Children.

Source: Ponza et al., 2004.



Table 12-13. Food Choices for Infants and Toddlers by WIC Participation Status.

|   | Infants 4 to 6 months |                 | Infants 7 to 11 months |                 | Toddlers 12 to 24 months |                 |
|---|-----------------------|-----------------|------------------------|-----------------|--------------------------|-----------------|
|   | WIC Participant       | Non-participant | WIC Participant        | Non-participant | WIC Participant          | Non-participant |
| Infant Cereals  | 69.7                  | 62.5            | 74.7                   | 69.7            | 13.5                     | 9.2             |
| Noninfant Cereals, Total  | 0.9                   | 0.5             | 21.7                   | 38.5*           | 58.1                     | 56.0            |
| Not Pre-sweetened   | 0.5                   | 0.5             | 18.7                   | 32.9*           | 43.7                     | 36.3            |
| Pre-sweetened   | 0.0                   | 0.0             | 4.0                    | 6.9             | 17.7                     | 24.1            |
| Grains in Combination Foods   | 0.9                   | 0.1             | 18.8                   | 14.7            | 50.3                     | 52.9            |
| Sample Size (unweighted)  | 265                   | 597             | 351                    | 808             | 205                      | 791             |
| <p>* = P&lt;0.01 non-participants significantly different from WIC participants.<br/> WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.</p> <p>Source: Ponza et al., 2004.</p> |                       |                 |                        |                 |                          |                 |



Chapter 12 - Intake of Grain Products

Table 12-14. Percentage of Hispanic and Non-Hispanic Infants and Toddlers Consuming Different Types of Grain Products on A Given Day

|                                  | Age 4 to 5 months  |                         | Age 6 to 11 months  |                           | Age 12 to 24 months |                         |
|----------------------------------|--------------------|-------------------------|---------------------|---------------------------|---------------------|-------------------------|
|                                  | Hispanic<br>(n=84) | Non-Hispanic<br>(n=538) | Hispanic<br>(n=163) | Non-Hispanic<br>(n=1,228) | Hispanic<br>(n=124) | Non-Hispanic<br>(n=871) |
| Any Grain or Grain Product       | 56.5               | 56.9                    | 95.0                | 93.5                      | 97.1                | 98.9                    |
| Infant Cereal                    | 55.2               | 56.5                    | 74.1                | 73.6                      | 15.9                | 9.3                     |
| Noninfant Cereal                 | -                  | -                       | 18.5*               | 29.2                      | 45.3                | 57.8                    |
| Breads <sup>a</sup>              | 1.4†               | -                       | 18.2                | 15.1                      | 44.0                | 52.9                    |
| Tortillas                        | 1.4†               | -                       | 4.0†                | -                         | 6.7†*               | 0.6†                    |
| Crackers, Pretzels, Rice Cakes   | 1.3†               | -                       | 27.8                | 22.5                      | 35.6                | 46.9                    |
| Pancakes, Waffles, French Toast  | -                  | -                       | 1.4†                | 4.3                       | 13.0                | 16.0                    |
| Rice and Pasta <sup>b</sup>      | -                  | -                       | 20.1*               | 10.3                      | 44.3                | 32.9                    |
| Rice                             | -                  | -                       | 15.9**              | 4.7                       | 26.9†*              | 13.0                    |
| Grains in Mixed Dishes           | -                  | -                       | 15.9                | 13.0                      | 38.8*               | 54.4                    |
| Sandwiches                       | -                  | -                       | 4.0†                | 4.6                       | 24.2                | 24.9                    |
| Burrito, Taco, Enchilada, Nachos | -                  | -                       | 1.3†                | -                         | 2.1†                | 3.0                     |
| Macaroni and Cheese              | -                  | -                       | 3.0†                | 3.1                       | 10.1                | 15.5                    |
| Pizza                            | -                  | -                       | -                   | 1.4                       | 1.0**†              | 9.7                     |
| Spaghetti, Ravioli, Lasagna      | -                  | -                       | 8.3†                | 4.6                       | 9.3†                | 12.1                    |

<sup>a</sup> Does not include bread in sandwiches. Sandwiches are included in mixed dishes. Includes tortillas, also shown separately.  
<sup>b</sup> Does not include rice or pasta in mixed dishes. Includes rice (e.g. white, brown, wild, and Spanish rice without meat) and pasta (e.g. spaghetti, macaroni, and egg noodles). Rice is also shown separately.  
- = Less than 1 percent of the group consumed this food on a given day.  
\* = Significantly different from non-Hispanic at the  $P < 0.05$ .  
\*\* = Significantly different from non-Hispanic at the  $P > 0.01$ .  
† = Statistic is potentially unreliable because of a high coefficient of variation.

Source: Mennella et al., 2006.



| Table 12-15. Average Portion Sizes Per Eating Occasion of Grain Products Commonly Consumed by Infants from the 2002 Feeding Infants and Toddlers Study |                |                          |                          |                           |
|--|----------------|--------------------------|--------------------------|---------------------------|
| Food group   | Reference unit | 4 to 5 months<br>(N=624) | 6 to 8 months<br>(N=708) | 9 to 11 months<br>(N=687) |
|  |                | Mean± SEM                |                          |                           |
| Infant cereal, dry   | tablespoon     | 3.1±0.14                 | 4.5±0.14                 | 5.2±0.18                  |
| Infant cereal, jarred  | tablespoon     | -                        | 5.6±0.26                 | 7.4±0.34                  |
| Ready-to-eat cereal  | tablespoon     | -                        | 2.3±0.34                 | 3.4±0.21                  |
| Crackers   | ounce          | -                        | 0.2±0.02                 | 0.3±0.01                  |
|  | saltine        | -                        | 2.2±0.14                 | 2.7±0.12                  |
| Bread  | slice          | -                        | 0.5±0.10                 | 0.8±0.06                  |
| - = Cell size was too small to generate a reliable estimate.<br>N = Number of respondents.<br>SEM = Standard error of the mean.                        |                |                          |                          |                           |
| Source: Fox et al., 2006.  |                |                          |                          |                           |

| Table 12-16. Average Portion Sizes Per Eating Occasion of Grain Products Commonly Consumed by Toddlers from the 2002 Feeding Infants and Toddlers Study |                     |                            |                            |                            |
|---|---------------------|----------------------------|----------------------------|----------------------------|
| Food Group  | Reference Unit      | 12 to 14 months<br>(N=371) | 15 to 18 months<br>(N=312) | 19 to 24 months<br>(N=320) |
|   |                     | Mean± SEM                  |                            |                            |
| Bread   | slice               | 0.8±0.04                   | 0.9±0.05                   | 0.9±0.05                   |
| Rolls   | ounce               | 0.9±0.11                   | 1.0±0.10                   | 0.9±0.15                   |
| Ready-to-eat cereal   | cup                 | 0.3±0.02                   | 0.5±0.03                   | 0.6±0.04                   |
| Hot cereal, prepared  | cup                 | 0.6±0.05                   | 0.6±0.05                   | 0.7±0.05                   |
| Crackers  | ounce               | 0.3±0.02                   | 0.4±0.02                   | 0.4±0.02                   |
|   | saltine             | 3.3±0.22                   | 3.5±0.22                   | 3.7±0.22                   |
| Pasta   | cup                 | 0.4±0.04                   | 0.4±0.04                   | 0.5±0.05                   |
| Rice  | cup                 | 0.3±0.04                   | 0.4±0.05                   | 0.4±0.05                   |
| Pancakes and waffles  | 1 (4-inch diameter) | 1.0±0.08                   | 1.4±0.21                   | 1.4±0.17                   |
| N = Number of respondents.<br>SEM = Standard error of the mean.   |                     |                            |                            |                            |
| Source: Fox et al., 2006.   |                     |                            |                            |                            |





*Chapter 12 - Intake of Grain Products*

| Table 12-17. Mean Moisture Content of Selected Grain Products Expressed as Percentages of Edible Portions |                  |        |          |
|---|------------------|--------|----------|
| Food  | Moisture Content |        | Comments |
|   | Raw              | Cooked |          |
| Barley - pearled  | 10.09            | 68.80  |          |
| Corn - grain - endosperm  | 10.37            |        |          |
| Corn - grain - bran   | 4.71             |        | crude    |
| Millet  | 8.67             | 71.41  |          |
| Oats  | 8.22             |        |          |
| Rice - white - long-grained   | 11.62            | 68.44  |          |
| Rye   | 10.95            |        |          |
| Rye - flour - medium  | 9.85             |        |          |
| Sorghum   | 9.20             |        |          |
| Wheat - hard white  | 9.57             |        |          |
| Wheat - germ  | 11.12            |        | crude    |
| Wheat - bran  | 9.89             |        | crude    |
| Wheat - flour - whole grain   | 10.27            |        |          |
| Source:   | USDA, 2007.      |        |          |



**APPENDIX 12A**

**CODES AND DEFINITIONS USED TO DETERMINE THE VARIOUS GRAIN  
PRODUCTS USED IN THE U.S. EPA ANALYSIS OF CSFII DATA IN FCID**



Table 12A-1. Food Codes and Definitions Used in Analysis of the 1994-96, 1998 USDA CSFII Data

|              |               |                                  |                                 |                                  |                      |
|--------------|---------------|----------------------------------|---------------------------------|----------------------------------|----------------------|
| Total Grains | 9500060       | Amaranth, grain                  | 15002331                        | Oat, groats/rolled oats-babyfood |                      |
|              | 15000250      | Barley, pearled barley           | 95003060                        | Psyllium, seed                   |                      |
|              | 15000251      | Barley, pearled barley-babyfood  | 95003110                        | Quinoa, grain                    |                      |
|              | 15000260      | Barley, flour                    | 15003230                        | Rice, white                      |                      |
|              | 15000261      | Barley, flour-babyfood           | 15003231                        | Rice, white-babyfood             |                      |
|              | 15000270      | Barley, bran                     | 15003240                        | Rice, brown                      |                      |
|              | 15000650      | Buckwheat                        | 15003241                        | Rice, brown-babyfood             |                      |
|              | 15000660      | Buckwheat, flour                 | 15003250                        | Rice, flour                      |                      |
|              | 15001200      | Corn, field, flour               | 15003251                        | Rice, flour-babyfood             |                      |
|              | 15001201      | Corn, field, flour-babyfood      | 15003260                        | Rice, bran                       |                      |
|              | 15001210      | Corn, field, meal                | 15003261                        | Rice, bran-babyfood              |                      |
|              | 15001211      | Corn, field, meal-babyfood       | 15003280                        | Rye, grain                       |                      |
|              | 15001220      | Corn, field, bran                | 15003290                        | Rye, flour                       |                      |
|              | 15001230      | Corn, field, starch              | 15003440                        | Sorghum, grain                   |                      |
|              | 15001231      | Corn, field, starch-babyfood     | 15003810                        | Triticale, flour                 |                      |
|              | 15001260      | Corn, pop                        | 15003811                        | Triticale, flour-babyfood        |                      |
|              | 15001270      | Corn, sweet                      | 15004010                        | Wheat, grain                     |                      |
|              | 15001271      | Corn, sweet-babyfood             | 15004011                        | Wheat, grain-babyfood            |                      |
|              | 15002260      | Millet, grain                    | 15004020                        | Wheat, flour                     |                      |
|              | 15002310      | Oat, bran                        | 15004021                        | Wheat, flour-babyfood            |                      |
|              | 15002320      | Oat, flour                       | 15004030                        | Wheat, germ                      |                      |
|              | 15002321      | Oat, flour-babyfood              | 15004040                        | Wheat, bran                      |                      |
|              | 15002330      | Oat, groats/rolled oats          | 15004050                        | Wild rice                        |                      |
|              | Cereal Grains | 15000250                         | Barley, pearled barley          | 15003230                         | Rice, white          |
|              |               | 15000251                         | Barley, pearled barley-babyfood | 15003231                         | Rice, white-babyfood |
|              |               | 15000260                         | Barley, flour                   | 15003240                         | Rice, brown          |
|              |               | 15000261                         | Barley, flour-babyfood          | 15003241                         | Rice, brown-babyfood |
|              |               | 15000270                         | Barley, bran                    | 15003250                         | Rice, flour          |
| 15000650     |               | Buckwheat                        | 15003251                        | Rice, flour-babyfood             |                      |
| 15000660     |               | Buckwheat, flour                 | 15003260                        | Rice, bran                       |                      |
| 15001200     |               | Corn, field, flour               | 15003261                        | Rice, bran-babyfood              |                      |
| 15001201     |               | Corn, field, flour-babyfood      | 15003280                        | Rye, grain                       |                      |
| 15001210     |               | Corn, field, meal                | 15003290                        | Rye, flour                       |                      |
| 15001211     |               | Corn, field, meal-babyfood       | 15003440                        | Sorghum, grain                   |                      |
| 15001220     |               | Corn, field, bran                | 15003450                        | Sorghum, syrup                   |                      |
| 15001230     |               | Corn, field, starch              | 15003810                        | Triticale, flour                 |                      |
| 15001231     |               | Corn, field, starch-babyfood     | 15003811                        | Triticale, flour-babyfood        |                      |
| 15001240     |               | Corn, field, syrup               | 15004010                        | Wheat, grain                     |                      |
| 15001241     |               | Corn, field, syrup-babyfood      | 15004011                        | Wheat, grain-babyfood            |                      |
| 15001260     |               | Corn, pop                        | 15004020                        | Wheat, flour                     |                      |
| 15001270     |               | Corn, sweet                      | 15004021                        | Wheat, flour-babyfood            |                      |
| 15001271     |               | Corn, sweet-babyfood             | 15004030                        | Wheat, germ                      |                      |
| 15002260     |               | Millet, grain                    | 15004040                        | Wheat, bran                      |                      |
| 15002310     |               | Oat, bran                        | 15004050                        | Wild rice                        |                      |
| 15002320     |               | Oat, flour                       | 9500060                         | Amaranth, grain                  |                      |
| 15002321     |               | Oat, flour-babyfood              | 95003060                        | Psyllium, seed                   |                      |
| 15002330     |               | Oat, groats/rolled oats          | 95003110                        | Quinoa, grain                    |                      |
| 15002331     |               | Oat, groats/rolled oats-babyfood |                                 |                                  |                      |



---

*Chapter 12 - Intake of Grain Products*

---

|      |          |                      |          |                      |
|------|----------|----------------------|----------|----------------------|
| Rice | 15003260 | Rice, bran           | 15003250 | Rice, flour          |
|      | 15003261 | Rice, bran-babyfood  | 15003251 | Rice, flour-babyfood |
|      | 15003240 | Rice, brown          | 15003230 | Rice, white          |
|      | 15003241 | Rice, brown-babyfood | 15003231 | Rice, white-babyfood |