

Improving Nutrition in the First 1000 Days in the United States: A Federal Perspective

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The first 1000 days begins with pregnancy and ends at the child's second birthday. Nutrition throughout the life course, and especially during the first 1000 days, supports maternal health and optimal growth and development for children.

We give a high-level summary of the state of nutrition in the first 1000 days in the United States. We provide examples where continued efforts are needed.

We then discuss select opportunities to strengthen federal research and surveillance, programs, and communication and dissemination efforts aimed at improving nutrition and positively, and equitably, influencing the health and well-being of mothers and children. (*Am J Public Health*. 2022;112(S8): S817–S825. <https://doi.org/10.2105/AJPH.2022.307028>)

The first 1000 days is a continuum that begins with pregnancy and ends at the child's second birthday. Nutrition throughout the life course, and especially during the first 1000 days, supports the health and well-being of mothers and the optimal growth and development of children.^{1,2} Brain development begins in utero and continues over the life course; however, a child's brain develops more rapidly within the first 1000 days than any other time in life. Neurodevelopment is progressive and sequential, building on each preceding step, which makes the overall process time sensitive.¹ The provision of key nutrients, including protein, long-chain polyunsaturated fatty acids, iron, zinc, iodine, folate, choline, and vitamins A, D, B₆, and B₁₂, are necessary for normal brain development and are especially needed at specific periods.¹ If

nutrients are limited, the consequences can be irreversible and could include serious birth defects of the brain and spine, increased risk of death, and impaired cognitive development.^{1,3,4} Although brain development is a key example, nutrients are involved in virtually all areas of early life development, and inadequacy can result in altered metabolic profiles that may increase the risk of subsequent disease.²

US NUTRITION IN THE FIRST 1000 DAYS

A healthy diet during the first 1000 days can have a profound impact on the health and well-being of mothers and children. The *Dietary Guidelines for Americans, 2020–2025 (Dietary Guidelines)* from the US Department of Agriculture (USDA) and the Department of Health

and Human Services provided, for the first time, a comprehensive set of federal recommendations on dietary intake for pregnant and lactating women and infants and toddlers.⁵

We present a high-level summary of the state of nutrition in the first 1000 days with a focus on dietary recommendations and associated health behaviors and outcomes. It is not meant to be a comprehensive review. We use the term “women” throughout; however, we recognize and acknowledge that pregnant and lactating people can be of any gender, and we intend for this article to be inclusive of all families.

Nutrition During Pregnancy and Lactation

The *Dietary Guidelines* identified healthy dietary patterns for pregnant and

lactating women that encouraged the consumption of nutrient-dense foods and beverages with an emphasis on nutrients such as folic acid, iron, iodine, and choline.⁵ The patterns balanced the increased caloric needs while accounting for healthy weight gain and prepregnancy weight status.⁵ Among the pregnant and lactating population, average intake of total vegetables, fruits, and dairy are below recommendations, whereas average intake of total grains is within recommendations. For protein foods (defined as meats, poultry, eggs, seafood, nuts, and seeds), average intake is within recommendations during pregnancy and above during lactation.⁵ A high percentage of pregnant and lactating women exceed limits on added sugars (70% and 51%, respectively), saturated fat (75% and 77%, respectively), and sodium (88% and 97%, respectively).⁵

Entering pregnancy at a healthy weight and achieving recommended weight gain during pregnancy are associated with positive health outcomes for both mother and child. Obesity during pregnancy increases risks for gestational hypertension, preeclampsia, gestational diabetes, birth defects, macrosomia, preterm birth, stillbirth, and early cessation of breastfeeding.^{6,7} Less than half of women begin pregnancy at a healthy weight; with about one third of Hispanic and non-Hispanic Black women starting at a healthy weight (33.2% and 30.2%, respectively).⁸ Gestational weight gain below recommendations is associated with small-for-gestational age births, whereas weight gain above recommendations is associated with large-for-gestational age births, childhood overweight and obesity, and maternal postpartum weight retention.⁹ A third of women gain the recommended

amount of weight during pregnancy, with about half gaining more and a fifth gaining less than recommended.¹⁰ Maternal health, including nutrient and weight status, can affect future pregnancies and may result in long-term impacts on fetal programming, infant development, and maternal and infant cardiometabolic health outcomes.²

Nutrition During Infancy and Toddlerhood

For most infants, human milk feeding is the ideal source of nutrition and has significant health benefits.^{11,12} It is recommended that infants be exclusively fed human milk for about the first 6 months and continue to be fed human milk for at least 12 months, longer if desired.^{5,13} In 2019, a quarter (24.9%) of infants were fed exclusively human milk through 6 months and 35.9% received any human milk at 12 months.¹⁴ Racial and ethnic disparities in feeding human milk rates persist.^{15,16}

Complementary foods and beverages, defined as any food or liquid other than human milk or infant formula, can be introduced around 6 months.⁵ Introducing before 4 months is not recommended, as most infants are not developmentally ready, and this practice may be associated with higher risk for overweight and obesity.¹⁷ Waiting until after 6 months to introduce complementary food is also not recommended because human milk and infant formula cannot meet all nutrient requirements after this age.⁵ About 1 in 3 (31.9%) infants are introduced to complementary foods before 4 months, with differences noted by geography, race and ethnicity, maternal education, household income, and milk-feeding status.¹⁸

Establishing early healthy dietary patterns can have long-lasting impacts on later dietary patterns and health outcomes, such as obesity and dental caries.^{19–22} Complementary foods and beverages play key roles in ensuring nutrient adequacy and must account for the high nutrient needs (e.g., iron, zinc, vitamins) relative to a child's body size, leaving little room for calories from added sugars.^{5,23} Not all infants obtain optimal nutrition from complementary foods. Compared with infants aged 6 to 12 months who were fed infant formula or a mix of infant formula and human milk, those who were fed human milk had lower intakes of fruit, grains, dairy, protein foods, and solid fats and were more likely to be at risk for inadequate intake of iron, zinc, and protein.²³ For children 12 to 23 months, current average intakes of total fruits, grains, and dairy were above recommendations, whereas average intakes of total vegetables were below recommendations.⁵ The average intakes of total protein foods were within the recommendations, with meats, poultry, and eggs making up the majority of intake. Seafood intake in this age group is low. Average intake of added sugars is 104 calories per day (recommended to avoid), and sodium is 1586 milligrams (recommended limit of 1200 mg).⁵

Responsive feeding, another important dimension, is characterized by caregivers creating a predictable and nurturing feeding environment and identifying and responding in a developmentally appropriate way to hunger and satiety cues.²⁴ Responsive feeding practices, mainly reported by the mother, are associated with "normal" weight gain and "normal" weight status among children from birth to 24 months.²⁵ Infants and toddlers are also exploring different tastes and textures.

Repeated exposures to fruits and vegetables improves later acceptance.²⁶

Dietary Chemical Contaminant Exposures

Exposures to chemical contaminants occur through food and can have detrimental effects on health, especially during the first 1000 days.^{27–31} The Food and Drug Administration (FDA) has launched an initiative, Closer to Zero, to reduce levels of lead, mercury, arsenic, and cadmium in foods commonly consumed by infants and young children.³² These elements may interact with nutrients and can decrease their bioavailability.^{29,33–35} In addition, nutritional status can be an important factor in how the body addresses a toxic exposure.^{29,34,36–38} The FDA monitors chemical contaminants and estimates exposures from foods through its Total Diet Study.^{39,40} Evidence on the interactions of nutrients and chemical contaminants and effects on child development is limited; however, this information is integral to understanding and improving outcomes for child development in the first 1000 days.

IMPROVING NUTRITION: A FRAMEWORK

Comprehensive federal dietary guidelines addressing the first 1000 days were not available before the *Dietary Guidelines*.⁵ The *Dietary Guidelines* are based on a large body of research^{41,42} and serve as the foundation for federal nutrition programs, policies, and education efforts. The *Dietary Guidelines* influence state and local programs, policies, and communication efforts aimed at improving nutrition in the US population. Gaps still remain; however, opportunities exist to strengthen federal

BOX 1— Examples of Opportunities to Strengthen Federal Research and Surveillance, Programs, and Communication and Dissemination Efforts Aimed at Improving Nutrition in the First 1000 Days

Research and surveillance	Modify existing surveillance and data systems to improve representation
	Use technology to supplement existing data
	Update nutrient content for human milk in food composition databases
Programs	Improve participation, retention, and implementation of standards in existing programs
	Increase implementation of clinical guidelines and recommendations
	Identify interventions to improve nutrition in first 1000 days
Communication and dissemination	Provide education on early feeding
	Develop audience-specific messages
	Identify effective dissemination tools or strategies

research and public health surveillance, programs, and communication and dissemination efforts aimed at improving nutrition in the first 1000 days (Box 1).

Research and Public Health Surveillance

Research and public health surveillance are key underpinnings to our understanding of the “who, what, where, when, why, and how” related to nutrition in the first 1000 days. However, inferences are based on the populations included. Representation of pregnant and lactating women, infants and toddlers, and different racial and ethnic groups are needed to draw accurate conclusions and generalizations. Historically, surveys have not included or have had insufficient samples of these key groups.^{43,44}

Public health surveillance, and in some instances research studies, are limited in the data they can collect and how they collect it. These limitations are often necessary because of time, cost, or feasibility; however, these limitations can result in a lack of data on

specific subpopulations and gaps in information on a major source of nutrition. For example, the National Health and Nutrition Examination Survey does not collect nutritional status indicators (e.g., iron, vitamins) on infants younger than 12 months. This leaves gaps in the ability to identify at-risk populations, focus programmatic work, and assess program effectiveness.

As another example, data on the composition of human milk and the volume consumed are limited and outdated and may not reflect the current feeding patterns of the country.^{45–47} Infants and toddlers who consume human milk are often excluded from dietary intake analyses because of the unknown variability in human milk composition or because their recorded nutrient intake reflects only the nonhuman milk foods and beverages consumed. This gives an incomplete and inaccurate assessment of total intake. There are limited validated infant- and toddler-specific dietary assessment instruments and methods that measure the unique feeding aspects of this population.

Validated measurement tools and methods can help capture behavioral and contextual information on feeding by parents and other caregivers, such as early care and education (ECE) providers, including concepts such as feeding mode (e.g., breast, bottle, cup, or spoon), caregiver feeding practices (e.g., responsive vs nonresponsive feeding behaviors), repeated exposures to different tastes and textures, mealtime environment, and the amounts consumed. Dietary data can provide information on what children are fed but are currently missing information on how children are fed. Collectively, these limitations affect the ability to accurately characterize nutrient intake and status profiles for infants and toddlers, identify populations at risk for over- or under intake of nutrients, and understand contextual feeding information.

To address these gaps and work toward a more representative and comprehensive framework for public health surveillance and research, there are opportunities that could be explored, including (1) modifying existing surveillance and data systems, (2) using technology to supplement existing data, and (3) updating nutrient content for human milk for food composition databases.

Modify existing surveillance and data systems to improve representation. The issue of improving the representation of underrepresented subpopulations has been discussed from the perspective of data needed to inform future iterations of the *Dietary Guidelines*⁴² and a broader public health perspective to improve health equity.^{48,49} Both are crucial to supporting the understanding of nutrition in the first 1000 days. Working across federal agencies

and nonfederal partners, including communities and the underrepresented people they serve, specific strategies could be developed to ensure more complete representation in national, state, and local public health surveillance data.

One potential strategy is the use of sentinel surveillance sites. Specifically, focusing on areas of the country with higher prevalences of poor nutritional outcomes or behaviors (e.g., poor micronutrient status or lower breastfeeding rates) could be an efficient way to provide insights into factors such as sociodemographic characteristics that are associated with different health outcomes. Programs or places that regularly serve or interact with pregnant and lactating women and infants and toddlers could act as sentinel surveillance sites that may complement other public health surveillance efforts. Examples of programs and places could include Special Supplemental Nutrition Program for Women, Infants and Children (WIC) clinics, federally qualified health care centers, and ECEs. Critical to this strategy is the identification of key nutritional indicators and the standardization of collection, measurement, and reporting to further their utility and improve comparability.

Complementary to the need for improving representation in surveillance systems is the need to improve timeliness of data collection and reporting. Real-time data collection and reporting can facilitate the forecasting of potential issues, such as the COVID-19 pandemic and the 2022 national infant formula shortage, and can inform any necessary programmatic or policy-level changes. The Household Pulse Survey is an example of a system that provided timely social and economic data on the impacts of COVID-19 and identified the

specific needs of US families. The Household Pulse Survey could be used as a model for future efforts.

Use technology to supplement existing data. Federal efforts to modernize data are under way.^{48,50} Electronic health records offer an opportunity to use technological advances to supplement existing data. Electronic health records could capture indicators of feeding decisions and behaviors (e.g., human milk feeding duration, infant formula use, timing of complementary food introduction, prenatal supplement use), health outcomes (e.g., gestational weight gain; infant and toddler weight and length), and biologic data (e.g., iron status). Additionally, provider notes may capture contextual feeding information (e.g., feeding mode, mealtime environment, frequency of food exposures), and standardized categorical labels to identify specific feeding concepts may allow easier data mining. Factors needed to support this strategy include (1) identifying feeding and nutrition indicators that can be added to Health Level Seven Fast Healthcare Interoperability Resources standards,⁵¹ (2) ensuring a standardized definition and assessment method for each indicator, and (3) ensuring that age-appropriate indicators are measured at well-child checks on all individuals.

Other opportunities include using data from apps or other online sources (e.g., the National Institutes of Health PregSource research project) designed to track or collect information on pregnancy weight gain and loss (e.g., the March of Dimes Cinemama app), infant and toddler growth, developmental milestones, feeding decisions, and other behaviors or outcomes. Although data obtained through these methods

have challenges, including generalizability, potential bias, and ensuring data privacy, discussions on how to harness and interpret such data may be an important future step.

Update nutrient content for human milk in food composition databases.

Updated nutrient content for human milk in food composition databases has the potential to inform future iterations of the *Dietary Guidelines*, research on maternal and infant health exposures and outcomes, and updates to the Dietary Reference Intakes for infants.⁵² Work is under way with the US and Canadian Human Milk Composition Initiative and existing public-private partnerships.⁵³

Programs

US programmatic efforts to support nutrition in the first 1000 days have relied primarily on the health care system, federal programs focusing on women and children, or by reaching children in ECE settings. Programs implemented in these settings may follow specific guidelines, recommendations, standards, or regulations in an effort to provide the families served optimal care and support,^{54–58} which can have positive health benefits and may reduce inequities.^{59,60}

Yet, gaps remain in access to and participation in these programs and in the implementation of programmatic standards designed to improve health outcomes, which can lead to fewer families receiving the full spectrum of available benefits, supports, and clinical care services. (For purposes of brevity, the term “standards” is meant to include guidelines, recommendations, standards, or regulations.) For example, in 2020, 29.1% of live births occurred in

maternity care facilities that provided recommended care to support optimal infant feeding.⁶¹ In 2018, an estimated 2 million children per year of age (1–4 years) were eligible for WIC services, yet program participation data indicate that only 44% of US eligible children participated in WIC, ranging from 61% of 1-year-old children to 27% of 4-year-old children.⁶² Addressing barriers to participation and systematic inequities that reduce access to or participation in these programs could help increase participation among eligible individuals and alleviate disparities.

Acting on opportunities to work within the existing programmatic approach can improve participation and retention in programs and increase the implementation of standards and clinical guidelines. Expanding complementary programmatic efforts could provide an additional level of support for families who may not have been previously reached.

Improve participation, retention, and implementation of standards in existing programs. Improving participation in programs such as WIC, the Child and Adult Care Food Program, and the Maternal, Infant, and Early Childhood Home Visiting Program as well as implementing standards that affect these programs (e.g., obesity prevention state licensing standards in ECEs) could translate to significant effects on health and nutrition outcomes. Examples include increased rates of human milk feeding,⁵⁹ more children receiving supportive infant feeding and meeting nutritional standards in ECEs,⁶³ reaching rural communities through home-visiting programs,⁶⁴ and reductions in disparities in human milk feeding.⁵⁹

Reassessing how programs engage with participants could be a first step in

advancing this opportunity. One example is the innovations implemented by WIC during the COVID-19 pandemic to address the constraints of in-person service provision. For WIC, the flexibilities and innovations, including 16 different types of waivers, reduced barriers to accessing WIC services.⁶⁵ Early findings on the 2 most commonly used waiver types, the physical presence and remote benefit issuance waivers, suggest WIC services were more accessible and convenient for participants, access to food was improved, and a higher percentage of remote nutrition education and breastfeeding counseling were provided.⁶⁵

The American Rescue Plan Act of 2021 (Pub L No. 117–2) provided \$390 million to the USDA to carry out outreach, innovation, and program modernization efforts to increase participation and redemption of benefits in both WIC and the WIC Farmers' Market Nutrition Program. As part of planning, the USDA Food and Nutrition Service held listening sessions with more than 200 WIC stakeholders to solicit input on ways to connect more eligible people to program benefits, opportunities to improve the participant experience, and ideas on how to streamline benefit delivery and reduce disparities in program delivery. The Food and Nutrition Service used this valuable input to develop a framework for this transformative investment of the American Rescue Plan Act of 2021 funds. With the framework, they could increase WIC enrollment and retention and reduce disparities in program delivery, which could improve health equity, reduce maternal mortality and morbidity, and improve child health outcomes. These innovations could serve as a model for other programs aimed at improving nutrition during the first 1000 days.

Increase implementation of clinical guidelines and recommendations.

Health care systems are reimagining how services can be provided to improve health care delivery and health outcomes. Some innovations are a direct result of the COVID-19 pandemic, whereas others were in progress and the pandemic accelerated their implementation.⁶⁶ Examples include using telehealth visits; engaging health care support teams to deliver care, including anticipatory guidance; using the data modernization efforts of electronic health records; and updating federal and clinical guidelines to drive changes in how, or when, clinical care is provided. Reducing disparities in access to high-quality care for rural populations and racial and ethnic groups have been noted with telehealth visits.^{67,68} The effectiveness of these strategies in reaching key populations, providing care to support nutrition in the first 1000 days, and assessing their impact on patients and providers are important steps to be explored.

Identify interventions to improve nutrition in the first 1000 days. Systematic reviews have documented interventions that target the first 1000 days.^{69,70} The following interventions could be prioritized for future implementation efforts:

1. those that have significantly affected health or behavioral outcomes,
2. those that can be scaled up,
3. those that reach higher-risk populations,
4. those that reduce inequities, or
5. those that complement existing federal or state programs.

The Global Nurturing Care Framework offers an example of a wholistic

model that supports early childhood development, including nutrition.⁷¹ Although this framework extends beyond the first 1000 days, its approach could be incorporated into US efforts to support families and caregivers. Additionally, the National Academies of Sciences has undertaken a scoping review of interventions aimed at improving infant and toddler feeding behaviors that could be scaled up to the community or state level. The contract is being processed. These findings will be an important contribution and can provide a basis for newer, larger-scale programmatic efforts to improve nutrition in the first 1000 days.

Communication and Dissemination

Effective translation of scientific recommendations is crucial to ensuring that audiences (e.g., parents and caregivers, pregnant and lactating women, health care providers, ECE providers, nutrition program administrators, policymakers) are aware of, knowledgeable about, and can make behavioral changes or take action as needed. As defined in [Box 2](#), communicating and disseminating these recommendations is part of this translation process. Effective

communication and dissemination require the identification of (1) the messages, (2) the audiences, and (3) how to reach the audiences.

The topic of nutrition during the first 1000 days is immense, complicated, and constantly evolving, which makes communicating and disseminating messages difficult. The *Dietary Guidelines* provided the federal standard related to healthy eating for pregnant and lactating women and children from birth to aged 24 months.⁵ Other organizations and entities, both professional and lay, have supplemented the *Dietary Guidelines* with recommendations on feeding and nutrition.^{56,77} However, ensuring that all families and caregivers have the most up-to-date recommendations and that key influencers are providing clear, consistent, and evidence-based messages can be challenging but are particularly important, given the role unhealthy food marketing can have on dietary choices and behaviors and the targeting of lower-income populations.

Provide education on early feeding. Education on early feeding for all families and caregivers could provide a foundation for those who may not be reached by programmatic or other

BOX 2— Key Definitions of Terms

Infants: Children aged birth through 11 months.

Toddlers: Children aged 12–23 months.

Public health surveillance: “The ongoing, systematic collection, analysis, and interpretation of health-related data essential to planning, implementation and evaluation of public health practice.”⁷²

Communication: The “use of communication strategies to inform and influence individual and community decisions that relate to health.”⁷³

Dissemination: “An active attempt to spread an evidence-based intervention to a target audience through identified channels and planned strategies.”^{74(p157)}

Research: A “systematic investigation, including research development, testing and evaluation, designed to develop or contribute to generalizable knowledge.”⁷⁵

Program: “An organized, planned, and usually ongoing effort designed to deliver services or products to target populations with need.”^{76(p5)}

system-level supports. Education could focus on key caregiver needs for knowledge and skills on different aspects of feeding and may be particularly impactful if it includes responsive feeding and parenting techniques and is implemented in a way that acknowledges and supports a families' cultural practices and beliefs.

Develop audience-specific messages.

Identifying key audiences and developing tailored messages consistent with existing guidelines and recommendations could help ensure effective messaging. Audiences such as parents and caregivers, ECE providers, health care providers, and program administrators have different needs when it comes to receiving a tailored message.⁷⁴ For example, parents and caregivers need specific guidance on when, what, and how to feed their child that are relevant and achievable. Comparatively, program administrators need to apply guidelines and recommendations to the implementation of a program. Examples of this include using updated *Dietary Guidelines* recommendations to inform the content of WIC food packages and Child and Adult Care Food Program meal patterns.

Identify effective dissemination tools or strategies. Disseminating messages on nutrition in the first 1000 days is a collective effort. With a rapidly changing landscape of how to reach diverse audiences, federal agencies, state and local governments, nonprofit organizations, professional organizations, the private sector, and others have a role in providing clear, consistent, and credible information. Examples of this collaboration exist (e.g., MyPlate and Alexa skills for parents and caregivers of infants aged 4 months or older; 1000 Days'

videos on how to feed younger children; Healthy Eating Research's toolkits and handouts on healthy beverages for children), and efforts to support and expand could focus on ensuring that tools and messaging are culturally and linguistically relevant.

CONCLUSIONS AND FUTURE DIRECTIONS

Optimal nutrition in the first 1000 days can have lifelong effects on the health and well-being of mothers and children. Although advancements have been made, we have an opportunity to work collectively to further these efforts. The White House Conference on Nutrition, Hunger, and Health will be a foundational moment in advancing US nutrition efforts for decades. Capitalizing on the visibility and importance of this event is analogous to the window of opportunity to support and ensure optimal nutrition in the first 1000 days. Advancing efforts related to research and surveillance, programs, and communication and dissemination could help positively, and equitably, influence the health and well-being of mothers and children. *AJPH*

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The authors have no conflicts of interest or financial relationships relevant to this article to disclose.

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