The STRONG Kids 2 Birth Cohort Study: A Cell-to-Society Approach to Dietary Habits and Weight Trajectories across the First 5 Years of Life

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ABSTRACT

Background: Dietary habits formed during the first 5 y of life portend lifelong eating patterns.

Objectives: The Synergistic Theory Research Obesity and Nutrition Group (STRONG) Kids 2 birth cohort study aimed to examine multilevel predictors of weight trajectories and dietary habits including individual biology, child socioemotional and behavioral characteristics, family environment, and child care environment over the first 5 y of life. This report describes recruitment strategies, an overview of survey measures, and basic descriptive statistics of the cohort.

Methods: The cohort includes 468 mothers and their offspring. A brief survey was completed at a 1-wk home visit including child's birth weight, intent to breastfeed, collection of an infant stool sample, and additional contact information should the family move. Mothers completed surveys including diet, child temperament, family environment, and child care when their child was 6 wk, 3, 12, 18, 24, 36, 48, and 60 mo of age. Height and weight of the mother and child were collected at each visit. Stool samples of the child were collected at each visit as well as saliva at 1 visit.

Results: Close to half of the mothers were either overweight (24.2%) or obese (25.2%) prepregnancy. At 6 wk of age, 32.9% of the children were overweight and 31.4% were obese based on direct measurement.

Conclusions: The STRONG Kids 2 research team has adopted a socioecological model that accounts for multiple influences on children's health including biological, child social and behavioral, family household organization, and community factors. The study is limited by a relatively educated and nondiverse sample. However, variations in maternal and child weight may inform future prevention programs and policy aimed at improving the diet and health of children under the age of 5 y. This trial was registered at clinicaltrials.gov as NCT03341858. Curr Dev Nutr 2019;3:nzz007.

Background

Recent epidemiology reports have indicated that 17% of children in the United States between 2 and 17 y of age are classified as obese (1). Dietary habits formed during the first 5 y of life portend lifelong eating patterns (2, 3). We know that beginning before 4 mo of age, infants and toddlers consume more calories than are required for healthy growth and development (3, 4). Of particular concern are the introduction of solids before 4 mo of age, the consumption of sugar-sweetened beverages before 2 y of age, and the low rates of consumption of green leafy vegetables across the first few years of life (5, 6). Thus, unhealthy weight and poor dietary habits in the first few years of life are a major public health concern. The Synergistic Theory Research Obesity and Nutrition Group (STRONG) Kids 2 (SK2): A Cells-to-Society Approach to Nutrition in Early Childhood

Keywords: pediatric obesity, birth cohort study, weight trajectories, nutrition, socioecological model

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Abbreviations used: SK2, STRONG Kids 2; SNP, single nucleotide polymorphism; STRONG, Synergistic Theory Research Obesity and Nutrition Group; WFLZ, weight-for-length z score.
birth cohort study aimed to examine multilevel predictors of weight trajectories and dietary habits including individual biology, child socioemotional and behavioral characteristics, family environment, and child care environment over the first 5 y of life in a low-risk sample of children born in the United States. In this report we describe the theoretical foundations of the study, study design, recruitment procedures, and initial demographic and participant characteristics.

**Theoretical Foundation**

The STRONG Kids program is grounded in a bio-ecological perspective proposing that child health outcomes are a result of multiple factors that extend across cell-to-society (7, 8). Although ecological models have been proposed to explain the complexities of childhood obesity (9, 10), they have rarely included the intersection of biological, family, and community processes. As originally proposed by Bronfenbrenner (11) and expanded by Bronfenbrenner and Evans (12), bio-ecological models suggest that individual biology is shaped by and expressed in an environmental context. The child’s dietary habits and weight trajectories will be influenced by multiple factors including individual biology, temperamental characteristics of the child, psychosocial factors in the family, and availability of resources. The SK2 birth cohort study (NCT03341858; registered 14 November, 2017; data are available, upon reasonable request, from the authors) focuses on 4 ecologies that are proposed to interact or transact with each other to affect children’s dietary habits and weight gain: cell, child, clan (family), and community (see Figure 1). Previous studies have identified a multitude of risk factors for unhealthy weight gain during the first 5 y of life including genetic risk and prenatal factors (13), maternal weight gain during pregnancy (5), breastfeeding practices (14), maternal feeding practices (15), and timing of entry into child care (5). What makes the SK2 study unique is the consideration of how these risk factors operate in concert with each other over time to predict weight trajectories as well as the cumulative effect of these factors in predicting dietary habits.

At the cellular level, variations in the maternal and child’s genetic makeup as well as child and maternal microbiome are being examined using 16S ribosomal RNA sequencing and whole genome shotgun sequencing. Previous reports by our team have identified that candidate gene single nucleotide polymorphisms (SNPs) previously associated with an increased risk of overweight and obesity in adults (16, 17) also associate with BMI in 2- to 3-y-olds (18). In the SK2 program, how route of delivery, maternal and child diet, maternal and child weight, and child growth trajectories affect the microbiome beginning at birth are being investigated. Importantly, changes in the microbiome during weaning and the introduction of solids are being documented and the microbiomes of infants who are exclusively breastfed, exclusively formula-fed, or fed both breast milk and infant formula are being compared and related to growth and health outcomes. For a subsample, breast milk samples have been collected alongside measurement of milk intake using a 24-h weighing procedure.

At the child level, child temperament, executive function, and how sleep characteristics interact with cellular and family factors to predict dietary habits and weight gain are being assessed. At the family level, the roles of feeding practices, parental and child emotion regulation, family routines (sleep and mealtime), and media use in establishing healthy dietary habits are being explored. In our earlier work, a relation between higher child weight status and unhealthy parental feeding practices was moderated by both parental responses to negative emotions and child genetic propensities for emotion reactivity (19). In addition, our data have shown that a combination of 4 household routines (mealtime, sleep, media use, and no TV during meals) predict child consumption of fruits and vegetables rather than a single

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**FIGURE 1** The Six C’s theoretical model guiding the Synergistic Theory Research Obesity and Nutrition Group Kids 2 cohort study. SNAP, Supplemental Nutrition Assistance Program; SNP, single nucleotide polymorphism; TANF, Temporary Assistance to Needy Families; WIC, Special Supplemental Nutrition Program for Women, Infants, and Children.
Community contributions to child diet include the child's participation in child care, the timing of entry into child care, and type of child care. Because children under the age of 5 y may receive 2 meals (breakfast, lunch, or supper) and 1 or 2 snacks per day (https://www.fns.usda.gov/cacfp/why-cacfp-important), it is crucial to track participation in child care. Previous reports by our team documented that type of child care was important in determining early risk of obesity because some child care centers and early childhood programs, such as Head Start, may engage in more responsive feeding practices associated with healthy dietary habits (21).

In this report an overview of the recruitment procedures, collection of anthropometric and biological samples, and an overview of the panel survey are provided, as well as a description of the baseline demographic characteristics of the participants. The overall aim of the project was to identify predictors of weight trajectories during the first year and weight trajectories from 12 mo to 5 y. Our primary outcome measures included weight-for-length z scores (WFLZ) and weight trajectories. Secondary outcomes included infant feeding practices, maternal and child diet, stool sample microbiome, breast milk microbiome, and salivary SNPs. A complete listing of primary and secondary outcomes may be found at clinicaltrials.gov: NCT03341858.

Recruitment Strategy

Women were recruited in their third trimester of pregnancy from health care facilities (e.g., obstetrics and gynecology) and birthing classes in east-central Illinois. Notices were also placed on a university-based website. Exclusion criteria included premature birth (<37 wk), birth conditions precluding normal feeding (e.g., phenylketonuria and other inborn errors of metabolism), and low birthweight (<2.5 kg). At the time of recruitment, participants were provided with a timeline schema indicating the points at which project staff would contact them and expectations for each visit (see Figure 2). Recruitment began in May, 2013 and ended in January, 2017. Initially 539 pregnant women agreed to participate. See Figure 3 for recruitment flow and loss of participants from study entry until first contact when the child was 1 wk of age.

Methods

This study was approved by the University of Illinois Institutional Review Board (# 13448). All participants completed online informed consent forms. The data set used in the current study is available from the corresponding author on reasonable request.

Participants

The final sample included 468 mothers and their offspring. Most caregivers were highly educated (72.9% college graduate/postgraduate degree), nonsingle (88.5%), employed (69.4%), and non-Hispanic/Latino white (76.1%). The mean ± SD age of the mothers was 30.8 ± 4.7 y at 6 wk postpartum. The mothers reported that 4.9% of their children were Hispanic/Latino, 83.1% were non-Hispanic/Latino white, 9.8% were African American/black, 9.4% were Asian, 1.1% were American Indian or Alaskan Native, and 1.1% preferred not to report. The majority of the children were first born (65.6%) and half were female (50%). A listing of participants' background demographic characteristics is shown in Table 1.

Power analysis

The null hypothesis was that there would be no difference in child weight trajectories over the first year, and between the first and fifth years. The alternative hypothesis was that there would be a significant difference between children who followed slow or gradual growth and those who followed rapid growth patterns during those durations.

Using developmentally appropriate child weight z scores (e.g., weight-for-length during the first 2 y of life), group sample sizes of 80 and 324 (total n = 404) achieved 80% power to detect a difference of ≥27% between 2 child weight trajectory groups in a repeated-measures design. Assumptions include ≥20% children in the slow or gradual growth trajectories, a minimum of 2 repeated measurements, a correlation coefficient (ρ) between observations on the same subject of 0.2, and a 5% α level.

Procedures

After recruitment into the study, project staff contacted the mother ~1 wk after the estimated due date. A home visit was conducted 1–2 wk after the child’s birth. To encourage retention, the family specialist who enrolled the mother into the study conducted the initial home visit and the 6-wk home visit whenever possible. A brief survey was completed at the 1-wk visit including child's birth weight, intent to breastfeed, collection of an infant stool sample, and additional contact information should the family move. More extensive visits were made at 6 wk, 3, 12, 18, 24, 36, 48, and 60 mo (see Figure 2 for a description of procedures at each visit). Mothers also collected a sample of their own stool at the 6-wk visit. At each visit, mothers were asked to collect a stool sample from the infant/child, which was sent back to the project office via mail or was collected during the home visit. Detailed instructions were provided with each sample collection kit, which included a disposable collection pad (Dynarex Corporation), nitrile, powder-free and latex-free gloves, tubes (Dealmed), a sampling spoon (Bel-Art, SP-Scienceware), and storage box. For those infants not yet potty trained, a freshly voided stool sample was collected from the diaper or training pants by the mother. At 1 and 6 wk, the infant stool sample was placed into a sterile 3.0-mL screw-top tube (Thermo Fisher Scientific). A sterile 50-mL polypropylene conical tube (Karter Scientific) was used for all subsequent infant stool samples. For stools from the mother and children after potty training, a sterile, single-use, Fisherbrand commode specimen collection system (Thermo Fisher Scientific) was placed into the commode before defecation. Subjects were asked to avoid passing urine into the specimen collection container. Approximately 10 g of stool sample was transferred to the sterile 50-mL polypropylene conical tube and any remaining stool was flushed down the toilet. Mothers were instructed to wear gloves and use the sterile spoons to transfer the stool sample into the tube. Tubes were then placed into a storage box, which was placed into a sealable bag and stored in their home freezer (~20°C) until being picked up by the research staff. In addition, at the 6-wk visit, saliva samples were collected from both the mother and infant (18). However, in some cases insufficient amounts of saliva were obtained from the infant at 6 wk of age. Therefore, additional...
| Your Baby’s Age | What Will Happen at This Visit? | Description |
|-----------------|---------------------------------|-------------|
| 1-2 weeks       |                                 | Home visit with birth height and weight record, stool sample from baby |
| 6 weeks         | Survey (breastfeeding, family health, maternal health, intent for childcare, household food security, economic strain) home visit with stool samples from mom and baby, saliva samples from mom and baby, weight and length for baby and height and weight for mom, breast milk/formula sample |
| 3 months        | Survey (breastfeeding, child health, family health, maternal health, food allergies, infant and parent sleep, sleep routines, infant temperament, child care intent, household income) home visit with length and weight for baby, stool sample from baby, food inventory, height and weight for mom |
| Introduction of solid food | Stool sample picked up after your baby begins solids |
| 12 months       | Survey (breastfeeding, child health, family health, maternal health, maternal food frequency, food allergies, infant and parent sleep, sleep routines, parent feeding practices, family routines, child care intent, child care hours, household income, food security) home visit with length and weight for baby, stool sample from baby, food inventory, height and weight for mom |
| 18 months       | Survey (food allergies, child health, maternal health, child and parent sleep, child temperament, parent feeding practices, child care intent/hours, household income) home visit with length and weight for baby, stool sample from baby, food inventory, height and weight for mom |
| 2 years         | Survey (child food frequency questionnaire, child health, family health, maternal health, maternal food frequency, food allergies, child and parent sleep, sleep routines, child and parent physical activity, parent feeding practices, family routines, media use, child care intent, child care hours, household income, food security, economic strain) home visit with length and weight for baby, stool sample from child, food inventory, height and weight for mom |
| 3 years         | Survey (child food frequency questionnaire, child health, family health, maternal health, maternal food frequency, food allergies, child and parent sleep, sleep routines, child and parent physical activity, parent feeding practices, family routines, media use, child care intent, child care hours, household income, food security, economic strain) home visit with length and weight for baby, stool sample from child, food inventory, height and weight for mom |
| 4 years         | Survey (child food frequency questionnaire, child health, family health, maternal health, maternal food frequency, food allergies, child and parent sleep, sleep routines, child and parent physical activity, parent feeding practices, family routines, media use, child care intent, child care hours, household income, food security, economic strain) home visit with length and weight for baby, stool sample from child, food inventory, height and weight for mom |
| 5 years         | Survey (child food frequency questionnaire, child health, family health, maternal health, maternal food frequency, food allergies, child and parent sleep, sleep routines, child and parent physical activity, parent feeding practices, family routines, media use, child care intent, child care hours, household income, food security, economic strain) home visit with length and weight for baby, stool sample from child, food inventory, height and weight for mom |

**FIGURE 2** Recruitment timeline.
Recruitment Flow

539 Agreed to Participate

- 41 Did Not Respond to Study Invitation after Delivery
- 28 Preterm Delivery
- 1 Infant Mortality
- 1 Ineligible (birth complications)

468 Participants

FIGURE 3 Recruitment flow.

saliva collections were made at a later date. Saliva and stool samples were stored at −80°C before analysis.

Height and weight (for mother) and length and weight (for child) were collected by trained research assistants. Maternal weight was measured using a digital scale (HealthOmeter, Model 349KLX). Maternal height was measured on a Seca 213 portable stadiometer. Maternal measurements were taken twice at each visit and the mean was determined. If the difference in height was >0.5 cm a third measurement was taken. If the difference in weight was >0.1 kg a third reading was taken. Maternal BMI (kg/m²) was classified as nonoverweight (0) consisting of underweight (BMI < 18.5) and normal weight (18.5 ≤ BMI < 25), overweight (1) (25 ≤ BMI < 30), and (2) obese (BMI ≥ 30) (22). Child length was obtained by measuring the distance from head to foot while the child lay flat on a scale (Seca, Model 728). Child weight was measured using a digital scale (HealthOmeter, Model 349KLX). A mean across 2 measurements was taken with adjustments for discrepancies, following the procedures outlined for maternal height and weight. Age- and gender-specific WFLZs were calculated using the 2006 WHO growth charts (23). Prepregnancy maternal weight was collected at study enrollment via maternal report. Although recall may be subject to bias, comparison of maternal recall of prepregnancy weight and clinical records indicates no significant differences except for women who are underweight (24).

A family food inventory was taken at the 3-, 12-, 24-, 36-, 48-, and 60-mo visits. Two trained research assistants used a structured checklist to ascertain the presence of foods in the family pantry, countertops, and refrigerator/freezer. Following a previously developed and validated approach, a healthy and obesogenic food index could be derived (25).

| TABLE 1 | Background demographics of study sample at 6 wk postpartum1 |
|----------|-----------------------------------------------------------|
| Characteristic                              | n (%) or mean ± SD | Range |
| Number of people living in the home          | 4 ± 1                | 2–11  |
| At least 1 older sibling in the home         | 161 (34.4)           |       |
| Mother’s education                          |                        |       |
| College graduate/postgraduate degree         | 341 (72.9)            |       |
| Some college/technical school                | 88 (18.8)             |       |
| Grade school/high school                     | 32 (6.8)              |       |
| Unknown/missing                              | 7 (1.5)               |       |
| Monthly household income                     |                        |       |
| <$3000                                       | 137 (29.3)            |       |
| $3001–5000                                   | 123 (26.3)            |       |
| ≥$5001                                       | 155 (33.1)            |       |
| Unknown/missing                              | 53 (11.3)             |       |
| Marital status                               |                        |       |
| Not single                                   | 414 (88.5)            |       |
| Single                                       | 45 (9.6)              |       |
| Unknown/missing                              | 9 (1.9)               |       |
| Employment status                            |                        |       |
| Employed                                     | 325 (69.4)            |       |
| Unemployed                                   | 37 (7.9)              |       |
| Stay at home                                 | 85 (18.2)             |       |
| Student                                      | 10 (2.1)              |       |
| Retired/disabled                             | 1 (0.2)               |       |
| Unknown/missing                              | 10 (2.1)              |       |
| Employment type                              |                        |       |
| Professional and related occupations         | 126 (26.9)            |       |
| Office and administrative support            | 38 (8.1)              |       |
| Management, business, or financial           | 21 (4.5)              |       |
| Service occupation (e.g., food industry)     | 18 (3.9)              |       |
| Sales                                        | 8 (3.9)               |       |
| Production                                   | 5 (1.1)               |       |
| Transportation or materials moving           | 2 (0.4)               |       |
| Farming, fishing, and forestry               | 1 (0.2)               |       |
| Other                                        | 105 (22.4)            |       |
| Unknown/missing                              | 144 (30.8)            |       |
| Health care coverage                         | 453 (96.8)            |       |
| Participation in WIC (mother, child, or both)| 97 (20.7)             |       |
| Participation in Childcare Assistance Program| 7 (1.5)               |       |
| Received food stamps in last 30 d            | 48 (10.3)             |       |
| Mother’s race/ethnicity                      |                        |       |
| Hispanic/Latino                              | 19 (4.1)              |       |
| Non-Hispanic/Latino white                    | 356 (76.1)            |       |
| Non-Hispanic/Latino nonwhite3               | 55 (11.8)             |       |
| African American                             | 19 (4.1)              |       |
| Asian                                        | 30 (7.2)              |       |
| Alaskan Native or American Indian            | 1 (0.2)               |       |
| Unknown/missing                              | 38 (8.1)              |       |
| Household food security                       |                        |       |
| Food secure                                  | 429 (91.7)            |       |
| Low food security                             | 27 (5.8)              |       |
| Very low food security                        | 5 (1.1)               |       |
| Unknown/missing                              | 7 (1.5)               |       |
| Subjective social status                     |                        |       |
| 1 and 2 (low)                                | 7 (1.5)               |       |
| 3 and 4 (low–mid)                            | 70 (14.9)             |       |
| 5 and 6 (mid)                                | 176 (37.6)            |       |
| 7 and 8 (mid–high)                           | 170 (36.2)            |       |
| 9 and 10 (high)                              | 28 (5.9)              |       |

(Continued)
Mothers completed an online survey that detailed dietary habits, sociodemographics, child health and personality characteristics, and family environment at each time point (Figure 2 provides an outline of procedures across all time points).

### Measures

The online survey measures were selected with a focus on dietary habits, nutrient intake, and potential cell-to-community influences on early diet. Surveys were administered that were age- and developmentally appropriate for the child (6 wk, 3, 12, 18, 24, 36, 48, and 60 mo of age). We drew from pre-existing measures with established reliability and validity estimates. In this section, a general overview of the survey measures broken down by demographics, child diet, maternal diet, child health, child social and emotional behaviors, parental and family practices, child care, and economic strain is provided. We also provide a brief overview of the analysis of the stool and saliva samples.

### Stool and saliva analysis

At this time, proposed analyses of the saliva samples include assessing SNPs for candidate genes associated with satiety and appetite control pathways with obesity-related traits as previously described (18). Data will be analyzed for individual associations with child outcomes as well as genetic predisposition scores (18). Future studies may also involve investigations of epigenetic changes between 6 wk and later time points and investigations into associations between microRNA and childhood obesity and growth trajectories (26, 27). Fecal microbiota composition of mothers and infants will be assessed by high-throughput sequencing of the V-3 to V-4 variable regions of the bacterial 16S ribosomal RNA gene (28). In addition, for the infant, microbiome metagenomics will be assessed by whole-genome shotgun sequencing (29) and the fecal metabolome by ultra-HPLC-MS (30). The impact of diet will be assessed in terms of the longitudinal development of the microbiome and its metabolic function. In addition, associations between the host microbiome and health outcomes will be investigated.

### Demographics

Mothers responded to general questions about marital status, highest level of education, race/ethnicity, household income, and employment status.

### Child diet

During the first year of life, mothers completed survey items drawn from the CDC Survey on Infant Feeding Practices Study II (31). Information about method of feeding, formula use, dietary supplements, infant health, use of medicines, stool characteristics, breastfeeding cessation, pumping and expressing milk, food allergy, and infant sleep quality and sleeping arrangements was collected. From 2 y onward, mothers completed the Child Block FFQ for Ages 2–7 developed by Nutrition Quest to ascertain the child’s consumption of fruits and vegetables, fats, proteins, and dairy (32). This is a 90-item questionnaire that parents complete in response to their child’s “usual eating habits in the past 6 months.” It takes ~30 min to complete and parents completed an online version that was analyzed by Nutrition Quest. The food list was developed from NHANES III dietary recall data and the nutrient database was drawn from the USDA Nutrient Database for Standard Reference (http://www.nutritionquest.com/assessment/list-of-questionnaires-and-screeners/).

### Maternal diet

Maternal dietary habits associated with breastfeeding were included in the CDC Infant Feeding Practices questionnaire (31). In addition, mothers completed the validated full-length Block 98 FFQ provided by Nutrition Quest at the 12-, 24-, 36-, 48-, and 60-mo points (33, 34). Mothers’ consumption of fruits and vegetables, fats, proteins, and dairy and dietary supplements was analyzed.

### Child health

Overall general health was ascertained from the Short Form of the Medical Outcomes Study Health Survey (35). In addition, survey questions included items pertaining to allergies and allergic reactions to food. Beginning at 2 y of age, 25 items were included about physical activity (36). These items included types of physical activity that the child and other family members engaged in such as walking and playing ball. Parents were also asked whether they provided opportunities for their child to engage in physical activity such as providing transportation to parks or taking lessons such as swimming. Beginning at 3 mo of age, survey items were included about sleep including time that the child went to bed, time that the child woke up, and nighttime waking (37). Parents were asked to report, on average, how many hours they had slept each night during the past 4 wk. Although self-report assessments of sleep duration are subject to bias they provide a cost-effective approach to understanding this important health factor (38).

### Child behavioral style, executive function, and eating behaviors

During the first year, mothers completed survey items pertaining to child temperament (39). During the second year, mothers completed survey items designed to assess children’s executive function in everyday activities (40), emotional eating (41), and picky eating (42).
Parental feeding practices
In addition to detailed information regarding breastfeeding practices, we assessed caregiver feeding styles including restrictive practices and pressure to eat (43) and parenting styles associated with feeding (44).

Maternal physical health
The Short Form of the General Health Survey was collected beginning at the 6-wk visit (35). Alcohol and tobacco use were surveyed as single items, respectively. Beginning at 2 y of age, physical activity was surveyed annually including participation in family physical activity such as walking and running (36). Amount of sleep experienced per night was collected at every survey period (37).

Household organization
Several aspects of household organization were surveyed at most time points. Sleep routines were monitored beginning at 3 mo of age (45). Family routines including mealtime, weekends, and special celebrations were surveyed on an annual basis (46). Family chaos, reflecting the lack of planning and disorganization in the household (47), was also measured on an annual basis. Media use in the household was also assessed beginning in the second year of life. This included type of media that the child was exposed to as well as the amount of time engaged with media (48).

Child care
Beginning at 1–2 wk, mothers were asked about their intent to use child care and the planning and support surrounding child care. Once their child was enrolled in child care, the type of child care (e.g., home-based care, center-based care, Head Start) was monitored, along with the number of hours enrolled in child care.

Economic strain
Although the sample was highly educated, we did track perceived economic strain and the family’s ability to make ends meet (49). In addition, we assessed the mother’s perceived social status to track her perception of relative economic worth (50). This approach is more sensitive than socioeconomic status alone. We also tracked participation in the Supplemental Nutrition Assistance Program; Women, Infants, and Children Program; Temporary Assistance to Needy Families Program; and household food security status as assessed by the USDA (51).

Baseline Description of Child and Maternal Health

Child and family health characteristics
Child health characteristics are presented in Table 2. The WFLZs of the children at 6 wk lie 0 SDs around the reference median value, hence they follow the age- and gender-adjusted growth pattern of the WHO reference population at 6 wk. The majority of the children were reported by their parent to be in excellent health at 6 wk (72.2%) and were exclusively breastfed at 1 wk (70.5%) and 6 wk (67.7%). Only 47 (10%) of the children received newborn care in an intensive care unit or premature nursery. At 6 wk postpartum, a low prevalence of problems was reported for the previous 2 wk, including cough (7%), colic (6.4%), diarrhea (4.7%), eczema (1.9%), fever (1.3%), and food allergy (0.4%). Notably, 223 (47.7%) of the children were reported to be fussy or irritable and 70 (14.9%) had reflux. At 6 wk, only 79 (16.9%) of the children had regular child care, including care by a family member (9.4%), in-home child care (6.6%), and center-based child care (1.9%).

In terms of family health history, there were low rates of reported diabetes, dyslipidemia, stroke, heart disease, Alzheimer disease, autism spectrum, anxiety, cancer, and asthma. The highest reported family history rates were 28.2% for hypertension (maternal grandfather) and 24.6% for environmental allergies (biological mother).

Maternal health characteristics
Maternal health characteristics are summarized in Table 3. Close to half of the mothers were overweight (24.2%) or obese (25.2%) prepregnancy, based on self-report. When the child was 6 wk of age, 32.9% were overweight and 31.4% were obese based on direct measurement. Fewer than 6% had gestational diabetes, hypertension, or pre-eclampsia. The majority of mothers delivered their infants vaginally (73.3%) and self-reported excellent or very good physical health at 6 wk.

Discussion
The SK2 birth cohort study aims to examine predictors of weight trajectories and dietary habits across the first 5 y of life. Our research
team has adopted a socioecological model that accounts for multiple influences on children’s health including biological, child social and behavioral, family household organization, and community factors. We aim to add to the literature by examining how individual biology of the child and mother transacts with the social environment over time to predict child dietary habits and weight trajectories over the first 5 y of life. We build on previous reports that have predicted weight trajectories based on single predictors of infant weight (52) or maternal weight (5), early introduction of solids (4), and breastfeeding practices (14). Rather than focus on single predictors of risk we hope to inform practice and policy that will take a richer approach to the complex origins of dietary habits and weight gain in the early years to include child socio-emotional development, family organization, and child care as they provide an environmental context in support of individual variations in biology.

In this descriptive report, we have outlined our recruitment procedures and the baseline health characteristics of the mother and child. Even though the sample is relatively well-educated, there were some indicators of risk for children being classified as overweight in this sample. Close to half of the mothers reported being overweight or obese pre-pregnancy and at 6 wk postpartum >65% of the mothers were overweight or obese. Prepregnancy BMI has been linked to adiposity rebound in early childhood (53) and risk of childhood obesity in the first 1000 d (5). We will be able to provide a nuanced examination of this potential risk factor in terms of the potential contribution of changes in the maternal and child microbiome before the introduction of solids and its interaction with characteristics of the family environment, including delivery mode, antibiotic use, pets in the home, siblings, daycare use, etc. (54).

We also note the relatively high incidence of breastfeeding in our sample. At 6 wk of age, close to 67% of the mothers reported breastfeeding exclusively and an additional 17% reported combined breastfeeding and formula feeding. The national average of exclusive breastfeeding at 3 mo is 46.9% (55). Although our sample may not be representative of all mothers across the nation, we will be able to look at not only risk factors associated with later dietary habits but also protective factors such as early feeding practices, transitions to solids, and the relationship between mother and child. Further, once the children enter child care we will be able to track community influences on diet and weight trajectories.

We recognize that this study is not without limitations. The relatively homogeneous nature of our sample will not allow us to address racial and ethnic variations, an important consideration in untangling health disparities in the early years of life (1). Our sample is also limited geographically and is relatively well-educated, which also raises concerns about representativeness.

This complex observational longitudinal birth cohort study should provide valuable information about growth trajectories and dietary habits in the first 5 y of life. We have amassed a transdisciplinary team of investigators that includes expertise in pediatric nutrition, human genetics, the gut microbiome, sensory science, human development and family science, and early care and education. Each investigator brings their own unique disciplinary perspective. Collectively the STRONG Kids team provides an opportunity to integrate these approaches across biological, family, and community systems. Ultimately, the results of the SK2 cohort study have the potential to inform practice and policy in the interest of improving children’s health from birth.

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Each member of the STRONG Kids 2 team has made a significant contribution to the intellectual content of the study. The authors’ responsibilities were as follows—BHF, KKB, BAM, and SMD: made substantial contributions to the conception and design of the study;
SM: made substantial contributions to the acquisition and analysis of the data; S-YL and MT-G: participated significantly in the drafting and review of the manuscript; and all authors: read and approved the final manuscript.

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