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WIC Infant and Toddler Feeding Practices Study-2: Third Year Report

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Study Overview 1

1.1 Background

The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) was established to safeguard the health of low-income pregnant women and infants who are at nutritional risk. The program was established by Congress as a pilot in 1972 under Public Law 92-433, Section 17 to the Child Nutrition Act of 1966, and made permanent in 1974.[1] The program provides nutrition assistance to pregnant, postpartum, and breastfeeding women and their infants and children up to age 5. Participants must meet the income guidelines and have a household income at or below 185 percent of the Federal Poverty Guideline[2] ($44,123 for a family of four in 2014) or be eligible based on participation in certain other means-tested benefit programs. The Food and Nutrition Service (FNS) of the U.S. Department of Agriculture (USDA) administers WIC, which is a Federal grant program, to 90 WIC State Agencies (SAs), including Indian Tribal Organizations (ITOs) and U.S. Territories. The SAs are responsible for program operations within their jurisdictions, and they provide services primarily through contracts with local WIC-sponsoring agencies (e.g., health departments, community centers, hospitals) that provide services to WIC participants at local service sites or clinics.

The WIC Infant and Toddler Feeding Practices Study (WIC ITFPS-2) is a longitudinal study designed to measure the feeding practices employed by caregivers and the nutrition outcomes of children who participate in WIC. By capturing data on caregivers and their children over the first 6 years of the child's life, the study informs a series of research questions regarding feeding practices, the association between WIC services and those practices, and the health and nutrition outcomes of children currently or previously on WIC.

The study is heavily predicated on the design used for the 1997 Food and Consumer Service's[3] longitudinal WIC Infant Feeding Practices Study (WIC IFPS-1) (Baydar, McCann, Williams, &

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[1] USDA Food and Nutrition Service. (n.d.). *About WIC-WIC's Mission*. Retrieved from http://www.fns.usda.gov/wic/about-wic-wics-mission on October 20, 2017.

[2] U.S. Federal Poverty Guidelines Used to Determine Financial Eligibility for Certain Federal Programs. Retrieved from https://aspe.hhs.gov/poverty-guidelines on December 20, 2018.

[3] In 1998, the Food and Consumer Service was renamed as the Food and Nutrition Service.

Vesper, 1997). WIC ITFPS-2 also makes comparisons to some studies that did not focus specifically on the WIC population. The Food and Drug Administration's Infant Feeding Practices Study II (FDA IFPS-II) (Fein et al., 2008), which is a well-known longitudinal study of infant feeding practices, was used extensively as a frame of reference during planning. Building on past longitudinal work maximizes the comparability between current study data and past work, which facilitates assessing changes over time. The study also makes comparisons to the Gerber/Nestle Feeding Infants and Toddlers Studies (FITS) conducted in 2016 to address nutrition and feeding practices of children from 30-36 months old (Anater et al., 2016). Additionally, in developing and revising the instruments, the study team has leveraged many of the approaches used in previous studies, such as rotating question modules, to ensure study efficiency.

The primary research topics for the WIC ITFPS-2 at age three years include:

- What are the background and environmental characteristics that may influence families' feeding practices and ultimately their children's nutrition and health outcomes?
- What is the influence of WIC on the nutrition and health of children in the study?
- What are children's nutrient intake, meal and snack practices, and how do feeding practices influence weight and growth?

The study at age 3 years is designed to address the three topics, as well as answer 10 research questions specified by FNS. These research questions are listed in Appendix A. Study findings from the prenatal period, the infant year, and the second year have been released previously by FNS (May et al., 2015; May et al., 2017; Borger et al., 2018).

1.2 Study Design

This observational study follows a hybrid design, incorporating a core longitudinal sample (the "core" sample) and a supplemental cross-sectional sample (the "supplemental" sample) to ensure precision in estimates at key points in time. The core longitudinal sample of women and their infants was enrolled in the study as they enrolled in WIC (either prenatally or before their infant was 2.5 months old if they did not enroll prenatally). The babies are followed until they are 72 months

old, with up to 18 maternal (or primary caregiver[4]) interviews occurring prenatally, and at 1, 3, 5, 7, 9, 11, 13, 15, 18, 24, 30, 36, 42, 48, 54, 60, and 72 months. The supplemental sample was also recruited as the women and their infants enrolled in WIC. This sample is interviewed at 11 key time periods (1 or 3, 7, 13, 24, 30, 36, 42, 48, 54, 60, and 72 months).[5] To become eligible for inclusion in the analysis sample, participants must complete either a 1-month or 3-month interview. This report focuses on data from the 24-, 30-, and 36-month interviews, all of which include both the core and supplemental samples.

Observational studies are well suited to social programs such as WIC for which random assignment is not feasible. The direct observation of individuals in their natural setting captures the multiple effects of participation in WIC. However, as an observational study, it should be noted that it is impossible to definitively attribute causality. The study team hypothesizes relationships and the analyses infer causality based on the correlations between variables; but causality cannot be unequivocally established.

1.3 Sample Selection

The goal of the WIC ITFPS-2 is to collect data from a national sample of participants who enroll in WIC prior to 3 months of age. This includes both those who enroll while the mother was pregnant, and those who first enroll as infants. To obtain a representative sample of WIC participants for WIC ITFPS-2, first a sample of WIC sites was selected, and then a sample of participants enrolling in WIC at each of the selected WIC sites was selected. A summary of the sampling plan is given below and further details of these procedures are provided in Appendix B1.

1.3.1 Sampling WIC Sites

The WIC sites were selected using a stratified two-stage sampling approach. Because no national list of service sites exists, a summary file at the level of the unit (either local agency or service site/clinic)

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[4] Over 98 percent of respondents are biological mothers. Throughout the report the terms "mother" and "caregiver" are used interchangeably. Throughout this report the term "infant" applies to the 0-13 month period; the term "child" applies to the entire period from 0-72 months.

[5] Study interviews are more frequent during the infant year to capture the rapid changes in feeding practices, and less frequent in subsequent years to reduce burden on participants. The supplemental sample interviews were selected with attention to achieving desired precision levels for subgroups at key time periods.

reported by each SA in the census of April 2010 (the WIC Program and Participant Characteristics 2010, or PC2010) was used as the sampling frame. This census resulted in a file with one record for each participant being served by WIC in that month. Because SAs had flexibility for how they reported local agency and service site/clinic identifiers for PC2010, the IDs provided in the records varied; some provided the service site ID in addition to a local agency code, while others included only a local agency code. As a result, two stages of selection were used to sample sites. The first stage involved the sampling of "PC2010 tabulation units"—the units for which IDs were provided in the PC2010 data. The second stage involved the sampling of local sites/clinics for situations in which the sampled tabulation unit was a local agency. Some sites were excluded for operational and design reasons, including geographic location (American Samoa, Guam, Northern Mariana Islands, and U.S. Virgin Islands), and small sites that were expected, on average, to enroll fewer than 30 new pregnant women/newborns per month.

The sample was stratified to improve the precision of survey estimates. To achieve this goal, the strata were formed in such a way that the units within the strata were more similar to each other (in terms of characteristics related to key survey outcomes) than units in general (i.e., strata should be internally *homogeneous*). Five characteristics of the first-stage sampling unit or its SA were used to group the sites into a total of 40 strata for selection (see Appendix B1, Table B1-1 for more details). The first three of these five characteristics are actually features of the WIC State Agency Plan and were included because they may be associated with key survey outcomes related to breastfeeding and nutrition. The characteristics included:

- **Peer Counseling Program.** Whether the SA has a breastfeeding peer counseling program in place.[6]
- **Trained Paraprofessionals.** Whether SA policy allows for trained paraprofessionals to provide nutrition education (versus requiring that staff members that provide nutrition education have professional training or credentials).
- **Policy to Provide Formula.** Whether SA policy permits providing one can of formula for breastfeeding infants during the first 30 days of life.
- **Percent of Women Who Used the Fully Breastfeeding Package.** The PC2010 data were used to measure food-package selection by first-stage sampling unit, and this rate was computed by taking the ratio of the number of postpartum women who received the fully breastfeeding package during April 2010 to the total number of postpartum women receiving any food package that same month.

[6] Ultimately there was no variation in this characteristic; all states reported offering a breastfeeding peer counseling program.

- **Average of Children's and Mothers' High Weight for Height Rates.** The PC2010 data were used to estimate the percent of children and the percent of mothers who are "high weight for height"[7] at the first-stage sampling unit level, and these percentages were averaged together to get a measure of risk of being overweight for all participants at the first-stage sampling unit level.

Within each stratum, two sites were sampled with probabilities proportional to size, where the measure of size was the expected number of eligible enrollees. Thus, a total of 80 WIC sites were sampled. These sites are operated by 27 WIC SAs.

1.3.2 Sampling WIC Enrollees

The study sampled new WIC participants who enrolled at the sampled sites during a pre-specified time period deemed the "recruitment window." Specifically, the sample included all women enrolling in WIC for the first time for either their current pregnancy or their newborn at the site during the recruitment window.[8] The recruitment window was a consecutive string of days during the study recruitment period in which all new WIC enrollees in that site were screened for eligibility and recruited into the WIC ITFPS-2. The length of the recruitment window for each site was pre-determined based on the estimated amount of time needed to yield 98 eligible new WIC enrollees per site (the target sample size for each site).[9] The start date for the recruitment window was randomly assigned to each site. Because the estimated average number of new WIC enrollees per day into the 80 sites varied substantially, the window length was much shorter in sites with a high estimated rate of new enrollees compared to sites with a lower estimated rate. The study participants must have enrolled in WIC at the site during the recruitment period, although the study screening and enrollment could occur at a later date.

Core and Supplemental Samples. Two samples were selected at each service site: a core longitudinal and supplemental cross-sectional sample. The core sample was originally designed to be

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[7] For children (12 months or older), "high weight for height" is determined based on nutrition risk code 110 (see http://www.fns.usda.gov/sites/default/files/WICPC2010.pdf, accessed May 8, 2017). For children 24 months and older, it is defined as higher than the 95th percentile of body mass index (BMI) for age. For children 12 to 24 months, it is defined as at risk of being overweight by virtue of having a mother or father who is obese (BMI of 30 or greater). For mothers, the criterion is a pregravid BMI of 25 kg/m^2 or higher.

[8] Women who had enrolled in WIC for previous pregnancies and/or enrolled other children in WIC were eligible for the study. Women below the age of 16, those who did not speak English or Spanish, and those enrolling a child over 2.5 months of age were not eligible for the study.

[9] Estimated amount of time needed to yield 98 new WIC enrollees was based on July 2012 enrollment figures from the sites.

an equal probability sample of all new enrollees. The supplemental sample was designed to increase the sample size at key time periods, and to focus to the extent possible on less common subpopulations. Details of the selection of the core and supplemental samples throughout the study recruitment period are discussed in more detail in Appendix B1.

Multiple Births. For those study mothers who had multiple births such as twins, a single infant was sampled at the first postnatal interview.

1.4 Data Sources

During the 7-year data collection period that began in July 2013,[10] the study is collecting data from numerous sources. The main source is a series of follow-up telephone interviews with the mother. Other key information such as child's weight and length is being obtained periodically through measurements taken at WIC sites or health care providers; and contextual information about the WIC sites and State policies is obtained from clinic and WIC program staff.[11] The data sources include:

- Screening and enrollment interviews with recruited WIC enrollees;
- Telephone follow-up interviews with study participants conducted prenatally and when their children are 1, 3, 5, 7, 9, 11, 13, 15, 18, 24, 30, 36, 42, 48, 54, 60, and 72 months of age;
- Measurements taken at WIC sites or by health care providers for height and weight measurements when the babies are born and at 6, 12, 24, 36, 48, 60, and 72 months of age;
- WIC administrative records for WIC food packages provided to mothers and infants;[12]
- At baseline, site visits to participating WIC sites and key informant interviews that profile state and local policies and practices; and

[10] The study collects data over a 6-year period in the children's lives, but the length of time a mother is a participant is dependent on when she was recruited. Mothers recruited when they were 1-month pregnant are participants for 6.8 years, whereas mothers enrolled when their baby was 2.5 months old are in the study for about 5.8 years.

[11] Information about the WIC sites is used as covariates in exploring the variation in feeding practices. Only site-level data on modes of nutrition education delivery are available for this study; no data are available on the mode of nutrition education received by individual study participants. See Appendix B2 for details.

[12] Child food package data are not collected after 11 months because there is only one non-medical food package for children ages 1-4 years.

- At baseline, A WIC site staff survey that collects information on local WIC programs and the training and experience of the staff.

Table 1-1 presents an overview of the information obtained from each data source. Key domains include socio-demographic characteristics, knowledge, and lifestyle; feeding practices and experiences; childrearing practices; and weight and length outcomes. The participant surveys that are the primary focus for this report are those during the third year of life, the 30- and 36-month participant interviews, as well as the WIC administrative data on child weight and height around the time of the third birthday. Whereas the 30-month interview focuses broadly on health, lifestyle, feeding practices and experiences, and childrearing practices, the 36-month interview focuses more specifically on the child's dietary intake. Socio-demographic characteristics from baseline (for static characteristics) or 24 months (for changing characteristics) are used in the report to examine the association between socio-demographic characteristics of study families and subsequent outcomes of interest during the third year.

1.5 Data Collection Procedures

The study is using multiple modes of data collection to obtain the necessary information to support the study objectives. Study mothers were recruited in-person at WIC sites, and are administered regular follow-up interviews by telephone. In addition, study staff periodically submit requests to SAs for data on the mother and child from WIC administrative records (e.g., length and weight data and food package data). The study also collected data from WIC site staff using a web survey, and from State and local agencies staff using a mix of in-person and telephone interviews.

1.5.1 Recruiting WIC Participants

Recruitment activities were rolled out over a 12-week period in the 80 sampled sites, with recruitment starting July 1, 2013 and ending November 18, 2013. Each site was assigned a recruitment window with the length of the recruitment window determined by the flow of new enrollees in the site. The target for each site was to sample 98 women and enroll in the study an average of 55 to 56 respondents per site during the recruitment window.

Table 1-1. Domains by source of data

Domain	Source of data																					
		WIC participant survey interview																				
	Screening/ enrollment	Baseline[a]	Prenatal	1 month	3 months	5 months	7 months	9 months	11 months	13 months	15 months	18 months	24 months	30 months	36 months	42 months	48 months	54 months	60 months	72 months	WIC Admin. data	Staff survey/ key informant interviews
Socio-demographic characteristics	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
WIC site characteristics and policies																						✓
WIC program awareness and utilization			✓		✓		✓			✓			✓			✓		✓		✓		
Maternal health and lifestyle	✓	✓		✓	✓		✓			✓			✓	✓		✓		✓		✓		
Feeding experience, knowledge, attitudes, beliefs, information, advice		✓	✓	✓	✓	✓	✓			✓	✓		✓	✓		✓		✓		✓		
Hospital feeding related practices				✓																		
Current feeding practices				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓		✓		
24-hour dietary recall				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓		✓	✓		
Child health behavior/rearing practices				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		
Food access and preferences														✓		✓		✓		✓		
Child developmental milestones																✓		✓				
Child weight and length[b]														✓	✓		✓		✓	✓	✓	
WIC food package type[c]																					✓	
Contact updates			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
New caregiver characteristics				*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		

[a] After Screening/Enrollment, baseline module questions are asked at the first interview (could be prenatal, 1 month, or 3 month) in addition to the other survey module completed at that same interview.

[b] Reported height and weight are gathered from interviews at months 30, 36, 48, 60 and 72. WIC administrative records or health care provider records are used for actual height and weight measures when the babies are born and at months 6, 12, 24, 36, 48, 60, and 72.

[c] Maternal food package data are collected at postnatal certification and at 6 months. Infant food package data are collected at initial infant certification, 6-month mid-certification, and 11 months. Food package data are not collected after 11 months because there is only one non-medical food package for children ages 1-4 years.

* These questions are asked anytime someone permanently replaces the primary caregiver.

In all but three of the 80 sites, an on-site Westat field recruiter was responsible for screening and enrolling eligible participants into the study.[13] To be eligible for the study, the participant needed to speak English or Spanish, be at least 16 years of age, and enroll in WIC for the first time for her current pregnancy or enroll a new baby less than 2.5 months old. WIC staff certifying new WIC enrollees identified eligible study participants. The on-site recruiter explained the study to the potential study participant, who was randomly assigned as a candidate for either the core or supplemental group. The recruiter then completed a computerized screener to verify study eligibility, obtained written informed consent, and conducted a computerized 10-minute enrollment interview. If interested participants could not stay to be enrolled on site, the recruiter followed up by telephone and conducted the screener and enrollment interview over the phone. All participants were given a $50 incentive for enrolling in the study and subsequent cash incentives for each completed interview.

A total of 6,775 WIC participants were referred to the study across the 80 sites and 4,367 were enrolled. Table 1-2 shows the disposition status of all participants referred. Study eligibility was undetermined for 987 referred participants, 816 refused to complete the referral form or screener, and 171 left the WIC site before completing the screener and could not be reached by telephone.

Table 1-2. Status of all referred participants

Total referred	Eligible	Enrolled	Ineligible	Eligibility undetermined
6,775	4,489	4,367	1,299	987

1.5.2 Interviewing WIC Participants

The study is conducting follow-up interviews with WIC participants over a 7-year period, beginning in July 2013 and ending in July 2020. Study participants assigned to the core sample are interviewed more frequently than those in the supplemental sample. As shown in Table 1-3, WIC participants in the core sample who enrolled prenatally are contacted to be interviewed 18 times over approximately a 7-year period, and women who enrolled in WIC after giving birth participate in 16 or 17 interviews (depending on the age of their child when they enroll). If their baby is less than 6 weeks old, they start with the 1-month interview; however, if their baby is between 6 weeks and 2.5 months old, they start with the 3-month interview. In the supplemental sample, women either

[13] In three sites, WIC staff identified eligible women and sent their contact information to Westat; Westat interviewers recruited the women by telephone.

receive a 1-month or a 3-month interview, but not both. Those who enrolled prenatally or before their child was 6 weeks old receive a 1-month interview, whereas those enrolled after the baby is 6 weeks old receive a 3-month interview. All supplemental sample women are interviewed at ten additional time points.

Table 1-3. Frequency of interviews for core and supplemental samples

Status of pregnancy at time of WIC enrollment	Interview schedule																		Total
	Prenatal	1 month	3 months	5 months	7 months	9 months	11 months	13 months	15 months	18 months	24 months	30 months	36 months	42 months	48 months	54 months	60 months	72 months	
Core sample																			
Prenatal	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	18
Infant <6 weeks		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	17
Infant 6 weeks – 2.5 months			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	16
Supplemental sample																			
Prenatal		✓			✓			✓			✓	✓	✓	✓	✓	✓	✓	✓	11
Infant <6 weeks		✓			✓			✓			✓	✓	✓	✓	✓	✓	✓	✓	11
Infant 6 weeks – 2.5 months			✓		✓			✓			✓	✓	✓	✓	✓	✓	✓	✓	11

The prenatal interviews were all completed within 60 days of enrollment. The follow-up interviews are scheduled based on the child's birthday; the window for conducting the follow-up interview starts 14 days before the child turns the age of the interview (e.g., 14 days before the child is 1 month old, 3 months old, etc.).

Because women could enroll in WIC at any stage in their pregnancy and many participants were recruited after the baby was already born, the length of time each follow-up interview is in the field is about 15 months.

Per the caregiver's preference, the telephone interviews are conducted in English or Spanish. All post-birth interviews except the 30-, 42-, and 54-month interviews include a 24-hour dietary recall using the USDA's Automated Multi-Pass Method (AMPM) (Raper, Perloff, Ingwersen, Steinfeldt, & Anand, 2004). The AMPM has been used to assess infant and child diet in other nationally representative studies, including the National Health and Nutrition Examination Survey (NHANES) (Ahluwalia et al., 2016). The AMPM is constructed such that the caregiver is asked to recall all her

child's dietary intake from 12:00 a.m. through 11:59 p.m. on the previous day. There are five steps to the AMPM method of collecting intake information from a respondent (Moshfegh et al., 2008):

1. Collect a ***quick list*** of all foods consumed during the target period;
2. Elicit information on nine categories of often ***forgotten foods;***
3. Collect information on ***when*** each food was consumed, and the name of each ***eating occasion***;
4. Collect ***detailed information*** on each food reported;
5. Provide a ***final opportunity*** to recall easily forgotten or disregarded foods.

Using this method, the caregiver is guided through the day and asked to report all foods, beverages, and dietary supplements for each eating event during the 24-hour period, which are recorded by the interviewer. Because the dietary recalls are conducted over the telephone, caregivers receive a package of measuring guides to help them more accurately report their child's portion sizes during the interview. Within 10 days of the initial dietary intake interview, the study collects a second, replicate intake on a randomly selected 10 percent subsample of children at 13, 15, 18, 24, 36, 48, 60, and 72 months to use in estimating "usual" intake of energy and nutrients for all respondents.[14] The interview data are then coded and analyzed for nutrient and food group content.[15]

1.5.3 Collecting Food Package Data

Throughout the first year of the child's life, WIC administrative data are used to identify what WIC food packages the mother and child are receiving. The study collects maternal food package information at postnatal certification and at 6 months, while infant food package information is collected at initial infant certification, at 6-month mid-certification, and at 11 months. Food package data are not collected after 11 months because there is only one non-medical food package for children ages 1-4 years (food package IV).

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[14] See Appendix B3 for details of the computation of usual intake using the NCI Method.

[15] Nutrient content of breastmilk is listed in the USDA Food and Nutrient Database for Dietary Studies (Ahuja et al., 2012) used to determine nutrient content of all AMPM reported foods.

1.5.4 Collecting Height and Weight Data

The study collects administrative weight and length/height measurements of the children at birth, 6 months, 12 months, 24 months, 36 months, 48 months, 60 months, and 72 months. As part of regular clinic visits, WIC sites collect these data for most enrolled participants and report the information to the State. The study then requests these measurements from the state's WIC administrative data. Through 24 months, for participants who are in the core sample and have left WIC, the study attempts to collect weight and length information from the child's health care provider. For those who do not have a health care provider, study staff arrange for a local home health agency to obtain weight and length measurements. After 24 months, the study asks all participants who are no longer receiving WIC to return to the WIC site to be measured, visit their health care provider for measurement, or agree to a home health agency visit. Caregiver reports of a recent child weight and height measurement are also sought during telephone interview at ages 30-, 36-, 48-, 60-, and 72-months.[16]

1.5.5 Conducting Site Visits and Key Informant Interviews

To characterize the policies and services of the sites, an onsite visit was conducted by Westat's partner, Altarum Institute, to each of the 80 sites between June and November 2013. The visits included observation of service delivery and a 1-hour key informant interview with the site supervisor or coordinator and other staff identified by the State or site. Additional key informant interviews were also conducted with one or more staff of each of the 27 SAs by telephone. The State WIC Director determined the appropriate staff member(s) for the SA interviews. The key informant interviews covered staff qualifications and training, nutrition education, breastfeeding support, and food package choices and policies. These data were used to create WIC program-related composite variables for analyses (see Borger et al., 2018, Appendix B2 for details).

1.5.6 Conducting the WIC Staff Survey

To obtain detailed information about staff qualifications that may affect how services are delivered, Altarum conducted a web survey between July and December 2013 to collect information from

[16] Caregivers were asked to provide recent height and weight measurements, the date of measurement, and whether the measurement was taken at home, at WIC, or by a health care provider. For analyses in the current report, maternal reports of height and weight were excluded to ensure consistency in the measurement techniques.

WIC staff members who were working in the study sites during the time period when participants were being recruited for the study. The online survey took approximately 30 minutes to complete, and covered staff demographic characteristics and education, WIC training, beliefs about WIC program impacts and influences on infant and child feeding practices, nutrition and breastfeeding education, materials, recommendations, and staff health behaviors. All staff members at each of the 80 study sites were asked by local leadership to complete a survey. A total of 802 staff completed the survey, and surveys were received from all 80 sites. These data were used to create WIC program-related composite variables for analyses (see Borger et al., 2018, Appendix B2 for details).

1.6 Weighting and Imputation

The data are weighted to support national estimates. The weights inflate the sample to represent the population and compensate for both the unequal sampling rates and nonresponse. For WIC ITFPS-2, the sample is weighted to represent the national population of infants enrolled in WIC for the first time either while the mother is pregnant, or postnatally before 3 months of age, whose mothers are at least 16 years old, speak either English or Spanish, and enroll in WIC initially at a site expected to enroll at least 30 new pregnant women or infants per month. All study findings are reported as percentages or proportions, and represent the characteristics, views, behaviors, and experiences of this population. Because the recruitment period for the study spanned 20 weeks, the weighted number of cases shown in the report tables is an estimate of the number of infants in the represented population who enrolled nationally during that 20-week period (July – November 2013). It is not an estimate of the monthly or annualized total number of WIC participants nationally, and should not be used as such.

The complex sample design also affects variance estimation. Replicate weights that facilitate accurately estimating the variances given the sample design are provided. Additionally, although almost all study participants have answered all the questions regarding key socio-demographic characteristics, there are few cases of item nonresponse for these variables. As these variables are used repeatedly in the analysis, missing baseline socio-demographic information has been imputed. Appendix B1 offers additional detail on weighting and imputation.

1.7 Sample Characteristics

As shown in Table 1-4, 4,489 new WIC enrollees were eligible to participate in the study and of those 4,367 (97%) were enrolled. Of these enrollees, 2,649 women are in the prenatal core sample and completed a prenatal interview. Similarly, across all the sampling groups, 3,777 respondents completed at least 50 percent of the core baseline module questions in the 1- or 3-month interview and were therefore eligible to continue in the study. These individuals comprise the main analysis sample.

Table 1-4. Study sample participation

Sample and enrollment timing	Eligible sample, screened and eligible	Enrolled sample, consented and enrolled	Percentage of enrolled sample used for prenatal analysis (N)	Percentage of enrolled sample used for main analysis (N)
Total sample	4,489	4,367	60.7% (2,649)	86.5% (3,777)
Core sample	3,605	3,503	–	86.2% (3,020)
Prenatal core sample	3,122	3,037	87.2% (2,649)	85.5% (2,596)
Postnatal core sample	483	466	–	91.0% (424)
Supplemental sample	884	864	–	87.6% (757)
Prenatal supplemental sample	688	678	–	86.9% (589)
Postnatal supplemental sample	196	186	–	90.3% (168)

Because women are both recruited into the study and have their babies over a long time window, their interviews are occurring at different times. Table 1-5 shows the percentage of the analysis sample that has completed interviews through 36 months postpartum. Table 1-6 shows the percentage of participants on whom the study received weight/length and food package data through 36 months.

Table 1-5. Counts and percentage of respondents who completed interviews by sample type and interview month

Interview	Percentage of the analysis sample that completed the interviews		
	Total combined sample (N=3,777)	Core sample (N=3,020)	Supplemental sample[a] (N=757)
Prenatal	70.1% (2,649)	87.7% (2,649)	NA
Month 1	90.0% (3,398)	90.5% (2,734)	87.7% (664)
Month 3	76.3% (2,881)	92.3% (2,788)	12.3% (93)
Month 5	69.8% (2,636)	87.3% (2,636)	NA
Month 7	83.0% (3,134)	83.2% (2,514)	81.8% (620)
Month 9	64.9% (2,451)	81.2% (2,451)	NA
Month 11	61.5% (2,322)	76.9% (2,322)	NA
Month 13	74.3% (2,807)	74.1% (2,239)	75.0% (568)
Month 15	54.7% (2,067)	68.4% (2,067)	NA
Month 18	52.7% (1,992)	65.9% (1,992)	NA
Month 24	65.2% (2,461)	64.1% (1,937)	69.2% (524)
Month 30	69.5% (2,625)	68.6% (2,071)	73.2% (554)
Month 36	69.0% (2,608)	67.7% (2,044)	74.5% (564)

[a] Supplemental sample is interviewed at either 1 month or 3 months, but not both.

NA denotes not applicable.

Table 1-6. Counts and percentage of analysis sample respondents on whom the study received weight and length data, and food package data

Data collection time points	Number received	Number expected	Percent received of expected
Weight and length measurements[a]			
6-month measurements	2,568	3,551	72.3%
12-month measurements	2,577	3,497	73.7%
24-month measurements	1,731	3,291	52.6%
36-month measurements	1,886	3,777	49.9%
Infant food package prescriptions[b]			
Initial infant certification	3,199	NA	NA
6 month	3,047	NA	NA
11 month	2,979	NA	NA

[a] Supplemental sample measurements for 6-, 12-, and 24-months were only sought from WIC records, and therefore not expected from participants not receiving WIC, thus numbers are smaller than the full analysis sample of 3,777.

[b] Mothers' food package data were also collected at postpartum certification and at 6 months.

NA denotes not applicable. Food package data are received on every study participant the selected WIC SAs identify as currently enrolled in WIC in that state and therefore receiving a food package.

Table 1-7 provides a summary of select, unweighted socio-demographic characteristics of the main analysis sample. The data in this table are based on the 3,777 women who completed a 1- or 3-month interview. If a participant did not complete the 24-month interview, these data are imputed (see Appendix B1 for details). For 36-months the variables are not imputed, and include only those participants who answered the question at the 36-month interview.

Table 1-7. Unweighted socio-demographic characteristics of main analysis sample

Socio-demographic characteristics[a]	Percentage of main analysis sample (count)[b]
Race of mother/caregiver	
African American	25.6 (965)
White	58.7 (2,218)
All Other	15.7 (594)
Ethnicity of mother/caregiver	
Hispanic or Latino	38.3 (1,445)
Not Hispanic or Latino	61.7 (2,332)
Maternal/caregiver marital status at 24 months	
Married	33.9 (1,280)
Not married (including divorced and widowed)	66.1 (2,497)
Maternal/caregiver marital status at 36 months	
Married	37.3 (970)
Not married (including divorced and widowed)	62.7 (1,629)
Household food security (measured using 6-item module) at 24 months	
High or Marginal Food Security	71.0 (2,680)
Low Food Security	17.7 (668)
Very Low Food Security	11.3 (429)
Household food security (measured using 6-item module) at 36 months	
High or Marginal Food Security	73.1 (1,907)
Low Food Security	16.3 (425)
Very Low Food Security	11.6 (275)
Participation in non-WIC programs at 24 months	
Does not participate in other programs	18.0 (681)
Participates in SNAP or in SNAP and other programs	46.6 (1,761)
Participates in Other Programs Excluding SNAP	35.4 (1,335)
Participation in non-WIC programs at 36 months	
Does not participate in other programs	18.6 (483)
Participates in SNAP or in SNAP and other programs	49.6 (1,288)
Participates in Other Programs Excluding SNAP	31.8 (824)
Timing of WIC enrollment	
1st trimester	29.6 (1,118)
2nd trimester	38.9 (1,471)
3rd trimester	16.1 (608)
Postnatal	15.4 (580)
Weight status of mother at 24 months	
Normal or underweight	37.0 (1,399)
Overweight	28.5 (1,078)
Obese	34.4 (1,300)
Poverty level at 24 months	
75% of poverty guideline or below	47.9 (1,808)
Above 75% but ≤ 130% of poverty guideline	31.3 (1,182)
Above 130% of poverty guideline	20.8 (787)
Poverty level at 36 months	
75% of poverty guideline or below	44.5 (1,109)
Above 75% but ≤ 130% of poverty guideline	30.9 (771)
Above 130% of poverty guideline	24.6 (612)
Age of mother or caregiver at child birth[c]	
16-19 years	11.8 (446)
20-25 years	41.5 (1,569)
26 years or older	46.7 (1,762)

Table 1-7. Unweighted socio-demographic characteristics of main analysis sample (continued)

Socio-demographic characteristics[a]	Percentage of main analysis sample (count)[b]
Child WIC participation status at 24 months	
Receiving WIC at 24 months	68.4 (2,583)
No longer receiving WIC at 24 months	31.6 (1,194)
Child WIC participation status at 36 months	
Receiving WIC at 36 months	56.8 (1,481)
No longer receiving WIC at 36 months	43.2 (1,125)

[a] If the participant does not complete the 24-Month Interview, or the data are missing, data are imputed. 36-month variables are not imputed if missing, and include only those participants who answered the question at the 36-month interview.

[b] The Main Analysis sample includes 3,777 cases that have completed a 1- and/or 3-month interview. Counts may sum to less than 3,777 due to item or survey non-response.

[c] Maternal age is significantly associated with parity, such that older mothers are likely to have additional children older than the target child. Therefore, some associations with maternal age may also be attributed to having older children.

Data source: Interview questions SD1, SD2, SD3, SD4, SD14, SD18, SD19, SD21, SD31, SD36-40, MH1,and MH13.

The baseline (for static characteristics) and 24-month (for changeable characteristics) socio-demographic variables in Table 1-7 serve as key subgroup variables, and the study examines 30- and 36-month outcomes of interest among these subgroups.[17] Of the 3,777 respondents, the majority are White (59%), unmarried (62%), report their families to be at high or marginal food security at 24 months (71%), and report receiving WIC at 24 months (68%). Approximately one-quarter (26%) are African American and almost 40 percent are of Hispanic or Latino ethnicity. Thirty-seven percent consider themselves normal weight or underweight at 24 months, while 34 percent are obese. Most women (69%) enrolled in WIC in their first or second trimester, and only a small number (about 15%) enrolled their baby in WIC postnatally without having enrolled during pregnancy. Nearly half (48%) are at or below 75 percent of the poverty guideline. Forty-seven percent of the women's households participate either in the Supplemental Nutrition Assistance Program (SNAP), or in SNAP plus other public assistance programs such as Temporary Assistance for Needy Families (TANF), Medicaid, or the National School Lunch Program (NSLP).

1.8 Analysis

The analysis addresses the research questions posed by FNS, as well as supplementary questions. The focus of analyses in the current report is on outcomes reported during the third year of life (30 and 36 month interviews, and height and weight measurements around the third birthday), both for the study population as a whole and by key socio-demographic subgroups. Where possible, WIC

[17] The baseline/24 month socio-demographic variables are used for subgroup analyses instead of 36-month socio-demographic variables to allow lagged influences of context on behaviors to emerge in the data, and to avoid analyzing 30-month data by future (36-month) subgroup membership.

ITFPS-2 data from 24-months are also presented to provide longitudinal context for the current findings. Additionally, some analyses are conducted to replicate analyses from the Gerber/Nestle 2008 and 2016 FITS studies. This report therefore compares current findings to 24-month findings from the study, to relevant past work, and to current objectives and standards.

Many of the research questions can be answered by descriptive analyses that tabulate the responses to specific interview questions; however, a subset focuses on understanding the underlying population and program factors that may drive nutritional and weight outcomes. Behavioral models are used to answer these types of questions.

1.8.1 Descriptive Analyses

Descriptive statistics (e.g., counts, proportions, means, medians, and cross-tabulations) are used throughout the report to examine outcomes by subgroups of interest. Measures of interest are analyzed by a standard set of socio-demographic variables shown previously in Table 1-7, and these subgroups are compared to determine if the differences between them are statistically significant. Bivariate analyses consider the association of each variable individually with the outcome of interest. Bivariate analyses, such as chi-square tests of independence, are used to explore whether these associations are statistically significant. Although chi-square indicates whether an outcome varies significantly by subgroups (for example whether breastfeeding initiation rates vary across racial subgroups), it does not identify which subgroup(s) are different from others. To examine whether the difference between two specific subgroups is statistically significant (for example whether a feeding practice is significantly different between White and African American women), followup tests such as t-tests are conducted between all possible pairs of subgroups, also called pairwise tests. Throughout the report, analyses explore participants' characteristics and behaviors by these subgroups. For subgroup findings that are both statistically significant and large enough in magnitude to be practically meaningful in context, the bivariate chi-square results and the follow-up pairwise tests are described in the text.[18]

As many of these socio-demographic variables measure similar concepts, initial analyses explore the associations between selected variables using our prenatal analysis sample of 2,649 women based on

[18] Differences in proportions are typically discussed if they are more than 3 percentage points in magnitude and/or form a pattern over time or items. This is done to reduce the likelihood of Type I (false positive) error, and avoid overinterpreting these very small effect sizes [see Cohen, J. (1988). Statistical power analysis for the behavioral sciences. 2nd edition].

chi-square tests of independence[19] as shown in Table 1-8. Ethnicity, marital status, and participation in non-WIC benefit programs are significantly associated with the greatest number (six) of other selected socio-demographic variables. This suggests that many of these socio-demographic variables are strongly related and may be measuring the same phenomenon.

Table 1-8. Correlated[a] socio-demographic variables

Socio-demographic characteristic	Race	Ethnicity	Marital status	Food security	Non-WIC benefits	Parity	Timing of WIC enrollment	Weight before pregnancy	Breastfeeding history	Poverty level
Race		✓	✓		✓				✓	
Ethnicity	✓			✓	✓		✓		✓	✓
Marital status	✓				✓	✓	✓		✓	✓
Food security		✓			✓			✓		✓
Non-WIC benefits	✓	✓	✓	✓		✓			✓	✓
Parity			✓		✓			✓		
Timing of WIC enrollment		✓	✓					✓		
Weight before pregnancy				✓		✓	✓		✓	
Breastfeeding history	✓	✓	✓		✓			✓		
Poverty level		✓	✓	✓	✓					

[a] Check marks indicate statistically significant correlations at $p \leq 0.05$.

Data source: Interview questions SD2, SD3, SD4, SD14, SD15, SD18, SD19, SD21, SD36 – 40, MH1, MH2, MH29, KA2, and KA6.

1.8.2 Multivariate Models

For the subset of the research questions that focus on identifying the relationships that drive the outcomes and decisions observed, bivariate analyses alone are not sufficient to address the questions. Outcomes are jointly determined by a variety of factors, thus multivariate analyses such as regression analysis use weighted data to explore how choices and characteristics impact outcomes such as child weight-for-length status. Multivariate analyses isolate the unique effects of individual variables on an outcome, while holding the influence of other variables constant. For example, multiple regression can be used to capture the unique effect of household poverty level on child BMI category, independent of any influence of the caregiver's marital status. As compared to bivariate analyses, multivariate analysis typically finds a more limited set of socio-demographic variables have a statistically significant association with the outcome.

[19] Chi-square tests are appropriately adjusted for our complex sample design. Statistical significance is at the 95 percent confidence level.

1.8.3 Statistical Tests

The majority of analyses for this report involve cross-tabulations of topical variables by one or more key socio-demographic variables. Significance tests are conducted on the cross-tabs to determine whether the variable of interest is associated with the socio-demographic variable. When the variable of interest is a proportion, a chi-square test, appropriately adjusted for our complex sample design, is used to determine if observed differences were statistically significant or more likely the result of random sampling error. If the variable of interest is a mean, a t-test, also adjusted for our complex sample design, is used to determine whether the differences were statistically significant. The Bonferroni correction method for comparing multiple means is employed as well. For the models, replication methods are used to estimate the sampling errors of estimators, based on our complex sample design. Statistical significance for analyses is at the level of $p \leq 0.05$.

1.8.4 Missing Item Data

Item nonresponse is reflected in the total number of observations available for analysis. Responses of "Don't Know" are typically considered item nonresponse and are, therefore, treated as missing for the purposes of analysis. The one exception involves statements of belief or intention. In such cases, the response of "Don't Know" is included as a valid response.

Missing responses for key socio-demographic variables were imputed. Any difference in sample sizes between interview questions is attributable to item nonresponse for variables of interest that were not one of the standard set of key socio-demographic variables.

Environmental Engagement of WIC ITFPS-2 Families 2

Key Findings:

At child age 30 months:

- Forty-nine percent of study mothers are working, and 15% are in school. Nine percent are doing both.
- Fifty percent of study children are in a regular non-parental child care arrangement. The most common care arrangement is having a provider care for the child in that provider's home, center-based child care is becoming more common.
- For 42% of the children in regular care, the provider is fully responsible for the child's food while in care. When looking only at children in care at centers, family daycare homes, or Early Head Start, for 78% of the children the provider is fully responsible for the food consumed in care.
- More than 90% of study children have a medical home, and more than 90% went to a doctor for a well-child visit around the time of their last (second) birthday.

At child ages 30 and 36 months:

- More than half of study children and/or mothers are receiving WIC (63% at 30 months, and 59% at 36 months).
- Approximately half of study families participate in SNAP, and about a third have a child participating in the National School Lunch Program, School Breakfast Program, or Summer Food Service Program.
- About three-quarters of study families have someone in the household receiving Medicaid.

2.1 Overview

This chapter focuses on environmental engagement in the WIC ITFPS-2 families, including work, school, and child care, as well as participation in Federal food benefit programs, and engagement with medical care. Data for this chapter are drawn from interviews conducted at child age 30 and 36 months, although data from child age 24 months are sometimes provided for context. Research questions explored in this chapter[20] include the following:

- What are the work and child care circumstances of WIC mothers?
- Who provides food to children in child care?
- Do study mothers participate in other federal food benefit programs?

[20] A complete list of research questions appears in Appendix A.

- How do study families engage with healthcare?
- Does continued participation in WIC have a positive corollary effect on access to healthcare and continuity of care?

Interview questions on work, on child care, and on child medical home and well visits are asked at 30 months, but not at 36 months. Interview questions on Federal program participation, including WIC, SNAP, Medicaid, and school and summer meals, are asked at both 30 and 36 months. Consequently, analyses include different months of data depending on the specific content.

2.2 Background

As children in the U.S. reach their third birthday, most of them are in regular non-parental care at least once a week. The 2016 National Household Education Survey found that 73 percent of children between 3 and 5 years of age spend time each week in non-parental care, with single parents more likely to use child care than two parent households (Corcoran & Steinley, 2017). Use of center-based care increases after the first birthday, with 45 percent of children 1 to 2 years and 82 percent of those 3 to 5 years participating in day care centers, Head Start, preschool, prekindergarten and other early childhood programs (Corcoran & Steinley, 2017).

Some child care providers are also responsible for providing the food children consume while in care. Child care centers, Head Start programs, and family daycare homes approved or licensed to provide childcare are eligible to participate in the federal Child and Adult Care Food Program (CACFP).[21] According to an analysis conducted using administrative data from the U.S. Department of Agriculture's Food and Nutrition Service (FNS), during 2017, 4.4 million children in nearly 64,000 child care centers and over 100,000 family daycare homes nationwide received nutritious meals through CACFP (Food Research and Action Center, 2018).

Screening and referrals to other health, welfare, and social services is one of the three core WIC benefits, along with supplemental nutritious foods and nutrition education and counseling.[22] WIC sites refer both adult and child participants to Medicaid if they are not receiving it, and to other food assistance programs (e.g. Supplemental Nutrition Assistance Program or SNAP). According to the

[21] U.S Department of Agriculture. Child and Adult Care Food Program. Retrieved from https://www.fns.usda.gov/cacfp/why-cacfp-important on August 20, 2018.

[22] U.S. Department of Agriculture. About WIC – WIC at a Glance. Retrieved from https://www.fns.usda.gov/wic/about-wic-wic-glance on August 20, 2018.

WIC Participant and Program Characteristics 2016 report, 71 percent of WIC participants were enrolled in Medicaid, and 33.2 percent were receiving SNAP benefits (Thorn et al., 2018). The National Survey of WIC Participants II reported that 65 percent of WIC local agencies provide direct referrals for a variety of healthcare and breastfeeding support services (Geller, Harrington, & Vinokurov, 2012). Research has shown that children who participate in WIC have greater use of healthcare services for prevention and treatment (Beuscher et al., 2003).

2.3 Sample and Analysis Approach

2.3.1 Sample

The analyses in this chapter utilize data from 30- and 36-month interviews. Table 2-1 shows the number of respondents to those interviews.[23] Both the core and supplemental samples were eligible for these interviews. In analyses, the responses to each interview are weighted so that findings reflect the WIC population as described in Chapter 1.

Table 2-1. Number of respondents by interview month

Sample structure	30-Month interview	36-Month interview
Core prenatal sample	1,838	1,813
Core postnatal sample	233	231
Supplemental prenatal sample	453	460
Supplemental postnatal sample	101	104
Total	2,625	2,608

2.3.2 Analysis

The analyses in this chapter examine work, school, child care choices, as well as participation in Federal food benefit programs, and engagement with medical care. Analyses also explore whether socio-demographic subgroups of participants differ on outcomes of interest during the third year. Socio-demographic characteristics were typically measured at the time of the first interview. For

[23] Because the study is longitudinal, and participants are retained for future events if they miss an interview, the number of respondents at each interview may fluctuate either up or down over time.

characteristics that change over time, such as food security or income relative to the poverty guideline, socio-demographic subgroups are updated to values reported at the 24-month interview.[24]

Analyses include bivariate analysis to examine whether an outcome of interest varies by subgroup, and follow-up t-tests between all pairs of subgroups to determine which subgroups are statistically significantly different from each other. Subgroup differences discussed in the chapter are limited to those that form a pattern over time or across questions, and are large in magnitude, to avoid focusing on findings that, while statistically significant, may have little practical importance.[25] Statistical significance, when indicated, is at the level of $p \leq 0.05$.

2.4 Working and Going to School

The following analyses explore the engagement of WIC ITFPS-2 mothers in work and/or school. This includes whether mothers are working full-time, part-time, or not working outside the home. Analyses also explore whether mothers are in school, and whether there are mothers who combine work and school.

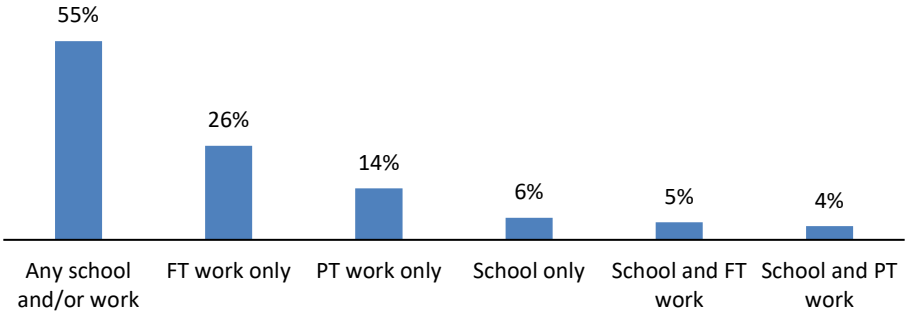
2.4.1 Work and School at 30 Months

More than half of study mothers (55%) report working, going to school, or doing both at the time of the 30-month interview (see Figure 2-1). The largest group among these is the 26 percent of mothers working full-time (FT) and not in school, followed by 14 percent of mothers working part-time (PT) and not in school. Six percent of mothers are in school and not working for pay, 5 percent are in school and work FT, and 4 percent are in school and work PT.

[24] The baseline/24 month socio-demographic variables are used for subgroup analyses instead of 36-month socio-demographic variables to allow lagged influences of context on behaviors to emerge in the data, and to avoid analyzing 30-month data by future (36-month) subgroup membership.

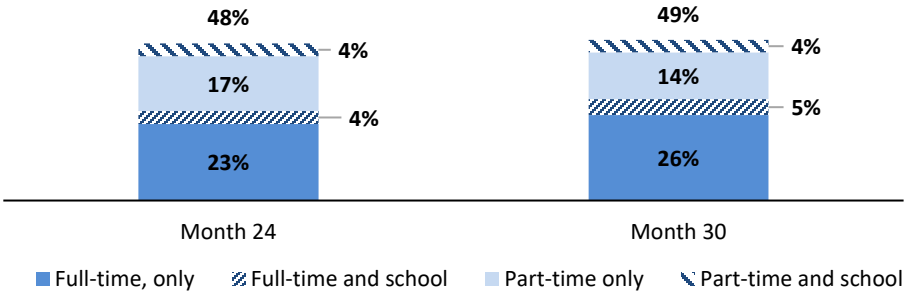
[25] Differences are typically discussed if they are more than 3 percentage points in magnitude and/or form a pattern over time or items. See Chapter 1 for details.

Figure 2-1. The percentage of WIC ITFPS-2 mothers working and going to school (month 30)



At the time of the 30-month interview, 49 percent of WIC ITFPS-2 mothers report working for pay. This is very similar to 24 months, when 48 percent of WIC ITFPS-2 mothers are employed. Figure 2-2 presents the total percentage of caregivers working at 24 and 30 months, and the breakdown by FT and PT employment, including whether the caregiver is in school while working. The data suggest a subtle shift to FT employment, with 27 percent of mothers working FT at 24 months, and 31 percent working FT at 30 months. At the same time there is a slight reduction in PT employment, with 21 percent of mothers working PT at 24 months, and 18 percent working PT at 30 months.

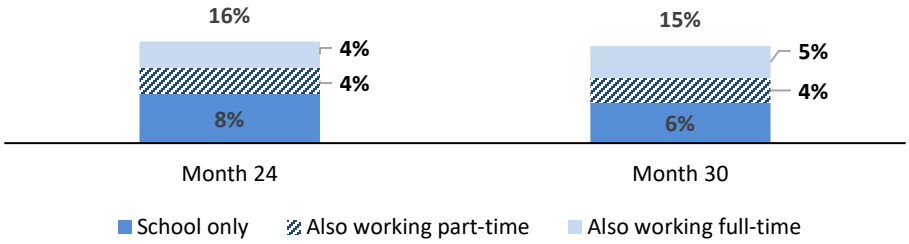
Figure 2-2. The percentage of WIC ITFPS-2 mothers working and going to school by work status (months 24 and 30)



NOTE: See Appendix B2a, Table B2a-1 for more details.

At 30 months, 15 percent of study mothers are in school (see Figure 2-3). Of those mothers, more than half are also working for pay, either PT or FT. Between 24 months and 30 months, the percentage of mothers in school remains relatively stable. The percentage of mothers who report being in school, but are not working, decreases slightly from 8 percent to 6 percent.

Figure 2-3. The percentage of WIC ITFPS-2 mothers attending school, by work status (months 24 and 30)

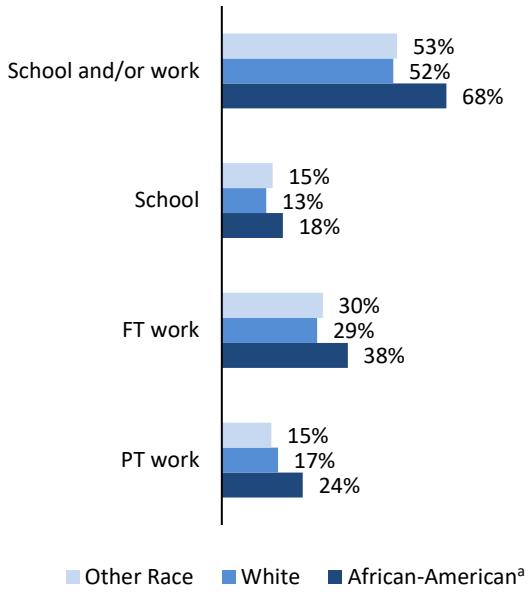


NOTE: See Appendix B2a, Table B2a-2 for more details.

2.4.2 Characteristics of Those Working and/or Going to School at 30 Months

At 30 months chi-square tests yield statistically significant associations between working and/or going to school and race, ethnicity, marital status, participation in non-WIC benefit programs, income relative to the poverty guideline, and child 24-month WIC participation status. The most consistent associations are by maternal race (see Figure 2-4). Follow-up pairwise t-tests indicate that African-American mothers are more likely to work and/or go to school, more likely to work FT, and more likely to work PT, than are White mothers or those in the Other race category. They are also more likely to go to school than are White mothers.

Figure 2-4. The percentage of WIC ITFPS-2 mothers attending school and work, by race (month 30)



NOTE: See Appendix B2a, Table B2a-3 for more details.
[a]African-American mothers are significantly more likely to work and/or go to school, more likely to work FT, and more likely to work PT, than are White mothers or those in the Other race category. They are also more likely to go to school than are White mothers.

Additional follow-up pairwise t-tests yield several additional associations. Non-Hispanic mothers are more likely to be working and/or going to school than are Hispanic mothers. Unmarried mothers are more likely to work and/or go to school than are their married counterparts. Mothers whose households do not participate in benefit programs other than WIC are more likely to work and/or go to school than are mothers whose households participate in benefit programs other than WIC but do not participate SNAP, or whose households participate in SNAP (with or without other non-WIC benefit programs). Overweight mothers are more likely to work or go to school than obese mothers. Those in the highest income category (above 130% of the poverty guideline) are more likely to be working and/or going to school than those in lower income categories (76%-130%, or 75% and below). Mothers of children not receiving WIC at 24 months are more likely to be working and/or going to school than mothers of children receiving WIC. See Appendix B2a, Table B2a-3 for more details.

In summary, at 30 months, 55 percent of study mothers are working and/or going to school. This includes 40 percent of mothers who are working but not going to school, 6 percent who are in school but not working, and 9 percent who are doing both.

2.5 Child Care Use and Feeding Practices

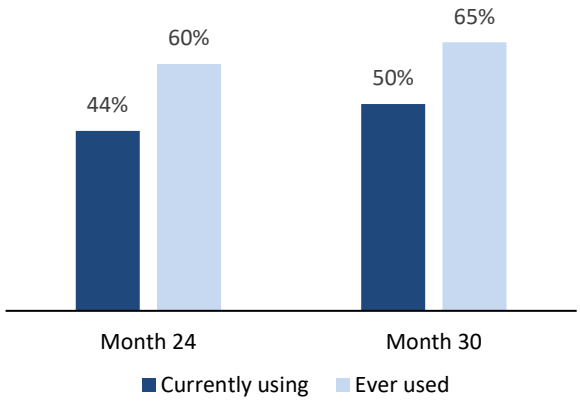
WIC ITFPS-2 continues to explore the use of child care at 30 months. The study defines regular child care as an arrangement in which someone other than the child's primary caregiver or the other parent cares for the child on a regular basis.

Analyses explore overall use of child care, types of child care used, and who provides food for children in regular child care arrangements.

2.5.1 Child Care Use and Types at 30 Months

Figure 2-5 presents the percentage of study children currently in regular child care, and the percentage who have ever been in regular child care. The percentage of children ever in child care increases slightly between 24 and 30 months from 60 percent to 65 percent, indicating that more children have entered child care for the first time during this period. The percentage currently in child care also increases, from 44 percent at 24-months to 50 percent at 30 months.

Figure 2-5. The percentage of study children in regular child care, currently and ever



NOTE: See Appendix B2a, Table B2a-4 for more details.

WIC ITFPS-2 asks caregivers who currently use regular child care to indicate the type of child care used. Response options include: child care centers; family daycare homes; Early Head Start; someone cares for the child in their home; someone cares for the child in the child's home; or another kind of arrangement not specified. Table 2-2 presents the percentage distribution of study children currently in regular child care at each month, by type of child care arrangement.

Table 2-2. Percentage of study children in regular child care by type of child care (months 24 and 30)

Type of Child Care	Month 24	Month 30
Currently using any type of child care	**43.7%**	**50.3%**
Someone cares for child in their home	15.5	17.2
Someone cares for child in the child's home	13.8	10.5
Child care center	10.1	15.5
Family daycare home	2.6	3.1
Early Head Start	1.4	3.5
Other	<1.0	<1.0
Unweighted n	2,461	2,625
Weighted n	442,405	442,408

Looking across interview months, there are slight shifts among the most common types of child care between 24 and 30 months. At both time points, children are most often cared for in someone else's home. By 30 months, however, a smaller proportion of the children are in regular care in their own homes, and a larger proportion are in child care centers. Early Head Start also becomes more common.

Chi-square testing indicates that at 30 months, there is a statistically significant association between current use of regular child care and race, ethnicity, marital status, income relative to the poverty guideline, maternal age at the birth of the child, and child's WIC participation status at 24 months. Follow-up pairwise t-tests are used to clarify these bivariate associations: African-American mothers are more likely to use regular child care than White or Other race mothers; Non-Hispanic mothers and unmarried mothers are more likely than their counterparts to be using regular child care; for each income group, those in the higher groups are more likely to use regular child care than those in the lower groups; mothers who were 16-19 years old when the child was born are more likely to use regular care than those who were 26+ years old; and, mothers whose children were not receiving WIC at 24 months are more likely to use child care than those receiving WIC at 24 months. See Appendix B2a, Table B2a-5 for details.

Chi-square testing also indicates some statistically significant associations between type of child care used at 30 months and socio-demographic characteristics. The differences that are large in magnitude are in the use of child care centers. African-American mothers and Non-Hispanic mothers are more likely to use child care centers than their counterparts. Mothers whose households are in the lowest income group (as compared to those in the highest income group), and mothers whose children are receiving WIC at 24 months, are less likely to use child care centers than their counterparts (See Table 2-3). Some of these differences may reflect personal preference, but the income-related difference and the WIC participation difference may also reflect the relatively higher cost of child care centers as compared to less formal arrangements (Child Care Aware of America, 2017).

Table 2-3. Significant associations between socio-demographic characteristics and use of center-based child care (month 30)

Socio-demographic Characteristics[a]	Percentage Using Center-Based Child Care	Unweighted n	Weighted n
Race			
African-American	26.0%	755	95,790
White	13.7	1,476	260,456
Other	9.8	394	86,161
Ethnicity			
Hispanic	8.7	972	204,894
Non-Hispanic	21.4	1,653	237,514
Poverty Level			
Above 130% poverty guideline	21.6	1,246	209,885
Above 75% but no more than 130% poverty guideline	17.7	882	142,132
75% of poverty guideline or below	11.5	557	90,391
WIC Participation Status at 24 Months			
Receiving WIC	13.5	1,838	318,062
Not receiving WIC	20.6	787	124,346

[a]African-American mothers and Non-Hispanic mothers are significantly more likely to use child care centers than their counterparts. Mothers whose households are in the lowest income group (as compared to the highest income group), and mothers whose children are receiving WIC at 24 months, are significantly less likely to use child care centers than their counterparts.

2.5.2 Child Care and Provision of Foods

Children in regular child care may consume many of their meals and snacks in that setting. To understand the feeding practices for children in regular child care better, analyses explore who provides the foods children eat while in child care.

Food provided to children in regular child care may come from the child care provider, the child's mother, or both the provider and the child's mother (see Table 2-4). Among mothers who report using regular child care when their infants are 24 months old, 31 percent report that the child care provider is responsible for all food, 42 percent of mothers report that they provide the food themselves; and 27 percent report that they and the providers equally split the provision of food. By 30 months the balance shifts, and 42 percent report that the child care

Table 2-4. Among study children in regular child care, percentage of children by source of food (months 24 and 30)

Source of Food	Month 24	Month 30
Child care provider	31.0%	42.4%
Mother	42.0	31.9
Equally divided	27.0	25.7
Unweighted n	1,126	1,143
Weighted n	192,728	185,094

provider is responsible for all food, 32 percent of mothers report that they provide the child's food themselves, and 26 percent report that they and the providers equally split the provision of food.

Who provides the food also differs by the type of child care arrangement. Child care arrangements may be divided into formal and informal arrangements. Formal arrangements are types of care that may be licensed and regulated, and may be eligible for food reimbursements through the Child and Adult Care Food Program (CACFP), including child care centers, family daycare homes, and Early Head Start.[26] Informal arrangements are individual arrangements in the child's home or the provider's home, as well as other (non-specified) types of arrangements. For children in formal child care arrangements, 78 percent of mothers report that the child care provider is responsible for all food. For children in informal care arrangements, only 15 percent of mothers report that the child care provider is responsible for all food.

In summary, at 30 months, 50 percent of study mothers report using a regular child care arrangement. The most common arrangement continues to be a provider caring for the child in the provider's own home, although the percentage of children in center-based care is increasing. For children in formal care arrangements, 78 percent of mothers report that the provider is responsible for all food consumed in care, whereas for informal arrangements, only 15 percent of mothers report that the provider is solely responsible for the child's food.

2.6 Participation in Federal Food Benefit Programs

Participants in WIC ITFPS-2 were all low-income at the time of enrollment, and by age two approximately 80 percent still reported household incomes at or below 130 percent of the poverty guideline. Consequently, analyses explore continued participation in WIC by the study child or mother, participation in WIC for another child in the household other than the study child, and participation of the household in the Supplemental Nutrition Assistance Program (SNAP), and the National School Lunch Program (NSLP), School Breakfast Program (SBP), or Summer Food Service Program (SFSP). Program participation questions are asked during interviews at both 30 and 36 months, thus results are reported for both months. Analyses also explore whether there are differences in program participation by socio-demographic subgroup membership.[27] Of note is that

[26] All Early Head Start programs participate in CACFP. Child care centers and family daycare homes must apply and establish eligibility to participate and receive reimbursements.

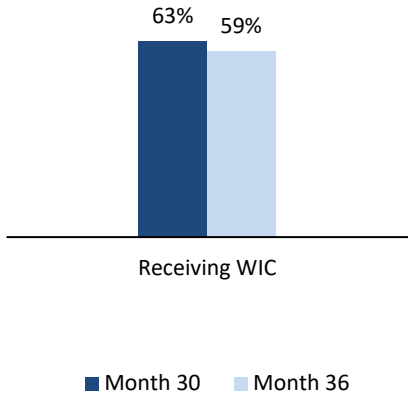
[27] As noted in section 2.3.2, socio-demographic subgroups are categorized based on data from baseline/24 month interviews.

these reports of program participation, and of household income, are self-reported by the study respondents. Neither income nor program participation is independently verified by the study.

2.6.1 WIC

During the third year of life many WIC ITFPS-2 children and/or mothers are receiving WIC. At 30 and 36 months more than half of study mothers report that either they or the study child is receiving WIC food or checks (30 months: 63%; 36 months: 59%; see Figure 2-6).

Figure 2-6. The percentage of WIC ITFPS-2 mothers reporting they receive WIC for themselves or the study child (months 30 and 36)



NOTE: See Appendix B2a, Table B2a-6 for more details.

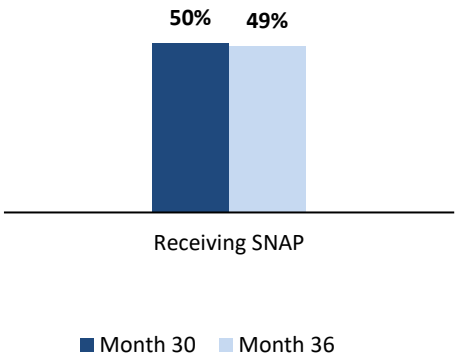
Chi-square analyses yield several associations between socio-demographic subgroup membership and WIC participation that are significant and persist at both 30 and 36 months. Mothers in the Other race category are more likely than White or African-American mothers, and Hispanic mothers are more likely than non-Hispanic mothers, to receive WIC for themselves or the target child at 30 and 36 months. Households that do not participate in other federal benefit programs, and households in the highest income group relative to the poverty guideline, are less likely to receive WIC than their counterparts. See Appendix B2a, Tables B2-7a and b for details.

In approximately a quarter of study families, another child in the family, other than the study child, is also receiving WIC at 30 months (23%) and 36 months (25%).

2.6.2 SNAP

At both 30 and 36 months, approximately half of WIC ITFPS-2 mothers report participating in SNAP (30 months, 50%; 36 months, 49%; see Figure 2-7). Chi-square analyses yield significant associations between SNAP participation at both 30 and 36 months and several socio-demographic subgroup characteristics, including maternal race, marital status at 24 months, maternal body mass index (BMI) category at 24 months, and income-related characteristics including income and participation in WIC at 24 months. African-American mothers and unmarried mothers are more likely to participate in SNAP at both 30 and 36 months. Mothers whose BMIs are classified as normal or underweight at 24 months are less likely to participate in SNAP at either 30 or 36 months than mothers whose BMIs are in the overweight or obese categories. Mothers who report having lower income relative to the poverty guideline, and those who have children participating in WIC at 24 months, are more likely to participate in SNAP at 30 and 36 months. See Appendix B2a, Table B2a-8 a and b for details.

Figure 2-7. The percentage of WIC ITFPS-2 mothers reporting they participate in SNAP (months 30



2.6.3 School and Summer Food Programs

At both 30 and 36 months, the interview probes whether any children in the household are participating in the NSLP, SBP, or SFSP. At 30 months, 35 percent of study mothers reported that a child in the household was getting food from one or more of these programs, and at 36 months it rose slightly to 37 percent.[28]

Socio-demographic subgroup characteristics that are significantly associated with participation in any of these programs at both 30 and 36 months include income relative to the poverty guideline, age of

[28] As with other benefit programs, the study did not collect information that ascertains whether anyone in the household is eligible for NSLP, SBP, or SFSP, including whether the household contains age-eligible children.

mother at the birth of the child, and child WIC participation status at 24 months. The highest income households, younger mothers (who may be less likely to have school-age children in the household), and those not receiving WIC at 24 months, are less likely to have children in the household participating in NSLP, SBP, or SFSP. See Appendix B2a, Table B2a-9 a and b for details.

In summary, at 30 and 36 months, WIC ITFPS-2 families are participating in federal food benefit programs. More than half of study families are still participating in WIC at 30 and 36 months. Half of the study families participate in SNAP, and slightly more than a third have a child in the household participating in NSLP, SBP, or SFSP.

2.7 Medical Care

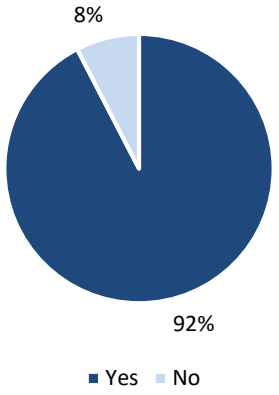
An important facet of WIC services is ensuring that children are receiving necessary medical care, through educating parents and through referrals.[29] WIC ITFPS-2 explores medical care and health resources used by study families in the third year by asking at 30 months whether the children have a medical home for regular care and whether the children had a well-child doctor's visit around the time of their second birthday, and whether anyone in the household receives Medicaid.

2.7.1 Medical Home

At 30 months, nearly all study mothers (92%) reported that their children have a doctor's office, health clinic, or other medical facility that they go to for routine physical examinations or well-child check-ups (see Figure 2-8).

There are no significant associations between having a medical home and socio-demographic subgroup characteristics that are meaningfully large in magnitude. The few associations that emerge are

Figure 2-8. The percentage of study children who have a medical home (month 30)



[29] U.S. Department of Agriculture. About WIC – WIC at a Glance. Retrieved from https://www.fns.usda.gov/wic/about-wic-wic-glance on August 20, 2018.

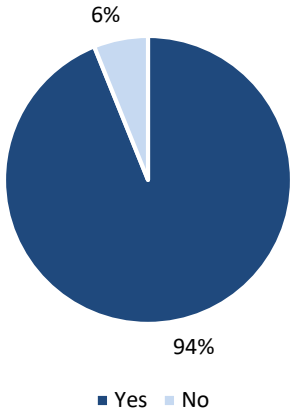
small, and within all socio-demographic subgroups 90 percent or more of children have a medical home.

2.7.2 Well Visits at Age 2

At 30 months nearly all mothers (94%) reported that the study child had a physical examination or a well-child visit around the time of his or her second birthday (see Figure 2-9).

As with having a medical home, there are no significant associations between having a medical home and socio-demographic characteristics that are meaningful, as within all socio-demographic subgroups, 90 percent or more of children have had a well-child visit around their second birthday.

Figure 2-9. The percentage of study children who had a well visit at age 2 (month 30)



2.7.3 Household Medicaid Participation

At 30 and 36 months study mothers are asked whether anyone in the household is participating in Medicaid. At both 30 and 36 months, 73 percent of households include someone who is receiving Medicaid.

There are several socio-demographic characteristics consistently associated with household Medicaid participation, including marital status, income relative to the poverty guideline, and WIC participation status of the child at 24 months. Mothers who are unmarried, who have lower incomes relative to the poverty guideline, and whose children were participating in WIC at 24 months are more likely than their counterparts to indicate household Medicaid participation at 30 and 36 months. All of these socio-demographic characteristics may be indicators of income eligibility for this means-tested program. See Appendix B2a, Table B2a-10 a and b for details.

In summary, WIC ITFPS-2 families are engaged with health care resources. Nearly all WIC ITFPS-2 children have a medical home and had a well-child doctor's visit around the time of their second

birthday. Nearly three-quarters of study mothers indicated that someone in their household is a Medicaid recipient.

2.8 Summary

More than half (55%) of WIC mothers with 30-month old children have work and/or school commitments. At 30 months, 49 percent of study mothers are working, 15 percent are in school, and 9 percent of these women are combining work and school. Although there is a slight shift between 24 and 30 months toward more FT employment and less PT employment, overall the numbers are quite stable.

The use of regular non-parental child care arrangements is increasing as children get older. Half of WIC ITFPS-2 children (50%) are in child care at age 30 months, which is a slight increase over the 44 percent in child care at age 24-months. Between 24 and 30 months use of child care centers becomes more common, and having someone care for the child in the child's home becomes less common. The most common type of arrangement is still having a provider care for the child in the provider's own home.

Food consumed at child care may be provided by the mother, the child care provider, or both. In WIC ITFPS-2 there is a shift in the balance of who provides the food for children between 24 and 30 months, with 42 percent of mothers indicating the providers are fully responsible for the child's food while in care, and only 32 percent of mothers indicating they provide all food themselves. The difference is even more extreme when one looks at CACFP-eligible types of care (center-based, family daycare homes, and Early Head Start). For children in these care arrangements, 78 percent of mothers indicate that the provider is responsible for all food consumed in care. For children in individual arrangements at their home or a provider's home, only 15 percent of mothers indicate that the provider is responsible for all food. This shift reinforces the important role that non-familial sources play in determining the children's dietary intake.

At both 30 and 36 months, more than half (63 and 59 percent, respectively) of study children and/or mothers are receiving WIC, and in approximately a quarter of families, another child is receiving WIC. Study families are also receiving benefits from other federal food benefit programs, as half the families participate in SNAP, and approximately a third have a child who participates in NSLP, SBP, or SFSP.

Nearly all study children are receiving health care. More than 90 percent of study mothers report that their children have a medical home, and had a well-visit around the second birthday. Although WIC serves their clients through education and referrals for medical care, there were no significant differences between those who were receiving WIC and those not receiving WIC at 24 months because almost all children were receiving care. Study households are also engaged with health resources, as 3 in 4 mothers report that someone in the household is receiving Medicaid.

Findings on federal program participation are self-reported by mothers, and must be viewed with some caution, as reports of program participation are not independently verified by the study. Nonetheless, findings suggest that many WIC ITFPS-2 mothers are working and/or furthering their education, and utilizing child care for the study children. The families are making use of federal food benefit programs, both through continuing to receive WIC and through utilizing other programs. Study children are receiving regular medical care, and are receiving the care from a regular source.

Healthy Food Purchasing, and Feeding Beliefs, Rules, and Practices

3

Key Findings:

- Nearly 90% of study mothers report that fresh fruits and vegetables are available and plentiful in their communities, although nearly 25% question the quality of available produce.
- Many study mothers hold feeding beliefs that emphasize parental control, with 40% agreeing it is important for children to finish the food on their plates, and nearly 60% agreeing parents need to decide how much children eat. Feeding rules also emphasize parental control, with 72% of mothers always or usually trying to get the child to finish food, and 59% always or usually carefully controlling how much the child eats.
- 14% of study children are perceived by their mothers as very picky eaters.
- Televisions are on during meals at least some of the time in over 50% of study households.
- 64% of families eat at least 5 meals together in a week.
- Almost 70% of study mothers say they have made a change in how they feed themselves or their families due to something they learned from WIC.

3.1 Overview

This chapter focuses on purchasing of healthy foods, and on caregivers' beliefs, rules, and practices for child feeding. The data in this chapter are drawn from the 30-month interview. Topics addressed in this chapter include the following:

- What are the main barriers to eating healthy?
- Do parents engage in feeding beliefs and practices that may be barriers to healthy eating?
- What is the influence of parenting and broader environmental factors on early dietary behaviors that might affect childhood obesity?
- Does participation in WIC lead to better eating behaviors?

3.2 Background

Numerous barriers exist to healthy eating. Inadequate access to high quality, affordable and convenient fruits and vegetables is one such barrier (Kamphius et al., 2006). Although children

become more autonomous as they transition to their third year of life, parents continue to shape the diets of young children. Parental modeling of healthy eating and making healthy foods available in the home are associated with increased acceptance by young children of new foods and healthier dietary intake (Ventura & Birch, 2008).

Studies show that parental feeding styles and practices can impact what and how much children eat. A feeding style that balances structure and flexibility is the most protective (Vollmer & Mobley, 2013). Such parents tend to monitor what children eat and respond appropriately to child signals of hunger and satiety. Less optimal feeding styles include behaviors such as using food to soothe a child or as a reward for desired behavior (Collins, Duncanson, & Burrows, 2014), or exerting rigid control of children's diets, such as overly pressuring children to eat and restricting consumption of less healthy foods. These less optimal feeding styles can result in unintended outcomes: reduced ability to self-regulate how much is consumed, and increased preference for less healthy over more healthy foods (Johnson & Birch, 1994; Thompson, 2010). This chapter explores both feeding beliefs (i.e., what parents agree are appropriate ways to feed children) and feeding practices (i.e., frequency of behaviors parents engage in to feed their own child). The feeding beliefs and practices variables discussed in this chapter were drawn from the Infant Feeding Style Questionnaire (IFSQ) (Thompson et al., 2009) and asked during the WIC ITFPS-2 30-month interview. The IFSQ addresses similar beliefs and behaviors to those in other child feeding questionnaires, but is focused on feeding infants and young children, and was developed specifically for use with low-income families.

Because WIC ITFPS-2 is particularly interested in practices that put children at risk for overweight, the beliefs and practices selected for inclusion focus primarily on those that emphasize parental control, and that may interfere with young children learning to self-regulate eating in response to feelings of hunger and satiety. Controlling feeding beliefs and practices can take two forms: pressuring and restricting (Thompson et al., 2009). Controlling/pressuring beliefs and practices involve pressuring the child to eat in response to cues other than hunger, such as eating all the food on a plate, eating when not hungry, or soothing a child through eating. Allowing children to eat while engaging in other activities such as walking around, which is significantly associated with soothing a child through eating (Thompson et al, 2009) is also included. Controlling/restrictive beliefs and practices involve limiting child consumption to more nutritious foods, and limiting the quantity of foods a child eats.

In the third year of life, parents also commonly report picky or fussy eating. Repeated exposure to tasting new foods has been associated with better acceptance by young children of a variety of foods

(Gibson & Cooke, 2017; Shim, Kim, Mathai, & STRONG Kids Research Team, 2011). Children characterized as picky eaters tend to be less overweight in early childhood than children who are less picky (Brown et al., 2018; Dubois, Farmer, Girard, Peterson, & Tatone-Tokuda, 2007a). However, picky eating by young children has been related to lower intake of protein foods, fruits and vegetables (Dubois, Farmer, Girard, & Peterson, 2007b), and lower diet quality (Brown et al., 2018).

Structuring of children's food environments, such as regularly eating family meals, and limiting TV and other screens at meals, predicts better self-regulation of eating and diet quality, and lower obesity in young children (Anderson & Whitaker, 2010; Frankel, Powell, & Jansen, 2018; Montaño, Smith, Dishion, Shaw, & Wilson, 2015).

3.3 Sample and Analysis Approach

3.3.1 Sample

The analyses in this chapter utilize interview data from 30-month interview, as questions related to food purchasing, feeding beliefs, and feeding practices were not asked at the 36-month interview. Table 3-1 shows the number of respondents to that interview. Both the core and supplemental samples were eligible for the 30-month interview. In analyses the responses to each interview are weighted so that findings reflect the WIC population as described in Chapter 1.

Table 3-1. Number of respondents by interview month

Sample structure	30-Month interview
Core prenatal sample	1,838
Core postnatal sample	233
Supplemental prenatal sample	453
Supplemental postnatal sample	101
Total	2,625

3.3.2 Analysis

The analyses in this chapter examine purchasing of healthy foods, as well as caregivers beliefs, rules, and practices for child feeding at 30 months. Analyses also explore whether socio-demographic subgroups of participants differ on outcomes of interest during the third year. Socio-demographic characteristics were typically measured at the time of the first interview. For characteristics that

change over time, such as food security or income relative to the poverty guideline, socio-demographic subgroups are updated to values reported at the 24-month interview.[30]

Analyses include descriptive analyses of outcomes of interest, bivariate analysis to examine whether an outcome of interest varies by subgroup, and follow-up t-tests between all pairs of subgroups to determine which subgroups are statistically significantly different from each other. Subgroup differences discussed in the chapter are limited to those that form a pattern over time or across questions, and are large in magnitude, to avoid focusing on findings that, while statistically significant, may have little practical importance.[31] Association between feeding beliefs and rules/practices are explored using Spearman's correlation. Statistical significance, when indicated, is at the level of $p \leq 0.05$.

3.4 Purchasing and Consumption of Fruits and Vegetables

Caregivers' ability to purchase healthy foods such as fresh fruits and vegetables is essential to making healthy choices in feeding their children. At the 30-month interview, study mothers are asked about their ability to purchase fresh fruits and vegetables, and about the quantity and quality of the produce available to them. Mothers are also asked about potential barriers to consuming fresh fruits and vegetables, including cost, effort required to prepare them, and dislike of fresh produce.

3.4.1 Availability of Fresh Fruits and Vegetables

Most study mothers (87%) agree or strongly agree that it is easy to buy fresh fruits and vegetables in their community (see Figure 3-1), and only 6 percent disagreed or strongly disagreed. Similarly, 88 percent of study mothers agreed or strongly agreed that fruit and vegetables are plentiful in their community, that is, that there are a lot of fresh fruits and vegetables available to them. Only 6 percent of mothers disagree or strongly agree that produce is easy to buy or plentiful.

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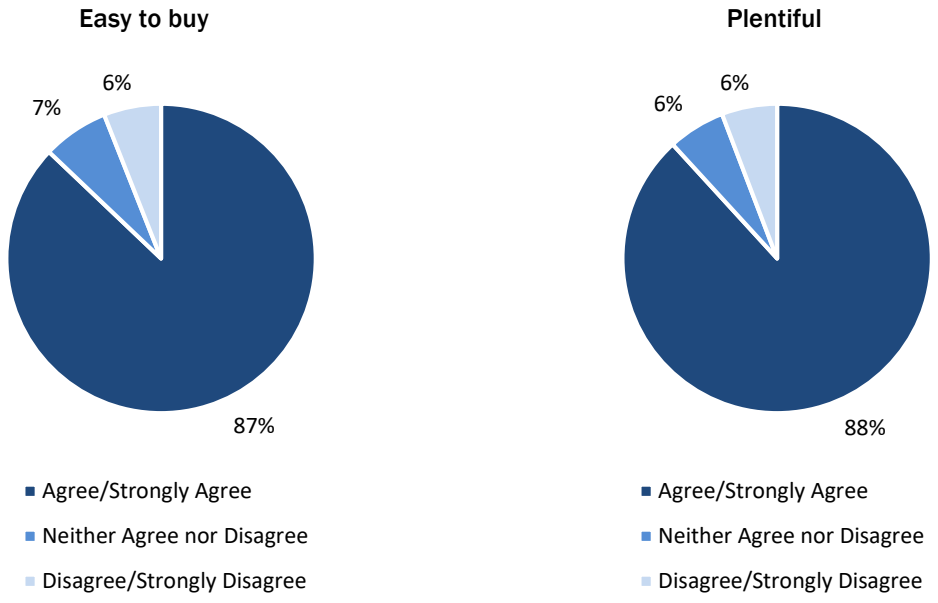
[30] The baseline/24 month socio-demographic variables are used for subgroup analyses instead of 36-month socio-demographic variables to allow lagged influences of context on behaviors to emerge in the data, and to avoid analyzing 30-month data by future (36-month) subgroup membership.

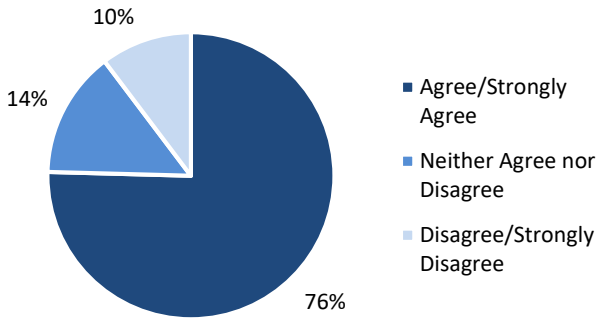
[31] Proportional differences are typically discussed if they are more than 3 percentage points in magnitude and/or form a pattern over time or items. See Chapter 1 for details. Median differences are discussed if they exceed half a scale-point of difference. Both indicate very small effect sizes (Cohen, 1988).

Figure 3-1. Percentage of study mothers agreeing that fruits and vegetables are easy to buy and plentiful in their communities (month 30)



When study mothers are asked about the quality of the fresh fruits and vegetables available to them, however, responses are more varied. Seventy-six percent of mothers agree or strongly agree that the fresh fruits and vegetables available to them are of high quality, and 10 percent disagree or strongly disagree (see Figure 3-2). There are few socio-demographic variables that are significantly and consistently associated with all three aspects of access (e.g., easy to buy, plentiful, high quality). One socio-demographic characteristic that is consistently associated with access is household food security. Mothers whose households have high or marginal food security, as compared to mothers whose households have low food security, are more likely to agree or strongly agree that fresh fruits and vegetables are easy to buy, and plentiful. Mothers whose households have high or marginal food security are also more likely to

Figure 3-2. Percentage of study mothers agreeing that fruits and vegetables are available in their communities are of high quality (month 30)

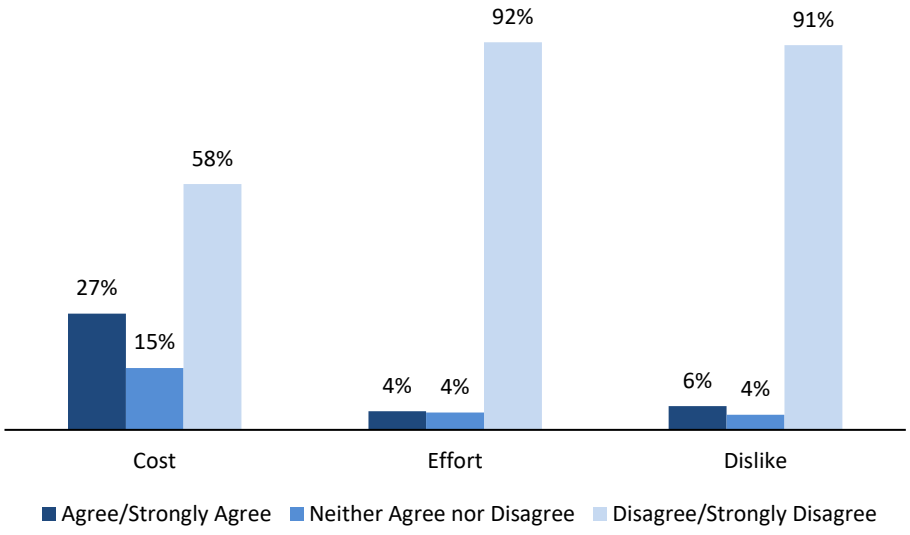


agree or strongly agree that fresh fruits and vegetables are of high quality than those with low or very low food security. See Appendix B2b, Table B2b-1, for more details.

3.4.2 Barriers to Consuming Fresh Fruits and Vegetables

During the 30-month interview study mothers are asked about the extent to which they agree that cost, effort involved in preparation, or dislike of fresh produce makes it more difficult to eat fresh fruits and vegetables (see Figure 3-3). Effort involved in preparing fresh fruits and vegetables, and dislike for them, do not emerge as particularly strong barriers to consumption. Twenty-seven percent of study mothers, however, agree or strongly agree that it is difficult to eat fresh fruits and vegetables because they cost too much.

Figure 3-3. Percentage of study mothers agreeing with select barriers to consumption of fresh fruits and vegetables (month 30)



There are a small number of socio-demographic variables significantly associated with cost as a barrier to fresh fruit and vegetable consumption. As is the case with access, food security is associated with cost as a barrier to consumption such that mothers from households with low or very low food security, as compared to those with high or marginal food security, are more likely to agree or strongly agree that cost is a barrier. Maternal marital status and maternal age at the child's birth, are also associated with perceiving cost as a barrier; married mothers are more likely than unmarried mothers to agree or strongly agree that cost is a barrier, and older mothers (26+ years

old) are more likely to agree or strongly agree that cost is a barrier than are younger mothers (age 16-19 and 20-25). See Appendix B2b, Table B2b-2, for more details.

3.5 Feeding Beliefs, Rules, and Practices

At the 30-month interview study mothers are asked about their beliefs, rules, and practices for feeding. Beliefs probed include items that reflect pressuring or restrictive control over child consumption, as well as when young children should be able to eat fast food, sugary food, and snack foods. Feeding rules and practices include behaviors that emphasize parental control over the child's eating (see Table 3-2 for a list of feeding beliefs and practices probed), as well as family practices such as having the TV on during meals and snacks, and most or all of the family eating meals together. Analyses also explore study mother's thoughts on picky eating – both whether she believes the study child to be a picky eater, and how often she introduces a new food before deciding that the child does not like it.

Table 3-2. Feeding belief and practice interview items (30 months)

Feeding Belief Items
Agree/Strongly Agree = 1; Neither Agree nor Disagree = 2; Disagree/Strongly Disagree = 3
It's ok for a child to walk around while eating as long as he or she eats.[a]
It's important for a child to finish all the food on his or her plate.
The best way to make a child stop crying is to feed him or her.
It's important that the parent decides how much a child should eat.
Whenever they want to = 1; Occasionally = 2; Never = 3
Children should be allowed to eat fast food
Children should be allowed to eat sugary foods
Children should be allowed to eat snack foods
Feeding Practice Items
Always = 1; Usually = 2; About half the time = 3; Occasionally = 4; Never = 5
I keep track of *what* food {CHILD} eats.
I try to get {CHILD} to finish his/her food.
I try to get {CHILD} to eat even if she/he seems not hungry.
I carefully control how much {CHILD} eats.
I am very careful not to feed {CHILD} too much.

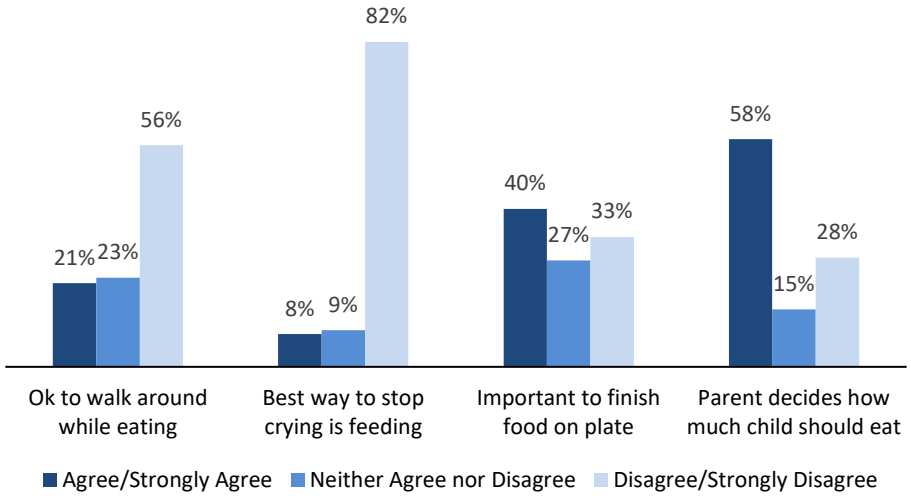
[a] Thompson et al. (2009) include this item in the laissez-faire style of parenting, but it was included here because it stresses an expectation to eat, and Thompson found that it was positively correlated with a controlling/pressuring style.

NOTE: Items are drawn from the IFSQ (Thompson et al., 2009)

3.5.1 Feeding Beliefs

One set of feeding beliefs the study explores is how much parents should control children's behavior and consumption during meal and snack time (Thompson et al., 2009). This includes controlling/pressuring beliefs such as whether parents should allow children to walk around while eating to ensure that they eat, or whether crying children should be soothed through feeding, and controlling/restrictive beliefs such as whether it is important for children to finish all the food on their plates, and whether it is important for parents to decide how much children eat. Study mothers are asked to rate how much they agree or disagree with each of these beliefs.

Figure 3-4. Percentage of study mothers agreeing with select beliefs about feeding practices (month 30)

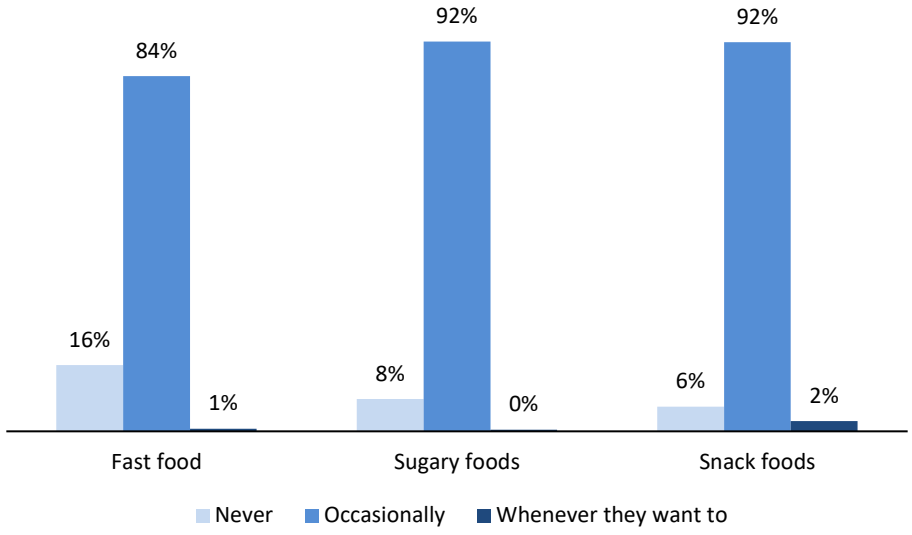


There are several socio-demographic characteristics associated with two controlling feeding beliefs, it is important for children to finish the food on their plates, and it is important for parents to decide how much children should eat. Mothers who are African-American, Hispanic, unmarried, or have household incomes at or below 75 percent of the poverty guideline are more likely than their counterparts to agree that it is important for children to finish the food on their plates, and that parents should decide how much children should eat. See Appendix B2b, Table B2b-3a and b, for more details.

Another set of beliefs the study explores is whether parents should restrict access to fast food, sugary foods such as candy, ice cream, cakes or cookies, and savory snack foods such as potato

chips, regular or flavored tortilla chips, and cheese puffs (see Figure 3-5). Within each type of food, less than 3 percent of study mothers indicated that children should have unrestricted access. Small percentages of mothers indicated that children should never have fast food (16%), sugary foods (8%), or snack foods (6%), and most mothers indicated a belief in more moderate occasional access (fast food, 84%; sugary foods, 92%; snack foods, 92%). There are no statistically significant associations between socio-demographic characteristics and beliefs about eating less healthy foods that are consistent and large in magnitude.

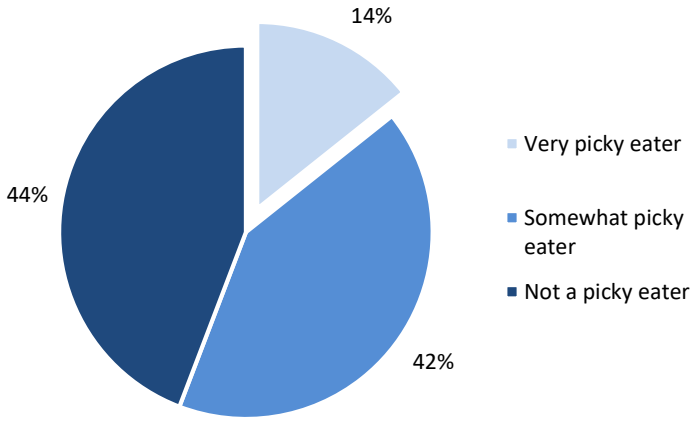
Figure 3-5. Percentage of study mothers indicating how often they believe children should be allowed to eat different types of less healthy foods (month 30)



3.5.2 Picky Eating

During the 30-month interview mothers are asked whether the study child is a very picky eater, a somewhat picky eater, or not a picky eater (see Figure 3-6). Nearly half (44%) of mothers report that their child is not a picky eater, while 42% are somewhat picky eaters, and 14% are very picky eaters.

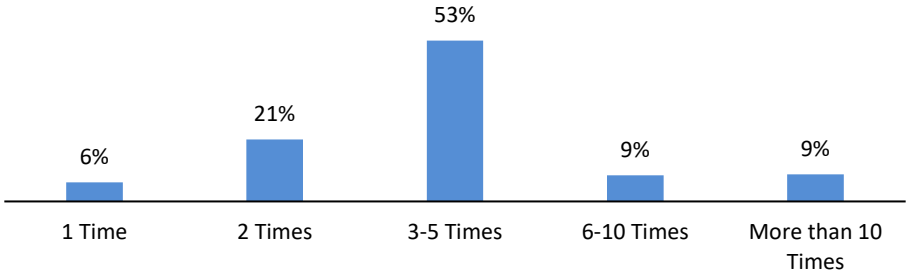
Figure 3-6. Percentage of study mothers who consider their children to be picky eaters (month 30)



Children of African-American mothers and Non-Hispanic mothers are more likely than their counterparts to be identified as very picky eaters. Children of Other race mothers (as compared to children of African-American mothers), children of Hispanic mothers, children of mothers with households in the lowest income group relative to the poverty guideline (as compared to those in the highest group), and children receiving WIC at 24 months are more likely to be identified as not picky eaters. See Appendix B2b, Table B2b-4, for more details.

Mothers are also asked how many times they introduce new foods before deciding that their child does not like a food. Although 2 percent of mothers say that their children like all foods, the remainder are distributed in how many times new foods are introduced, with more than half (53%) reporting they introduce new foods 3-5 times before deciding the child does not like it (see Figure 3-7). Six percent of mothers report introducing a new food only once before deciding the child doesn't like it, and 9 percent report introducing a food more than 10 times before making this judgment.

Figure 3-7. Distribution of number of times study mothers introduce a new food before deciding the child does not like it (month 30)

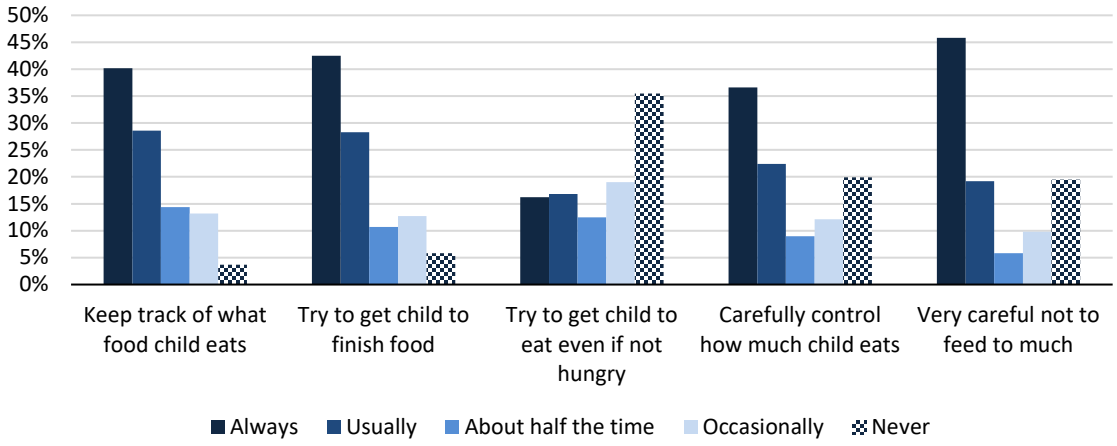


3.5.3 Feeding Rules and Practices

Questions about feeding beliefs ask mothers to indicate what they think parents *should do* in feeding their children. In contrast, questions about feeding rules and practices ask mothers to indicate what behaviors they are *actually doing* in feeding their children. During the 30-month interview mothers are asked about feeding rules and behaviors that control child consumption, how often the television is on during meals or snacks at home, and how often all or most of the family sat down together to eat a meal in the past week.

Mothers are asked how often they engage in various behaviors that track and control child consumption, including keeping track of what the child eats, trying to get the child to finish his or her food, trying to get the child to eat when he or she does not seem hungry, controlling how much the child eats, and being careful not to feed the child too much. As with beliefs, many study mothers engage in behaviors to track and control their children's eating (see Figure 3-8). Most mothers (72%) report always or usually trying to get the child to finish food, and 59 percent report that they always or usually carefully control how much the child eats. Sixty-nine percent of mothers report that they always or usually keep track of what the child eats, and 65 percent are always or usually careful not to feed the child too much. Thirty-three percent of mothers report always or usually trying to get the child to eat even if he or she is not hungry, and 36 percent report never doing so. Although several socio-demographic groups show significant median differences on these variables, all are small in magnitude (see Appendix B2b, Tables B2b-5 to B2b-10, for more details).

Figure 3-8. Percentage of study mothers engaging in select feeding rules and practices (month 30)

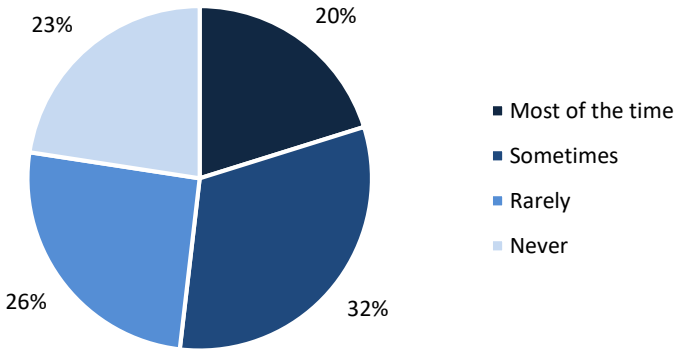


NOTE: See Appendix B2b, Table B2b-5, for more details.

When asked how often a television is on during meals, mothers were almost evenly split between those who either most of the time or sometimes have the television on during meals (52%), and those who rarely or never have the television on during meals (48%). Less than a quarter of mothers (23%) report that the television is never on during meals (see Figure 3-9).

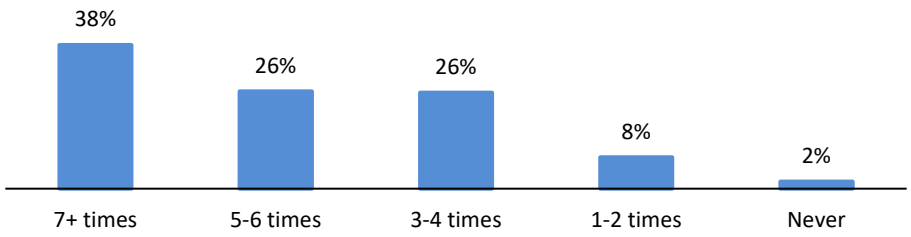
African-American mothers, Non-Hispanic mothers, and mothers whose children were not receiving WIC at 24 months are more likely than their counterparts to report that the television is on most of the time during meals. See Appendix B2b, Table B2b-11, for more detail.

Figure 3-9. Percentage of study mothers reporting how often the television is on during meals (month 30)



When asked about how often all or most of the family sat down together for a meal in the past week, 38 percent of mothers indicated this happened 7 or more times, which averages to one meal per day or more (see Figure 3-10). Only 2 percent of mothers report that their families never ate a meal together in the past week.

Figure 3-10. Frequency of families sitting down for meal together (month 30)



Race, ethnicity, and marital status are all associated with family meals. White and Other race mothers are more likely than African-American mothers to report sitting down for 7 or more meals together. Hispanic mothers and married mothers are also more likely than their counterparts to report sitting down for 7 or more meals. See Appendix B2b-12 for more details.

3.5.4 Associations between Beliefs and Practices

Analyses were conducted to explore the extent to which parental beliefs about control of child feeding are associated with their reported feeding practices. To reduce the number of associations explored, the study team created an index of feeding control behaviors.[32] The behaviors included in the index, which ranges from 0-5, are keeping track of what the child eats, trying to get the child to finish his or her food, trying to get the child to eat when he or she does not seem hungry,

[32] Cronbach's alpha was tested for these items, and the modest internal consistency reliability (.60) indicated the variables are better suited to an index than a scale. All variables are positively correlated. To form the index score, participants were given a point for each control item on which they endorsed that they always or usually engaged in the practice, resulting in an index score from 0 to 5.

controlling how much the child eats, and being careful not to feed the child too much. Higher index scores indicate engaging in more controlling feeding behaviors.

The feeding belief variables were tested for their bivariate associations with the feeding control behavior index, the frequency of having the television on during meals, and the frequency of the family eating together (see Table 3-3). While 7 of the associations are statistically significant most are small in magnitude, ranging between 0.4 percent (r=.06) and 9.0 percent (r = .30) of variance shared between the variables. The two largest associations confirm that more controlling beliefs are moderately associated with more controlling rules and practices. Both mothers who agree that it is important for children to finish all the food on their plates, and mothers who agree that it is important for parents to decide how much children eat, score higher on the feeding control behavior index. The third largest association is that mothers who agree or strongly agree that it's ok for children to walk around while eating as long as they eat are more likely to report having the television on during meals. This seems to indicate an association between a pressuring but permissive belief (that the child can walk around but must eat) with a practice that is lower control and permissive, possibly reflecting the laissez-faire element of both variables.

Table 3-3. Associations between feeding beliefs and feeding rules/practices (month 30)

Belief[a]	Rule/Practice[b]	Correlation
OK for children to walk around while eating as long as they eat	Feeding Control Behavior Index	0.03
	Television on while eating	0.16 *
	Family eats together	-0.07 *
Important for children to finish all the food on their plates	Feeding Control Behavior Index	-0.30 *
	Television on while eating	0.03
	Family eats together	-0.07 *
Crying children should be soothed through feeding	Feeding Control Behavior Index	-0.04
	Television on while eating	0.03
	Family eats together	-0.09 *
Important for parents to decide how much children eat	Feeding Control Behavior Index	-0.27 *
	Television on while eating	-0.03
	Family eats together	-0.06 *
Unweighted n		2,623
Weighted n		441,838

[a] Beliefs are scored from strongly agree = 1 to strongly disagree = 5.

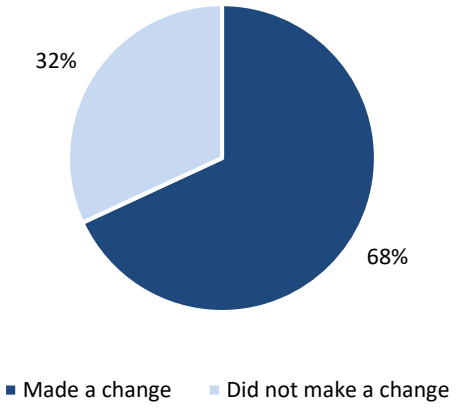
[b] Feeding control behavior Index is scored from low = 0 to high = 5. Television on during meals is scored from 1 = most of the time to 4 = never. Family eats together is scored from 1 = 7 or more times to 5 = never.

* The correlation is statistically significant at p<0.05.

3.6 Perceived Benefits of WIC Participation

WIC provides nutrition education that may have a positive influence on feeding practices, and nutritious foods that may promote a healthier diet. During the 30-month interview, mothers are asked whether they have changed how they feed themselves or their families because of something they learned from WIC. They were asked an open-ended question about the most important change, which interviewers then coded into categories that reflect aspects of WIC nutrition education. Nearly 7 in 10 women (68%) said they had made a change because of WIC education (see Figure 3-11).

Figure 3-11. Percentage of study mothers reporting making a change due to something learned at WIC (month 30)



Women who report they made a change are asked what the most important change is (see Table 3-4). The most common changes reported include how to choose more healthy foods (31%), eating more fruit and vegetables (28%), and offering the right portion sizes of food (11%).

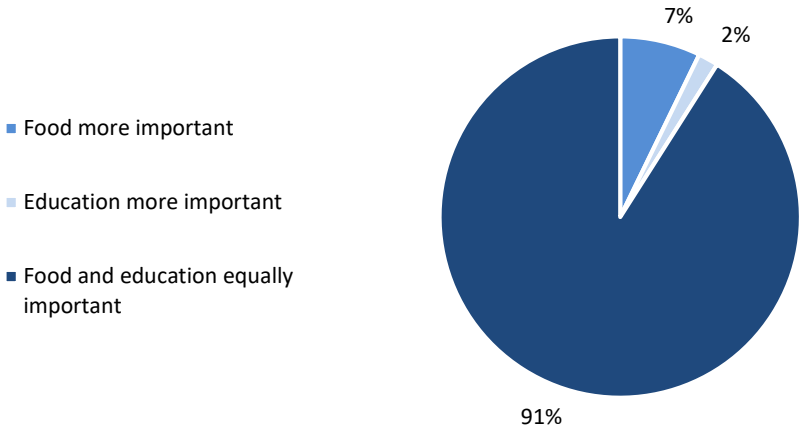
Table 3-4. Most important changes made because of something learned at WIC (month 30)

Most Important Change Made	Study Mothers %
How to choose more healthy foods	30.7%
Eat more fruit and vegetables	27.5
Offer the right amount of foods (portion)	10.6
Drink/buy fewer sugar-sweetened beverages	2.1
Eat more whole grains	1.6
Drink more reduced fat/low-fat/non-fat milk	1.1
Other	*25.4*
Unweighted n[a]	1,763
Weighted n	299,472

[a] n is the number of mothers who made a feeding change because of something they learned at WIC.

Study mothers who report receiving WIC for themselves or the study child at 30 months are also asked about the relative importance for them of the WIC food and nutrition education benefits: whether the foods from WIC are more important, education from WIC is more important, or both food and education are equally important. Slightly more than 9 in 10 study mothers (91%) indicate that food and education from WIC are equally important (see Figure 3-12).

Figure 3-12. Percentage of study mothers indicating whether food or education from WIC is the most important benefit for them (month 30)



3.7 Summary

Nearly 90 percent of study mothers report that fresh fruits and vegetables are available and plentiful in their communities, although only 76 percent agree or strongly agree that the available produce is of high quality. No clear barriers to consumption of fresh fruits and vegetable are reported, as mothers indicate that neither the burden required to prepare fresh fruits and vegetables, nor dislike for them, are reasons why it is difficult for them to include them in their diets. Cost emerges as an issue for some mothers, particularly those with low or very low food security, but over half of study mothers disagree or strongly disagree that cost is a deterrent.

Findings show that many study mothers agree with feeding beliefs that emphasize parental control over child food consumption, particularly with regard to how much children should eat. In contrast, almost all study mothers report believing that children should be allowed to eat fast food, sugary foods, and savory snack foods occasionally. Only 1 in 7 study mothers reports that her child is a very picky eater, and 71 percent report introducing a new food 3 or more times before deciding that the child does not like it. Feeding rules and practices reported by study mothers, like beliefs, tend to emphasize parental control over child consumption.

More than half of study mothers report that the television is on during most or some mealtimes. Families are eating meals together regularly, with nearly 65 percent of families eating at least 5 meals together during the week. Nonetheless, 10 percent of families eat together less than 3 times in a week. Beliefs and practices are associated with each other, such that agreeing with beliefs that are higher on feeding control is positively associated with controlling rules and practices.

Participation in WIC does seem to have a positive influence on feeding practices. Study families receiving WIC at 24 months are less likely at 30 months to have children who are picky eaters, and are less likely to have the television on during meals. Ninety-one percent of study mothers value foods from WIC and nutrition education from WIC equally. Finally, mothers report that WIC nutrition education is having an impact on their feeding practices. Almost 70 percent of study mothers report having made at least one change due to something they learned at WIC, including choosing more healthy foods, eating more fruits and vegetables, and offering appropriate portion sizes.

Meals and Snacks, Food Intake, and Diet Quality 4

Key Findings:

On a given day at 36 months:

- 72% of the children consume a fruit (excluding juice), 69% consume 100 percent fruit juice, and 63% consume a vegetable.
- 98% of the children consume a grain; less than half (41%) consume a whole grain.
- 82% of children are consuming a dessert, candy, other sweet, or sugar-sweetened beverage.

With regard to diet quality:

- The average total score on the Healthy Eating Index is at 61/100, comparable to other national data on children, but indicating a need for improvement.
- Most children are meeting the Dietary Guidelines for Americans (DGA) for servings of fruit including 100% juice (77%) and added sugars (71%).
- In general, improvement is needed for children to meet the DGA servings of vegetables and whole grains.

4.1 Overview

This chapter focuses on food intake and meal and snack patterns. The data in this chapter emphasize intake at 36 months, the interview at which the study collected dietary intake data for age three years, although data from 24 months are included where applicable to provide context. Topics addressed in this chapter include the following:

- What are the study children's meal and snack patterns?
- What percentage of study children are consuming fruit on a given day?
- What percentage of study children are consuming vegetables on a given day?
- What percentage of study children are consuming dairy products, meat and other protein sources on a given day?
- What percentage of study children are consuming grains on a given day?
- What percentage of study children are consuming desserts, sugar sweetened beverages, and salty snacks?
- What is the overall diet quality of study children at 36 months?

4.2 Background

Fruits and vegetables are excellent sources of nutrients such as potassium, folate, fiber, vitamin A, vitamin C, vitamin K, and various phytochemicals (Nebeling, 2002; U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015). Yet, most children in the U.S. do not consume sufficient amounts of fruits and vegetables (National Cancer Institute, 2018a; Kim et al., 2014). Despite the well-known health benefits of fruits and vegetables (He, Nowson, & MacGregor, 2006; He, Nowson, Lucas, & MacGregor, 2007; Montonen, Knekt, Järvinen, & Reunanen, 2004; World Cancer Research Fund, 2007), meeting recommended targets for fruit and vegetable consumption, along with other essential food groups like whole grains, continues to be a challenge for WIC participants, as compared to higher-income nonparticipants. A USDA analysis of NHANES 24-hour dietary recalls from 2005-2008 reports that among children aged 1-4 years, children receiving WIC were significantly less likely to consume whole grains, vegetables, and whole fruits compared to higher-income nonparticipants, and significantly more likely to consume soda and sugar, syrups, or other sweet toppings compared to higher-income nonparticipants (Condon et al., 2015).

Studies of nationally representative samples highlight substantial increases in childhood snacking from 1977 to 2006, with children ages 2-6 eating almost three snacks per day (Piernas & Popkin, 2010). With this increase in snacking, intake of salty snacks and sweets has significantly increased, as desserts and sweetened beverages are a primary source of snack calories (Piernas & Popkin, 2010). For sugar-sweetened beverages (SSBs), consumption typically starts during the preschool years and increases with age (Wang, Bleich, & Gortmaker, 2008).

Consumption of individual foods provides an incomplete picture without a measure of diet quality. The Healthy Eating Index-2015 (HEI-2015) is the most up-to-date version of HEI, which can be used to evaluate diet quality of children (National Cancer Institute, 2018b). The most recent study evaluating HEI scores in young children compared HEI-2010 scores between preschoolers ages 2-5 from a low-income community and an age-matched national sample from NHANES (2009-2012). Mean total HEI-2010 scores for the low-income sample (62.1) and the national sample (59.9) were both suboptimal. Intakes for total fruit, whole fruit, dairy, and total protein across both samples were closest to meeting the maximum scores, however, intakes of greens and beans and fatty acids were among the lowest across both samples (Page, Crixell, Beidiger-Friedman, Markides, Bishop, 2017).

The U.S. Department of Agriculture's (USDA) and Department of Health and Human Services Dietary Guidelines for Americans (DGAs) recommendations for 3-year-old children are another way to evaluate diet quality. For young children this includes a daily intake of 1-1.5 cups of fruits, 1-1.5 cups of vegetables, 3-5 ounces of grains, 2-4 ounces of protein, and 2-2.5 cups of dairy, depending on the child's sex and daily physical activity levels (USDA, 2016).[33] In addition, limited daily amounts of sodium (1,500 mg), saturated fat (11-16 g), and added sugars (25-30 g) are advised (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015).

4.3 Sample and Analysis Approach

4.3.1 Sample

The analyses in this chapter utilize dietary intake data from the 24- and 36-month interviews. Table 4-1 shows the number of respondents to those interviews. Both the core and supplemental samples were eligible for these interviews. In analyses the responses to each interview are weighted so that findings reflect the WIC population as described in Chapter 1.

Table 4-1. Number of respondents by interview month

Sample structure	24-Month interview	36-Month interview
Core prenatal sample	1,702	1,813
Core postnatal sample	235	231
Supplemental prenatal sample	425	460
Supplemental postnatal sample	99	104
Total	2,461	2,608

4.3.2 Analysis

The analyses in this chapter use data from a 24-hour dietary recall to examine meal and snack patterns, food intake, and diet quality at child age 24 and 36 months, with an emphasis on intake at 36 months.[34] Analyses explore socio-demographic characteristics associated with these patterns of

[33] Fruits, vegetables, whole grains, dairy, and protein foods such as eggs, legumes, and peanut butter, are available through the WIC child food package.

[34] Food group intake is adjusted for usual intake (see Appendix B3 for details). Usual intake is used in HEI and DGA analyses as well. In contrast, meal and snack patterns, and consumption of individual food items, represent intake on a given day.

intake. Socio-demographic characteristics are typically measured at the time of the first interview. For characteristics that change over time, such as food security or income relative to the poverty guideline, socio-demographic characteristics are updated to values reported at the 24-month interview.[35]

Analyses include bivariate analysis to examine whether an outcome of interest varies by subgroup, and follow-up t-tests between pairs of subgroups to determine which subgroups are statistically significantly different from each other. Subgroup differences discussed in the chapter are limited to those that form a pattern over time or across items, and are large in magnitude, to avoid focusing on findings that, while statistically significant, may have little practical importance.[36] Statistical significance, when indicated, is at the level of $p \leq 0.05$.

When available and comparable, data are presented from other relevant studies alongside current findings to examine differences and similarities between studies. The additional relevant study used as a point of comparison in this chapter is the Gerber/Nestle Feeding Infants and Toddlers Studies (FITS) conducted in 2016 (Anater et al., 2018; Welker et al., 2018), the latest in a well-known series of national studies of infant and toddler feeding practices that include both WIC participant and non-participant children. In FITS 2016 (Welker et al., 2018) approximately 27 percent of the 2 and 3 year old children are WIC participants. Like WIC ITFPS-2, FITS studies collects 24-hour dietary recall data,[37] with replicate dietary intakes on a portion of the cases to allow for estimation of usual intake, making FITS a good source of comparison for food intake among WIC ITFPS-2 children. The FITS studies are cross-sectional studies; FITS 2016 includes children from birth to 4 years. Because FITS 2016 is a cross-sectional study covering a range of ages, their findings are published in bands of ages. Comparisons between WIC ITFPS-2 and FITS data therefore match the WIC ITFPS-2 month to the closest relevant FITS age bands: WIC 24 months to FITS 24-35.9 months, and WIC 36 months to FITS 36-47.9 months. The lack of complete alignment between child age in the two studies, and the fact that WIC ITFPS-2 is a low-income sample whereas FITS 2016 includes both low income and higher income families, may be possible sources of differences in findings between the two studies. Differences between FITS 2016 and WIC ITFPS-2 in methodology, as well

[35] The baseline/24 month socio-demographic variables are used for subgroup analyses instead of 36-month socio-demographic variables to allow lagged influences of context on behaviors to emerge in the data.

[36] Differences are typically discussed if they are more than 3 percentage points in magnitude and/or form a pattern over time or items. See Chapter 1 for details.

[37] The methodology for coding dietary intakes differs slightly between FITS 2016 and WIC ITFPS-2 such that some of the changes observed when comparing food groups or nutrient intakes over time may be due in part to the codes applied to the various foods and the food grouping scheme used to classify foods. See Welker et al. (2018) for details of the differences in coding between FITS 2008 and 2016.

as limits in the availability of data from other studies on which to conduct analyses, prevent making direct statistical comparisons between the studies. Consequently, comparisons focus on the magnitude of differences between the studies, rather than statistical significance of the differences.

In WIC ITFPS-2, all post-birth interviews through 24 months, as well as the interviews at 36, 48, 60, and 72 months, include a 24-hour dietary recall using the U.S. Department of Agriculture's (USDA) Automated Multi-Pass Method (AMPM) (Raper, Perloff, Ingwersen, Steinfeldt, & Anand, 2004), as described in Chapter 1. When conducting the 24-hour dietary recall, an interviewer guides the caregiver through the prior day's intake, and asks the caregiver to report all foods, beverages, and dietary supplements the child consumed for each eating occasion during the 24-hour period. The interviewer records all information, and trained coders then code and analyze the data for food group and nutrient content. Intakes after 11 months of age are adjusted statistically for day-to-day variation. Within 10 days of the initial dietary intake interview, the study collects a second, replicate intake on a randomly selected 10 percent subsample of children at 13, 15, 18, 24, 36, 48, 60, and 72 months to use in estimating "usual" intake of food groups, energy, and nutrients for all study children. Analyses in this chapter also use specific individual foods, and eating event (e.g., breakfast, lunch, dinner, snack), to describe food intake and meal and snack patterns as a snapshot of particular foods consumed on the day of the 24-hour dietary recall (i.e., on a given day).

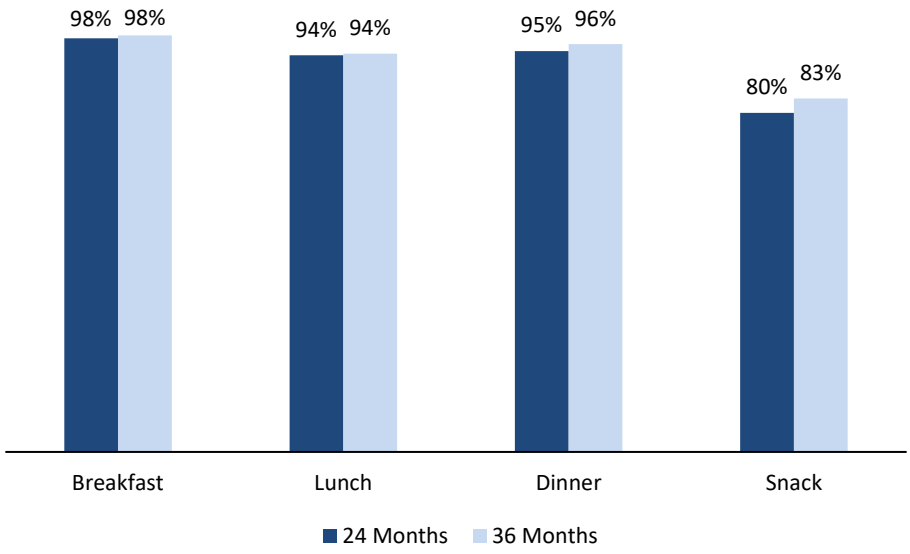
Because one of the goals of WIC ITFPS-2 is to enable comparisons to other studies, particularly the FITS studies, food group classifications used for WIC ITFPS-2 are the same as those used for FITS 2008 (Fox, Pac, Devaney, & Jankowski, 2004), and are based on the Continuing Survey of Food Intakes by Individuals. These food group classifications may therefore not always be an exact match to the food groups described in other sources such as the DGA, and the USDA Food Pattern Equivalents Database; however, using older definitions is necessary to allow comparisons to the previous work. See Appendix B3 for additional information on dietary coding procedures.

4.4 Meal and Snack Patterns

As a part of the study protocol, WIC ITFPS-2 caregivers are asked to identify each eating occasion when completing their child's 24-hour dietary recall interview. At both 24 and 36 months almost all children are eating breakfast (98%), lunch (94%) and dinner (95% and 96%, respectively) on a given day (see Figure 4-1). Snack consumption increases slightly over time, from 80 percent of children having at least one snack on a given day at 24 months, to 83 percent at 36 months. On average,

study children consume 2.3 snacks on a given day. At 36 months less than 2 percent of children are skipping breakfast, although 6 percent do not consume lunch on a given day, and 4 percent do not consume dinner.

Figure 4-1. Percentages of study children eating meals and snacks on a given day (months 24 and 36)



4.5 Food Intake

Understanding what foods children are eating is essential to understanding dietary improvements that are needed, and associations between diet and health outcomes. The following sections explore the foods eaten on a given day by the WIC ITFPS-2 children at 24 and 36 months, and their meal and snack patterns. Dietary intake information for WIC ITFPS-2 is compared to the data from the FITS 2016 (Welker et al., 2018) to give context to the WIC ITFPS-2 findings.

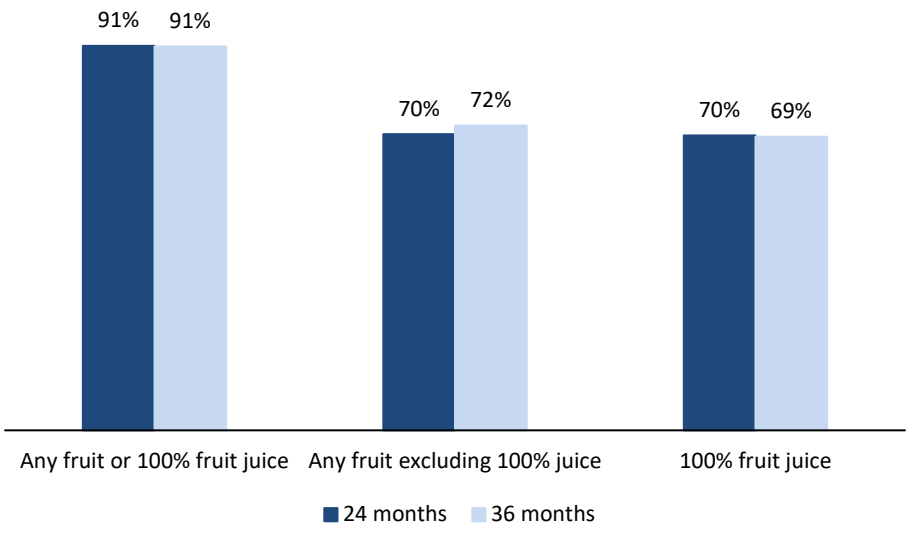
Data addressing details of dietary intake during the first two years of life can be found in the *WIC ITFPS-2 Second Year Report,* Chapter 4 (Borger et al., 2018). Data presented here focus on the percentages of 36 month olds consuming these foods groups, or particular foods on a given day; data on consumption at 24 months, although reported previously, are provided for context. The foods addressed include fruits, vegetables, milk and other dairy, meats and other proteins, grains, and desserts, sugar sweetened beverages, and salty snacks. This section focuses only on whether the

food groups or foods are consumed. Quantities of foods consumed will be addressed in Section 4.6 of this chapter.

4.5.1 Fruit Consumption

The percentage of WIC ITFPS-2 children consuming fruit or 100 percent fruit juice remains steady between 24 and 36 months (see Figure 4-2). The most common form of fruit (excluding juice) consumed at 36 months is fresh or frozen fruit (67%), followed by canned fruit (10%).

Figure 4-2. Percentage of study children consuming fruit on a given day (months 24 and 36)



There are some patterns of socio-demographic characteristics associated with any fruit or 100 percent fruit juice consumption that emerge at 36 months, including significant differences by race, ethnicity, and receiving WIC, as well as marital status, SNAP participation, income relative to the poverty guideline, and maternal age (see Appendix B2c, Table B2c-1, for details). Children of Hispanic mothers and children who are receiving WIC at 24 months are more likely to consume any fruit or 100 percent fruit juice on a given day than their counterparts (Hispanic: 94% vs. non-Hispanic 88%; receiving WIC 92% vs. not receiving WIC 88%). Because these differences remain for 100 percent juice consumption (Hispanic: 73% vs. non-Hispanic 66%; receiving WIC 71% vs. not receiving WIC 65%), but not for fruit consumption excluding juice, difference seems to be due to higher likelihood of consumption of 100 percent juice in these groups. Children of Other race

mothers are more likely to consume any fruit or fruit juice (96%) on a given day than children of African-American (88%) or White (90%) mothers.

When looking at consumption of any fruit excluding 100 percent juice, there are several significant socio-demographic differences. A series of differences emerged in consumption of any fruit (excluding juice), and taken together they suggest that children at lower economic and social risk are more likely to consume fruit (excluding juice): children of married caregivers (77%) are more likely to consume fruit (excluding juice) than children of unmarried caregivers (69%); children whose mothers were 26 years or older at their birth (78%) are more likely to consume fruit (excluding juice) than children whose mothers were 20-25 years old (67%) and more likely to consume fruit (excluding juice) than children whose mothers were 16-19 years old (63%); children in households that participate in federal benefit programs but not in SNAP (76%) are more likely to consume fruit (excluding juice) than children in households that participate in SNAP and other programs (69%); and, children in households above 130 percent of the poverty guideline (75%), and children in households from 76 to 130 percent of the poverty guideline (75%) are more likely to consume fruit (excluding juice) than children at or below 75 percent of the poverty guideline (68%).

The top five most commonly consumed fruits on a given day at 24 months, and the top five at 36 months, are shown in Table 4-2. The top five fruits remain the same across the two interviews, and the distribution changes only slightly.

Table 4-2. Top five fruits consumed by study children on a given day (months 24 and 36)

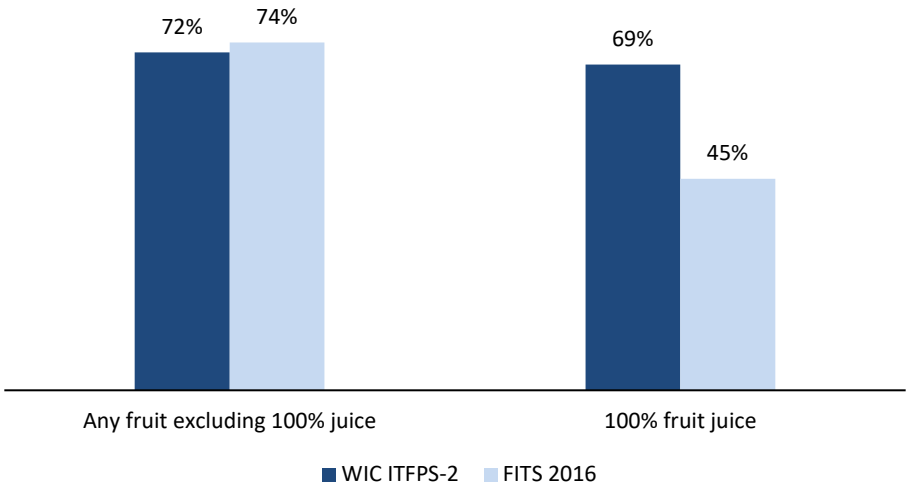
Top five fruits	Percent of study children who consumed the fruit on a given day
24 months	
Banana	30.3%
Apple	23.4
Grapes	13.5
Orange	11.0
Strawberries	9.5
Unweighted n	2,438
Weighted n	439,020
36 months	
Banana	29.6%
Apple	26.5
Grapes	13.7
Orange	11.2
Strawberries	9.7
Unweighted n	2,586
Weighted n	438,319

NOTE: One hundred percent fruit juice is excluded from this table.

When comparing to findings from FITS (see Figure 4-3) we use data from FITS 2016 (Welker et al., 2018). The percentages of WIC ITFPS-2 children consuming any fruit (excluding 100% fruit juice)

are similar at age 3 (WIC ITFPS-2: 72%, FITS 2016: 74%).[38] One hundred percent fruit juice, in contrast, is consumed by substantially more children in the WIC ITFPS-2 children at age 3 (WIC ITFPS-2: 69%, FITS 2016: 45%).

Figure 4-3. Percentages of 3 year old children consuming fruit or 100 percent fruit juice on a given day in WIC ITFPS-2 and FITS 2016



NOTE: The FITS 2016 cross-sectional sample includes children ages 36-47.9 months in the age 3 group. The WIC ITFPS-2 data for 36 months, shown, were collected between child ages 35.5-36.9 months.

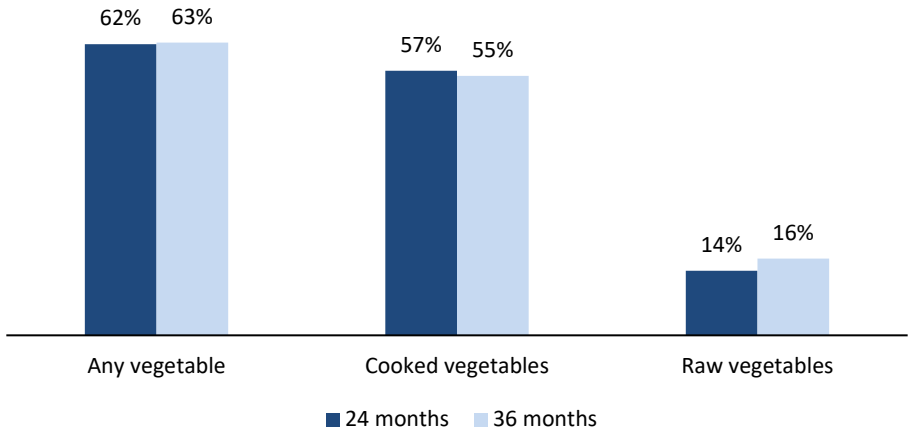
4.5.2 Vegetable Consumption

The percentage of WIC ITFPS-2 children consuming any type of vegetable, including 100 percent vegetable juice,[39] at 24 and 36 months remains steady at 62-63 percent. Looking at the percentages, consumption of cooked vegetables decreases slightly over the period from 57 percent to 55 percent, and consumption of raw vegetables increases slightly, from 14 percent to 16 percent (see Figure 4-4).

[38] The FITS 2008 cross-sectional sample is divided into ranges including children ages 24-35.9 months (2 years), used for comparison to the WIC ITFPS-2 24 month interview, and 36-47.9 months (3 years) used for comparison to the WIC ITFPS-2 36 month interview. Any fruit includes fresh, frozen, canned, or dried fruits, but excludes 100 percent fruit juice.

[39] 100 percent vegetable juice, when reported, is coded as a cooked vegetable.

Figure 4-4. Percentage of study children consuming vegetables on a given day (months 24 and 36)



NOTE: Any vegetable includes cooked vegetables and raw vegetables. One hundred percent vegetable juice, when reported, is coded as a cooked vegetable.

Several different subtypes of vegetables are examined, including dark green vegetables, deep yellow or orange vegetables, white potatoes (non-fried), french fries or other fried potatoes, other starchy vegetables, and other vegetables.[40] Consumption of most types of vegetables fall within two percentage points across the two interviews, although there is a slightly larger increase in the consumption of fried potatoes and of other vegetables, and a slightly larger decrease in the consumption of white potatoes (see Table 4-3). At 36 months consumption of dark green vegetables remains the lowest, although deep yellow or orange vegetables, white potatoes, and other starchy vegetables are also low. As at 24 months, at 36 months the highest consumption is of other vegetables, which contains both green beans, and tomatoes that may be consumed in sauce.

[40] Vegetable type names do not match the vegetable subgroups in the Dietary Guidelines for Americans (DGAs) because food groups are constructed to match the FITS 2008 study. Examples of dark-green vegetables include broccoli, spinach, other greens, and romaine lettuce; examples of deep-yellow or orange vegetables include carrots, pumpkin, sweet potatoes, and winter squash; examples of starchy vegetables include corn, green peas, immature lima beans, black-eyed peas (not dried), cassava, and rutabaga; examples of other reported vegetables include artichoke, asparagus, beets, Brussels sprouts, cabbage, cauliflower, celery, cucumber, eggplant, green beans, lettuce, mushrooms, okra, onion, pea pods, peppers, tomatoes/tomato sauce, wax/yellow beans, and zucchini/summer squash.

Table 4-3. Percentage of study children consuming different types of vegetables on a given day by interview month (months 24 and 36)

Type of vegetable	Month 24	Month 36
Dark green vegetables[a]	10.6%	10.8%
Deep yellow or orange vegetables[b]	12.9	13.3
White potatoes	15.2	13.0
French fries and other fried potatoes	14.5	16.9
Other starchy vegetables[c]	13.9	12.3
Other vegetables[d]	31.7	34.7
Unweighted n	2,438	2,586
Weighted n	439,020	438,319

[a] Reported dark-green vegetables include broccoli, spinach, other greens, and romaine lettuce.

[b] Reported deep-yellow or orange vegetables include carrots, pumpkin, sweet potatoes, and winter squash.

[c] Reported starchy vegetables include corn, green peas, immature lima beans, black-eyed peas (not dried), cassava, and rutabaga.

[d] Other reported vegetables include artichoke, asparagus, beets, Brussels sprouts, cabbage, cauliflower, celery, cucumber, eggplant, green beans, lettuce, mushrooms, okra, onion, pea pods, peppers, tomatoes/tomato sauce, wax/yellow beans, and zucchini/summer squash.

There are few socio-demographic subgroup differences in consumption of any vegetables at 36 months (see Appendix B2c, Table B2c-2a, b, and c for more details). Race, ethnicity, and WIC receipt at 24 months are all significantly associated with vegetable consumption. Children of African-American mothers are more likely to eat any vegetable (71%) than children of White (62%) or Other race (54%) mothers. The origin of the difference seems to be significant differences in the consumption of fried potatoes and starchy vegetables. Children of non-Hispanic mothers are significantly more likely to eat any vegetable (70%) than children of Hispanic mothers (54%). The origins of this difference are again fried potatoes and starchy vegetables, as well as other vegetables. Because these analyses are bivariate, they do not indicate if race and ethnicity are each independently associated with vegetable consumption. WIC participation is also significantly associated with vegetable consumption, with children receiving WIC at 24 months less likely to consume any vegetable at 36 months (60%) than their counterparts who were not receiving WIC at 24 months (69%). The difference between these two groups seems to be distributed across types of vegetables, but a significant difference emerges only for the other-vegetables category.

Table 4-4. Top five vegetables consumed by study children on a given day (months 24 and 36)

Top five vegetables	Percent of study children who consumed the vegetable on a given day
24 months	
Tomatoes	15.6%
French fries or other fried potatoes	14.4
Mashed potatoes	10.4
Green beans	8.9
Corn	8.1
Unweighted n	2,438
Weighted n	439,020
36 months	
Tomatoes	19.0%
French fries or other fried potatoes	16.9
Carrots	9.4
Green beans	8.9
Mashed potatoes	8.5
Unweighted n	2,763
Weighted n	434,035

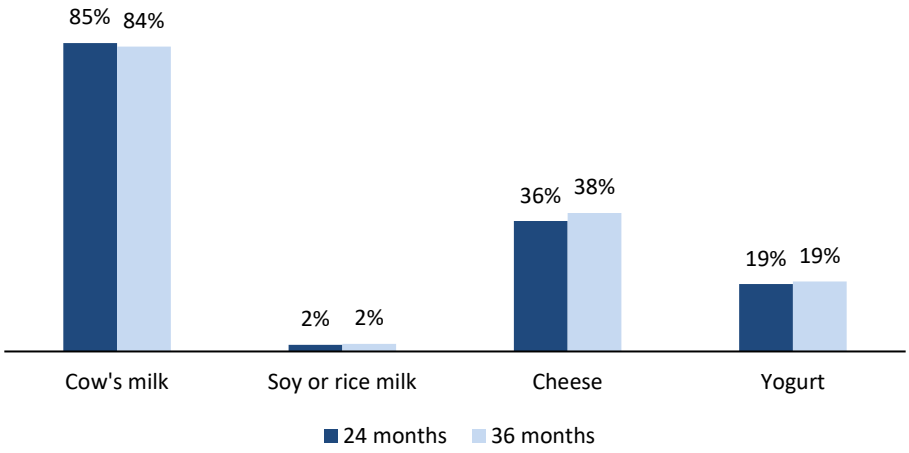
The top five vegetables consumed on a given day show only slight shifts between 24 and 36 months (see Table 4-4). At both 24 and 36 months, tomatoes, which may be cooked in sauces, top the list of vegetables. French fries or other fried potatoes occupy the second spot at both months. Carrots enter the top five at 36 months and corn drops out, and green beans and mashed potatoes remain in the top five list for both ages.

When compared to the vegetable consumption findings from the FITS 2016 study (Welker et al., 2018), the percentages of WIC ITFPS-2 children consuming any vegetable is lower than in the FITS 2016 sample. At 24 months, 62 percent of WIC ITFPS-2 children are consuming any vegetable on a given day, whereas at age two 73 percent of FITS 2016 children are doing so. At 36 months the WIC ITFPS-2 rate stays nearly steady at 63 percent, and the FITS 2016 rate remains at 73 percent.

4.5.3 Dairy, Meats, and Other Protein Sources Consumption

The percentage of WIC ITFPS-2 children consuming dairy products on a given day at 24 and 36 months remains very steady across the two interviews (see Figure 4-5). At 24 months and 36 months cow's milk is consumed by most of the children (85% and 84%, respectively). Cheese and yogurt are consumed by less than half of WIC ITFPS-2 children on a given day. At 24 months, 36 percent consume cheese, rising slightly to 38 percent at 36 months. At both 24 and 36 months, 19 percent consume yogurt. At both 24 and 36 months, soy milk and rice milk are consumed by very small percentages (2%) of the study children. Following a trend that began at 24 months, at 36 months, African-American children are less likely to be consuming cow's milk, cheese, or yogurt than are White or Other race children.

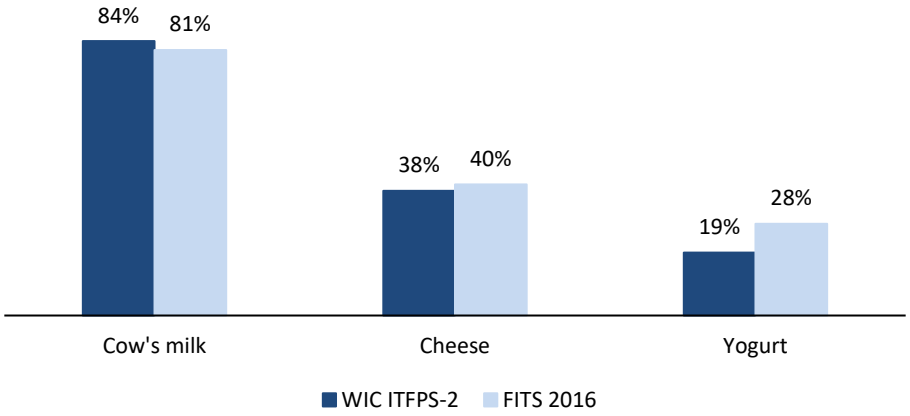
Figure 4-5. Percentage of study children consuming dairy or milk substitutes on a given day (months 24 and 36)



When compared to the dairy consumption findings from the FITS 2016 study (Welker et al., 2018), the percentages of WIC ITFPS-2 children consuming milk and cheese on a given day follow a similar pattern overall to the FITS 2016 data (see Figure 4-6). The percentages of children consuming cow's milk at age 3[41] for the two studies run in close parallel, with 84 percent of WIC ITFPS-2 children, and 81 percent of FITS 2016 consuming it on a given day. The pattern for cheese consumption is also very similar, with 38 percent of WIC ITFPS-2 children, and 40 percent of FITS 2016 children consuming it on a given day. Yogurt consumption, in contrast, does seem to differ slightly across the two studies. At age 3, higher percentages of FITS 2016 children (28%) are consuming yogurt on a given day than are WIC ITFPS-2 children (19%).

[41] The FITS 2016 cross-sectional sample includes children ages 36-47.9 months in the age 3 group. The WIC ITFPS-2 data for 36 months, shown, were collected between child ages 35.5-36.9 months.

Figure 4-6. Percentages of 3 year old children consuming select dairy foods on a given day in WIC ITFPS-2 and FITS 2016



NOTE: The FITS 2016 cross-sectional sample includes children ages 36-47.9 months in the age 3 group. The WIC ITFPS-2 data for 36 months, shown, were collected between child ages 35.5-36.9 months.

Looking more specifically at the types of cow's milk WIC ITFPS-2 children are consuming on a given day at 36 months, whole (4% fat) milk remains the most commonly consumed (32%), followed by low fat (2% fat) milk (29%), and reduced fat (1% fat) milk (24%). Less than 2 percent of the children are consuming skim (nonfat) milk. There is a significant association between type of milk consumed at 36 months and WIC status at 24 months. Children who are not receiving WIC at 24 months are more likely to consume whole milk or reduced fat milk at 36 months than are children who are receiving WIC at 24 months (whole milk, 38% vs. 30% respectively; reduced fat milk 33% vs. 20%, respectively). Children receiving WIC are more likely to consume low fat milk than are children not receiving WIC (35% vs. 11%, respectively). This is in line with the 2014 final rule for the contents of children's food package for WIC, which typically provides low fat milk,[42] and with the DGAs (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015).

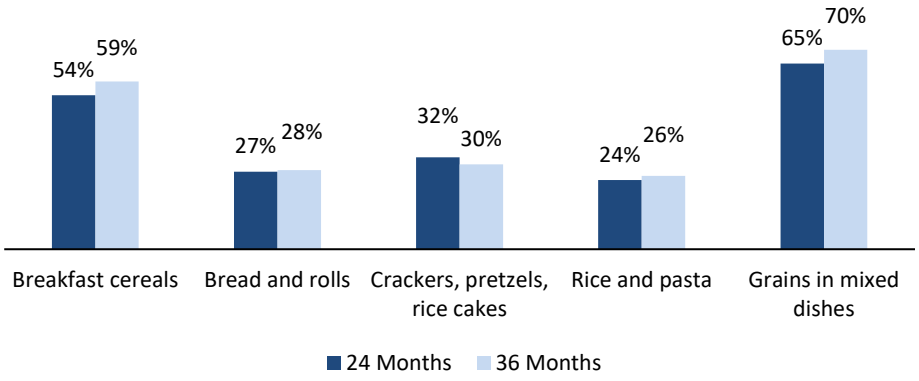
[42] *Special Supplemental Nutrition Program for Women, Infants and Children (WIC): Revisions in the WIC food packages; Final rule*, 7 CFR Part 246, Volume 79 Federal Register Number 42, Section 246.10 Supplemental Foods. March 4, 2014.

Nearly all (96%) WIC ITFPS-2 children are consuming a meat or another protein source[43] on a given day at 24 months, and this remains steady at 36 months, increasing very slightly to 97 percent. The mostly commonly consumed types of meat at 36 months are chicken (55%), and hot dogs, sausages, or cold cuts (27%). Other common protein sources include cheese (38%), protein sources in mixed dishes[44] (33%), and eggs (31%). There are no notable associations between socio-demographic characteristics and any meat and other protein consumption.

4.5.4 Grain Consumption

Most WIC ITFPS-2 children are consuming a grain product on a given day at 24 months (97.2%) and at 36 months (98.2%). The most commonly consumed types of grains are breakfast cereals, breads and rolls, crackers, pretzels, or rice cakes, rice and pasta, or grains in mixed dishes (see Figure 4-7). The percentage of children consuming breakfast cereals increases between 24 months (54%) and 36 months (59%). Consumption of grains in mixed dishes, which include foods such as sandwiches, burritos, tacos, enchiladas, nachos, macaroni and cheese, pizza, spaghetti, ravioli, and lasagna, also increases between 24 months (65%) and 36 months (70%).

Figure 4-7. Percentage of study children consuming different types of grains on a given day by interview month (months 24 and 36)



[43] Other protein sources include dried beans or peas; vegetarian meat substitutes; eggs; peanut butter, nuts, and seeds; cheese; yogurt; and, protein sources in mixed dishes such as: beans and rice, chili, and other bean mixtures; mixtures with vegetables and/or rice or pasta. Cheese and yogurt, while also noted as dairy foods in this chapter, are included as other protein sources to align with food classifications in FITS 2008.

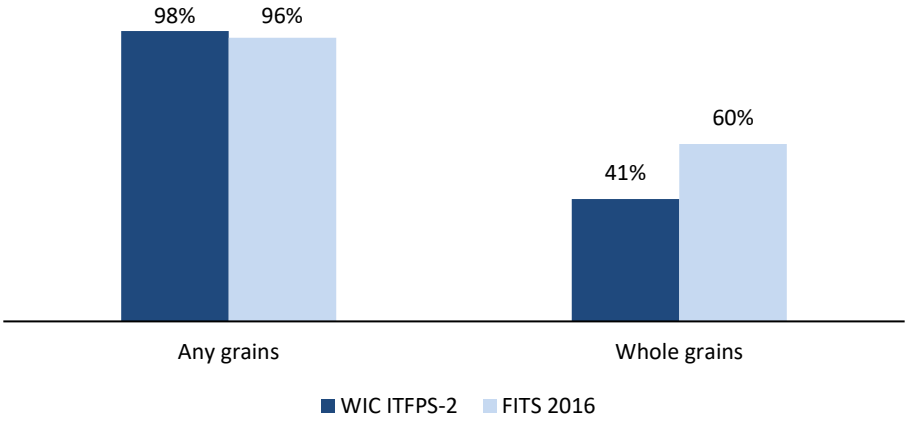
[44] Mixed dishes include beans and rice, chili, other bean mixtures, and mixtures with vegetables and/or rice or pasta.

Forty-one percent of study children are consuming a whole grain on a given day at 36 months, and many of the whole grains are coming from whole grain breakfast cereals (available through the WIC food package), as 38 percent of study children are consuming whole grain breakfast cereals, yet only 1 percent are consuming whole grain bread and rolls. Six percent are consuming whole grain salty snacks.

There are no socio-demographic variables associated with consumption of any grains, but several that are associated with consumption of whole grains (see Appendix B2c, Table B2c-3, for details), including race, ethnicity, and age of mother at the child's birth. Children of African-American mothers are more likely to consume whole grains (47%) than children of Other race mothers (34%), children of Non-Hispanic mothers are more likely to consume whole grains (46%) than children of Hispanic mothers (36%), and children of mothers 26 years old or older are more likely to consume whole grains (43%) than children of mothers who were 16-19 years old at the birth of the child (32%). The differences are attributable primarily to significant differences in consumption of whole grain breakfast cereal, with 43 percent of children of African-American mothers consuming whole grain breakfast cereal, but only 29 percent of children of Other race mothers doing so; 42 percent of children of non-Hispanic mothers and 31 percent of children of Hispanic mothers consuming whole grain breakfast cereal; and, 39 percent of children of mothers 26 years old or older consuming whole grain breakfast cereal and 27 percent of children of mothers 16-19 years old doing so. WIC participation status at 24 months is not significantly associated with consumption of whole grains at 36 months.

Comparing the WIC ITFPS-2 data at 36 months to FITS 2016 (Welker et al., 2018) data at age 3 years, both studies show that most of the children are consuming a grain on a given day. WIC ITFPS-2 children, however, are less likely to be consuming a whole grain on a given day (see Figure 4-8).

Figure 4-8. Percentages of 3 year old children any grains and whole grains on a given day in WIC ITFPS-2 and FITS 2016



NOTE: The FITS 2016 cross-sectional sample includes children ages 36-47.9 months in the age 3 group. The WIC ITFPS-2 data for 36 months, shown, were collected between child ages 35.9-36.2 months.

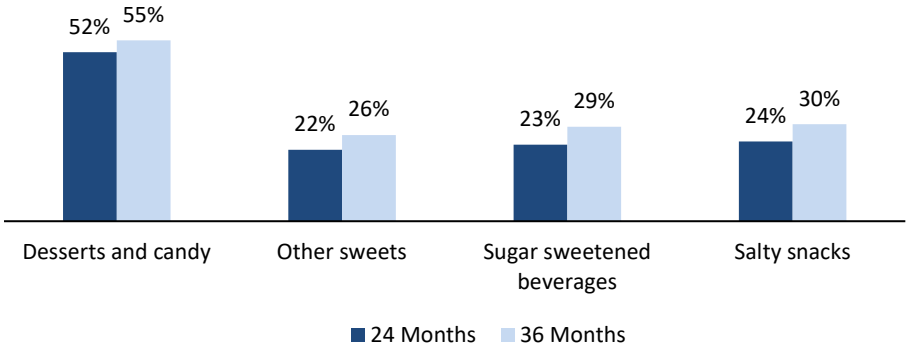
4.5.5 Desserts and Sweets, Sugar Sweetened Beverages, and Salty Snacks Consumption

The percentages of WIC ITFPS-2 children consuming desserts and candy, other sweets, sugar sweetened beverages (excluding 100 percent fruit juice), and salty snacks on a given day increase with age between 24 and 36 months (see Figure 4-9).

Looking across all types of desserts, sugar-sweetened beverages, and other sweets, 82 percent of study children are consuming a sweetened food on a given day at 36 months. Fifty-five percent of children are consuming a dessert or candy. Cakes, pies, cookies, and pastries are the most commonly consumed dessert items, with 32 percent of children consuming at least one of these on a given day at 36 months. Candy is the next most common item, with 19 percent of children consuming candy on a given day. Twenty-six percent are consuming other sweetened items, such as milk flavorings (2%), or sugar, syrup, and preserves (25%). The percentage of children consuming sugar-sweetened beverages on a given day rises to 29 percent by 36 months. As was the case at 24 months, at 36 months most of those sweetened beverages are fruit flavored drinks, consumed by 19 percent of children. The next most common sugar-sweetened beverage is carbonated soda, consumed by 6 percent of children at 36 months.

Consumption of salty snacks (e.g., potato chips, popcorn, cheese curls/puffs, tortilla chips, and other types of chips and salty snacks) also rises, and 30 percent of children are consuming a salty snack on a given day at 36 months.

Figure 4-9. Percentage of study children consuming desserts and candy, sugar-sweetened beverages, and salty snacks on a given day (months 24 and 36)



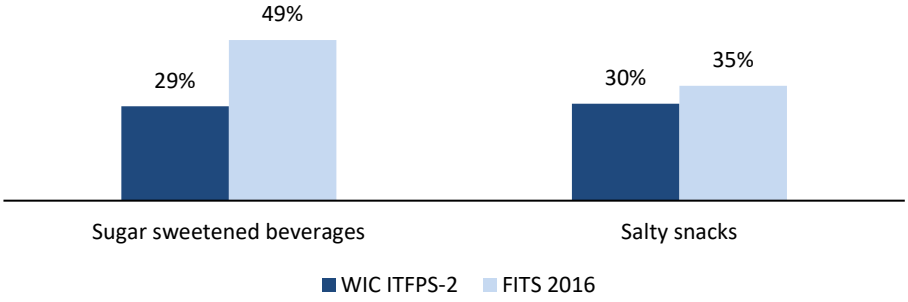
Analyses at 36 months yield few patterns of socio-demographic differences in the percentages of children consuming desserts and candy, or sugar sweetened beverages. Children of mothers who were 26 years or older at the birth of the child are more likely to consume desserts and candy (59%) than are children of mothers who were 16-19 years old at the child's birth (48%). Children of African-American or White caregivers are more likely to consume sweetened beverages (33% and 30%, respectively) than are children of Other race caregivers (22%).

Consumption of salty snacks also yield significant associations with race and ethnicity. Children of African-American caregivers are more likely (43%) than children of White or Other race caregivers (27% and 23% respectively) to consume salty snacks, as are children of non-Hispanic caregivers (36%) as compared to children of Hispanic caregivers (23%).

When compared to the findings from the FITS 2016 study (Welker et al., 2018), the data suggest that a lower percentage of WIC ITFPS-2 children are consuming sugar sweetened beverages, and to a lesser degree, salty snacks, at age 3 (see Figure 4-10).[45] This could be an indication of a trend toward fewer unhealthy choices among children receiving WIC. The FITS age band, however, extends throughout the third year, making the ages not fully comparable.

[45] The FITS 2016 data do not break out desserts and candy in a way that permits direct comparison.

Figure 4-10. Percentages of 3 year old children consuming sweetened beverages and salty snacks on a given day in WIC ITFPS-2 and FITS 2016



NOTE: The FITS 2016 cross-sectional sample includes children ages 36-47.9 months in the age 3 group. The WIC ITFPS-2 data for 36 months, shown, were collected between child ages 35.5-36.9 months

4.6 Indicators of Diet Quality

Although knowing whether children are consuming particular foods on a given day is informative, those details do not indicate whether the quantities consumed are appropriate for a healthy diet. To evaluate the quality of WIC ITFPS-2 children's diets, analyses calculate Healthy Eating Index 2015 (HEI-2015) scores based on amounts consumed, on a 0-100 scale with higher scores indicating better diet quality. Separate analyses compare per-day servings to DGA standards.

4.6.1 Healthy Eating Index-2015 Scores

The Healthy Eating Index-2015 (HEI) is a standard measure of diet quality for age 2 years and above that conforms to the DGA. Using data from a 24-hour dietary recall adjusted for usual intake, the HEI produces both scores for dietary components, and a total score. Total scores of 100 on the HEI indicate that the individual is fully meeting the DGA. Although component scores yield the most information, a general interpretation of total scores is that scores above 80 represent a good quality diet; scores of 51-80 indicate a need for improvement; and scores below 51 indicate a poor quality diet (Carlson, Lino, Gerrior, & Basiotis, 2001). HEI scores were calculated for WIC ITFPS-2 study children based on the population ratio method (National Cancer Institute, 2017). Average HEI component and total scores for 24 and 36 months appear in Table 4-5.

The total HEI scores for study children fall into the range indicating needing improvement, both at 24 and 36 months (mean scores of 60.5 and 61.4, respectively). Most mean component scores show only minor fluctuation between 24 and 36 months; scores for whole fruit and fatty acids increase, and most moderation scores (i.e., components for which an upper limit is recommended) show a decrease. The component scores that are furthest below the adequacy standard at 36 months are greens and beans, whole grains, seafood and plant proteins, and fatty acids. The component score that is furthest below the moderation standard at 36 months is sodium. These findings are consistent with findings from previous research on low-income children receiving WIC (Page et al., 2017). There are no significant socio-demographic differences in total HEI scores at 36 months.

Table 4-5. Average Healthy Eating Index (HEI-2015) Scores for study children (months 24 and 36)

Food Group	Maximum score	Standard for maximum score[a]	24 months	36 months
Adequacy				
Total Fruits	5	≥0.8 cup equiv. per 1,000 kcal	4.7	4.8
Whole Fruits	5	≥0.4 cup equiv. per 1,000 kcal	3.6	4.2
Total Vegetables	5	≥1.1 cup equiv. per 1,000 kcal	2.5	2.6
Greens and Beans	5	≥0.2 cup equiv. per 1,000 kcal	2.2	1.9
Whole Grains	10	≥1.5 oz equiv. per 1,000 kcal	3.5	3.5
Dairy	10	≥1.3 cup equiv. per 1,000 kcal	9.5	9.1
Total Protein Foods	5	≥2.5 oz equiv. per 1,000 kcal	4.3	4.5
Seafood and Plant Proteins	5	≥0.8 oz equiv. per 1,000 kcal	1.7	1.6
Fatty Acids[b]	10	(PUFAs + MUFAs)/SFAs ≥2.5	1.7	2.9
Moderation				
Refined Grains	10	≤1.8 oz equiv. per 1,000 kcal	7.5	6.5
Sodium	10	≤1.1 gram per 1,000 kcal	5.6	5.0
Added Sugars	10	≤6.5% of energy	9.1	8.7
Saturated Fats	10	≤8% of energy	6.2	6.2
TOTAL HEI-2015 SCORE	100		60.5	61.4
Unweighted n			2,199	2,586
Weighted n			371,245	438,319

[a] Scoring criteria for HEI-2015 can be found at https://epi.grants.cancer.gov/hei/developing.html , accessed June 14, 2018.

[b] Ratio of poly- and monounsaturated fatty acids (PUFAs and MUFAs) to saturated fatty acids (SFAs).

4.6.2 DGA Recommended Food Group Servings

Another way to examine the quality of children's diets is to look at whether the WIC ITFPS-2 children are meeting the DGAs by consuming the recommended amounts of select food groups (see Table 4-6). At both 24 and 36 months, at least half of study children meet DGA food group servings for fruits, protein foods, total grains, and for staying under the recommended limits of added sugars. The percentage of children meeting the DGA for vegetables fell between 24 and 36 months, less

than 1 percent of children are meeting the DGA at 36 months. Additionally, as noted in section 4.5.2, one of the most commonly consumed vegetables at 36 months is french fries which may meet the DGA in quantity while remaining a less healthy choice than non-fried vegetables.

Table 4-6. Consumption of DGA recommended servings for food groups by study children (months 24 and 36)

Select Food Groups	24 Months	36 Months
Vegetables	1 cup eq.	Female 1.5 cup eq. Male 1.5 cup eq.
Percentage meeting DGA	8.4	0.1
Mean intake (cup eq.)	0.6	0.8
Median intake (cup eq.)	0.6	0.8
Fruits	1 cup eq.	Female 1 cup eq. Male 1.5 cup eq.
Percentage meeting DGA	81.9	76.6
Mean intake (cup eq.)	1.6	1.8
Median intake (cup eq.)	1.6	1.8
Protein foods	2 oz eq.	Female 3 oz eq. Male 4 oz eq.
Percentage meeting DGA	75.8	50.4
Mean intake (ounce eq.)	2.8	3.5
Median intake (ounce eq.)	2.7	3.5
Dairy	2 cup eq.	Female 2.5 cup eq. Male 2.5 cup eq.
Percentage meeting DGA	63.7	29.8
Mean intake (cup eq.)	2.3	2.1
Median intake (cup eq.)	2.3	2.1
Total Grains	3 oz eq.	Female 4 oz eq. Male 5 oz eq.
Percentage meeting DGA	69.7	51.3
Mean intake (ounce eq.)	3.7	4.6
Median intake (ounce eq.)	3.6	4.5
Whole Grains	1.5 oz eq.	Female 2 oz eq. Male 2.5 oz eq.
Percentage meeting DGA	0.3	0.0
Mean intake (ounce eq.)	0.7	0.8
Median intake (ounce eq.)	0.6	0.7
Added sugars	<10% kcal	<10% kcal
Percentage meeting DGA	82.9	71.0
Mean intake (ounce eq.)	7.6	8.8
Median intake (ounce eq.)	7.2	8.6
Unweighted n	2,434	2,586
Weighted n	438,206	438,319

There are several socio-demographic characteristics associated with meeting the DGA for individual food groups at 36 months, but ones associated with multiple food groups include race, ethnicity, and WIC participation status at 24 months (see Tables 4-6a, 4-6b, and 4-6c).

Table 4-6a. Associations between meeting guidelines for DGA food group consumption and race, (month 36)

DGA Food Groups	Race		
	African American	White	Other Race
	Percentage Meeting DGA		
Vegetables	0.3%	0.0%	0.2%
Fruits[bc]	72.7	75.1	85.3
Protein foods[bc]	56.5	51.2	41.1
Dairy[ab]	20.1	30.7	33.1
Total grains[ab]	63.3	49.0	44.8
Whole grains	0.0	0.0	0.0
Added sugars[abc]	57.9	71.7	83.4
Unweighted n	741	1,451	394
Weighted n	94,039	259,116	85,164

[a] Children of African-American mothers are significantly different from children of White mothers
[b] Children of African-American mothers are significantly different from children of Other race mothers
[c] Children of White mothers are significantly different from children of Other race mothers.

Children of African-American mothers are more likely to meet the DGA for total grains, and less likely to meet the DGAs for dairy and for added sugars (i.e., consume less than the recommended maximum) than are children of White or Other race mothers. Children of Other race mothers are more likely to meet the DGA for fruits, and less likely to meet the DGA for protein foods, than are children of White mothers or children of African-American mothers, and more likely to meet the DGA for added sugars than children of White or African American mothers (see Table 4-6a). These findings correspond well to the findings in Section 4.4 of this report on associations between race and consumption on a given day.

Ethnicity is also associated with meeting the DGAs for food groups (see Table 4-6b). Children of Non-Hispanic caregivers are more likely to meet the DGA for total grains and less likely to meet the DGAs for fruits and for added sugars than children of Hispanic mothers.

Table 4-6b. Associations between meeting guidelines for DGA food group consumption and ethnicity, (month 36)

DGA Food Groups	Ethnicity	
	Hispanic	Non-Hispanic
	Percentage Meeting DGA	
Vegetables	0.1%	0.2%
Fruits*	79.3	74.2
Protein foods	49.4	51.2
Dairy	29.6	28.3
Total grains*	37.1	63.8
Whole grains	0.0	0.0
Added sugars*	77.9	65.0
Unweighted n	984	1,602
Weighted n	205,139	233,181

* Children of Hispanic mothers are significantly different from children of Non-Hispanic mothers

Because the associations between DGA food group consumption and socio-demographic variables are bivariate analyses, they do not indicate whether race and ethnicity are each independently associated with consumption.

Table 4-6c. Associations between meeting guidelines for DGA food group consumption and 24-month WIC participation status (month 36)

DGA Food Groups	WIC Participation Status at 24 months	
	Receiving WIC	Not Receiving WIC
	Percentage Meeting DGA	
Vegetables	0.2%	0.0%
Fruits	77.1	75.4
Protein foods	49.6	52.3
Dairy	29.2	28.0
Total Grains*	48.3	58.7
Whole Grains	0.0	0.0
Added sugars*	73.0	65.9
Unweighted n	1,808	778
Weighted n	314,441	123,878

* Children receiving WIC at 24 months are significantly different from children not receiving WIC at 24 months.

WIC participation status at 24 months is significantly associated with meeting the DGAs for two food groups at 36 months (see Table 4-6c). Children receiving WIC at 24 months are more likely to meet the DGA for added sugars, and less likely to meet the DGA for total grains, than children not receiving WIC at 24 months.

4.7 Summary

WIC ITFPS-2 study children's diet at 36 months remains very similar to their diets at 24 months. Most children are consuming breakfast, lunch, and dinner on a given day, and many are consuming snacks. They are consuming a varied diet including fruits, vegetables, dairy, grains, and meats and other proteins. As they get older they are, however, continuing to increase their consumption of energy-dense, nutrient poor foods such as desserts, candy, sugar-sweetened beverages, and salty snacks. By 36 months study children are more likely to consume a dessert, candy, sweet, or sweetened beverage on a given day (82%) than to consume a non-juice fruit (72%) or vegetable (63%).

WIC ITFPS-2 children's fruit consumption rises only slightly between 24 and 36 months, from 70 percent to 72 percent consuming a fruit (excluding juice) on a given day. Consumption of 100 percent fruit juice declines only slightly from 24 to 36 months (70% and 69%, respectively).

Vegetable consumption among WIC ITFPS-2 remains low between 24 to 36 months, with 62 percent of children at 24 months, and 63 percent at 36 months consuming a vegetable. Cooked vegetables remain the most common form of vegetables consumed at 36 months (55%), with a smaller percentage of children (16%) consuming raw vegetables. On a given day at 36 months, 28 percent of children are not consuming any non-juice fruit, and 37 percent are not consuming any vegetables.

Consumption of dairy remains steady, with 85 percent of children drinking cow's milk on a given day, 38 percent consuming cheese, and 19 percent consuming yogurt. The most commonly consumed type of cow's milk is whole milk (32%); 31 percent consume either low-fat milk or skim milk, the types of milk provided to children by WIC. Consumption of protein foods remains high, with 97 percent of children consuming a meat or another protein on a given day at 36 months.

As was the case at 24 months, nearly all WIC ITFPS-2 children are consuming grains on a given day at 36 months (98%). Less than half of the children (41%), however, are consuming a whole grain on a given day at 36 months. Most whole grain consumption is through consuming whole grain breakfast cereal.

Consumption of desserts and candy, sugar-sweetened beverages, and salty snacks continues to increase incrementally during the third year of life. By 36 months, slightly more than half (55 percent) of study children are consuming a dessert or candy on a given day, 29 percent of the children are consuming a sugar sweetened beverage such as fruit drinks or carbonated sodas, and 30 percent are consuming a salty snack on a given day. Although the percentage point increase between 24 and 36 months of children consuming these foods is still relatively small (desserts or candy: 3 percentage points; sugar sweetened beverages: 6 percentage points; salty snacks: 6 percentage points) the magnitude of the increases is larger than for healthier foods such as fruits (excluding juice, 2 percentage points) or vegetables (1 percentage point).

These consumption patterns follow the same basic trends seen in the FITS 2016 data (Welker et al., 2018). Following the same pattern seen at age 2, by age 3 the consumption rates of fruits, vegetables, grains, and cow's milk are similar across the two studies. On a given day a lower percentage of WIC ITFPS-2 children than FITS 2016 children are consuming sugar sweetened beverages (29% and 49%, respectively). A lower percentage of WIC ITFPS-2 children than FITS 2016 children, however, are consuming whole grains (41% and 60%, respectively).

Diet quality of WIC ITFPS-2 children leaves room for improvement. The total average score on the HEI-2015 is 61.4 at 36 months, far below the optimal range of 81 or above, but consistent with the score of 62.1 from previous research on young children from low-income families, and somewhat higher than the 59.9 average score of the age-matched national population (Page et al., 2017). Analysis of consumption of DGA recommended food group servings shows that while high percentages of WIC ITFPS-2 children meet the DGAs for fruits (77%) and added sugars (71%), improvement is particularly needed with regard to the DGAs for vegetables (0.1%) and whole grains (0.0%).

There are two food group consumption differences at 36 months between children who had been receiving WIC at 24 months, and those who had not. By 36 months, children who had been receiving WIC at 24 months are more likely than their counterparts to consume 100 percent fruit juice and low fat milk, but less likely to consume any vegetable. Looking at daily portions instead of any consumption on a given day, children who had been receiving WIC at 24 months are also more likely than children not receiving WIC at 24 months to meet the DGAs for added sugars, but less likely to meet the DGAs for total grains.

These findings on food consumption and diet quality demonstrate that WIC ITFPS-2 study children are eating a variety of fruits, vegetables, dairy, and meats and proteins. Their food consumption at 36 months is highly consistent with consumption at 24 months, although consumption of nutrient poor foods such as desserts, candy, and sugar sweetened beverages is increasing slightly. While the children's average diet quality is consistent with other research on U.S. children, it shows a need for improvement, particularly for vegetables and whole grains.

Energy and Nutrient Intake 5

Key Findings:

- As expected, median energy intakes of WIC ITFPS-2 children increase between 24 and 36 months.
- Median macronutrient intakes meet or exceed recommended levels at 36 months, and fall within acceptable levels as percentages of total daily energy intake.
- The median intakes of most micronutrients meet or exceed recommended levels at 36 months; intakes of vitamin D and potassium, however, fall below recommended levels.
- The median intake of vitamin E, which was below recommended levels at 24 months, exceeds recommended levels at 36 months but still has a prevalence of inadequate intake of 27 percent.
- Median sodium intake continues to exceed the UL at 36 months, reaching 1.5 times the UL.

5.1 Overview

This chapter focuses on energy and nutrient intake. The data in this chapter emphasize intake at 36 months, the interview at which the study collected dietary intake data for age three years, although data from 24 months are included where applicable to provide context.

Examples of questions addressed are:

- What is the energy intake of young children?
- What is the macronutrient intake of young children?
- What is the micronutrient intake of young children?

5.2 Background

Children three years of age need sufficient amounts of total energy, macronutrients, and micronutrients for healthy growth and development. It is possible to evaluate the nutrient intakes of groups of children at age 36 months using Dietary Reference Intakes (DRIs). DRIs are nutrient standards (Institute of Medicine, 2000), that can be used as a point of comparison to estimate the prevalence of inadequate or excessive intakes. The *2015-2020 Dietary Guidelines for Americans* (DGAs)

can also be used as a reference point for children age 24 months and older for standards for a healthy, nutritionally adequate diet (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015).

5.2.1 Energy and Nutrient Intake

To examine dietary intake comprehensively, the total energy (as measured in kilocalories), macronutrient, and micronutrient contents of individuals' diets are typically estimated and, when appropriate, compared to existing standards or references. For total energy, comparisons may be made using the estimated energy requirement (EER). EER is the average estimated amount of energy necessary to promote adequate and appropriate growth among various age groups. The EER for children (Institute of Medicine, 2005), which is based on both total energy expenditure and energy deposition during growth, requires an accurate body weight and height for the child at the same time point as the dietary intake. Although the current study did collect data on weight and height around the time of the third birthday, measurements were not obtained at the exact time of the interview. As such, individual-level EERs could not be determined for each study child, and comparisons between median energy intake and EERs are not appropriate for the WIC Infant and Toddler Feeding Practices Study (WIC ITFPS-2) data.[46]

Comprehensive dietary evaluations will also examine the macronutrient and micronutrient contents of individuals' diets. Essential macronutrients (i.e., protein, carbohydrate, and fat) are needed in relatively large quantities to provide energy and promote growth, whereas micronutrients (i.e., vitamins and minerals) are needed in smaller amounts, but are still essential for various physiological and metabolic processes. Insufficient consumption of the necessary micronutrients can increase risk of disease and can impede growth and development. Iron and iodine, in particular, are critical for cognitive development (Micronutrient Initiative, 2009). In addition, adequate zinc intake contributes to developmentally appropriate growth patterns, immune system development, and neurobehavioral development in infants and children (Wessells & Brown, 2012).

[46] A similar determination regarding energy intake for children and EER comparisons was made for FITS 2008 (Butte et al., 2010).

The National Academies of Science, Engineering and Medicine (formerly the Institute of Medicine) has established various standards, or Dietary Reference Intakes (DRIs), for essential nutrients,[47] which can be used to estimate the prevalence of inadequate or excessive intakes. Examples of these standards include Recommended Dietary Allowances (RDAs), Estimated Average Requirements (EARs), adequate intake levels (AIs), and tolerable upper intake levels (ULs). RDAs represent levels of daily intake sufficient to meet the needs of the majority of the population, and are typically used when assessing individual level dietary intakes. The setting of RDAs depends on the establishment of an EAR. EARs represent levels of daily intake sufficient to meet the nutrient requirements of half of all healthy individuals, and are the standard used within each age group to estimate the prevalence of inadequate intakes. EARs can be used as a cut point for most nutrients (i.e., those that are normally distributed); the prevalence of inadequate intakes is estimated as the proportion of the population with intakes below the EAR (Murphy, Guenther, & Kretsch, 2006). In the absence of sufficient data to produce EARs, AIs are estimated. AIs represent average nutrient levels believed to meet the nutrient requirements of most or all healthy members of a given age group. If the average group intake meets or exceeds the AI, while the exact prevalence of low intakes cannot be determined, a low prevalence of inadequate intake is assumed (Murphy et al., 2006). Nutrient intake levels may also be compared to the UL, the highest level of daily nutrient intake that is likely to pose no risk of adverse health effects. If a sizeable proportion of a group has intakes above the UL, it may be appropriate to reduce intakes (Murphy et al., 2006).

In addition to the DRIs, macronutrients can also be expressed as percentages of total daily energy intake. For example, when assessing daily carbohydrate intake, dietary intakes can be expressed in absolute amounts (as measured in grams) or as a percentage of total energy. The latter is then compared with a range known as the Acceptable Macronutrient Distribution Range (AMDR). Like the other DRIs, the AMDR is based on the ideal range necessary to promote health and growth while reducing chronic disease risk.

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[47] Dietary Reference Intakes for calcium, phosphorous, magnesium, vitamin D, and fluoride (1997); Dietary Reference Intakes for thiamin, riboflavin, niacin, vitamin B6, folate, vitamin B12, pantothenic acid, biotin, and choline (1998); Dietary Reference Intakes for vitamin C, vitamin E, selenium, and carotenoids(2000); Dietary Reference Intakes for vitamin A, vitamin K, arsenic, boron, chromium, copper, iodine, iron, manganese, molybdenum, nickel, silicon, vanadium, and zinc (2001); Dietary Reference Intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein, and amino acids (2002/2005); and Dietary Reference Intakes for calcium and vitamin D (2011). Retrieved from http://nationalacademies.org/hmd/~/media/Files/Report%20Files/2019/DRI-Tables-2019/6_DRIValues_Summary.pdf?la=en on September 13, 2018.

When evaluating nutrient intake of young children, it is important to consider the intake of several micronutrients that are essential for growth and development, including iron, zinc, vitamin D, calcium, and potassium. Iron deficiency and iron-deficiency anemia are implicated in neurodevelopment (Baker & Greer, 2010), and inadequate zinc intake may be associated with compromised cognitive development (Salgueiro et al., 2002), as well as growth faltering, and impaired immune and gastro-intestinal tract function (Krebs, Miller, & Michael Hambidge, 2014). Inadequate vitamin D in childhood can cause rickets and suboptimal bone mass (Del Valle, Yaktine, Taylor, & Ross, 2011; Holick, 2006). Similarly, inadequate calcium intake contributes to decreased bone health (Del Valle, Yaktine, Taylor, & Ross, 2011; Stallings & Yaktine, 2007). Finally, adequate intake of potassium is critical for the maintenance of cellular function and fluid balance (World Health Organization, 2012.).

5.3 Sample and Analysis Approach

5.3.1 Sample

The analyses in this chapter focus on the dietary intake interviews at 24 and 36 months. Table 5-1 shows the number of respondents to those two interviews. Both the core and supplemental samples participated in these interviews. In analyses, the responses to each interview are weighted so that findings reflect the WIC population as described in Chapter 1. Table 5-1 shows the number of respondents to the 24- and 36-month interviews.

Table 5-1. Number of respondents by interview month

Sample structure	24-Month interview	36-Month interview
Core prenatal sample	1,702	1,813
Core postnatal sample	235	231
Supplemental prenatal sample	425	460
Supplemental postnatal sample	99	104
Total	2,461	2,608

5.3.2 Analysis

The analyses in this chapter examine energy and nutrient intake at 36 months; data on 24-month intakes, which were reported in the WIC ITFPS-2 Second Year Report (Borger et al., 2018), are also shown to provide context. All energy and nutrient intakes for the group of WIC ITFPS-2 children

are reported as median intakes, rather than as mean intakes, to reduce the influence of extreme values in the summary statistics. Additional analyses are conducted to explore whether socio-demographic characteristics are associated with these intakes. Socio-demographic characteristics are typically measured at the time of the first study interview (prenatal, 1-, or 3-month interview). For characteristics that change over time, such as food security or income poverty, socio-demographic characteristics are updated to values reported at the 24-month interview.

When possible, data are compared to the Gerber/Nestle Feeding Infants and Toddlers Studies (FITS) conducted in 2016 (Anater et al., 2018, Bailey et al., 2018), the latest in a well-known series of national studies of infant and toddler feeding practices that include both WIC participant and non-participant children. Like WIC ITFPS-2, FITS studies collects 24-hour dietary recall data,[48] with replicate dietary intakes on a portion of the cases to allow for estimation of usual intake, making FITS a good source of comparison for nutrient intake among WIC ITFPS-2 children. The FITS studies are cross-sectional studies; FITS 2016 includes children from birth to 4 years, and approximately 27 percent of the 2 and 3 year old children are WIC participants (Anater, 2018). Because FITS 2016 is a cross-sectional study covering a range of ages, their findings are published in bands of ages. Comparisons between WIC ITFPS-2 and FITS data therefore match the WIC ITFPS-2 36 month data to the closest relevant FITS age band, which is 36-47.9 months. The lack of complete alignment between child age in the two studies, and the fact that WIC ITFPS-2 is a low-income sample whereas FITS 2016 includes both low income and higher income families, may be possible sources of differences in findings between the two studies. Differences between FITS 2016 and WIC ITFPS-2 in methodology, as well as limits in the availability of data on which to conduct comparative analyses, prevent making direct statistical comparisons of the studies. Consequently, comparisons focus on the magnitude and patterns of differences between the studies, rather than statistical significance of the differences.

All post-birth interviews through 24-months, as well as the interviews at 36, 48, 60, and 72-months, include a 24-hour dietary recall using the U.S. Department of Agriculture's (USDA) Automated Multi-Pass Method (AMPM) (Raper, Perloff, Ingwersen, Steinfeldt, & Anand, 2004), as described in Chapter 1. When conducting the 24-hour dietary recall, an interviewer guides the caregiver through the prior day's intake, and asks the caregiver to report all foods, beverages, and dietary supplements the child consumed for each eating occasion during the 24-hour period. The interviewer records all

[48] The methodology for coding dietary intakes differs slightly between FITS 2016 and WIC ITFPS-2 such that some of the changes observed when comparing food groups or nutrient intakes over time may be due in part to the codes applied to the various foods and the food grouping scheme used to classify foods. See Welker et al. (2018) for details of the differences in coding between FITS 2008 and 2016.

information, and trained coders then code and analyze the data for nutrient content. Intakes after 11 months of age are adjusted statistically for expected day-to-day variation. Within 10 days of the initial dietary intake interview, the study collects a second, replicate intake on a randomly selected 10 percent subsample of children at 13, 15, 18, 24, 36, 48, 60, and 72 months to use in estimating "usual" intake of energy and nutrients for all study children. Analyses in this chapter use energy and nutrient content of reported foods, beverages, and dietary supplements, and eating occasion, to describe estimated usual intake.

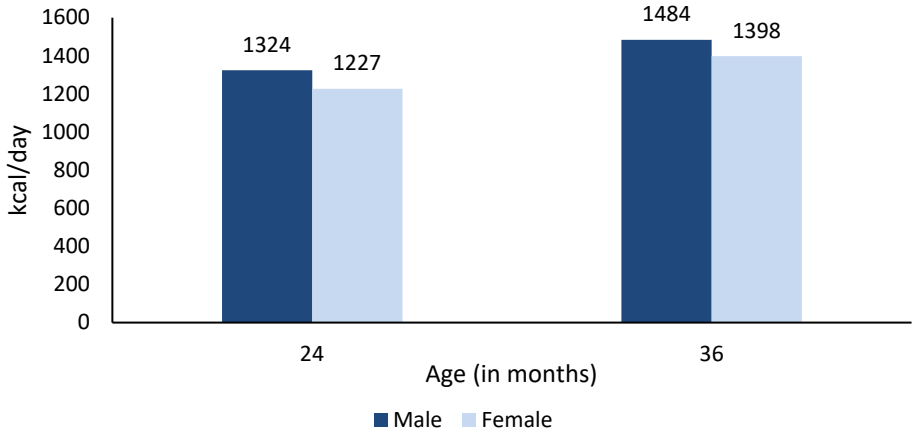
5.4 Energy and Nutrient Intake

Chapter 4 focused on foods and food groups consumed, and diet quality of WIC ITFPS-2 children. Analyses in this chapter address energy intake, macronutrient intake, and micronutrient intake at 36 months. Data are also presented on energy and nutrient intake at 24 months to provide context.

5.4.1 Energy Intake

Data from WIC ITFPS-2 suggest that young children's median energy intakes continue to increase as the children age (see Figure 5-1). This is consistent with the increased calorie needs children experience as they grow and become increasingly active. Between ages 24 and 36 months, median energy intake increases by 12 percent for male children, and by 14 percent for female children. At both time points, males have higher median energy intakes than females; this is expected given that energy requirements for male children between ages 1-3 is slightly higher than that of female children.

Figure 5-1. Study children's median energy intake by gender (months 24 and 36)



There are some statistically significant socio-demographic differences in median energy intake at 36 months that are consistent across both male and female children (see Table 5-2). Median energy intake differs by race, such that children of African-American mothers, as compared to children of Other race mothers, have higher energy intake. Median energy intake also differs by ethnicity, with children of Hispanic caregivers having lower median intake levels than children of non-Hispanic caregivers. Children also have higher median energy intake if their mothers are unmarried, and if the children were not receiving WIC at 24 months. Children in households that participate in SNAP have higher energy intake than children in households that participate in other benefit programs, but not SNAP. Children of married mothers have lower median energy intake than children of unmarried mothers. Finally, children whose mothers were 16-19 years old at their birth have higher median intakes than children whose mothers were 26 years old or older.

Median energy intake at 36 months in WIC ITFPS-2 combined across child gender is 1444 kcal/day, which is slightly higher than the median level of 1370 kcal/day reported for children ages 36-47.9 months (also combined across gender) in FITS 2016. According to the *Dietary Reference Intakes 2002/2005*, the recommended daily caloric intake ranges from 1,162 kcal/day for sedentary three-year-old boys to 1,485 kcal/day for active three-year-old boys, and from 1,080 kcal/day for sedentary three-year-old girls to 1,395 kcal/day for active three-year-old girls.[49] Although no relevant measure of activity level is available for WIC ITFPS-2 children, and measurements on the day of the

[49] Dietary Reference Intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein, and amino acids (2002/2005). Based on the DRI reference weight and height for boys of 31.5 pounds and 37.4 inches, and reference weight and height for girls of 30.6 pounds and 37 inches. Retrieved from http://nationalacademies.org/hmd/~/media/Files/Report%20Files/2019/DRI-Tables-2019/6_DRIValues_Summary.pdf?la=en on September 7.

dietary intake are not available, median energy intakes for study children may be exceeding recommendations.

Table 5-2. Statistically significant socio-demographic differences in median energy intake (month 36)

Socio-demographic characteristics*	Median energy intake	
	Male children	Female children
Race of mother/caregiver[a]		
African American	1544.9	1452.7
White	1481.8	1397.3
All Other	1443.3	1347.4
Ethnicity of mother/caregiver[b]		
Hispanic or Latino	1416.9	1317. 4
Not Hispanic or Latino	1555.1	1460.4
Maternal/caregiver marital status at 24 months[c]		
Married	1412.5	1338.4
Not married (including divorced and widowed)	1548.4	1440.8
Participation in non-WIC programs at 24 months[d]		
Does not participate in other programs	1492.5	1378.4
Participates in SNAP or in SNAP and other programs	1515.9	1426.7
Participates in Other Programs Excluding SNAP	1439.4	1369.6
Age of mother or caregiver at child birth[e]		
16-19 years	1641.3	1470.6
20-25 years	1498.1	1440.6
26 years or older	1442.0	1349.3
Child WIC participation status at 24 months[f]		
Receiving WIC at 24 months	1475.5	1369.6
No longer receiving WIC at 24 months	1536.7	1459.2
Unweighted n	1,337	1,249
Weighted n	230,224	208,095

NOTES:

* All significant differences are significant at the level of $p \leq 0.05$.

[a] Children of African-American caregivers are significantly different from children of Other race caregivers in median energy intake.

[b] Children of Hispanic caregivers are significantly different from children of non-Hispanic caregivers in median energy intake.

[c] Children of married caregivers are significantly different from children of unmarried caregivers in median energy intake.

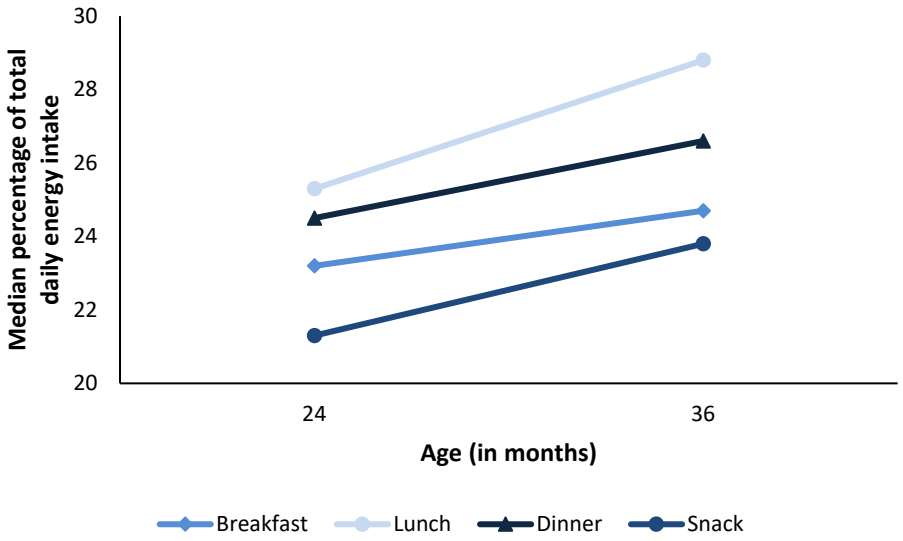
[d] Children of households that participate in SNAP and/or other programs are significantly different from children of households that participate in other programs, but not SNAP, in median energy intake

[e] Children of 16-19 year old mothers are significantly different from children 26+ year old mothers in median energy intake. Male children of 16-19 year old mothers are significantly different from male children of 20-25 year old mothers in median energy intake, and female children of 20-25 year old mothers are significantly different from female children of 26+ year old mothers in median energy intake.

[f] Children receiving WIC at 24 months are significantly different from children not receiving WIC at 24 months in median energy intake.

Another way to examine energy intake is to look at the median percentage of daily energy intake contributed by each eating occasion (see Figure 5-2).[50] At both 24 and 36 months, the median percentage of daily energy contributed by lunch is the highest, followed by dinner, breakfast, and snacks. Lunch and dinner contributed similar median percentages of daily energy at 24 months (25.3 and 24.5 percent respectively), but by 36 months the median contribution of lunch accounts for a slightly higher median percentage of total energy intake than dinner (28.8 and 26.3, respectively). The median percentage of energy accounted for by snacks also increases between 24 and 36 months, accounting for 21.3 percent of energy intake at 24 months, and 23.8 percent at 36 months.

Figure 5-2. Median percentage of total energy intake contributed by each eating occasion (months 24 and 36)



Note: Because of the way it is calculated, the sum of the median percentages is not expected to sum to 100 percent.

Overall, WIC ITFPS-2 children continue to consume more energy with each year, a trend which is expected as young children grow.

[50] The percentage of total energy by eating occasion = (sum of energy for foods reported at the eating occasion)/(total energy for the day)*100. The median percentage of energy intake for each eating occasion is the point at which half the WIC ITFPS-2 children fall at a lower percentage contribution of that eating occasion to total daily energy, and half fall at a higher percentage. Because of the way it is calculated, the sum of the median percentages is not expected to sum to 100 percent.

5.4.2 Macronutrient Intake

WIC ITFPS-2 examines median macronutrient intakes of dietary fat, carbohydrate, and protein, using the AIs/RDAs, EARs, and AMDRs as points of comparison when available.

At 24 and 36 months EARs are available for carbohydrate, thus the cut point method is used to estimate prevalence of inadequate intakes. The cut point method for estimating the prevalence of inadequate intakes in a group (Murphy et al., 2006) involves examining the distribution of intakes to determine the proportion that falls below the EAR. At 24 months, 2.1 percent of WIC ITFPS-2 children fall below the EAR for carbohydrate intake. By 36 months, only 0.1 percent of the children fall below the EAR for carbohydrate intake. For protein, prevalence of inadequate intakes cannot be estimated; however, median protein intakes exceed the RDA[51] at both 24 and 36 months, with median intake increasing slightly from 24 to 36 months (see Table 5-3).

Table 5-3. Median macronutrient intake of study children compared to recommendations and to FITS 2016 (months 24 and 36)

Macronutrients	Median Intake		
	WIC ITFPS-2		FITS 2016
	24 months	36 months	36-47.9 months
Intake			
Fat (g/d)	45.0	49.2	48
AI	*ND*	*ND*	*ND*
Carbohydrate (g/d)	169.8	198.6	186
EAR	*100*	*100*	*100*
Protein (g/d)	50.9	55.6	51
RDA[a]	*13*	*13*	*13*
Intake as a median percentage of energy intake			
Fat	32.1%	31.0%	31%
AMDR[b]	*30-40*	*30-40*	*30-40*
Carbohydrate	53.4	55.3	53
AMDR[b]	*45-65*	*45-65*	*45-65*
Protein	15.8	15.4	15
AMDR[b]	*5-20*	*5-20*	*5-20*
Unweighted n	2,434	2,586	295
Weighted n	438,206	438,319	

[a] For protein, RDA was used as a point of comparison instead of EAR. EAR is expressed in grams per kilograms of body weight, and because the study did not obtain body weight measurements at the time of the interview, the comparison to EAR could not be made.

[b] Acceptable Macronutrient Distribution Range, measured as calories from macronutrient as a percent of total energy

ND indicates not determined for this age.

[51] Recommended dietary allowance is the intake level sufficient to meet the nutrient requirements of nearly all healthy individuals in a group. Comparisons to the RDA are not reliable indicators of inadequate intakes.

When estimating the median percent of total energy intake at months 24 and 36, study children's intakes of dietary fat, carbohydrate, and protein all fall within their respective AMDRs. Across all three macronutrients, the absolute levels of macronutrient intakes are similar to those reported in FITS 2016 (Bailey et al., 2018).

Median carbohydrate and protein intakes meet or exceed recommended levels at 24 months and 36 months. Additionally, median fat, carbohydrate, and protein intakes all fall within the AMDR for ages 24 and 36 months.

5.4.3 Micronutrient Intake

With the exception of vitamin D[52] and potassium, the median intake levels of WIC ITFPS-2 study children for most micronutrients meet or exceed the AI or EAR and have low estimates of inadequate intake based on the EAR[53] at 36 months (see Table 5-4). Median intake of Vitamin E, which is below the EAR at 24 months, is above the EAR at 36 months. There are no notable socio-demographic differences in meeting the DRIs.

The estimate of the prevalence of inadequate intakes for vitamin D is 82.1 percent at 36 months, rising 4.5 percentage points from the estimate of 77.6 percent inadequate intakes at 24 months. The estimate of prevalence of inadequate intakes for vitamin E at 36 months is 27.1 percent, falling to nearly 28 percentage points lower than the estimate of 55 percent at 24 months. Median intake of potassium at 36 months is below the AI, suggesting inadequate intake in the population; however, there is no EAR from which to estimate the exact prevalence of inadequate intake. All other median levels of micronutrients at 36 months are above the AI or EAR, and have estimates of the prevalence of inadequate intake below 1 percent. FITS 2016 children (ages 36-47.9 months) show similar levels of median intake of micronutrients (Bailey et al., 2018), although WIC ITFPS-2 children have somewhat higher median intake for vitamins D and for potassium, and slightly lower

[52] Dietary Reference Intakes (DRIs) for vitamin D are based on an assumption of little or no sun exposure, although individuals' vitamin D levels are increased by exposure to sunlight. Consequently, DRIs for vitamin D have been a subject of disagreement in the scientific literature (Ross et al., 2011).

[53] Dietary Reference Intakes for calcium, phosphorous, magnesium, vitamin D, and fluoride (1997); Dietary Reference Intakes for thiamin, riboflavin, niacin, vitamin B6, folate, vitamin B12, pantothenic acid, biotin, and choline (1998); Dietary Reference Intakes for vitamin C, vitamin E, selenium, and carotenoids (2000); Dietary Reference Intakes for vitamin A, vitamin K, arsenic, boron, chromium, copper, iodine, iron, manganese, molybdenum, nickel, silicon, vanadium, and zinc (2001); Dietary Reference Intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein, and amino acids (2002/2005); and Dietary Reference Intakes for calcium and vitamin d (2011). Retrieved from http://nationalacademies.org/hmd/~/media/Files/Report%20Files/2019/DRI-Tables-2019/6_DRIValues_Summary.pdf?la=en on June 5, 2018.

median intakes for vitamin E. Estimates of prevalence of inadequate intakes for vitamins D and E are also similar across the two studies (see Table 5-5).

At the other end of the spectrum, median intakes of several micronutrients are above the UL at 36 months. Median niacin intake exceeds the UL of 10 mg/d, median magnesium is above the UL of 65 mg/d, median folate is above the UL of 300 µg/d, vitamin A is above the UL of 600 µg RAE/day, zinc is above the UL of 7 mg/d. Median sodium intake, which was already above the UL at 24 months, is 1.5 times the UL of 1500 mg/d by 36 months. Median intake of these nutrients, with the exception of vitamin A, also exceed the UL in the FITS 2016 data (Bailey et al., 2018).

Table 5-4. Median micronutrient intake of study children compared to recommendations (months 24 and 36)

Micronutrients	AI/EAR for children 1-3 years	Median intake		Percent inadequate intakes[c]	
		Month 24	Month 36	Month 24	Month 36
Antioxidants					
Vitamin C (mg/d)	13[b]	80.6	94.2	0.0%	0.0%
Vitamin E (mg/d)	5[b]	4.8	6.0	55.0	27.1
B vitamins					
Thiamin (mg/d)	0.4[b]	1.2	1.4	0.1	0.0
Riboflavin (mg/d)	0.4[b]	1.8	2.0	0.0	0.0
Niacin (mg/d)	5[b]	15.2	18.3	0.3	0.0
Vitamin B-6 (mg/d)	0.4[b]	1.4	1.8	0.1	0.0
Folate (µg/d)	120[b]	290.6	370.3	0.9	0.0
Vitamin B-12 (µg/d)	0.7[b]	4.4	5.0	0.1	0.0
Bone-related nutrients					
Calcium (mg/d)	500[b]	944.3	981.5	0.9	0.7%
Phosphorus (mg/d)	380[b]	1,011.0	1,090	0.1	0.0
Magnesium (mg/d)	65[b]	185.8	208.8	0.0	0.0
Vitamin D (µg/d)	10[b]	8.1	7.8	77.6	82.1%
Other micronutrients					
Vitamin A (µg RAE/d)	210[b]	591.1	663.3	0.5	0.0
Vitamin K (µg/d)	30[a]	37.2	42.8	NA	NA
Iron (mg/d)	3.0[b]	11.3	13.1	0.3	0.0
Zinc (mg/d)	2.5[b]	7.7	8.9	0.2	0.0
Sodium (mg/d)	1,000[a]	1,915	2,220	NA	NA
Potassium (mg/d)	3,000[a]	1,950	2,125	NA	NA
Unweighted n		2,434	2,586	2,434	2,586
Weighted n		438,206	438,319	438,206	438,319

[a] Adequate Intake (AI)

[b] Estimated Average Requirement (EAR)

[c] Prevalence of inadequate intakes is estimated as the percentage of the group falling below the EAR, NA indicates no EAR is available. For iron, which is not normally distributed in the population, the full probability method for determining average risk of inadequate intake was used.

Table 5-5. Median micronutrient intake of WIC ITFPS-2 and FITS 2016 study children compared to recommendations

Micronutrients	AI/EAR for children 1-3 years	Median intake		Percent inadequate intakes[c]	
		WIC ITFPS-2 36 Months	FITS 2016 36-47.9 Months	WIC ITFPS-2 36 Months	FITS 2016 36-47.9 Months
Antioxidants					
Vitamin C (mg/d)	13[b]	94.2	90.0	0.0%	0.0%
Vitamin E (mg/d)	5[b]	6.0	8.5	27.1	30
B vitamins					
Thiamin (mg/d)	0.4[b]	1.4	1.3	0.0	0.2
Riboflavin (mg/d)	0.4[b]	2.0	1.7	0.0	0.1
Niacin (mg/d)	5[b]	18.3	16	0.0	0.3
Vitamin B-6 (mg/d)	0.4[b]	1.8	1.7	0.0	0.1
Folate (µg/d)	120[b]	370.3	422.0	0.0	0.2
Vitamin B-12 (µg/d)	0.7[b]	5.0	5.0	0.0	0.2
Bone-related nutrients					
Calcium (mg/d)	500[b]	981.5	845.0	0.7%	9.2
Phosphorus (mg/d)	380[b]	1,090	943.0	0.0	0.8
Magnesium (mg/d)	65[b]	208.8	184.0	0.0	0.6
Vitamin D (µg/d)	10[b]	7.8	6.6	82.1	79
Other micronutrients					
Vitamin A (µg RAE/d)	210[b]	663.3	558.0	0.0	0.8
Vitamin K (µg/d)	30[a]	42.8	40.0	NA	NA
Iron (mg/d)	3.0[b]	13.1	10.0	0.0	3.0
Zinc (mg/d)	2.5[b]	8.9	8.4	0.0	0.3
Sodium (mg/d)	1,000[a]	2,220	1,955	NA	NA
Potassium (mg/d)	3,000[a]	2,125	1,751	NA	
Unweighted n		2,586	295	2,586	295
Weighted n		438,319		438,319	

[a] Adequate Intake (AI)

[b] Estimated Average Requirement (EAR)

[c] Prevalence of inadequate intakes is estimated as the percentage of the group falling below the EAR, NA indicates no EAR is available.

Overall, at 36 months of age, most median micronutrient intakes exceed the EARs or AIs, and have low prevalence of inadequate intakes based on the EARs. Prevalence of inadequate intake of vitamin E improves between 24 and 36 month. Potassium intake remains below the AI at 36 months, as it was at 24 months. Several nutrients exceed the UL at 36 months. Among the most concerning is sodium, which has a median that exceeds the UL at 24 months, that increases in magnitude to 1.5 times the UL by 36 months.

5.5 Summary

As expected, the median energy intakes of WIC ITFPS-2 children vary by gender, and increase between 24 and 36 months. Median energy intake varies by race, ethnicity, maternal marital status, WIC or SNAP receipt at 24 months, and maternal age at the child's birth, indicating that socio-demographic factors are relevant for total energy intake at this age. At age 36 months WIC ITFPS-2 children may be exceeding recommended levels of energy intake, based on average dietary reference intake standards. Research has found that single proxy 24-hour dietary recalls on very young children may be subject to error, particularly overestimation of energy intake (Fisher et al., 2008). Additional research has found that two recalls provide much better estimates of energy intake for preschool-age children on a group level (Börnhorst et al., 2014). WIC ITFPS-2 conducts second recalls on a subset of the study sample and uses those replicate recalls to estimate usual intake, but the proxy intakes themselves may still be subject to reporting error. Future research should use multiple methods to explore how median energy intakes of subgroups of children who are current or past WIC recipients compare to EERs, as excessive energy intake could be a risk factor for overweight and obesity.

WIC ITFPS-2 children's median micronutrient intakes generally meet or exceed AIs or EARs during the third year. Vitamin D continues to be an exception, however, with median intakes falling below the EAR at both 24 and 36 months, although sources of vitamin D other that food and supplements were not accounted for in the estimates. Estimates of inadequate intakes of vitamin D increase between 24 and 36 months as median intake decreases. Defining vitamin D intake adequacy is an active area of research that may continue to evolve as researchers debate how best to incorporate the contribution of non-dietary sources of vitamin D (Ross et al., 2011). Median vitamin E intakes improve between 24 and 36 months, but the prevalence of inadequate intakes remains above 25 percent. Potassium continues to have median intake levels below the DRIs as well. For six nutrients, WIC ITFPS-2 children are exceeding the ULs. Of particular note is median sodium intake, which increases between 24 and 36 months, and continues to exceed the UL. These findings underscore the importance of continuing to educate WIC participants on appropriate sources of vitamins D, E, and potassium as children get older, including foods available in the WIC food package such as vitamin D fortified milk and cereals, eggs, peanut butter, and select fruits, vegetables, and beans. Furthermore, nutrition messages focused on avoiding adding salt when cooking for children, and reducing intake of processed foods that contain high levels of sodium, could be prioritized.

Data on nutrient intake from WIC ITFPS-2 suggest that at 36 months children who started out on WIC are having most of their nutritional needs met. These patterns of nutrient intake follow the same trends, and are of comparable levels, to those reported in FITS 2016, suggesting that children who started out on WIC have similar intakes at 36 months to children from samples that contain both low-income and higher income children.

Weight and Growth 6

Key Findings:

- At 3 years, 65 percent of study children are in the normal/healthy range of BMI percentiles, 4 percent are underweight, 14 percent are overweight, and 17 percent are obese.
- Mothers who are obese at 24 months are about 62 percent more likely to have an obese child than a healthy-weight child at three years of age as compared to healthy weight mothers.
- Mothers who were breastfeeding at 1 month postpartum are about 38 percent less likely to have an obese child at age 3 than mothers who were not breastfeeding.
- Multivariate growth curve modeling of the trajectories of child BMI from early infancy to the third year shows a relatively flat growth trajectory, with only a slight downward trend between toddlerhood and the third year.

6.1 Overview

This chapter focuses on weight and growth trajectory outcomes among study children. The timeframe addressed runs from 6 to 40 months,[54] but the emphasis is on measurements around the time of the third birthday. The main research questions addressed in this chapter are:

- How do feeding practices affect children's weight and growth?
- What is the impact of participation in other federal food benefit programs on health outcomes?
- Does continued participation in WIC lead to better health outcomes?

Analyses in this chapter explore the influence of maternal diet, child activities, maternal beliefs, opinions, and rules about feeding, and family eating routines, on growth outcomes. The research uses weight and length/height measurement data on the study child in conjunction with survey data.

[54] The WIC Infant and Toddler Feeding Practices Study (WIC ITFPS-2) 36-month interview ended before 37 months, but data collection for children's weight and length permitted an age window from 32 to 40 months.

6.2 Background

Early feeding and nutrition patterns play an important role in growth in young children, and in later dietary habits and health outcomes, and these patterns provide an opportunity for primary prevention of adult-onset diseases (Arenz, Rückerl, Koletzko, & von Kries, 2004; Agostoni, Baselli, & Mazzoni, 2013; Campbell et al., 2016; Harder, Bergmann, Kallischnigg, & Plagemann, 2005; Owen, Martin, Whincup, Smith, & Cook, 2005). Multiple feeding and dietary factors contribute to weight and growth. Initiation and duration of breastfeeding (Armstrong & Reilly, 2002; Whaley et al., 2017) has been associated with weight and growth outcomes. While this was a primary focus of weight and growth analyses in the WIC ITFPS-2 Second Year Report (Borger et al., 2018), later feeding and dietary factors associated with weight and growth at age 3 will be examined in this chapter. In early childhood, consumption of nutritious foods has been associated with more optimal growth patterns in children (Taveras, Gillman, Kleinman, Rich-Edwards, & Rifas-Shiman, 2013). Conversely, consumption of nutrient-poor foods, such as sugar-sweetened beverages, has been associated with less optimal growth patterns (Davis, Whaley, & Goran, 2012). Parental feeding practices, including keeping track of what the child eats and encouraging the child to finish his/her food, have also been associated with child growth outcomes (Birch & Fisher, 1998; Birch et al., 2001), as has participation in SNAP (Barroso et al., 2016). The relationship between these multiple factors and child weight and growth will be explored in this chapter.

There is evidence based on data from the National Health and Nutrition Examination Survey (NHANES) that obesity prevalence among 2-5 year old children in the United States declined starting in the period from 2003-2004, and continuing through 2013-2014 (Ogden et al., 2016; Ogden, Carroll, Fryar, & Flegal, 2015; Ogden, Carroll, Kit, & Flegal, 2014). However, two recent publications also using the NHANES data report a significant increase in obesity among 2-5 year old children in 2015-2016 (Skinner et al., 2018; Hales, Fryar, Carroll, Freedman, & Ogden, 2018). A decrease between 2010-2014 was also observed in WIC administrative data among preschool-aged WIC participants, from a peak of 15.9 percent in 2010 to 14.5 percent in 2014 (Pan et al., 2016). Given the timing of the WIC ITFPS-2 data collection, with data collection for children ages 24-36 months taking place during and after 2014, it is critical to explore weight and growth outcomes of study children, as well as the associations between growth and food intake, feeding practices, participation in other food programs, and continued WIC participation.

6.3 Sample and Analysis Approach

6.3.1 Sample

The analyses in this chapter uses data through the 36-month interviews, although the focus is on Body Mass Index (BMI) outcomes at age 3 years. Table 6-1 shows the number of respondents to the 30- and 36-month interviews. Both the core and supplemental samples were eligible for these interviews. In analyses the responses to each interview are weighted so that findings reflect the WIC population as described in Chapter 1.

Table 6-1. Number of respondents by interview month

Sample structure	30-Month interview	36-Month interview
Core prenatal sample	1,838	1,813
Core postnatal sample	233	231
Supplemental prenatal sample	453	460
Supplemental postnatal sample	101	104
Total	2,625	2,608

The study collects weight and length/height measurements of the children at four periods of time[55] through the end of the third year of life: 6 months, 12 months, 24 months, and 36 months (see Table 6-2). As part of regular clinic visits, WIC sites collect these data for most enrolled participants and report the information to the WIC State Agency. The study then requests these measurements from the state's WIC administrative data. Through 24 months, for participants who are in the core sample and have left WIC, the study attempts to collect weight and length measurements taken by the child's health care provider.[56] At 36 months the study attempts to collect weight and height data for all study children, both core and supplemental, regardless of WIC participation status. All weight and length/height data used for analyses in this chapter are from WIC or provider measurements. Although mothers were also asked to report on a recent child weight and height during some interviews, those data are not used in analyses.

[55] Although data are also requested on birth weight and length, the data are not consistently available from WIC records.

[56] For core sample participants who are no longer on WIC and do not have a health care provider, study staff arrange for a local home health agency (HHA) nurse to obtain weight and length measurements at the participant's home. This option was used by fewer than five participants, and for most cases measurements from WIC were ultimately provided, obviating the need for the HHA measurements.

Table 6-2. Number of analysis sample children[a] on whom the study received weight and length data, by source of measurement

Time period	Number received	Source of measurement		
		WIC administrative data	Health care provider records	Caregiver report of provider measurement
6-month measurements	2,568	2,394	62	112
12-month measurements	2,577	2,347	147	83
24-month measurements	1,731	1,449	158	124
36-month measurements	1,886	1,139	747	0

[a] Supplemental sample measurements for 6, 12, and 24 months were only sought from WIC records, and therefore not expected from participants not receiving WIC, thus expected numbers are smaller than the full analysis sample of 3,777.

The weight and length data vary greatly because timing of measurements at WIC and by providers varied. In order to facilitate analysis, the data are broken into four age periods eligible for analysis: early infancy, late infancy, toddlerhood, and third year. *Early infancy* ranges from 1 to less than 7 months; *late infancy* ranges from 7 through 15 months; *toddlerhood* ranges from 20 through 28 months; and, *third year* ranges from 32 through 40 months. Table 6-3 reports on the number of observations in each age period for which weight and length data are available. Although the majority of study children have repeated measures, the time between measures is uneven.

Table 6-3. The number of study children with weight and length measurement data in each age group for analysis

Age period	Unweighted n	Weighted n
Early infancy (1 to <7 months)	2,014	349,824
Late infancy (7 to 15 months)	2,442	420,357
Toddlerhood (20 to 28 months)	1,731	442,713
Third year (32 to 40 months)	1,886	442,544

6.3.2 Growth Standards

From birth to age 24 months, child growth is assessed through weight and recumbent length (weight length, or WFL). Beginning at age 24 months, child weight and length continue to be measured and tracked, with a shift in measurement procedure from recumbent length to standing height. Weight for height (WFH) growth charts are commonly used, and the concept of BMI is introduced at this age. BMI is an individual's weight in kilograms divided by the square of their height in meters. Growth charts consist of a series of percentile curves that illustrate the distribution of selected measurements of children in a standard reference population. Percentiles are the most commonly

used clinical indicator to assess the size and growth patterns of individual children in the U.S. (Kuczmarski et al., 2002; CDC, 2018), allowing practitioners to rank the position of an individual by indicating what percent of the reference population the individual would equal or exceed. Weight that is higher than what is considered as a healthy weight for a given height is described as overweight or obese. Weight that is lower than what is considered as healthy for a given height is described as underweight. In the current bivariate analyses, weight status categories based on BMI or WFH z-score use the CDC recommended classification criteria: underweight (less than the 5th percentile), normal/healthy weight (5th to $<85^{th}$ percentile), overweight (85th to $<95^{th}$ percentile), or obese (95th percentile and above) (CDC, 2018a). Because the body proportions of young children are rapidly changing, age- and sex-specific z-score and percentile are generally considered more valid measures of weight status than raw BMI and WFH, since they attempt to take into consideration the changing relationship between BMI (or WFH) and adiposity as the child's height, weight and body proportions change with age.

In the multivariate analyses, an alternative approach is used to in order to maintain consistency in measuring a growth trajectory across the 40-month time period. Prior to 24-months, the CDC advocates use of the growth charts developed by the World Health organization (WHO) because these standards are considered the best for optimal growth trajectories from birth to 24-months. During this early period, WFL, but not BMI, is the measure on which clinicians focus; however, BMI percentile cutoffs are available over the entire interval for research purposes (Roy et al., 2016). For consistency along each child's growth trajectory, in analyses of growth trajectories the WHO BMI percentiles were used.

6.3.3 Analysis

For analyses, study children's weight and growth outcomes are categorized into the underweight, normal/healthy, overweight, and obese groups based on BMI percentiles. Analyses then explore the relation between BMI percentile groups and interview responses, to examine relations between behaviors measured by the interview and outcomes captured in administrative data. The focus is on feeding practices and daily activities as they relate to child weight and growth outcomes, including breastfeeding practices, outdoor play time, sedentary screen time, and maternal dietary intake.

First, third year BMI percentile group distributions are described. Analyses also explore whether socio-demographic characteristics are associated with these groups. Socio-demographic characteristics are typically measured at the time of the first interview. For characteristics that change

over time, such as food security or poverty level, socio-demographic characteristics are updated to status from the 24-month interview.

For most variables, chi-square tests of association are used to examine whether behaviors are associated with BMI percentile group outcomes, and follow-up t-tests between pairs of subgroups are used to determine which subgroups are statistically significantly different from each other. For items reflecting feeding practices and beliefs that have Likert-type scale response options, median differences are examined to explore bivariate relationships. This bivariate approach lays the groundwork for more nuanced multivariate analyses. Subgroup differences discussed in the chapter are limited to those that are large in magnitude,[57] to avoid focusing on findings that, while statistically significant, may have little practical importance. Statistical significance, when indicated, is at the level of $p \leq 0.05$.

Finally, multivariate analyses are reported. Multivariate analyses isolate the unique effects of individual variables on an outcome, while holding the influence of other variables constant. As compared to bivariate analyses, multivariate analysis typically finds a more limited set of behavioral variables have a statistically significant association with the outcome. For multivariate analyses predicting weight and growth, ordered logistic regression is used to examine the independent associations between feeding practices, behavioral variables, and socio-demographic factors and child BMI percentile group at 36-months. Growth curve modeling is used to examine the independent associations of these variables with BMI percentile trajectories through 36 months.

6.4 BMI Outcomes for Study Children

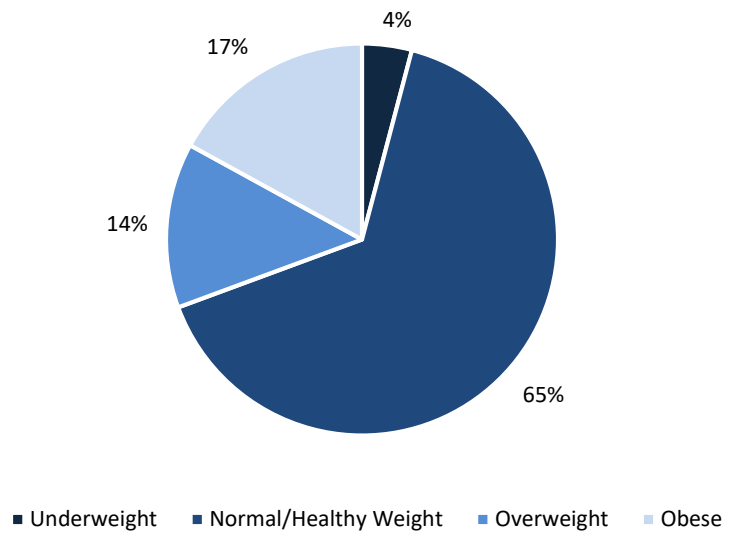
6.4.1 BMI Distributions in the Third Year

Figure 6-1 presents the percentage distribution of study children into third year BMI percentile groups. Most study children (65%) have a BMI that falls in the normal/healthy percentile group. Few (4%) fall into the underweight group. Fourteen percent fall in the overweight group, and 17 percent are categorized as obese. See Appendix B2d, Table B2d-1, for details.

[57] Proportional differences are typically discussed if they are more than 3 percentage points in magnitude and/or form a pattern over time or items. See Chapter 1 for details. Median differences are discussed if they exceed half a scale-point of difference. Both indicate very small effect sizes (Cohen, 1988).

The percentage of study children falling into the overweight (14%) and obese (17%) categories is in line with findings from other research. Using data from the national estimates for the entire U.S. population from the 2015-2016 NHANES Study, Skinner and colleagues found that 10 percent of 2-5 year old children have BMIs in the overweight range, and 16 percent have BMIs in the obese range (Skinner, Ravanbakht, Skelton, Perrin, & Armstrong, 2018). Research specifically with WIC children in southern California found that among 3-year old children, the obesity rate in 2014 was 17.9 percent (Nobari, Whaley, Prelip, Crespi, & Wang, 2018).

Figure 6-1. The percentage of study children by third year BMI percentile groups



6.4.2 Characteristics Associated with Child Third Year BMI Category

Socio-Demographic Characteristics

Chi-square analyses exploring associations between third year BMI percentile group and socio-demographic variables yield few statistically significant results. The standard set of socio-demographic variables described in chapter 1 were tested, as well as the child's birth weight.[58] Only maternal BMI percentile group at the 24 month interview is significantly associated with the child's third year BMI percentile group (see Table 6-4). Follow-up pairwise t-test indicate that obese mothers are less likely than normal/underweight or overweight mothers to have healthy weight

[58] Because there were no cases of high birth weight infants that were subsequently underweight based on BMI at 36-months, the bivariate analyses excluded the underweight BMI percentile group to facilitate analysis.

children. Sixty percent of obese mothers have healthy weight children, whereas 69 percent of healthy weight mothers have healthy weight children. Additionally, obese mothers are more likely than normal/underweight mothers to have obese children. About 21 percent of obese mothers have obese children, whereas 14 percent of healthy weight mothers have obese children.

Table 6-4. The percentage of study children in each BMI percentile group by maternal BMI at 24 months

Maternal BMI Percentile Group at 24-Months	Child Third Year BMI Percentile Group				Unweighted n[c]	Weighted n
	Underweight % (SE)	Normal/ Healthy Weight[a] % (SE)	Overweight % (SE)	Obese[b] % (SE)		
Normal or Underweight	4.8 (0.9)	68.7 (2.3)	12.8 (1.4)	13.7 (1.8)	651	163,555
Overweight	2.6 (0.6)	67.2 (2.1)	14.3 (2.0)	15.8 (1.9)	536	120,819
Obese	4.6 (0.8)	60.2 (2.0)	14.0 (1.4)	21.2 (1.7)	699	158,170

[a] Obese mothers are significantly less likely to have normal/healthy weight children than normal/underweight or obese mothers

[b] Obese mothers are significantly more likely to have obese children than normal/underweight mothers

[c] n is the number of children who had valid 36-Month measurement data.

Breastfeeding Practices and Dietary Intake

Analyses first examine associations between breastfeeding practices at 1 month and child third year BMI percentile group. Since the underweight group may have unique health needs that affect feeding, bivariate analyses were undertaken both including and excluding this group. When the underweight group was included in the analysis, there was not a significant association; however, when the underweight group was excluded from the analysis, there was a statistically significant association between breastfeeding status at 1 month and child third year BMI percentile group (see Table 6-5). Follow-up pairwise t-tests indicate that mothers who were feeding breastmilk at the time of the 1-month interview are significantly less likely to have children in the obese third year BMI percentile group (16%), as compared to mothers who were not feeding breastmilk at 1 month postpartum (22%).

Table 6-5. The percentage of study children by third year BMI percentile group and breastfeeding status at 1 month

Breastfeeding status at 1 month	Child Third Year BMI Percentile Group			Unweighted n[a]	Weighted n
	Normal/ Healthy Weight % (SE)	Overweight % (SE)	Obese % (SE)		
Feeding breastmilk	69.8 (1.78)	14.5 (1.15)	15.7 (1.50)	1,043	244,219
Not feeding breastmilk	65.6 (2.32)	12.8 (1.80)	21.6 (1.92)	600	140,394

[a] n is the number of children who had valid third year measurement data.

Analyses also explored the association between child dietary intake and third year BMI percentile group, using data from the 36-month 24-hour dietary recall to examine whether meeting the recommended intake of fruits, vegetables, and dairy, and remaining below the recommended limit of added sugars from the Dietary Guidelines for Americans (DGA) are associated with BMI percentile group. Chi-square analysis yielded no significant associations.

WIC and Other Benefit Program Participation Status

Analyses explore whether maternal reports of WIC participation at 24 or 36 months, or of other federal benefit program participation at 24 months, is associated with third year child BMI percentile groups. There are no significant associations observed between program participation and third year child BMI percentile group.

Child Physical Activity and Screen Time

To investigate associations between physical activity and screen time and third year BMI percentile group, the 30-month interview asks mothers about how long the child spends playing outdoors; the amount of time spent in front of the television or playing electronic games; and whether the television is on during meals.[59]

The mother's report of the number of minutes or hours the child typically spends playing outdoors on weekdays and weekends forms the basis for the outdoor play measure (Burdette, Whitaker, &

[59] Physical activity and screen time were asked at the 30 month interview. Third year BMI was measured during a window between 32-40 months, after the time of the interview.

Daniels, 2004). Reports of outdoor play time are high – at 30 months, 30 percent of mothers report more than 3 hours of outdoor play on a typical weekday, and 53 percent report more than 3 hours of outdoor play on a typical weekend. There are no significant associations observed between outdoor play time and third year BMI percentile group.

The mother's report of the number of minutes or hours per day the child typically spends watching TV or video games at 30 months is used to estimate hours per week of screen time. Reports of screen time are also high – at 30 months, 43 percent of the children are spending more than 11 hours per week watching TV or playing video games.[60] Nonetheless, there is no significant association observed between screen time and third year BMI percentile group.

Feeding Beliefs and Practices

Parental reports at 30-months of their beliefs about child feeding, and their practices within their family, are explored in relation to third year[61] BMI percentile groups. Feeding beliefs probe how much parents should control children's behavior and consumption during meal and snack time (Thompson et al., 2009), including whether parents should allow children to walk around while eating as long as they eat, whether crying children should be soothed through feeding, whether it is important for parents to decide how much children eat, and whether it is important for children to finish all the food on their plates. Study mothers are asked to rate the extent to which they agree or disagree with these beliefs on a five point scale, ranging from 1 (strongly agree) to 5 (strongly disagree). There is a significant difference in medians on the belief that it is important for a parent to decide how much a child should eat, but the difference is very small in magnitude. On average (median) mothers of obese children agree more that it is important for a parent to decide how much a child should eat as compared to parents of healthy/normal weight children (see Appendix B2d, Table B2d-2 for details).

Beliefs are also probed about how often children should eat fast food, sugary foods, and savory snack foods. Study mothers indicate children whether they believe children should eat these foods

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[60] The American Academy of Pediatrics recommends no more than 1 hour per day of screen time for children ages 2-5. https://www.aap.org/en-us/about-the-aap/aap-press-room/Pages/American-Academy-of-Pediatrics-Announces-New-Recommendations-for-Childrens-Media-Use.aspx . Accessed September 15, 2018.

[61] Feeding beliefs and practices were asked at the 30 month interview. Third year BMI was measured during a window between 32-40 months, after the time of the interview. See Chapter 3 for additional information on feeding beliefs and practices.

whenever they want to, occasionally, or never. Chi-square analyses yield significant associations between beliefs about how often children should eat savory snack foods. Follow-up pairwise t-tests indicate that mothers of overweight children (but not mothers of obese children) are more likely to say children should never eat savory snacks (12%) than are mothers of healthy/normal weight children (4%) (see Appendix B2d, Table B2d-3 for details).

Analyses also explore the relationship between third year child BMI percentile group and parental practices related to feeding. Five feeding practices related to control of feeding are probed at 30 months, including keeping track of what the child eats, trying to get the child to finish his or her food, trying to get the child to eat when he or she does not seem hungry, controlling how much the child eats, and being very careful not to feed the child too much. Study mothers are asked to indicate how often they engage in these behaviors on a five point scale, ranging from 1 (*Always*) to 5 (*Never*).

There was a difference in median scores on the practice of being very careful not to feed the child to much. Median scores for mothers of obese children are lower than scores for mothers of normal/healthy weight children (1.0 and 1.4, respectively), and median scores for mothers of overweight children are lower than for underweight children (1.1 and 1.6, respectively). All median scores were less than 2, however, indicating median responses for all groups that fall between *Always* (1) and *Usually* (2), and therefore limiting the practical implications of the differences. This finding should be interpreted with some caution as it is possible that child weight status issues predated those practices. See Appendix B2d, Table B2d-2 for details.

In summary, there are few statistically significant bivariate associations between child BMI percentile category at three years and the key socio-demographic or behavioral variables used in this study. Maternal BMI category at 24 months is significantly associated with third year child BMI category, and few parental beliefs and practices related to feeding are significantly associated with child BMI category.

6.4.3 Models Predicting BMI Outcomes

Two types of modeling were done predicting children's BMI outcomes. The first model uses logistic regression to examine factors associated with the child's BMI percentile group (excluding the underweight group). The second model is a growth curve model predicting changes in the trajectory of BMI percentile (not percentile group) between early infancy (1 to less than 7 months), late infancy (7 to 15 months), toddlerhood (20 to 28 months), and third year (32 to 40 months) measurements.

Logistic Regression Model

The multivariate analyses examines factors associated with the odds of children being overweight or obese relative to the healthy weight group of children. Covariates are drawn from the bivariate analyses and used in a multivariate ordered logistic model with three possible BMI percentile group outcomes: healthy weight, overweight, and obese. The underweight groups is excluded from the analyses because of their potential unique health needs. The independent variables include the mother's race, the mother's ethnicity, the mother's BMI percentile group at 24 months, the mother's highest educational attainment, the mother's breastfeeding status at 1 month postpartum, whether the family received SNAP benefits at 24 months, the child's WIC participation status at 24 months, and select beliefs and opinions about feeding practices at 30 months (see Table 6-6).

Two socio-demographic variables, maternal BMI at 24 months and maternal race, are independently and significantly associated with the likelihood of the child being overweight or obese relative to healthy weight in the multivariate regression. Mothers who are obese at 24 months are about 62 percent more likely to have an obese child than a healthy-weight child at three years of age. Compared to White mothers, mothers in the Other race group were about 38 percent less likely to have an overweight child than a healthy weight child at age three.

A few feeding-related variables are also associated with the likelihood of the child being overweight or obese relative to healthy weight in the multivariate regression. Mothers who were breastfeeding at 1 month postpartum were about 38 percent less likely to have an obese child at age 3 than mothers who were not breastfeeding. Parents who said at 30 months that children should be allowed to each snack foods "occasionally" were about 41 percent less likely to have an overweight child than parents who indicated children should "never" be allowed to eat snack foods. Parents who said at 30 months that they "always" "usually" or "about half the time" are very careful not to feed their child too much are significantly more likely to have an obese child in the third year than those who said that they "never" engage in that practice. Additionally, parents who said that they "always" are careful not to feed their child too much are significantly more likely to have an overweight child. As in the bivariate analyses, this variable should be interpreted with some caution as the child's overweight or obesity may have predated the feeding practice.

Table 6-6. Odds ratios and confidence intervals from ordered logistic regression examining factors affecting the odds of being obese or overweight relative to healthy weight at 3 years

Independent Variable	Child's Weight Category	Odds Ratio	Confidence Interval
Race of the caregiver: reference category White			
Other race	Obese	0.747	0.476 – 1.171
Other race*	Overweight	0.622	0.398 – 0.971
African-American	Obese	0.662	0.413 – 1.059
African-American	Overweight	0.644	0.407 – 1.017
Ethnicity of the caregiver: reference category Not Hispanic or Latino			
Hispanic	Obese	0.970	0.639 – 1.473
Hispanic	Overweight	1.336	0.828 – 2.156
BMI category of mother at 24 months: reference category Normal or Underweight			
Obese*	Obese	1.617	1.021 – 2.559
Obese	Overweight	1.141	0.712 – 1.828
Overweight	Obese	1.102	0.647 – 1.879
Overweight	Overweight	1.175	0.721 – 1.916
Child's birth weight category: reference category Normal			
High	Obese	2.002	0.271 – 14.780
High	Overweight	5.083	0.755 – 34.227
Low	Obese	0.656	0.271 – 1.590
Low	Overweight	0.489	0.188 – 1.272
Mother's highest educational attainment: reference category More than High School			
High school or Less	Obese	1.452	0.940 – 2.241
High school or Less	Overweight	0.925	0.502 – 1.704
Breastfeeding status at 1 month: reference category Not Breastfeeding			
Breastfeeding*	Obese	0.652	0.442 – 0.962
Breastfeeding	Overweight	1.069	0.679 – 1.684
Receipt of SNAP at 24 months: reference category No			
Yes	Obese	0.864	0.525 – 1.424
Yes	Overweight	1.012	0.651 – 1.572
Child's WIC participation status at 24-month: reference category Not on WIC			
On WIC	Obese	1.203	0.722 – 2.005
On WIC	Overweight	1.473	0.773 – 2.809
Important that parent decides how much child should eat: reference category Strongly Disagree			
Agree	Obese	0.247	0.039 – 1.572
Agree	Overweight	0.472	0.127 – 1.746
Disagree*	Obese	0.164	0.027 – 1.017
Disagree	Overweight	0.366	0.094 – 1.416
Neither agree nor disagree*	Obese	0.206	0.036 – 1.168
Neither agree nor disagree	Overweight	0.540	0.186 – 1.562
Strongly agree	Obese	0.220	0.033 – 1.481
Strongly agree	Overweight	0.605	0.140 – 2.610
Restrictions on eating snack foods: reference category Never Eat Snacks			
Occasionally	Obese	0.878	0.467 – 1.650
Occasionally*	Overweight	0.587	0.360 – 0.959
Whenever they want	Obese	0.876	0.207 – 3.702
Whenever they want	Overweight	0.973	0.273 – 3.467

Table 6-6. Odds ratios and confidence intervals from ordered logistic regression examining factors affecting the odds of being obese or overweight relative to healthy weight at 3 years (continued)

Independent Variable	Child's Weight Category	Odds Ratio	Confidence Interval
Careful not to feed the child too much: reference category Never			
Always*	Obese	3.197	1.596 – 6.402
Always*	Overweight	2.058	1.062 – 3.985
Usually*	Obese	4.227	1.961 – 9.112
Usually	Overweight	1.539	0.765 – 3.097
About half the time*	Obese	4.776	1.698 – 13.434
About half the time	Overweight	1.737	0.598 – 5.045
Occasionally	Obese	1.978	0.764 – 5.120
Occasionally	Overweight	1.035	0.464 – 2.309

* Statistically significant at the 95% confidence level.

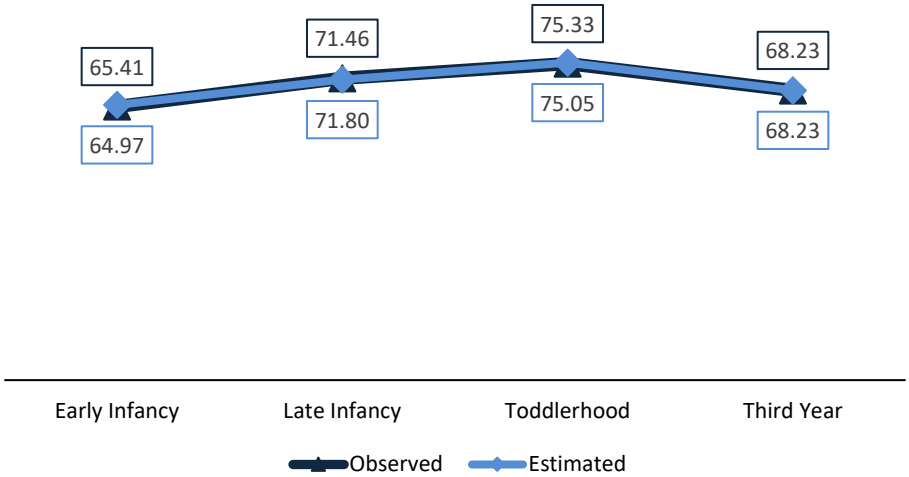
NOTE: After accounting for missing variables, the sample size was 1,088 observations.

Growth Curve Model

Multivariate analysis of change in children's estimated BMI-for-age percentiles over time is done using a latent growth curve modeling approach, to explore the factors that may influence children's growth. An unweighted total of 817 cases with complete measurement data are available for analysis. Because the time intervals between measurements are uneven, the time points for measurements are coded as Early Infancy = 0, Late Infancy = 1, Toddlerhood = 3 and Third Year = 5 to spread out the temporal trajectory appropriately on the axis. Observed individual growth trajectories indicate no clear trend.

The analysis first establishes a baseline model with good fit. Subsequently, the replicate weights are added to the baseline model. The resulting estimated and observed mean BMI percentiles are plotted in Figure 6-2. As can be seen in the figure, the observed growth trajectory is relatively flat.

Figure 6-2. Observed and estimated mean BMI for age percentiles from the growth model, with replicate weights



Covariates are then added to the model to attempt to explain variation. Covariates included those associated with BMI in previous research, as well as variables associated with BMI in this study's bivariate analyses. Covariates included are maternal race, maternal ethnicity, mother's BMI category at the 24-month interview, mother's highest educational attainment, breastfeeding status at the 1-month interview, child WIC participation status at 24 months, whether the household was receiving SNAP benefits at 24 months, and select feeding beliefs and practices at 30 months. Due to missing data on the covariates, the unweighted sample size is reduced from 817 to 607. However, the model still achieves good model fit for the Root Mean Square Error of Approximation (RMSEA = 0.039 90% confidence interval 0.023 - 0.055, probability RMSEA $\leq$ .05 = 0.86), and the Standard Root Mean Residual (SRMR = 0.015). Values below 0.08 for both statistics are indicative of a good fit.

The model parameter estimates are presented in Table 6-7. Statistically significant results are indicated by an asterisk. The growth parameters in the table summarize the means of the initial value or intercept (i.e., the BMI percentile estimates at early infancy), growth rate or slope (i.e., changes on BMI percentile every 6 months), and quadratic change or curvature (i.e., non-linear change over time, or change in growth rate). The unconditional model is run without covariates. The results suggest that the mean BMI-for-age percentile does not consistently increase over time, but it does turn downward after 30 months.

The interactions with the growth parameters summarize the effects of the covariate on the intercept, slope, and curvature of the trajectory. Results indicate that the majority of the covariates are not significantly associated with growth patterns. The only significant covariates are child birth weight, and a feeding belief and a feeding practice from the 30-month interview (i.e., the mother's belief that it is important for the parent to decide how much the child eats, and the frequency with which the mother says she is careful not to feed her child too much). The effect of birth weight is limited to the intercept: children who were born with normal weight have higher BMI-for-age percentile scores in early infancy than children whose birth weight was low. Significant differences by birth weight are not, however, observed for growth rate (slope) and curvature of the trajectory. The belief that it is important for the parent to decide how much the child eats is significant associated with both the growth rate and curvature. For children with mothers who "agree" with this statement, as compared to children whose mothers "strongly agree" with this statement, the children's BMI-for-age percentile scores increase more slowly between early and late infancy but accelerate thereafter. The frequency with which the mother says she is careful not to feed her child too much is significantly associated with intercept and curvature, but not growth rate (slope). For children whose mothers indicate that they are "always" careful not to feed the child too much, the children start with a higher BMI-for-age percentile compared those whose mothers report they are "never" careful not to feed the child too much, suggesting that it is possible that the high BMI-for-age may have pre-dated the feeding practice reported at 30 months. There is also a significant difference in the curvature for children whose mothers are "always" careful not to feed her child too much compared to those who "never" are, and a significant difference in the curvature for children whose mothers indicate that they "occasionally" are careful not to feed the child too much compared to those who "never" are. In both cases, the positive significant values indicate that the change in the growth rate is higher for children whose mothers "always" or "occasionally" are careful not to feed the child too much children whose mothers "never" are.

Overall, the growth curve analysis showed that the trajectory of BMI-for-age percentile is relatively flat for WIC ITFPS-2 children, turning slightly downward after 30 months. Few covariates are significantly associated with the BMI-for-age trajectories. Of note among the significant findings, mothers who are the most controlling about not feeding their children too much at 30 months have children who started out at a higher BMI-for-age percentile in early infancy, and have children whose BMI-for-age percentiles rise more quickly over time, than mothers who are least controlling about feeding too much.

Table 6-7. Estimated coefficients of factors associated with intercepts, slopes, and curvature of study children's BMI-for-age percentiles over time

Growth model	Intercept		Slope		Curvature	
	Coef.	SE	Coef.	SE	Coef.	SE
Growth Parameters						
Without covariates (Unconditional)	66.23*	1.17	6.96	0.99	-1.28*	0.18
With covariates (Conditional)	43.88*	15.06	17.78*	8.86	-3.14	1.65
Interaction with Growth Parameters						
Race of the caregiver: Reference category Other race						
African-American	-9.93	5.70	4.01	2.99	-0.51	0.55
White	-0.62	5.16	1.31	2.24	-0.17	0.41
Ethnicity of the caregiver: reference category Not Hispanic or Latino						
Hispanic	1.61	4.32	-1.30	2.59	0.13	0.45
BMI category of mother at 24 months: reference category Obese						
Normal or Underweight	-2.40	3.26	-1.09	2.83	0.14	0.49
Overweight	-4.26	3.83	-1.59	2.05	0.36	0.37
Mother's highest educational attainment: reference category High school or Less						
More than High school	0.11	3.62	-2.41	2.40	0.25	0.42
Breastfeeding status at 1 months: reference category No						
Yes	0.49	2.50	-3.23	2.47	0.56	0.45
Child's WIC participation status at 24-month: reference category No						
Yes	0.84	6.31	0.74	3.75	-0.34	0.67
Receiving SNAP at 24-Month interview: reference category Not receiving SNAP						
Receiving SNAP	2.51	2.78	-1.25	2.38	0.09	0.43
Birth weight: reference category Low						
Normal	10.05*	4.13	-1.06	4.53	0.22	0.89
High	20.88	12.31	3.82	7.19	-0.53	1.20
Important for parent to decide how much child eats: reference category Strongly agree						
Agree	5.45	5.07	-6.87*	2.90	1.09*	0.54
Neither agree nor disagree	-6.48	5.91	-4.88	3.09	1.03	0.54
Disagree	4.95	6.70	-7.62	4.05	1.38	0.71
Strongly disagree	10.94	7.66	-0.90	5.53	0.17	1.10
Restrictions on eating snack foods: reference category Never						
Whenever they want to	11.28	9.93	-5.75	7.09	0.47	1.25
Occasionally	4.70	6.73	1.97	4.34	-0.54	0.76
Careful not to feed child too much: reference category Never						
Always	11.77*	3.97	-5.00	3.44	1.31*	0.66
Usually	4.15	4.31	3.03	2.93	-0.01	0.57
About half of the time	5.37	7.16	-6.30	5.55	1.78	1.09
Occasionally	-6.58	6.62	-6.86	4.44	1.92*	0.75

* Statistically significant at the $p < 0.05$ significance level.

6.5 Summary

This chapter looks at weight and growth outcomes during the third year among WIC ITFPS-2 children. At age 3 years, 65 percent of study children fall into the normal/healthy range of BMI percentiles. Few (4%) fall into the underweight range. More than a quarter, however, fall above the normal/healthy range, with 14 percent in the overweight BMI percentile range, and 17 percent falling into the obese range. The high rates of overweight and obesity at age 3 are concerning, but are in line with trends seen for preschool-aged children in both in the national population and in WIC-specific research (Nobari et al., 2018; Skinner et al., 2018).

There are few statistically significant bivariate associations between socio-demographic or behavioral characteristics and child BMI category at age 3. Maternal BMI category at 24 months is significantly associated with child BMI, perhaps speaking to a genetic component of child BMI (Kelly, Murrin, Viljoen, O'Brien, & Kelleher, 2009). Breastfeeding status at 1 month postpartum is also significantly associated with BMI, with children who were not being fed breastmilk at the time of the 1 month interview more likely to fall into the obese BMI percentile category in the third year. Mothers of obese children seem to have somewhat more controlling feeding beliefs and practices than mothers of normal/healthy weight children, but although 30-month beliefs are measured temporally before third year BMI, it is not possible to ascertain direction of effect; these controlling beliefs may either contribute to, or result from, the children's weight status. Other covariates, including dietary intake, participation in WIC or other federal benefit programs, physical activity, and screen time are not consistently and significantly associated with child BMI. It is also possible that maternal report of dietary intake active and sedentary time are subject to systematic misreporting, obscuring relationships that might be found through objective accounts of family practices.

In multivariate logistic regression analyses, maternal BMI in the obese range at the 24 month interview, and more controlling maternal feeding beliefs and practices at 30 months, significantly increase the odds of the child being in the overweight or obese BMI percentile group at age 3 (as compared to the healthy BMI percentile group). Breastfeeding at 1 month postpartum, and being in the "Other" race group (as compared to the White group) decreases the odds.

Growth curve modeling of temporal changes in child BMI-for-age percentile show a relatively flat trajectory, and few of the tested covariates are significantly associated with either the growth rate (slope) or the curvature of the trajectory.

These findings indicate that while normal/healthy weight is the most common status at age 3 for children who started out receiving WIC, many children are either overweight or obese. This continues a trend from the study at age 2 (Borger et al., 2018) which showed that high weight-for-length is fairly common in the first 2 years of life among study children. At age 3 few factors emerged that are associated with child BMI status. Maternal BMI may represent at least some non-modifiable genetic factors. In this study, breastfeeding until 1 month is a practice that may be protective of healthy weight at age 3 years. Family feeding beliefs and practices may be modifiable, but the direction of effect of their relationship with child BMI cannot be fully ascertained in this observational study.

Summary, Conclusions, and Interpreting the Data 7

7.1 Summary and Conclusions

Results from the third year demonstrate that WIC ITFPS-2 families are actively engaged with their environments, and showing some health promoting behaviors:

- At 30 months, 49% of study mothers are working, and 15% are in school. Nine percent are doing both.
- More than half of study children and/or mothers are still receiving WIC at 30 and 36 months (63% and 59%, respectively).
- More than 90% of study children have a medical home, and more than 90% went to a doctor for a well-child visit around the time of their second birthday.
- 72% of the children consume a non-juice fruit, 69% consume 100 percent fruit juice, and 63% consume a vegetable on a given day.
- Most children are meeting the Dietary Guidelines for Americans (DGA) for servings of fruits (76%) and added sugars (71%).
- Median macronutrient intakes meet or exceed recommended levels at 36 months, and fall within acceptable levels as percentages of total daily energy intake.
- The median intakes of most micronutrients meet or exceed recommended levels at 36 months.
- Almost 70% of study mothers say they have made a change in how they feed themselves or their families due to something they learned from WIC.

Some practices and outcomes reflect less healthy behaviors, and warrant monitoring as WIC ITFPS-2 continues:

- Televisions are on during meals at least some of the time in over 50% of study households.
- 82% of children are consuming a dessert, candy, other sweet, or sugar-sweetened beverage on a given day.
- Low percentages of children are meeting the DGA for servings of vegetables (0.1%), dairy (30%), or whole grains (0.0%).

- Dietary intakes of vitamin D and potassium are still falling below recommended levels.
- Median sodium intake continues to exceed the recommended upper limit (UL) at 36 months, reaching 1.5 times the UL.
- At 3 years, although 65 percent of study children are in the normal/healthy range of BMI percentiles, 4 percent are underweight, 14 percent are overweight, and 17 percent are obese.

7.1.1 Environmental Engagement

More than half (55%) of WIC mothers with 30-month old children have work and/or school commitments. At 30 months, 49 percent of study mothers are working, 15 percent are in school, and 9 percent of these women are combining work and school.

The use of regular non-parental child care arrangements is increasing as children get older. Half of WIC ITFPS-2 children (50 percent) are currently in child care at age 30 months. The most common type of arrangement is still having a provider care for the child in the provider's own home.

At both 30 and 36 months, more than half (63 and 59 percent, respectively) of study children and/or mothers are still receiving WIC, and in approximately a quarter of families, another child is receiving WIC. Study families are also receiving benefits from other federal food benefit programs, as half the families participate in SNAP, and approximately a third have a child who participates in NSLP, SBP, or SFSP.

Nearly all study children are receiving health care. More than 90 percent of study mothers report that their children have a medical home, and had a well-visit around the second birthday. Their households are also engaged with healthcare-related systems, as 3 in 4 mothers report that someone in the household is receiving Medicaid.

7.1.2 Healthy Food Purchasing, and Feeding Beliefs, Rules, and Practices

Nearly 90 percent of study mothers report that fresh fruits and vegetables are available and plentiful in their communities, and about 75 percent are positive about the quality of the available produce. No clear barriers to consumption of fresh fruits and vegetable are reported, as mothers indicate that neither the burden required to prepare fresh fruits and vegetables, nor dislike for them, are reasons

why it is difficult for them to include them in their diets. Cost emerges as an issue for some mothers, particularly those with low or very low food security, but over half of study mothers disagree or strongly disagree that cost is a deterrent.

Feeding beliefs that emphasize parental control over child food consumption are held by many study mothers, particularly with regard to how much children should eat. In contrast, almost all study mothers report believing that children should be allowed to eat fast food, sugary foods, and savory snack foods occasionally. Only 1 in 7 study mothers reports that her child is a very picky eater, and 71 percent report introducing a new food 3 or more times before deciding that the child does not like it.

Feeding rules and practices, like beliefs, tend to emphasize parental control over child consumption. Nearly half of study mothers report that the television is rarely or never on during mealtimes, although 20 percent of study mothers report that the television is on during most mealtimes. Families are eating meals together regularly, with nearly 65 percent of families eating at least 5 meals together during the week. Nonetheless, 10 percent of families eat together less than 3 times in a week.

Mothers report that WIC nutrition education is having an impact on their feeding practices. Almost 70 percent of study mothers report having made at least one change due to something they learned at WIC, including choosing more healthy foods, eating more fruits and vegetables, and offering appropriate portion sizes.

7.1.3 Meals and Snacks, Food Intake, and Diet Quality

WIC ITFPS-2 study children are consuming a varied diet including fruits, vegetables, dairy, grains, and meats and other proteins. As they get older, however, more of the children are consuming energy-dense, nutrient poor foods such as desserts, candy, sugar-sweetened beverages, and salty snacks. By 36 months study children are more likely to consume a dessert, candy, sweet, or sweetened beverage on a given day (82%) than to consume a fruit other than juice (72%) or to consume a vegetable (63%).

WIC ITFPS-2 children's fruit consumption rises only slightly from 24 to 36 months from 70 percent to 72 percent consuming a fruit other than juice on a given day. Consumption of 100 percent fruit juice also remains steady from 24 to 36 months (70% and 69%, respectively). Vegetable

consumption among WIC ITFPS-2 remains low and rises only slightly from 24 to 36 months, with 62 percent of children at 24 months, and 63 percent at 36 months consuming a vegetable. On a given day at 36 months, 28 percent of children are not consuming any fruit (excluding juice), and 37 percent are not consuming any vegetables.

At 36 months, 85 percent of children drinking cow's milk on a given day, 38 percent consuming cheese, and 19 percent consuming yogurt. The most commonly consumed type of cow's milk is whole milk (32%); 31 percent consume either low-fat milk or skim milk, the types of milk provided to children by WIC. Consumption of protein foods remains high, with 97 percent of children consuming a meat or another protein on a given day at 36 months.

As was the case at 24 months, nearly all WIC ITFPS-2 children are consuming grains on a given day at 36 months (98%). Forty-one percent of study children are consuming a whole grain on a given day at 36 months. Many of the whole grains are coming from whole grain breakfast cereals (available through the WIC food package), as 38 percent of study children are consuming whole grain breakfast cereals, yet only 1 percent are consuming whole grain bread and rolls.

By 36 months, slightly more than half (55 percent) of study children are consuming a dessert or candy on a given day, 29 percent of the children are consuming a sugar sweetened beverage such as fruit drinks or carbonated sodas, and 30 percent are consuming a salty snack on a given day.

Diet quality of WIC ITFPS-2 children leaves room for improvement. The total average score on the Healthy Eating Index-2015 is 61.4 at 36 months. Analysis of consumption of DGA servings show that while high percentages of WIC ITFPS-2 children meet the DGAs for fruits (77%) and added sugar (71%), improvement is particularly needed with regard to the DGAs for vegetables (0.1%) and whole grains (0.0%).

7.1.4 Nutrient Intake

As expected, the median energy intakes of WIC ITFPS-2 children vary by sex, and increase between 24 and 36 months. At age 36 months WIC ITFPS-2 children may exceeding recommended levels of energy intake, based on average dietary reference intake standards.

WIC ITFPS-2 children's median micronutrient intakes generally meet or exceed AIs or EARs at 36 months. Vitamin D continues to be an exception, however, with median intakes falling below the

EAR at both 24 and 36 months. Median vitamin E intakes improve between 24 and 36 months, but the prevalence of inadequate intakes remains above 25 percent. Potassium continues to have median intake levels below the DRIs as well. For some nutrients, WIC ITFPS-2 children are exceeding the ULs. Of particular note is median sodium intake, which increases between 24 and 36 months, and continues to exceed the UL.

7.1.5 Weight and Growth

At age 3 years, 65 percent of study children fall into the normal/healthy range of BMI percentiles. Few (4%) fall into the underweight range. More than a quarter, however, fall above the normal/healthy range, with 14 percent in the overweight percentile range, and 17 percent falling into the obese range.

There are few statistically significant associations between socio-demographic or behavioral characteristics and child third year BMI percentile group. Maternal BMI category at the 24 month interview is significantly associated with child third year BMI percentile group, such that mothers who are obese are more likely to have children who are in the obese or overweight BMI percentile groups, as compared to the healthy BMI percentile group, perhaps speaking to a genetic component of child BMI. Breastfeeding at 1 month postpartum is significantly associated with a greater likelihood of the child being in the healthy third year BMI percentile group. Only two parental beliefs and practices related feeding are significantly associated with child BMI. Parents of obese and overweight children seem to have somewhat more controlling feeding beliefs and practices, but although beliefs and practices are measured temporally before BMI, it is not possible to ascertain direction of effect; these controlling beliefs may contribute to, or result from, the children's weight status.

7.1.6 Associations between WIC Participation and Key Outcomes

WIC program participation status at 24 months and its association with key outcomes is reported within each chapter of the report. WIC Program participation at 24 months was selected as the participation marker rather than concurrent participation at 30 or 36 months, as leaving the WIC program would likely have a gradual effect on feeding practices and choices that become evident over time, rather than immediate effects. WIC participation continues to be common during the third year of life, as more than half of study mothers report that either they or the study child is

receiving WIC food or checks at 30 months (63%) or 36 months (59%). Additionally, in approximately a quarter of study families, another child in the family other than the study child is also receiving WIC at 30 months (23%) or 36 months (25%).

The statistically significant associations between WIC program participation at 24 months and key outcome variables include findings across all topics explored in this report.

Environmental Engagement

There are several findings that may indicate that mothers of children not receiving WIC at 24 months have improved financial circumstances at 30 or 36 months. Improved financial circumstances may have prompted them to discontinue WIC participation. Mothers of children not receiving WIC at 24 months are more likely than those still receiving WIC to be working and/or going to school, and using child care, and less likely to be participating in SNAP, school and summer food programs, and Medicaid.

Feeding Beliefs and Practices

Families of children receiving WIC at 24 months seem to be benefitting from the nutrition education WIC provides. As compared to children not receiving WIC at 24 months, children receiving WIC at 24 months are less likely to be identified as picky eaters at 30 months, and mothers whose children were receiving WIC at 24 months are less likely than their counterparts to report that the television is on most of the time during meals at 30 months.

Looking across all study families, WIC nutrition education may have had a lasting impact. At 30 months, nearly 7 in 10 study mothers say they have made a change in how they feed themselves or their families because of WIC education. Looking specifically at families still receiving WIC at 30 months, slightly more than 9 in 10 women (91%) indicate that the food and the nutrition education they get from WIC are equally important.

Dietary Intake

There are several food group consumption differences at 36 months between children who were receiving WIC at 24 months and those who were not. Children receiving WIC at 24 months are more likely to consume 100 percent fruit juice on a given day than their counterparts, although there are no differences in the consumption of whole fruit (excluding juice). WIC participation is also significantly associated with vegetable consumption, with children receiving WIC at 24 months less likely to consume any vegetable (60%) on a given day than their counterparts who do not receive WIC.

Children who are receiving WIC at 24 months are less likely to consume whole milk or reduced fat milk, and more likely to consume low fat milk at 36 months than are children who are not receiving WIC at 24 months. This is in line with the 2014 final rule for the contents of children's food package for WIC, which typically provides low fat milk, and with the Dietary Guidelines for Americans (DGAs) (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015).

Looking at daily portions instead of any consumption on a given day, children receiving WIC at 24 months are also more likely to meet the DGAs for added sugars, but less likely to meet the DGAs for total grains, than children not receiving WIC at 24 months.

7.2 Interpreting the Data: Study Limitations

As with all research studies, design decisions and study-specific goals for WIC ITFPS-2 result in limitations to the conclusions that the study team can draw, both now and in future analyses. These limitations are most evident with regard to establishing causal relations, generalizing beyond the population represented by our probability sample, comparing data to other national studies, and disentangling caregiver perceptions of her experiences from actual experiences.

7.2.1 Establishing Causal and Direct Relationships

This is an observational study, which is a design well-suited to studying the influences of ongoing public programs. Under such circumstances, randomly assigning participants to a treatment group

that gets the program and a control group that does not get program is not possible. Additionally, because WIC reaches a substantial portion of its eligible population there is no naturally occurring large, well-matched, unbiased comparison group available. As such, WIC ITFPS-2 also lacks a non-WIC comparison group. Because of this observational study design, however, the study team can only infer causality between program predictors and outcomes rather than establishing it with certainty.

Additionally, this report focuses primarily on descriptive analyses of key outcome variables, and bivariate analyses between socio-demographic subgroups and those key variables, painting a detailed picture of the circumstances, choices, and status of families who were receiving WIC at the outset of the study. Some bivariate relationships between socio-demographic variables and outcomes may mask other third-variable characteristics, circumstances, or experiences that actually underlie these associations. Further research using complex multivariate modeling will be useful in identifying unique predictors of the key outcome variables.

7.2.2 Generalizing Findings

The study team is also limited in generalization of the findings by the study eligibility rules and sample design. Eligible mothers were either pregnant, or their infants were less than 3 months old, and they were enrolling in WIC for the first time for that pregnancy or child. Mothers were at least 16 years old at the time of enrollment, and spoke either English or Spanish. WIC clinics expected to serve small numbers of new participants each month were excluded from the sampling frame for operational purposes. The study team chose these eligibility characteristics to be inclusive of a large portion of the WIC population. Nonetheless, there may be characteristics or feeding patterns not captured that pertain to mothers who are very young, who speak a language other than English or Spanish, who enroll in WIC for the first time after 3 months postpartum, or who receive services at smaller WIC clinics. Similarly, the weighted sample represents the infants from the population who enrolled in WIC during our 20-week enrollment period. It does not represent a full year of WIC enrollments, and if there were strong seasonal differences in WIC enrollees, the sample would not capture that full variation.

7.2.3 Comparisons to Other Studies

One of the goals of WIC ITFPS-2 is to examine how the feeding choices and practices of WIC mothers have changed since the WIC Infant Feeding Practices Study (WIC IFPS-1), 20+ years ago, and to compare findings from WIC ITFPS-2 to other studies such as the Food and Drug Administration's Infant Feeding Practices Study II (FDA/CDC IFPS-II) and the Gerber/Nestle Feeding Infants and Toddler Studies (FITS) 2016. Now that the WIC ITFPS-2 children are three years old, however, both WIC IFPS-1 and FDA/CDC IFPS-II do not have a comparable cohort, as both stopped at 12 months of age. The FITS 2016 study does include comparably aged children for the WIC ITFPS-2 36-month dietary intake data, yet the FITS age 3 group extends from 36.0 to 47.9 months. Although this report describes comparisons to FITS findings, these are comparisons of the magnitude of the findings, and not tests of the statistical significance of those differences. As the standard errors of the weighted estimates FITS 2016 are not consistently available for analysis, it is not possible to conduct valid statistical comparison between the studies. Additionally, the studies' methodologies, including timing of all interviews and populations included, would need to be more clearly aligned than is possible while still meeting other important goals of WIC ITFPS-2. To ensure that comparisons between WIC ITFPS-2 and other studies are robust, the study team focuses on describing differences that are large in magnitude, and that are comparable in nature and developmental stage.

7.2.4 Influence of Caregiver Perceptions

Most of the study data about individual experiences and practices come from caregiver report during telephone interviews. Although the study team collects child measurement data from WIC State Agencies and sites that are used in analyses, most data rely on caregiver responses, and are therefore filtered through the perceptions and memories of those caregivers. Primary caregivers are the most knowledgeable informants about dietary intake and their feeding practices with their children, however, all reports that rely primarily on a single informant may contain some elements of bias or misreporting. Other major studies of feeding practices have also relied on caregiver report, thus WIC ITFPS-2 is not unusual in this structure. Nonetheless, busy caregivers may at times be imperfect informants.

Additionally, WIC ITFPS-2 relies on respondents to provide information about current receipt of benefits from WIC and from other federal benefit programs. Program participation is not verified

through external records. Consequently, to the extent that respondents misreport participation, data on program participation and its relation to child outcomes may contain error.

7.2.5 Scope of the Study

Finally, WIC ITFPS-2 will follow this national sample of study children until they turn 6 years old. While this is an unprecedented opportunity, and the study will yield many years of rich data, not all issues related to childhood weight and health outcomes are apparent by age 3, and may not even be apparent by age 6. Factors beyond those explored in this study may influence, and continue to influence, eating and health as obesity risk continues into middle childhood and beyond.

7.3 Next Steps

This third year report, which follows the release of three previous WIC ITFPS-2 reports (May et al., 2015; May et al., 2017; Borger et al., 2018) is the fourth in what will be a series of reports from the ongoing WIC ITFPS-2. Subsequent reports from the study will cover the through ages 3, 4, 5, and 6 years, examining nutrition, health outcomes, and family feeding practices of WIC children. The data from WIC ITFPS-2, which the Food and Nutrition Service will make available, will also provide scientific researchers and the public with a landmark platform of data from which to pursue further analyses on nutrition and health in children of low-income families.

There are many research topics from this report that will be carried forward, and further explored, in subsequent WIC ITFPS-2 reports. Three that are particularly notable are:

- WIC ITFPS-2 will continue to track median energy and nutrient intake among children beyond the first 3 years of life. Given WIC's goal of safeguarding the health of low-income children by providing nutritious supplemental foods, it will be important to continue to examine the children's dietary intakes.
- WIC ITFPS-2 will continue to follow the weight and height of WIC children through age 6 years, to understand the future trajectory of overweight and obese children in this population. Around the time of the third birthday, 14 percent of study children are overweight, and 17 percent are obese. Future reports will determine how weight status at age 3 relates to subsequent overweight or obesity status.

- As more WIC ITFP-2 children discontinue WIC participation, future reports will examine the relationship between continued WIC participation and key outcomes in greater depth.

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