

# Feeding Infants and Toddlers Study: Overview of the Study Design

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## ABSTRACT

**Objective** Describe the design, data collection procedures, and sample characteristics of the Feeding Infants and Toddlers Study.

**Design** We conducted up to three telephone interviews with a random sample of parents or caregivers of infants and toddlers four to 24 months of age from March to July 2002. The three interviews included (a) a recruitment and household interview; (b) a 24-hour dietary recall, with supplementary questions on growth, development, and feeding patterns; and (c) a second dietary recall for a random subset of the sample. Two age subgroups of infants (four to six months and nine to 11 months) were over sampled. Sample weights adjusted for over sampling, nonresponse, and under coverage of some subgroups in the sample frame.

**Subjects** A national random sample of 3,022 infants and toddlers, with two days of dietary recall available for 703 sample members.

**Results** Of sampled households that could be located and had an eligible child in the study age range, the response rate to the recruitment interview was 73%. Of recruited households, the response rate for the dietary recall interview was 94%.

**Applications/Conclusions** The Feeding Infants and Toddlers Study (FITS) provides a wealth of data on the food and nutrient intakes, background characteristics, growth and development milestones, and feeding patterns and transitions for a nationally representative sample of infants and toddlers. Subsequent papers in this journal issue present study findings and conclusions from in-depth analysis of the FITS data.

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**N**utrition is an important component of child health. A child's physical, cognitive, and emotional growth and development depend largely on how much and what type of foods are eaten and the timing of the introduction of different food items. During the first two years after birth, the nutritional needs of infants and toddlers change rapidly, and their eating patterns progress from simple diets of breast milk and formula to more varied diets that include juices, cereals, and solid foods. During this time, they form eating habits that may affect their later nutrition and health.

The Feeding Infants and Toddlers Survey (FITS) was a study sponsored by Gerber Products Company to update our knowledge of the food and nutrient intakes of infants and toddlers in the United States. The FITS included a survey of the parents or caregivers of a sample of infants and toddlers four to 24 months of age and subsequent analysis of the survey data. The FITS survey collected data on nutrient intakes of infants and toddlers four to 24 months of age; food choices and their nutrient impact; feeding practices and patterns; and infant and toddler growth and developmental milestones.

Five infant nutrition surveys sponsored by Gerber Products Company over the past three decades have tracked infant feeding practices and assessed the nutritional adequacy of infants' diets. The most recent survey, conducted in 1994, interviewed the parents and caregivers of 1,941 infants and toddlers aged one to 36 months and used food diaries to collect information on all food items eaten over a four-day period. The analysis of those data focused on the frequency of infant feeding, quantities consumed, food groups consumed (formula, fruits, vegetables, meats, dairy, and juice), food type (table food, baby food), nutrient intake, and the relationship between household demographics and feeding patterns (1).

National surveys of infant and toddler nutrition include the Continuing Survey of Food Intakes by Individuals (CSFII), the National Health and Nutrition Examination Survey (NHANES), and the Ross Mothers' Survey (2-4). The 1994 to 1996 and 1998 CSFII and NHANES data (either 1988-1994 or 1999-2000 data) provide intake data for a nationally representative samples of infants and toddlers, but the samples for infants and toddlers are small, and published results often omit breastfed infants. The Ross Mothers' Survey, conducted since 1955, has tracked breastfeeding rates, the use of infant formula (type of formula and timing of introduction), and use of cow's milk over time.

The FITS provides a valuable update to these earlier surveys. Several considerations make such a survey a useful and important undertaking:

- The FITS data allow examination of the correspondence of current infant and toddler feeding practices with new guidelines made by professional organizations such as the American Academy of Pediatrics (5).

- The analysis uses the newly developed Dietary Reference Intakes (DRI) to assess the nutritional adequacy of diets (6).
- The FITS provides two days of recall data for a subsample of the total sample, allowing use of recommended dietary methodologies for estimating the usual nutrient intake of groups (7).
- Findings from the FITS can be used to promote both healthy early eating patterns and long-term child health and development, reflecting a public health focus on decreasing the prevalence of overweight, obesity, and type 2 diabetes in youth (8).

This supplement is based on a comprehensive analysis of the FITS data collected from a random sample of 3,022 infants and toddlers four to 24 months of age during the period March to July 2002. The survey consisted of three separate interviews, all conducted by telephone: (a) a brief recruitment and household interview; (b) a 24-hour dietary recall, with a supplemental set of questions on infant and toddler growth, development milestones, and feeding patterns and transitions; and (c) a second 24-hour dietary recall interview for a random subsample of respondents.

The remainder of this paper provides detail on the FITS survey methodology, dietary recall data collection system, sampling design, and sample characteristics. Subsequent papers provide the detailed findings from in-depth analyses of topics related to the food and nutrient intakes of infants and toddlers.

## SAMPLE DESIGN

The FITS target population was all children four to 24 months of age living in the 50 states and the District of Columbia. Researchers designed the sampling plan so that study results could be generalized to infants and toddlers four to 24 months of age in the United States. However, to generalize the study results to all US infants and toddlers required a sample frame—that is, a comprehensive list or mechanism to enumerate all infants and toddlers age four to 24 months.

Unfortunately, an ideal sample frame does not exist. There is no list or mechanism available to create a list of all infants and toddlers in a timely manner. The closest is the vital statistic registration system, which includes a certified birth certificate for each live birth in the United States. However, these files are available only with considerable delay and, because of strict confidentiality policies, are typically not available to researchers. The vital statistic registration birth files were, therefore, not a feasible sample frame for the FITS.

We also considered a random-digit-dialing telephone approach to identify eligible respondents. However, because of the small proportion of the population with children in the relevant age range (about 4% of all households), these procedures would be prohibitively costly and time intensive.

The sample frame chosen for this study was a child-level database, the New Parent Database from Experian, Inc. (9). This database contains both prenatal and postnatal records. Postnatal names are tracked from birth to 36 months of age. On an annual basis, the New Parent database contains approximately 3.1 million families with newborns. Experian compiles this database from over 2,500 different sources, which include hospitals, ma-

ternity clothing stores, hospital photographers, baby furniture suppliers, diaper companies, hospital “welcome” gift packs, bank surveys, and other public and proprietary sources. The file is updated weekly with records for children of any age. Each record contains a parent’s name, address, and the child’s month and year of birth. Comparing the list of eligible children (those who reside in the United States and meet the age eligibility criteria) to the list of national Vital Statistic Reports (10), we estimate that the frame covered 51% to 67% of all children in the target ages.

Statisticians first stratified the sample frame by age of the child and region of the country then selected a simple random sample from each stratum. There were six target age groups: four to six months, seven to eight months, nine to 11 months, 12 to 14 months, 15 to 18 months, and 19 to 24 months. To meet analytic goals, the design called for larger samples in two age groups: four to six months, and nine to 11 months. These two age groups typically experience significant transitions in infant feeding patterns and practices, most notably an introduction of complementary infant cereals and other baby foods in the four- to six-month period and transitions to table foods in the nine- to 11-month period. Children between the ages of two and 22 months were selected at the time of sampling so that the sampled children were age eligible at the time of the dietary intake interview. Because the New Parent database is updated weekly and we wanted to maximize the coverage rate of the target population by the sample frame, the sample was selected in four separate waves, with each wave being an independent sample.

If a household contained more than one child in the target age, interviewers collected information about the sampled child only. During the household recruitment survey, interviewers asked about the actual month and year of birth for the target child. The household was considered eligible if it contained a child born in the month listed on the sample, one month earlier, or one month later. Having determined the household was eligible, interviewers requested its participation in the study.

## SURVEY METHODOLOGY

The goals of the recruitment interview were to (a) confirm that the household was eligible, that is, had an infant or toddler between four and 24 months of age; (b) recruit the household for inclusion in the study; (c) collect household characteristics, such as income and employment status of parents and household composition; (d) determine whether the child spent part of his or her day in the care of someone other than a parent; and (e) determine the most knowledgeable adult with regard to the child’s food intake for future interviews. Any adult in the household could complete the recruitment interview. In contrast, only the adult most knowledgeable about what the child ate could complete the intake interview.

The appropriate adult for the intake interviews (referred to as the most knowledgeable adult) was mailed a packet of information about the study that included a letter from the study’s principal investigator, a study brochure, a food measurement booklet, a permission form for child-care providers, and an incentive check for \$20. All materials were written in both English and Spanish. The letter thanked the respondents for their willingness to participate and explained that an interviewer would

call them in about a week to ask questions about the types and quantities of foods that their child ate over a 24-hour period. The letter also inquired whether their child attended day care and, if so, that they inform the provider about their child's inclusion in the study and the possibility of needing the provider's help to determine the foods consumed by the child while in day care. In an effort not to bias results, there was no mention of Gerber, the survey sponsor, in any of the materials or scripts used.

To assist parents and caregivers in accurately estimating quantities of foods their infants and toddlers consumed, the information package contained a detailed two-dimensional food measurement booklet customized to infant and toddler feeding tools. Researchers, with the aid of a graphic designer, created the booklet through focus group pilot testing with mothers of infants and toddlers. The guide included eight pictures of popular toddler "sippy" cups, four pictures of different spoons, and two pictures of bowls, all drawn to scale. In addition, the visual aid included a circle diagram of concentric circles ranging from 1 to 8 inches in diameter for use in estimating the diameter of round foods such as cookies or pancakes. There was also a five- by five-inch grid to help estimate the size of square and rectangular foods such as bread and crackers. The first page of the measurement guide also included a list of frequently forgotten foods.

One week to 10 days after sending the information packet, an interviewer called the household to conduct the 24-hour dietary recall and ask additional questions related to breastfeeding, introduction of foods, growth and development, and child care. The study used the Nutrition Data System for Research (NDS-R) from the University of Minnesota Nutrition Coordination Center (NCC) (11) to collect the 24-hour dietary recalls. We selected the NDS-R because it includes a well-tested, computerized, 24-hour dietary recall data collection linked to a comprehensive food and nutrient database. Food and nutrient analyses can be conducted at the ingredient level, food level, meal level, or daily total level.

Interviewers asked parents (or the most knowledgeable adult) about all foods and liquids that the infant or child consumed from midnight through midnight on the previous day. The dietary recall recorded the use of vitamin and mineral supplements. For breastfed infants, interviewers documented the duration of each feeding in minutes. Interviewers used a special protocol when the parent was unable to provide information about foods their child ate while under the care of someone else. In these cases, interviewers asked parents or guardians to call the child-care providers and obtain detailed information about the foods their child ate while under the provider's supervision. If this was not possible, interviewers obtained permission from the parent to call the caregiver directly to complete the child's recall. In all but a few cases, the parent or guardian reported that they had obtained the dietary recall information directly from the provider. The additional information was obtained within 72 hours of the original interview.

Dietetics professionals reviewed all 24-hour recalls for missing foods, unrealistic quantities reported, supplement use including brand name and type, and breastfeeding status. Because the study focused on infants and toddlers, brand names of baby foods were of interest. Many brand name baby foods, however, were not in the nutrient database. Researchers identified missing foods, obtained nutrient information when possible, and sent

the list to the NCC to have the database updated. Nutrient calculations were performed using the NDS-R software version 4.03, developed by the NCC (11). If an analytic value was not available for a nutrient in a food, the NCC calculated the value based on the content of other nutrients in the same food, on a product ingredient list, or on the nutrient content of similar foods.

For exclusively breastfed infants under seven months of age, we assumed an intake of 780 mL breast milk per day, and, for infants who had both breast milk and formula, we subtracted the volume of formula from 780 mL to obtain an estimate of the quantity of breast milk consumed (12). For infants seven months and older, the comparable quantity was 600 mL per day as the quantity of breast milk for those being fed only breast milk as their milk intake. As with younger infants, the volume of formula or cow's milk was subtracted from 600 mL for infants who consumed both breast milk and other milk products to estimate the quantity of breast milk consumed.

After completing the 24-hour dietary recall, the parent or caretaker responded to a set of additional questions as part of the interview. The questionnaire included sections on the child's characteristics and circumstances, such as height and weight; child-care use, participation in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC); breastfeeding status and history; use of formula and cow's milk; initiation of solid foods; and motor development questions including items about self-feeding and information about the parents, such as age, race, education, and income levels.

A random subset of respondents was selected to complete a second 24-hour dietary recall three to 10 days after the first recall to calculate usual nutrient intake distributions and to assess the adequacy of the nutrient intakes of infants and toddlers (6,7). This interview was a dietary recall only and was always conducted on a different day of the week from the first interview. As with the first recall, if needed, interviewers contacted child-care providers to complete the child's dietary recall. These respondents received a \$5 gift certificate for baby goods as a token of appreciation for their additional effort.

Approximately 50 telephone interviewers conducted the study. Each interviewer received one week of training including extensive practice using the NDS-R program. Bilingual interviewers received training for those respondents who preferred to complete the recall and interview in Spanish.

All data collection instruments and procedures were reviewed and approved by Mathematica's Quality Assurance system. All participants received written information on the study, understood that study participation in the study was voluntary, and were assured of the confidentiality of the data received. We obtained consent from each respondent before proceeding with the study interviews.

## RESPONSE RATES

Of those sampled households who could be located and had a child in the eligible age range, the response rate to the recruitment interview was 73%. Despite considerable effort, approximately 37% of sampled households could not be located. Of those households that were located, 38% did not have a child in the eligible age range for the

sample frame of two to 22 months. If those households that could not be located are included in the calculations of response rates, the response rate for the recruitment interview is 46%. This response rate is comparable with response rates from other telephone dietary studies (13).

A total of 3,224 households completed the household recruitment interview. Of these 3,224 households, interviewees completed 3,022 dietary recalls for infants and toddlers four to 24 months of age, resulting in a response rate for the intake interview of 94% of households that had completed the recruitment interview. Because of the importance of the dietary recall survey to this study, researchers considered complete cases as only those respondents who completed both the recruitment and intake interviews. In addition, 703 randomly selected respondents completed the second recall (approximately 23% of the day one sample), which was 85% of the cases originally flagged for the second-day recall.

Statisticians computed probabilities of selection for each level of sampling. Sampling weights were calculated as the inverse of the probability of selection. These sampling weights were adjusted for nonresponse at each stage of the interviewing process. To compensate for under coverage of children not on the sampling frame, statisticians applied poststratification adjustments to the nonresponse-adjusted sample weights.

One unavoidable issue arose in the interviewing process regarding the ages of sample infants and toddlers. As noted above, children were two to 22 months of age at the time of sample selection so that, by the time the household was located and had completed the recruitment interview, the sampled children would be four to 24 months of age at the time of the dietary recall interview. However, in some cases, the lag between sampling and the dietary recall interview was shorter than expected and, in other cases, it was longer than expected. As a result, there were some sample cases less than 4 months of age and greater than 24 months of age. Specifically, the study sample includes 157 infants who were three months of age (the majority were greater than 3.5 months of age) and five toddlers who were 25 months of age. These sample members were retained and included in the analyses of the papers in this supplement and were included in the four- to six-month age group and 19- to 24-month age group, respectively, for analyses conducted by age subgroups.

## SAMPLE CHARACTERISTICS

The Table presents data on the sample characteristics of the FITS sample. Although this table presents unweighted data on sample characteristics, all analyses in the subsequent papers used the sample weights in calculating means, distributions, and tests of statistical significance. As noted above, the sample design included an oversampling of two age groups: infants four to six months and nine to 11 months.

Several sample characteristics of the FITS study sample are important to highlight:

- Roughly equal proportions of the FITS infants and toddlers were male and female and first born vs second born or higher.
- Reported weight-for-age was roughly equally distributed among the quartiles of the National Center for Health Statistics Growth Charts (14), although a

slightly larger proportion fell into the upper quartile (30%) and slightly lower proportions fell into the middle quartiles (21% and 22%, respectively) than would be expected.

- Almost 78% of the sample was ever breastfed, which is slightly higher than estimates from other national surveys (4,15).
- The ethnicity of the sample—about 12% Hispanic and 20% nonwhite—were similar to national estimates for the percentage of nonwhites but lower for the percentage of those of Hispanic origin (16). Poststratification weights adjusted for the under coverage of race and ethnic subgroups.
- Roughly 27% the infants and toddlers participated in the WIC program (30% of infants and 21% of toddlers), which was considerably lower than other estimates of WIC participation by infants but only slightly lower than estimates of WIC participation by toddlers (17).
- The sample had an income distribution that had slightly lower percentages under \$25,000 and over \$100,000, and higher percentages at middle-income levels, than national distributions of household income (16).
- More than half (55%) of the mothers worked, which was similar to national labor force participation rates of women with young children (16).

Although rich in detail, some limitations of the FITS data should be noted. First, because it is impossible to estimate precisely the quantity of breast milk consumed in a large dietary recall study such as the FITS, we used published estimates of breast milk quantity derived from studies that weighed infants before and after each feeding to determine the quantity of breast milk consumed (12). For younger infants age four to six months, the assumption used is likely to lead to overestimates of nutrient intakes for those infants who consume both breast milk and other solid foods. This is because the breast milk quantity estimate (780 mL) for this age group is based on data from exclusively breastfed infants. A large proportion of infants age four to six months, however, consume nonmilk foods such as juices and infant cereals, and the literature suggests that energy from breast milk declines as energy from solid foods increases (18). Estimates of substitution vary in the literature, however, and were not incorporated into our estimates of the quantity of breast milk consumed for infants four to six months of age. This same issue of estimating the quantity of breast milk also applies to older breastfed infants, although the assumed quantity of breast milk consumed for these older infants (680 mL for breastfed infants older than six months) does account for the fact that energy from solid foods replaces energy from breast milk as solids are introduced. This issue is discussed further and examined in more detail for infants four to six months of age in the nutrient intake paper that follows.

A second limitation of the FITS data relates to the sampling frame used to draw the sample. Because no national sampling frame was available within the level of resources available for this study, a commercial list of infants and toddlers yielded the sample. Many of the households on this commercial list could not be located and did not have children in the target age group. As a result, the response rate was lower than what would have occurred with a true national sample frame. In addition, given that the commercial list frame used multiple

<b>Table. Feeding Infants and Toddlers Study: Sample characteristics</b>		
<b>Characteristic</b>	<b>Sample size</b>	<b>Percentage of sample</b>
<b>Gender</b>		
Male	1,549	51.3
Female	1,473	48.7
<b>Birth order</b>		
First born	1,455	48.1
Second born	951	31.5
Third born or higher	604	20.0
Missing	12	0.4
<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 weight-for-age percentile</b>		
≤25th percentile	741	24.5
25th-50th percentile	640	21.2
50th-75th percentile	663	21.9
>75th percentile	893	29.6
Missing	85	2.8
<b>Ever breastfed</b>		
Yes	2,336	77.3
No	680	22.5
Missing	6	0.2
<b>Child's ethnicity</b>		
Hispanic or Latino	367	12.1
Non-Hispanic	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>Age of mother at birth (y)</b>		
<20	121	4.0
20 to 24	562	18.6
25 to 29	838	27.7
30 to 34	891	29.5
35 or older	587	19.4
Missing	23	0.8
<b>Mother's education</b>		
11th grade or less	190	6.3
Completed high school	753	24.9
Some post secondary	857	28.4
Completed college	1,192	39.4
Missing	30	1.0
<b>Parent's marital status</b>		
Married	2,479	82.0
Not married	518	17.1
Missing	25	0.8
<b>Receives WIC</b>		
Yes	821	27.2
No	2,196	72.6
Missing	5	0.2
<i>(continued)</i>		

<b>Table. (continued)</b>		
<b>Characteristic</b>	<b>Sample size</b>	<b>Percentage of sample</b>
<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>Mother or female guardian works</b>		
Yes	1,673	55.4
No	1,320	43.7
Missing	29	0.9
<b>Urbanicity</b>		
Urban	1,389	46.0
Suburban	1,014	33.6
Rural	577	19.1
Missing	42	1.3
<b>Sample Size</b>	<b>3,022</b>	<b>100.0</b>
Data from 2002 Feeding Infants and Toddlers Study, unweighted sample characteristics.		

sources, including retail establishments, to obtain updated lists of the target population, it is likely that the sample obtained is of higher socioeconomic status compared with all infants and toddlers four to 24 months of age. The use of telephone interviews to conduct the survey would also omit lower-income households without telephones from the study.

Despite the limitation of not having a true national sample frame of all US infants and toddlers, the FITS applied statistical methods and procedures to select a random sample and calculate sample weights, and all analyses in this journal issue use these sample weights. The sample weights adjust for over sampling of two age groups, differential response rates, and differences in the age and racial composition of the sample, so the sample obtained is nationally representative of the age and racial distribution of infants and toddlers. Moreover, despite some limitations associated with the lack of an ideal sample frame, the large sample sizes of the FITS and the detailed information on food and nutrient intakes, as well as infant feeding practices and developmental milestones, makes the data set a valuable resource for those interested in infant and toddler nutrition.

## SUMMARY

The FITS provides a wealth of data on the food and nutrient intakes, background characteristics, growth and development, and feeding patterns and transitions for a sample of 3,022 infants and toddlers. Because of the large sample size, analyses could be conducted separately by age group and by many of the sample characteristics that the Table presents. Subsequent papers in this supplement provide detailed study findings and conclusions

from investigations of food choices and nutrient intakes, transitions in infant and toddler feeding, the relationship between food intakes and child growth and development, and selected other topics.

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