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Dietary Habits of Children 0 - 23 Months in Rural Kansas: Early Life Diets of Rural Children

MacKenzie G. Gwinner, B.S.[1], Arika L. Marchetti, M.S.[2], Lynn Chollet-Hinton, Ph.D., MSPH[3], Lynn R. Fisher, M.D.[1,4]
[1]University of Kansas School of Medicine-Wichita, Wichita, KS
[2]University of Kansas School of Medicine, Kansas City, KS
Office of Rural Medical Education
[3]University of Kansas Medical Center, Kansas City, KS
Department of Biostatistics & Data Science
[4]University of Kansas School of Medicine-Wichita, Wichita, KS
Department of Family and Community Medicine

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ABSTRACT

Introduction. Children in rural areas face increased rates of obesity compared to their urban counterparts, and diet in early childhood may influence the development of diseases related to food intake. This study sought to determine current diet of children 0-23 months of age in rural Kansas.

Methods. Medical students participating in 6-week, summer, rural clinical experiences offered the survey to caregivers of children 0-23 months, born at term as singletons without a specialized diet. The survey asked respondents to answer with the child's diet over the last seven days. The survey was in the style of a validated Food Frequency Questionnaire for infants with an image for estimating portion sizes. Diets were compared to guidelines set by the Dietary Guidelines for Americans, 2020-2025.

Results. Of 44 responses, 21 children were aged 0-5 months, 7 aged 6-11 months, and 16 aged 12-23 months. Breastfeeding rates were nearly double reported national averages. All children aged 0-5 months met guidelines. None of the children 6-11 months or 12-23 months met guidelines. In the 6-11 month group, four consumed food in addition to breastmilk or formula (complementary foods). In the 12-23 month group, protein and dairy foods were lower than, and whole grains and vegetables were higher than, reported national averages, respectively.

Conclusions. Children may fall short of meeting dietary recommendations due to foods consumed in addition to breastmilk. There is a need for improved survey methods to capture the diets of young children in the rural United States. ***Kans J Med 2023;16:5-10***

INTRODUCTION

The first 1,000 days of life is defined as the period of conception until 24 months of age.[1,2] There is increased focus on early nutrition as research has revealed its important connections to health and success later in life. Conception to 24 months is a vital time for development due to the rapid neural development that occurs.[3] Post-partum nutrition is particularly important for sensitive periods of growth, and infants are at an increased risk for malnutrition given their intensive growth requirements. Dietary habits in the first 1,000 days may predispose children to non-communicable diseases such as obesity.[4] Additionally, research related to the role of the gut microbiome in health has been expanding, suggesting a relationship between a healthy, diverse gut microbiome and linear growth in childhood. Exposure to maternal microbes during childbirth and breastfeeding coupled with the complementary solid foods that are introduced into an infant's diet lead to the development of the microbiome.[5]

Quality nutrition in early life is linked to better health and associated with higher earning potential and intellectual attainment.[6] A long-term follow-up of a nutritional intervention in Guatemala found that improving nutrition in children under three resulted in increased work capacity, reading comprehension, and wages. A longitudinal U.S. study using the Early Childhood Longitudinal Studies Program found that healthful eating habits and physical activity in Kindergarten predicted higher test scores in reading, math, and science as eighth grade students.[7] Due to the importance of diet in the first 1,000 days of life, the American Academy of Pediatrics developed a policy statement to support programs aimed at encouraging breastfeeding and optimizing early childhood nutrition.[2]

The importance of the first 1,000 days of life is reflected in recent policy changes from the United States Government. The 2014 Farm Bill dictated the inclusion of "national nutrition and dietary information and guidelines for pregnant women and children from birth until the age of 2" beginning in 2020.[8] This is reflected in the inclusion of dietary recommendations for pregnant women and children under two years old for the first time in the Dietary Guidelines for Americans, 2020-2025.[9]

With the publication of the Dietary Guidelines for Americans, 2020-2025,[9] understanding the current dietary habits of children is necessary for determining interventions to improve adherence to federal guidelines and improve the health of children into adulthood. The guidelines indicated that only 25% of children 0-5 months met the recommendation of exclusive breastfeeding and only 35% of children 6-11 months continued to consume some breastmilk in their diet. For children 12-23 months, dairy and protein food recommendations generally were met. However, the guidelines reported that 60% meet recommendations for fruits, only 10% for vegetables, and a meager 5% for whole grains.

Current dietary trends of children in the U.S. showed that children under the age of five consumed added sugar, saturated fat, and sodium in excess of current recommendations, which may contribute to rising obesity rates among U.S. children.[10-12] Nearly 1 in 5 children are obese in the U.S.,[13] with increased risk of obesity for rural compared to urban children.[14-16] A meta-analysis found the odds of obesity is 26% higher in rural compared to urban children.[17] This trend remained despite no difference in levels of physical activity amongst rural children compared to those from urban areas.[17-19] Childhood obesity places these children at risk for diabetes, cardiovascular diseases, psychological disorders, poor academic performance, and decreased quality of life, contributing to health inequities for rural vs. urban children.[20,21] Additionally, an analysis of obesity-related measures in children, such as diet, physical activity, and environment, found that 70% of studies were conducted in urban areas, while 14% were conducted in rural areas, revealing that the diets of rural populations are understudied compared to urban populations.[22]

To our knowledge there has been no assessment of dietary habits

during the first 1,000 days in the rural U.S. Due to the important future health outcomes associated with early childhood nutrition, it was necessary to understand the current dietary habits of children under 24 months to plan more effective interventions. This was especially critical for rural populations, which face health inequities compared to urban areas.

METHODS

This project was approved by the University of Kansas Medical Center (KUMC) Institutional Review Board. The study design was a descriptive analysis of a cross-sectional survey offered to caregivers of children 0-23 months in rural Kansas. Study data were collected and managed using REDCap® electronic data capture tools hosted at the University of Kansas Medical Center.[23,24] Components of the survey included demographic questions, inclusion criteria questions, and diet questions. The survey contained a short demographic questionnaire to understand age, gender, ethnicity, language, community population, income and education, other children in the household, and participation in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC).

The questionnaire was based on a Food Frequency Questionnaire (FFQ) validated against 24-hour food recalls, the gold standard in determining food intake.[25] While this survey was developed originally for Hispanic children aged 0-24 months, the survey authors postulated that the survey tool was applicable to non-Hispanic U.S. populations due to the origin of the survey and importation of many U.S. foods to Puerto Rico resulting in similar childhood diets. To assess foods in the diet not captured in the survey, caregivers were asked open ended questions regarding other foods consumed by the child. The dietary questions were accompanied by an image to assist respondents in estimating food amounts.[26] The FFQ included nine main sections: Breastmilk/formula, Dairy/Beverages, Grains, Fruits, Vegetables, Starchy vegetables, Protein, Sugary/processed foods, and Fats. Each main section was broken down by specific types of foods. The grains section included an option to select regular or whole grain. The respondent selected if a food was eaten daily, less than daily, or did not eat over the last seven days and asked for the quantity consumed each time and how many times per day/week it was consumed. A daily average was calculated by multiplying amount by times per day, or by times per week and divided by seven.

Guidelines were reported as met or exceeded by the following measures as recommended by the Dietary Guidelines for Americans, 2020-2025.[9]

- In the 0-5 month age group: exclusive breastfeeding or infant formula. If an infant 4-5 months old was reported as consuming a complementary food they still met guidelines unless the food item included added sugar, cow's milk or milk alternatives, or fruit/vegetable juice.
- In the 6-11 month age group: human milk or formula remains as part of the diet. Additionally, these infants should be consuming complementary foods. Guidelines are not met if these complementary foods contain added sugar, cow's milk or milk alternatives, or fruit/vegetable juice.
- In the 12-23 month age group: infants should be consuming a variety of complementary foods and may continue to consume breastmilk or formula. Guidelines are met if they consume the following amounts or more: 2/3 Cups (C) vegetables/day, 1/2 C fruit/day, 1.75 oz grains per day of which 1.5 oz are whole grains, 1 and 2/3 C dairy/day, 2 oz protein/day. Guidelines are not met if added sugars are consumed.

Participant Selection and Study Setting. Research participants were recruited during in-person or virtual medical visits at primary care medical centers participating in the Summer Teaching Option for Rural Medicine (STORM) program at the University of Kansas School of Medicine. This took place between June 7, 2021 and July 16, 2021 in rural medical centers across Kansas. Patients 18 years old or older were asked if they care for a child under the age of 24 months and if they would be interested in completing a survey as part of a research study. Patients were presented with the study's aims, risks/benefits, and data safety measures by a medical student participating in STORM. Flyers and informed consent forms were available at the medical centers.

Inclusion criteria included participants at least 18 years of age that care for a child 0-23 months of age living in rural Kansas and presenting to a medical center participating in the STORM program between June 7 and July 16, 2021. Exclusion criteria included caregivers who could not complete the survey in English or who had a child born less than 37 weeks gestational age, as a multiple (twin, triplet, etc.), or who had a physical/neurological condition that required specialized feeding practices/diets.

Data Analysis. Exported data were separated into food groups and serving sizes were calculated as cup equivalents per day (dairy, fruits, and vegetables) or ounce equivalents per day (grains and proteins). The equivalents were estimated by multiplying times eaten/drank per day by the amount in cups or ounces eaten/drank at a time, or converting foods eaten/drank less than daily to days. If a range was reported, the lowest number in the range was used for calculations (i.e., 2-3 times per week treated as two times per week) due to a previous report suggesting that food intake may be overestimated in the FFQ compared to a standard dietary recall.[25] Foods and beverages reported in cups, ounces, tablespoons, or teaspoons were converted to either cup or ounce equivalents. Equivalents are defined in the Dietary Guidelines for Americans, 2020-2025.[8] Equivalent amounts were determined by the U.S. Department of Agriculture MyPlate food tables for fruit, vegetables, grains, protein foods, and dairy.[27]

Statistical Analysis. All summary statistics were tabulated using R Statistical Software, version 4.2.1.[28] Demographic characteristics of the caregivers, children, and their community were described with means, standard deviations (SD), medians and minimum and maximum values, as well as visually with histograms. Reported food intake was converted to serving sizes and used to estimate daily and weekly consumption of different food groups (e.g., Breastmilk/formula, Dairy/Beverages, Grains, Fruits, Vegetables, Starchy vegetables, Protein, Sugary/processed foods, and Fats). Daily and weekly consumption of each food

group was compared to recommended guidelines as reported by the Dietary Guidelines for Americans, 2020-2025[8] to identify the proportion of children meeting or exceeding each individual food group guideline. Proportion of young children meeting national guidelines can be found in Table 1. Diets were assessed according to recommendations for the following age groups: 0-5 months, 6-11 months, and 12-23 months of age.

Table 1. National averages meeting dietary guidelines.

0-5 Months	Met Guidelines
Exclusive Breastfeeding	25%
6-11 Months	Met Guidelines
Any Breastmilk in Diet	35%
12-13 Months	Met Guidelines
Protein	Generally meet recommendations*
Fruit	60%
Vegetable	10%
Total Grains	Generally exceed recommendations*
Whole Grains	5%
Refined Grains	Generally exceed recommendations*
Dairy	Generally exceed recommendations*
Beverages/Sugar	Generally exceed recommendations*

*percentage not defined

RESULTS

There were 79 responses submitted. Of those, 24 were incomplete, 8 were born at less than 37 weeks gestational age, 1 was a multiple, and 2 did not respond to all exclusion criteria questions, leaving 44 responses. A response rate was not obtainable due to the anonymity of respondents and placement of flyers as a recruitment tool. There were 44 respondents included in the study, with 21 children in the 0-5 month age group, 7 in the 6-11 month age group, and 16 in the 12-24 month age group. The median age of caregivers was 30 years (SD = 5.15), with a range of 20 to 44 years. The most commonly reported community population size was 2,500 - 9,999 (36.4%), followed by less than 2,500 people (34.1%). Demographic statistics of caregivers are in Table 2.

For the children included in the study, the median age was six months, with a minimum age of zero months and a maximum age of 23 months. Most came from English speaking households (88.6%) and the median number of children in the home was two, with a range of one to six children. Demographic statistics of children included in the study are in Table 3.

Table 2. Demographic statistics of caregiver respondents.

Demographics of Caregivers	**Overall (N = 44)**
Age of Parent (years)	
Mean (SD)	29.6 (5.2)
Median [Min, Max]	30.0 [20.0, 44.0]
Number of Children Raised	
Mean (SD)	2.00 (1.0)
Median [Min, Max]	2.00 [1.00, 6.00]
Education of Caregiver	
High school graduate (includes equivalency, like GED)	6 (13.6%)
Some college	12 (27.3%)
Associate degree	6 (13.6%)
Bachelor's degree	13 (29.5%)
Graduate or Professional degree	7 (15.9%)
Population of Community	
Less than 2,500 people	15 (34.1%)
2,500 - 9,999 people	16 (36.4%)
10,000 - 49,999 people	12 (27.3%)
50,000 people or more	1 (2.3%)
Income of Caregiver	
Less than $10,000	2 (4.5%)
$10,000 - $29,999	3 (6.8%)
$30,000 - $49,999	11 (25.0%)
$50,000 - $69,999	9 (20.5%)
$70,000 or higher	17 (38.6%)
Prefer not to answer	2 (4.5%)
Race of Caregiver	
White	34 (77.3%)
Hispanic	6 (13.6%)
Black or African American	1 (2.3%)
Other	3 (6.8%)

Table 3. Demographic statistics of children included in the study.

Demographics of Children	**Overall (N = 44)**
Age of Child (months)	
Mean (SD)	8.71 (8.0)
Median [Min, Max]	6.00 [0, 23.0]
Number of Children in Home	
Mean (SD)	2.05 (1.03)
Median [Min, Max]	2.00 [1.0, 6.0]
Languages Spoken	
English	39 (88.6%)
English and Spanish	4 (9.1%)
Missing	1 (2.3%)
Gender of Child	
Female	21 (47.7%)
Male	23 (52.3%)

All children in the 0-5 month age group met dietary guidelines for their age group, meaning they were fed breastmilk or formula exclusively with potential supplementation of complementary foods between 4-5 months if breastfed. Results of this age group are in Table 4. The majority of children less than six months of age consumed some breastmilk daily (81%), with 10 (47.6%) consuming breastmilk exclusively and 38% reporting some daily formula consumption. Only one (4.8%) child consumed other foods, which consisted of vegetables (carrots, green beans, and pumpkin or squash).

Table 4. Guidelines met for children aged 0 - 5 months.

0 - 5 Months	Met Guidelines	Did Not Meet Guidelines
	(N = 21)	(N = 0)
Breastmilk		
Daily or more than daily	17 (81.0%)	0 (0%)
Does not drink	4 (19.0%)	0 (0%)
Formula		
Does not drink	11 (52.4%)	0 (0%)
Daily or more than daily	8 (38.1%)	0 (0%)
Less than daily	2 (9.5%)	0 (0%)
Other Food		
No	20 (95.2%)	0 (0%)
Yes	1 (4.8%)	0 (0%)
Breastmilk Only (No formula or other food)		
No	11 (52.4%)	0 (0%)
Yes	10 (47.6%)	0 (0%)

The guidelines for children 6-11 months included breastmilk, as well as a diet consisting of protein, fruits, vegetables, yogurt or cheese, and grains, and results can be found in Table 5. No cow or other milk, sugar, or fruit or vegetable juices were allowed according to recommended guidelines. Breastmilk was consumed daily or more than daily by 85.7% of all of the children in the 6-11 month age group, and 57.1% of the children in this age group consumed other food. The most common proteins consumed by all of the children in the 6-11 month age group were beans, chickpeas, or hummus (28.6%), beef or pork (28.6%), and chicken or turkey (28.6%), although all were consumed less than daily. The most common foods from each food group that were reported as consumed daily or more than daily were hot cereal eaten with a spoon (28.6%), bananas (14.3%), other fruits (14.3%), carrots (14.3%), and green beans (14.3%). Consumption of ice cream (14.3%), 100% fruit or vegetable juice (14.3%) and cake, muffins, donuts, cookies, or other pastries (14.3%) was reported though not allowed in this age group according to dietary guidelines. Overall, 85.7% met breastmilk guidelines, only 57.1% met the other food guidelines, and none met all guidelines.

Table 5. Guidelines met for children aged 6 - 11 months.

6 - 11 Months	Met Guidelines	Did Not Meet Guidelines
Breastmilk	6 (85.7%)	1 (14.3%)
Protein	2 (28.6%)	5 (71.4%)
Fruit	2 (28.6%)	5 (71.4%)
Vegetable	4 (57.1%)	3 (42.9%)
Grains	3 (42.9%)	4 (57.1%)
Dairy	1 (14.3%)	6 (85.7%)
Beverages	5 (71.4%)	2 (28.6%)
Sugar	6 (85.7%)	1 (14.3%)
Other Foods	4 (57.1%)	3 (42.9%)
Total	0 (0.0%)	7 (100.0%)

Guidelines for the lower limits of each food group serving recommended for children 12-23 months and results for guidelines met are outlined in Table 6. In this age group breast milk or formula are not required parts of the diet but may be consumed. In our sample, one (6.25%) child consumed breastmilk and none consumed formula during the second year of life. No children met all dietary guidelines. Guidelines were met for refined grains (87.5%) and fruit (81.3%). Nearly all children consumed added sugars or sweetened beverages in their diet (87.5%). This was a deviation from the 6-11 month age group in which only one child (14.3%) consumed added sugar and two (28.6%) consumed sweetened beverages. The most common dairy products consumed were plain cow's milk, which was consumed by all the children with 93.8% consuming it daily or more than daily, and cheese (93.8%). Also, 93.8% of children ate rice or pasta, bread, and pancakes, waffles, French toast, or cinnamon rolls. The most consumed vegetables were carrots (93.8%), and the most common fruits were bananas, citrus, and other fruits (87.5%). The most common protein consumed was beef or pork, which was consumed by all the children with 37.5% consuming it daily or more than daily. The most common sweets consumed were cake, muffins, donuts, cookies, or other pastries (75.0%) and candy (62.5%). Not all respondents included amounts of food or units in their responses, leading to missing data.

Table 6. Guidelines met for children aged 12 - 23 months.

5 - 23 Months	Guideline Definition (per day)	Met Guidelines	Did Not Meet Guidelines
Protein	2 oz	8 (50.0%)	8 (50.0%)
Fruit	1/2 C	13 (81.3%)	3 (18.7%)
Vegetable	2/3 C	5 (31.3%))	11 (68.7%)
Total Grains	1 3/4 oz	36 (37.5%)	10 (62.5%)
Whole Grains	1 1/2 oz	4 (25.0%)	12 (75.0%)
Refined Grains	1/4 oz	14 (87.5%)	2 (12.5%)
Dairy	1 2/3 C	9 (56.3%)	7 (43.7%)
Beverages/ Sugar	0	2 (12.5%)	14 (87.5%)
Total		0 (0.0%)	16 (100.0%)

DISCUSSION

This study suggested that there may be room for improvement in the diets of young children in rural Kansas, although more research needs to be done. Exclusive breastfeeding rates in the 0-5 month age group were higher in our sample, 47.6% compared to a reported national average of 25%.[9] However, there was a steep decline in meeting dietary guidelines after five months. A follow-up study of the survey tool found that the quality of diets decreased over time, so this result was not unexpected.[29] More research on the changes in diet over time may determine if this is a consistent finding.

Breastmilk consumption continued to be high in the 6-11 month sample (85.7% compared to a reported national average of 35%).[9] Notably, adding complementary foods to the diet appeared to be where most children failed to meet guidelines. The Dietary Guidelines for Americans, 2020-2025[9] recommends beginning complementary foods when an infant is 4-6 months old to develop healthy eating habits, prevent allergies, and ensure adequate nutrition. Early introduction of foods containing peanuts may prevent developing a peanut allergy, an important intervention due to the impact on quality of life and high economic cost associated with treating allergen exposures.[30] Another important reason to begin complementary foods by six months is low iron content in breastmilk, an important nutrient for neurological development and the immune system, as well as zinc.[9] In our sample, only four of the seven children in the 6-11 month age group consumed complementary foods. This may indicate an area of intervention by community health providers.

No children in the 6-11 months or 12-23 months age groups met all dietary guidelines. For the 6-11 months age group, only one met guidelines (consumed any) for dairy, two for fruits and proteins, three for grains, and four for vegetables. For the 12-23 month age group, guidelines for fruit and refined grains were well met (13 and 14 children, respectively). This was expected, as the Dietary Guidelines for Americans, 2020-2025[9] reported 60% of children in this age group met recommendations for fruit and nearly all for refined grains.

Interestingly, this sample showed that nearly half of respondents met protein and dairy guidelines, which was a deviation from national expectations where these food groups tended to be well met. A total of 31.3% of our sample met vegetable guidelines, compared to a national average of 10%, and 25% met whole grain guidelines as compared to 5% nationally.[9] A study using data from the UNICEF global database discovered that children from urban areas and wealthier households had a higher rate of consuming a minimally diverse diet as defined by the World Health Organization.[31] This may explain lower rates of protein and dairy foods in our sample. Most children in the 12-23 months age group consumed added sugars in their diet, which was not recommended before 24 months of age. While unable to form any definite conclusions, children in our sample aged 6-23 months did not meet guidelines largely due to the complementary foods they consumed. Further research needs to be done to identify if this is a larger trend.

Future research would benefit from some alterations to the study tool. In the "other foods" category of the fruits and vegetables section, respondents were able to list other food items not included explicitly in the FFQ. Commonly listed fruits were strawberries, blueberries, and peaches. Common vegetables were broccoli and peas. Adding these foods to the survey tool may better characterize the diets of children in this age group in rural Kansas. Additionally, increasing the length of study time may increase the sample size. The study this survey was based on collected responses for three months in a population that presented to the clinic monthly.[25] While this survey was offered at 28 rural sites, it was offered for six weeks and in a general clinic setting instead of a WIC clinic.

Study Limitations. The study had some limitations primarily related to small sample size and missing data, resulting in challenges conducting statistical hypothesis tests. Some respondents reported the child eating certain foods but did not report the amounts/frequency of foods eaten; thus, the amount of daily consumption could not be calculated for those children nor compared to recommended guidelines. Major categories of missing data for each food group were yogurt (100%), rice/pasta (37.5%), other vegetables (31.3%), other fruit (31.3%), peanut (75.0%), and honey (6.3%). Therefore, some individuals in the 12-23 month age group may have been misclassified as not meeting guidelines due to missing data. This may indicate an area for improvement in future studies. In adults FFQs with more questions have shown increased validity, however, estimating portion sizes does not have a consistent impact.[32] Eliminating portion sizes may simplify the survey without compromising validity. Despite these limitations, this study extended the use of validated childhood FFQs in a novel population, resulting in the first description of dietary patterns for children aged 0-23 months living in rural Kansas.

CONCLUSIONS

Children aged 0-5 months in our sample met dietary guidelines, however, no children aged 6-23 months met dietary guidelines largely due to the complementary foods added to their diet. This result highlighted a potential avenue for intervention by educating caregivers on early childhood nutrition. More research needs to be done to characterize the diets of children aged 0-23 months in rural Kansas.

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