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Racial Disparities in Cancer Care | Access to Care for Transgender Veterans | Hepatitis C Among US Veterans | Battling Tobacco Use at Home | [illegible] | How Might the Provision of Culturally Competent Services Be Enhanced for American Indian and Alaska Native Veterans? | Improving Trends in Gender Disparities | Suicidality Among Hispanic and African American Veterans Following Surgery

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COVER: A child less than 6 months old is being spoon-fed her first meal by her mother.

Cover concept and selection by Aleisha Kropf. Photo by Getty/skaman306. Printed with permission.

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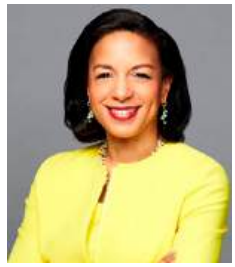
Nutrition in the 1000-Day Window: Biden–Harris Administration Setting the Foundation for the Health of Our Nation



As most parents know, the first couple of years of a child's life are both exhausting and exhilarating. Sleep deprivation, feeding struggles, and tantrums coexist alongside first steps, first words, and impossibly cute smiles.

Those early years—the first 1000 days—are also critical for the health of mothers and their children. Those days lay the foundation for children's future growth and development. And, to have a healthy baby, mom must be healthy too.

In September, President Biden underscored his administration's commitment to raising healthy families by hosting a White House Conference on Hunger, Nutrition, and Health. The conference—the first in more than 50 years—charged Americans with ending hunger and improving healthy eating and physical activity by 2030 so fewer Americans experience diet-related diseases, all while reducing disparities. The conference brought together people from diverse backgrounds and sectors to identify actions to banish hunger and diet-related disease.

Alongside the conference, the administration released a national strategy for achieving this goal, including steps to support environments where all mothers and children can thrive (https://bit.ly/3ezrooN). The strategy complements and builds on the White House Blueprint for Addressing the Maternal Health Crisis (https://bit.ly/3e8mW01), a multiyear, multiagency effort to combat maternal mortality and morbidity in the United States.

The strategy lays out numerous actions that the federal government is taking to promote children's health in those first 1000 days. For example, the Department of Defense and General Services Administration—which runs child development programs and centers serving thousands of children—is committing to enhancing and promoting nutrition and physical activity standards in these programs. These commitments will help instill healthy eating and physical activity habits for a lifetime.

Because the foods that we are exposed to early on influence our lifelong preferences, federal agencies are taking action to reduce sodium in foods, including the Food and Drug Administration issuing revised, voluntary sodium reduction targets for a range of processed, packaged, and prepared foods.

Breastfeeding also provides significant health benefits to babies and mothers. Yet, only 60% of mothers breastfeed for as long as they intend to. To support moms that choose to breastfeed, the Department of Health and Human Services and the Department of Labor is working to enforce the Affordable Care Act requirement that most private health insurers and Medicaid cover breastfeeding support and counseling at no cost. The Department of Labor will ensure that nursing moms and their employers understand their rights and responsibilities, and the administration will continue to support extending workplace protections to breastfeeding mothers.

Prioritizing the health of babies, younger children, and mothers will reap significant returns on investment, setting the foundation for the health of our nation. But, the federal government cannot do this alone. Everyone has a role to play—the private sector; state, local, tribal, and territory governments; civil society; academia; philanthropy; and other partners.

The goals that President Biden set out at the White House Conference on Hunger, Nutrition, and Health are ambitious. With the concerted effort of Americans across the country, they are absolutely achievable. Meeting these goals will help ensure that our children are healthy, not only in those critical first 1000 days but also in the years to come. AJPH

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4 Years Ago

Sugar-Sweetened Beverage Attitudes and Consumption During the First 1000 Days of Life

The first 1000 days of life . . . was recently recognized as a critical period for development of childhood obesity and its adverse consequences. . . . Among infants, approximately 14% to 26% consume SSBs during the first year of life, leading to a 2-fold higher odds of obesity at age 6 years compared with counterparts with no SSB intake. . . . We found that parents with more negative attitudes toward SSBs habitually consumed fewer daily SSB calories and were less likely to have infants who drank SSBs. Considering that . . . frequent SSB consumption during these critical periods in the life course can adversely affect later child health, efforts to curb SSB intake during pregnancy and to avoid introduction during infancy are needed.

From AJPH, *December 2018, pp. 1659–1664, passim*

50 Years Ago

Malnutrition, Learning, and Intelligence

It has long been recognized that the nutrition of the individual is perhaps the most ubiquitous factor affecting growth, health and development. Inadequate nutrition results in stunting, reduced resistance to infectious disease, apathy and general behavioral unresponsiveness. In a fundamental sense it occupies a central position in the multitude of factors affecting the child's development and functional capacity. It is therefore entirely understandable that in a period dedicated to the improvement of man and his capacities that renewed attention has come to be directed to the relation of nutrition to intelligence and learning ability. . . . A responsible analysis of the problem . . . seeks to define the particular role . . . played by nutritional factors in the development of malfunction, and the interaction of this influence with other circumstances affecting the child.

From AJPH, *June 1972, p. 773*

How to Collectively Move Forward to Achieve Optimal Nutritional Status During the First 1000 Days

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Note. The findings and conclusions of this article are those of the author and do not necessarily reflect the official position of the Centers for Disease Control and Prevention.

A critical component of food and nutrition security for all is optimal nutrition during the first 1000 days, a time from pregnancy through a child's second birthday. This special issue of *AJPH* sets the stage for what we know about nutrition in the first 1000 days in the United States and what is needed to move forward. This time period is critical because children experience more growth and development in the first 1000 days than at any other time in life. If malnutrition occurs in this window, there may be no recovery in brain development and health.[1,2] Unfortunately, nutritious foods are not uniformly and equally available to all. This has unique relevance to the first 1000 days because inequities in childhood growth and development due to poor nutrition can have long-term effects on cognitive development and health throughout that child's life.[1,3,4]

PAST INTERNATIONAL FOCUS CAN INFORM THE DOMESTIC APPROACH

In a series of international articles published in 2008, 2013, and 2021 that drew attention to the critical impact of maternal and child malnutrition during the first 1000 days, four main themes emerged: data showing burden, the uniqueness and importance of the first 1000 days, science-based interventions, and what is needed to move forward. Regarding the first theme, these articles provided compelling data on the global burden of maternal and child malnutrition, including the prevalence of stunting, wasting, and micronutrient deficiencies in low- and middle-income countries,[2,5,6] and how maternal malnutrition, suboptimal breastfeeding, and micronutrient deficiencies negatively affect children's development.[5] Second, the 2008 series of articles were the first to emphasize the first 1000 days as a critical period for nutrition.[2] The subsequent series of articles continued to emphasize the negative effect on adult human capital if nutrition, including micronutrients, was not adequate during the first 1000 days.[6] Third, the overall series of articles showed the continued advancements in proven interventions to address maternal and child malnutrition in high-burden countries.[2,7,8] Last, the series consistently acknowledged that despite progress, more needed to be done to harness collaborative momentum and increase political support.[7,8]

US CONTEXT AND THEMES TO CONSIDER IN IMPROVEMENTS

This special issue focuses on how the United States can begin to improve maternal and child nutrition in the first 1000 days. This work can be informed by the international work, with the additional context of US history. One pivotal point in the domestic nutritional support in the 1000 days was the first White House Nutrition Conference on Food, Nutrition and Health in 1969.[9] This conference greatly influenced maternal and child nutrition through the establishment of two major food assistance programs: the Special Supplemental Nutrition Program for Women, Infants and Children (WIC) and the expanded Food Stamp Program (now the Supplemental Nutrition Assistance Program). In addition, the leaders of the 1969 conference established the process for the *Dietary Guidelines for Americans* so advancements in science could continuously improve approaches to maternal and child nutrition.[9]

Such advancements increasingly support the importance of nutrition during the first 1000 days and how best to address both food security, which is provided by calories, and nutrition security, which considers the quality of food. This acknowledgment about the need for both food and nutrition security is best reflected by the Committee on World Security's robust definition:

> "Food and nutrition security exists when all people, at all times, have

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> physical, social and economic access to food which is safe and consumed in sufficient quantity and quality to meet their dietary needs and food preferences, and is supported by an environment of adequate sanitation, health services and care, allowing for a healthy and active life."[10]

This context sets the stage for this special issue's focus on the first 1000 days. The articles in this issue touch on the same themes that emerged from the series of international articles mentioned earlier and match those of any good public health model: data to investigate the problem (in this case, nutritional status during the first 1000 days), implementation of science-based programs and policy and system interventions, and how to continuously improve an approach to a problem to accelerate impact.

THEME 1: NEED FOR NUTRITION DATA DURING THE FIRST 1000 DAYS

The most recent version of the *Dietary Guidelines for Americans* included, for the first time, a specific focus on the importance of nutrition during the first 1000 days.[11] Yet gaps in knowledge exist. As Hamner et al. (p. S817) point out, there are gaps in the US surveillance of nutrition status and eating behaviors during the 1000 days. A similar tone is reflected regarding micronutrient deficiencies—specifically in iron status—during the first 1000 days by Jefferds et al. (p. S826). Although some data are available on iron deficiencies among children and pregnant women, there are areas for improvement. This is critical, as children and pregnant women are especially vulnerable to the consequences of iron deficiency, which can include maternal mortality and decreased motor and cognitive development of children.[12] The editorial by Baker (p. S776) points out similarities and differences between the international and domestic (US) approaches to nutritional assessment and potential actions during the first 1000 days.

THEME 2: IMPLEMENTING SCIENCE-BASED INTERVENTIONS

There are many areas in which the United States can continue and enhance many effective programs and interventions. High-quality food assistance programs should continue to be a priority for this country, as noted in the editorial from Rice (p. S748) and Bleich et al. (p. S773) at the US Department of Agriculture. In addition to food assistance programs, other enhancements may be needed to specifically improve maternal nutritional status. The editorials by Ramakrishnan (p. S763) and Kavle (p. S760) offer potential steps to consider improving maternal nutritional status. Other domestic progress that should be continued and expanded includes the promotion of breastfeeding and the establishment of healthy eating behaviors during the first 1000 days. Breastfeeding promotion and support are critical, as breast milk is an ideal food for infants, with short- and long-term health benefits.[13] Unfortunately, the potential benefits of breastfeeding are not uniformly realized.[14,15] The editorial by Pérez-Escamilla (p. S766) thoughtfully describes how the United States can improve breastfeeding initiation and duration with attention to the existing disparities. To best promote healthy eating patterns among infants, the transition to foods should be to those that are the healthiest, as long-term eating behaviors are influenced by tastes and behaviors established early in life.[11] Given that many children spend time in nonparental early care and education arrangements,[16] the editorial by Dooyema et al. (p. S779) discusses how these settings can be used to help children learn about and enjoy healthy foods.

THEME 3: IMPROVING NUTRITIONAL IMPACT IN THE FIRST 1000 DAYS

With any solution-oriented approach, there needs to be continuous assessment of how one might accelerate impact through incorporation of advances in science, learning from failures, adapting to new challenging contexts, and bringing in new partners. The editorial by Thomas et al. (p. S754) provides a vision for what actions across sectors can best address nutrition during the first 1000 days. An example of how challenging new contexts can disrupt nutrition security is exemplified by Lewis et al. (p. S787), who report on how the COVID-19 pandemic affected breast milk feeding in the hospital.

POTENTIAL BARRIERS AND OPPORTUNITIES

There are barriers and opportunities that need to be considered in advancing the quality of nutrition during the first 1000 days. Although many factors affect nutrition during the first 1000 days, three factors are worth emphasizing. First, the unequal access to nutritious foods has been influenced, in part, by historical systems of discrimination and racism,[17] including the historical distribution of land as the United States was established. The editorial by Salvador

(p. S785) provides a sobering summary of this history. Second, as noted in the recent update of the *Dietary Guidelines for Americans*,[11] children aged younger than two years should not have any added sugars in their diet, as this may lead them to develop lifelong taste preferences for overly sweet foods.[11] Intake of sugar in the first 1000 days is prompted by parent and caregiver behaviors. This can be influenced by repeated exposure of marketing of unhealthy foods and accessibility of beverages and foods containing sugar.[18] Decreasing, or counterbalancing, this influence will require action at different levels, as discussed in the editorial by Krieger and Freudenberg (p. S770). One part of this plan can include effective countermarketing messages, such as the intervention presented by Harris et al. (p. S807).

Third, there is a growing call for improving nutrition education in medical schools. Although physicians cannot, and should not, replace registered dieticians in team-based care models, most physicians graduate from medical school without knowledge on how to help women of reproductive age and caregivers of infants and young children achieve the optimal nutrition status during the first 1000 days.[19] In addition, many physicians do not understand the importance that nutrition plays in underpinning a lifetime trajectory for health and chronic disease prevention and management. Two editorials, by Essel (p. S757) and Kavle (p. S760), emphasize the opportunity that exists to improve nutrition education.

CONCLUSIONS

There is much to be done to achieve adequate nutritional status during the first 1000 days for every woman and child across the country. This is a critical building block toward achieving a vision that the United States has vibrant, healthy resilient communities. This is not just about individual behaviors. We must consider a complex web of distal, population-level influences such as agriculture practices, food systems, food science, marketing, pricing, and social inequities. To address these influences, we will need effective programs, policies, and system changes that consider the complexities of long-standing inequities. These could include addressing economic stability (e.g., living wages, earned income tax credit), reducing the marketing of unhealthy products, and changing procurement strategies to promote healthier options being universally available and to drive market demand for healthier production. The challenge is to create momentum and sustain action—supported by government agencies, industry, health care, public health, nonprofit organizations, community-based organizations, and communities—to give nutrition the attention it deserves during the first 1000 days. AJPH

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CONFLICTS OF INTEREST

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From Evidence to Action: Uniting Around Nutrition in the 1000-Day Window

Blythe Thomas, BS

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If you had 1000 days to change the world, how would you do it? For us, it starts with an urgent opportunity to safeguard a child's potential to learn, grow, and thrive.

Studies show that countries that fail to invest in the well-being of women and children in the first 1000 days, the time between a pregnancy and the baby's second birthday, lose billions of dollars to lower economic productivity and higher health costs.[1] Roger Thurow, author of *The First 1000 Days*, said, "If we want to shape the future, to truly improve the world, we have 1000 days to do it, mother by mother, child by child."[2]

While the international global health community has been guided by the United Nations Millennial Development Goals—and now, the Sustainable Development Goals—since 2000, the United States has failed to take meaningful action to protect its mothers and young children. The United States has one of the highest infant mortality rates and maternal mortality rates of any wealthy country, with notable disparities along racial and ethnic lines. Our nation also ranks among the worst of our peers on key child health metrics: one in 10 babies is born prematurely,[3] one in six babies is never breastfed,[4] and one in eight toddlers is overweight.[5] Workers are not guaranteed comprehensive, job-protected paid leave, jeopardizing the ability of many parents to care for themselves and their children. And too many families struggle to put nutritious foods on the table. Even before the COVID-19 pandemic and related economic recession hit, nearly one in seven households with children were food insecure.[6]

Nutrition plays a foundational role in a child's development and her country's ability to prosper. Poor nutrition in the first 1000 days can cause irreversible damage to a child's growing brain, affecting her ability to do well in school and earn a good living—and making it harder for a child and her family to rise out of poverty.[7]

In 2008 (https://bit.ly/3BIgxlG), and again in 2013 (https://bit.ly/3oYUtLY) and 2021 (https://bit.ly/3Q7g5Sy), a landmark series of papers was published that identified the first 1000 days as a powerful window of opportunity for tackling undernutrition and improving maternal and child health in low- and middle-income countries. For nearly two decades, the first 1000 days has been an organizing agenda for nutrition advocacy and programming in international settings.

While the medical, public health, and social support communities in the United States know which interventions are most critical to support the health and well-being of vulnerable families, a clear, unifying plan for policy, systems, and environmental change to improve nutrition security has been elusive. Now more than ever—in the face of persistent racial health disparities, an ongoing pandemic, and its economic fallout, we see four sectors where immediate actions can be taken, and where long-term investment can make a significant impact on maternal and child health.

EARLY CHILDHOOD DEVELOPMENT

The early childhood development sector is complex and involves a dizzying array of programs and assessments. However, because two thirds of infants and toddlers in the United States are in some form of care outside the home,[8] access to nutritious food and the opportunity to establish healthy eating habits at a young age should be some of the most fundamental supports provided by child-care programs. In addition, we must prioritize paid leave and workplace support programs to encourage breastfeeding and optimize the physical and mental health and nutrition of the mother, as well as home wellness visits and other whole-child solution supports.

Some key actions for this sector include the following:

- Improve monitoring and measurement of healthy infant feeding practices and availability of nutritious foods in early care and child care settings.
- Invest in support for breast milk and breastfeeding.
- Invest in the Child and Adult Care Food Program to increase participation and support implementation.
- Improve integration of nutrition programs into federal funding for

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early care and education including the Child Care and Development Block Grant.
- Make intentional connections to the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) and Supplemental Nutrition Assistance Program to connect families to other programs for which they may receive assistance.
- Engage and train early childhood professionals working with expectant mothers, babies, and toddlers on the importance of early nutrition and optimal infant and young child feeding practices.

HEALTH CARE

Nutrition is not a core subject at most US medical schools. This could potentially undermine doctors' abilities to effectively support families in those critical early years.[9] Within the first 1000 days, pregnant, birthing, postpartum, and parenting people and their children have numerous interactions with health care providers. Each one of these interactions is a critical touchpoint to ensure individuals have access to the nutritious foods and feeding supports they need. To address this gap, the health care sector can do the following:

- Provide ongoing training and professional development to providers and staff who serve families in the first 1000 days.
- Better equip these trusted messengers with accessible and culturally appropriate nutrition messages and services.
- Streamline health care and nutrition programs so that education and resources are provided for families all in one location.
- Increase access to experts, including registered dietitians and lactation consultants, as well as leverage peer support models.

Philanthropy

There are numerous foundations and funding collaboratives that focus on maternal health, child health, early childhood education, and nutrition security. Unfortunately, these funding streams often work in silos and with sector-specific goals and metrics.

Imagine a philanthropic landscape in which funding for programs, communications, and services serving those in the first 1000 days incorporate nutrition into their logic models. Expecting success in other outcomes will not be realized without investing in this basic and critical need. Leveraging funding collaboratives and pooled funds could serve as a catalyst to build consensus around shared priorities and outcomes that include developmental milestones, health, and nutrition security.

US Government Relations

The addition of pregnant and lactating women, as well as children aged 0 to 2 years, in the current *Dietary Guidelines for Americans* was a critical step to elevate the importance of nutrition for mothers and children in their 1000-day window in the US policy landscape.[10] Now, equal focus on ensuring implementation of those guidelines into programs and policies, including guaranteed access to federal programs such as WIC and the Child and Adult Care Food Program, requiring breastfeeding workplace supports, and advancing paid leave is needed. Increased surveillance of pregnant and nursing people and children aged 2 years and younger is also needed to make sure there are accurate data on nutritional intake and health status of these age groups.

Above all, work in this field must be centered by the voices in the communities we serve. We provide a platform for women the world over to tell their own stories, in their own words, and give them opportunities to take action on the issues they care about, like Darlene from Texas, who told us, "If it weren't for WIC, there would have been many days that I would not have been able to eat a meal when I was pregnant and breastfeeding."

Achieving nutrition security during the first 1000 days will ultimately require multisector collaboration, advocacy, and action to fully support families where they live, learn, work, play, and gather. We invite all to join us in prioritizing and realizing the opportunity presented by this *AJPH* supplement issue. AJPH

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The First 1000 Days—A Missed Opportunity for Pediatricians

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I remember sitting in front of my four-month-old patient and their family during my pediatric residency and being asked an important question: "Doctor, we want to make sure our child grows up healthy. How do we incorporate solid foods for our baby?" I did not know the answer. I asked for advice from my supervisors and was met with an uncomfortable silence. I realized at that moment that I had failed my patient, and, more importantly, the medical education system had failed to prepare pediatricians like me with the skills necessary to initiate meaningful infant feeding and nutrition guidance for young families during those first 1000 days (i.e., conception to two years). It is a missed opportunity when pediatricians do not receive the necessary education to inform and support families as they set the stage during the first 1000 days for improved nutritional status and healthy eating behaviors over the entire lifespan.[1] It is time for pediatricians to become a stronger voice in advocating changes to policy, curriculum, and cross-collaborative approaches that will advance healthy taste preferences and the dietary intake of infants and toddlers, no matter their culture or income.

MEDICAL SCHOOLS' NUTRITION EDUCATION

The lack of focus on nutrition-related medical education in the United States does a disservice to our children's health. I discovered that the gap in knowledge of child nutrition and infant feeding was common among my colleagues in medical schools and residencies across the country. Graduating medical students report having insufficient nutrition knowledge to support the nutritional needs of patients.[2] In the 1980s, a groundbreaking seminal report recommended a minimum of 25 hours of nutrition education in medical student preclinical years.[3] In 1997, the National Institutes of Health established the Nutrition Academic Award program, ultimately creating a set of comprehensive objectives that continue to guide many curricula around the country.[4,5]

By 2015, 71% of medical schools provided less than the recommended 25 hours, and 36% provided less than half of those hours.[6] As physicians, we recognize that nutrition-related chronic diseases play a key role in affecting the psychological, economic, and physical health of our families and, ultimately, our nation. Poor diets are a leading contributor to worsening morbidity and mortality and are linked to $50 billion in US health care costs.[7] We also recognize that most of our evidence-based national and professional recommendations addressing nutrition-related chronic diseases focus on changes in lifestyle and, more importantly, food and nutrition as fundamental first-line interventions. However, it remains true to this day that medical students across the United States learn the intricacies of biochemistry, metabolism, and macronutrients but lack pragmatic translational science training to counsel patients about food and the impact it has on their health.[6]

Advocating policy changes to enhance nutrition education is necessary for motivating institutions and accreditation bodies to assess and improve training for medical students, residents, and fellows. Most recently, a bipartisan resolution authored by Congressman James McGovern and Congressman Michael Burgess was passed by the House on May 17, 2022. The resolution calls for "substantive training in nutrition and diet sufficient for physicians and health professionals to meaningfully incorporate nutrition interventions and dietary referrals into medical practice" (https://bit.ly/3IVyVsZ). Policy changes, such as the McGovern resolution, are a welcome step toward driving systemic and institutional changes that will ultimately influence the most marginalized patients and families.

EQUIPPING 21ST CENTURY PHYSICIANS

Modern teaching strategies often use experiential learning models. This activity-oriented technique may include small group, case-based, and problem-based learning modules. Institutions may

consider these engaging approaches to enhance trainee education. At the Culinary Medicine Program of the George Washington University School of Medicine & Health Sciences, we are using the Culinary Medicine Specialist Board's Health Meets Food curriculum to prepare 21st-century physicians to enter the workforce ready to help families meet their nutritional needs.[8] The student classroom is their kitchen, and their lessons revolve around purchasing, chopping, cooking, and counseling to engage families with cultural humility.[9]

In addition, we are beginning to train faculty as well as those in residency and fellowship programs, allowing us the opportunity to tailor our education to specific specialties. A focus on the first 1000 days of life in culinary medicine offers many entry points and includes strategies to enhance complementary feeding, allergy prevention, and even working with families to identify feeding disorders and implement techniques to expand taste preferences. These policy, curricular, and clinical levers are critical to addressing the gaps in nutrition education, yet by themselves are incomplete. Medical nutrition must be taught in the context of social determinants of health, especially food (i.e., food quantity) and nutrition (i.e., food quality and equity) security.

According to the US Department of Agriculture, one in seven households with children experiences food insecurity. This has tangible effects on the purchasing power, food selection, and overall health outcomes of families and children. To effectively engage families with children in the first 1000 days of children's lives, the 21st-century pediatrician must gain effective counseling strategies that recognize barriers to healthy eating, such as food insecurity, by screening to identify its role and connecting families with meaningful and sustainable resources.[10]

NUTRITION DESERVES A CHANCE

Nutrition deserves a chance throughout the life course of families and in every aspect of medicine. The data are clear that the first 1000 days of a child's life are too important to be treated as "forgotten years." These early years provide a unique window of opportunity to cultivate healthy long-term taste preferences and dietary patterns that affect future disease risk.[11] For example, it is clear that early and frequent exposure to vegetables during infancy can play a role in the long-term receptivity of their unique flavors.[12,13] Findings like these highlight the opportunities that exist at an early age. Informative texts such as the American Academy of Pediatrics' *Pediatric Nutrition* handbook must be incorporated as core material in pediatric residency training programs.[14]

Pediatricians will not replace dietitians, but they must become more informed and provide tailored nutrition guidance. Infant feeding and nutrition are multidisciplinary, and practicing pediatricians can enhance clinical care by tapping into interprofessional and cross-collaborative approaches, such as joint trainings that enhance meaningful referrals to necessary clinical and community partners.

PEDIATRICIANS MUST ADVOCATE CHANGE

One pediatrician champion working in a clinic is not enough to create a paradigm shift. This shift requires a collective effort that activates pediatricians to work in cross-sector collaboratives to influence change alongside industry, researchers, and even early childhood educators. It requires pediatricians to use their voices to support local policy that shifts the food landscape, supports national policy that enhances nutrition security for our families, and transforms medical education for current and future providers.

I now see my work alongside community partners, patients, and families as part of a collective effort in the first 1000 days of life. Pediatricians can become a trusted source of information while appreciating the rich cultural diversity of feeding practices in our settings. Our families hear and respect our voice, and it is time to use that voice for a coordinated, impactful, grounded, and evidenced-based message as we work with families toward improved health. AJPH

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Opportunities to Strengthen Women's Nutrition Within Maternal Health Service Delivery: Reflections From Global Health Implementation

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The World Health Organization (WHO) set an Ending Preventable Maternal Mortality target, embodied in Sustainable Development Goal 3, to "reduce global maternal mortality ratio (MMR) to less than 70 per 100 000 live births by 2030" (https://bit.ly/3DneAvO). Yet, the United States is woefully lagging behind, as one of two countries to report a substantial increase in MMR. In the United States, pregnancy-related deaths have doubled in the past two decades from 9.8 to 17.4 women per 100 000 deaths.

MATERNAL NUTRITION IS CENTRAL TO MATERNAL HEALTH

The 2021 Global Nutrition Report reveals that the prevalence of anemia among American pregnant women is 36.5%, and low birth weight affects nearly 15% of newborns. Furthermore, a 2021 March of Dimes report revealed the sobering realities of the US maternal health crises with a rise in preterm births, insufficient access to quality maternal health services, and inadequacies in prenatal care, especially experienced by communities of color.

The quest to prevent maternal mortality merits renewed thinking in our efforts to address women's nutrition in light of obesity- and nutrition-related diseases, such as hypertension and heart disease, which underlie much of maternal death in the United States. Optimal maternal nutrition is the cornerstone of maternal and child health, especially in averting adverse birth outcomes (i.e., low birth weight, preterm birth), which have not shown appreciable improvement over the years. Importantly, certain women-centered nutrition interventions have been rolled out in the United States with some success. For example, the United States Special Supplemental Nutrition Program for Women, Infants, and Children evaluated the provision of a nutrition package during pregnancy, which demonstrated modest improvements in dietary quality among recipients (i.e., increased fruit and whole grain intake, decreased fat intake) versus non-recipients.[1] This editorial reflects on four considerations for improving women's nutrition across the continuum of care (pregnancy, childbirth, and the postnatal period), described in the subsections below, that should be central to the US maternal health agenda moving forward. Experiences from the global health community provide evolving understanding of gaps and lessons learned from implementation of maternal nutrition interventions and can lend insight into ensuring quality provision of well-woman health services in the United States as delineated in the Affordable Care Act.

Better Integrate Nutrition in Medical Education

A recent systematic review illuminated gaps in nutrition medical education and skillsets in nutrition knowledge and counseling.[2] Only 29% of US medical school graduates reported receipt of sufficient nutrition training; yet, basic skills widely varied, and some did not feel their role was to discuss issues of weight with patients (i.e., overweight).[3,4] A low percentage (12%) were aware of dietary reference intakes and recommendations on protein, fat, and carbohydrates.[5]

Moreover, data show that both students and medical faculty described students' lack of preparation and comfort level to provide nutrition advice.[4] Patient-centered counseling skills, as well as the role of weight in well-being and morbidities, were described as an identified gap in medical curricula.[4] To meet these gaps in medical education and provider knowledge, alternative models of training health providers

may be considered. In Guatemala, the *Diplomado*, a maternal and child nutrition course, provided preservice and in-service training to frontline health workers (i.e., physicians, auxiliary nurses, health educators) to improve knowledge and capacities for provision of quality maternal health services (i.e., counseling on dietary diversity, weight gain during pregnancy, micronutrient supplementation during pregnancy, physical activity, and breastfeeding).[6] Since 2015, the *Diplomado* course has largely been implemented through local universities and has trained 1855 health professionals and 194 facilitators in western Guatemala.[6] For the US context, important considerations for adaptation are (1) the course was provided free of charge, (2) health providers were incentivized through the receipt of 25 continuing medical education credits, and (3) the hybrid model of online coursework combined with in-person, peer-to-peer exchange onsite at health clinics improved health providers' knowledge of maternal and child health service delivery.[7]

Strengthen Routine Maternal Nutrition Counseling

Recent data show that 10%–43% of US pregnant women have inadequate dietary intakes of essential nutrients, such as vitamins A, D, and E, iron, folate, and calcium, required to support healthy pregnancy and fetal growth and development.[7] US women's suboptimal diets are likely exacerbated by a food system centered on processed unhealthy foods and beverages, which lack important nutrients to support optimal maternal health and well-being. Moreover, a few studies showed that provider advice on diet, weight gain, and physical activity during pregnancy was often perceived as vague or too generalized by women themselves.[8] Similarly, in other country contexts across Africa, Asia, Latin America, and the Middle East, there is often little to no provision of maternal dietary counseling during routine health contacts at health facilities.[9] Health professionals in the United States and globally who have a thorough understanding of WHO Antenatal (ANC) Guidelines and Quality of Care Standards, which provide evidence-based guidance for health service delivery regarding maternal and infant health and nutrition interventions, can aid in setting standards for the quality delivery of maternal health services. Building the capacity of nurses, midwives, and physicians to apply this evidence-informed guidance through the lens of cultural and social norms and racial, ethnic, and socioeconomic inequities while addressing any sources of misinformation (i.e., social media outlets, Internet searches) can aid in shaping women's food choices, preferences, and related dietary behaviors (i.e., physical activity). Country experiences from the Democratic Republic of Congo, Egypt, Kenya, Mozambique, and Tanzania, funded by the United States Agency for International Development (USAID), has shown that conducting formative assessments and subsequent use of these data can aid in operationalizing global guidance to specific contexts and developing culturally relevant counseling approaches and messages to address beliefs and misperceptions about dietary diversity, weight gain, or micronutrient supplementation during pregnancy and diet during breastfeeding.[10] These examples can be drawn upon in designing and implementing United States-based public and private initiatives aiming to improve health service delivery through clinical care settings, health professional associations, and behavior change approaches. Furthermore, it is of critical importance that such initiatives are tailored to US Black, Indigenous, and people of color communities (i.e., African, Asian, Latinx, Middle Eastern, and Native American ethnic groups) that may not have been exposed to or had access to action-oriented, culturally resonant nutrition advice.

Ensure Quality Counseling on Pregnancy Weight Gain

A global review noted little knowledge of and counseling on weight gain during pregnancy from women's and health providers' perspectives in Egypt and Nigeria.[9] Some women were not weighed or monitored for weight gain or loss and expressed confusion about the amount of weight to gain during pregnancy. Although most countries and regions do not have context-generated guidance on weight gain during pregnancy, the WHO ANC guidelines reference the US Institute of Medicine (IOM)-developed weight gain classifications (i.e., underweight, normal weight, overweight, obese) as current guidance. Yet, some data indicate that US health providers tend to target advice to overweight and obese pregnant women rather than provide counseling as a standard part of routine health care for all pregnant women, as indicated in the IOM guidance.[11,12] Another study noted that women in the United States were less likely to have correct knowledge of gestational weight gain recommendations if they were obese before becoming pregnant, Black, and socioeconomically disadvantaged.[13] With this in mind, health professionals should be equipped during routine health visits to discuss the topics of how much total weight to gain, why, and progress achieved in

relation to prepregnancy body mass index, dietary intake, and physical activity during ANC.

Engage Women and Their Communities

Finally, use of multiple platforms, such as women's groups and participatory strategies, are additional ways to meaningfully engage women and their peers to provide the motivation and social support to improve women's dietary diversity and breastfeeding practices, as has been demonstrated in South Asia. In Bangladesh, a mixed model that included counseling by both health facility workers and community volunteers, alongside active engagement with key influencers (i.e., fathers), improved maternal, infant, and young child nutrition outcomes.[14] In the United States, community doula programs have provided support across the continuum of antenatal care, childbirth, and postpartum care, fostered linkages with local champions at partner hospitals for comprehensive childbirth support for people of color, and provided peer-to-peer doula mentorship. In the future, building upon successful, community-based and multifaceted approaches may aid in improving women's nutrition outcomes.[15]

CONCLUSIONS

In sum, these reflections for improving health provider capacity and the implementation of maternal nutrition interventions from various countries may renew thinking and spur action to better strengthen delivery of women's nutrition-health services in the United States. AJPH

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Focusing on Maternal Nutrition to Improve the Health and Well-Being of Pregnant Women in the United States

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Women's health, nutrition, and well-being across the continuum of preconception, pregnancy, and postpartum are critical for ensuring positive pregnancy outcomes and long-term outcomes for both mothers and their offspring.[1,2]

CURRENT STATE AND IMPORTANCE OF MATERNAL NUTRITION

Poor maternal nutrition remains a critical public health problem globally, including the United States. The global prevalence of maternal underweight and short stature were 14.2% and 9.7%, respectively, in 2015, and nearly half were still anemic. Although we have made significant progress in reducing maternal underweight, there is considerable inequality by region, combined with little to no progress for the other indicators, such as anemia, and increases in overweight and obesity.[1,3]

Studies have shown that routine prenatal iron-folate supplementation is effective in reducing anemia and improving birth outcomes, but several other micronutrient deficiencies (vitamins A, D, B_1, B_2, B_6, B_{12}, and zinc) are common, especially during pregnancy and lactation, when requirements are increased,[1,4] and factors such as climate change, the COVID-19 pandemic, and conflicts are expected to worsen the availability of and access to quality food across the globe by 2030.[5] Although the prevalence of anemia during pregnancy is much lower in the United States than in other parts of the world, 1 in 10 pregnant women who participated in the Special Supplemental Nutrition Program for Women, Infants, and Children were anemic, and these rates were much higher in selected subgroups and also increased from 2008 to 2018 in some states.[6] Poor diet quality and inadequate intakes of key nutrients such as *n*-3 fatty acids, iodine, and iron are also common in the United States.[7,8] Data from the National Health and Nutrition Examination Surveys show that more than 95% of women of reproductive age, including pregnant women, do not meet the recommended intake of at least 250 milligram (mg) of the long chain *n*-3 fatty acids, docosahexaenoic acid, and eicosapentaenoic acid, and iodine status is also suboptimal during pregnancy.[8,9]

Finally, a major concern is the increased consumption of ultra-processed foods and reduced physical activity that have contributed to dramatic increases in obesity and overweight across the life course in the past three decades.[10] Maternal obesity is a major risk factor for adverse pregnancy outcomes, including gestational diabetes, hypertension, preeclampsia, cesarean delivery, preterm delivery, large size for gestational age, and infant death, and recent data from the National Vital Statistics System show that prepregnancy obesity (body mass index >30 kg/m^2) increased from 26.1% in 2016 to 29% in 2019 in the United States across all age, education, and race/ethnicity groups.[10,11] Furthermore, women who are overweight or obese may also experience increased difficulties in breastfeeding their infants.[12]

CAUSES OF MATERNAL MALNUTRITION

The causes of maternal malnutrition are complex and multifactorial. Similar to child undernutrition, the distal causes, namely the underlying social, economic, and political context and the lack of capital (financial, human, physical, social, and natural), may affect maternal nutritional status either directly or indirectly through more proximal factors, including access to health services, water, and sanitation, women's status, and food insecurity.[2] Of particular note is the role of women's status, including access to education, early age at marriage or unplanned pregnancies, maternal empowerment, and gender equality. Although women have more rights in countries such as the United States, disparities remain for many of the above indicators. Similarly, food insecurity may

also affect women disproportionately in many settings, including the United States, and can be influenced by food affordability, availability, and distribution of food between household members. Finally, even in developed countries such as the United States, access to quality health care (both preventive and treatment of high-risk conditions) and healthy food, especially for pregnant and lactating women, remains a challenge in many communities that face a range of disparities. Collectively, these factors influence the health and nutritional status of women (inadequate dietary intake, care for women, and disease) both before and during pregnancy.

PRIORITY AREAS AND KNOWLEDGE GAPS

Despite progress resulting from improvements in living conditions and women's status, there remain several important priority areas and knowledge gaps for improving women's nutrition (Box 1). Although there is a strong evidence base for maternal nutrition interventions, most of them focus on pregnancy, which is a very narrow yet important window of opportunity. For example, several systematic reviews provide evidence supporting the provision of prenatal iron-folate supplementation to improve birth outcomes, but studies evaluating preconception interventions are still limited, with the exception of preconceptional folic acid.[2,3] The success story of folate fortification is an excellent example of public–private partnership that has significantly reduced the burden of preventable neural tube defects and congenital anomalies in the United States and several other countries globally by reaching women during the critical period when they do not know that they are pregnant. Mandatory fortification of cereal grain products went into effect in January 1998 in the United States, and studies show that that the number of neural tube defects, such as spina bifida, have dropped by 25%.[13] Similar efforts are needed to find ways to ensure that women enter pregnancy in optimal health and with good nutrition. Another major gap is the paucity of representative data, even in the United States, on nutrient intakes and status, especially among pregnant and lactating women, which are needed to track trends and target appropriate interventions.

Although the United States has one of the lowest infant mortality rates, declining steadily from the 1990s to an all-time low of 5.6 deaths per 1000 births in 2019, pregnancy-related deaths and serious complications for mothers have increased during the past 30 years, with significant disparities by race/ethnicity and region.[14] There is no doubt that obesity and related chronic diseases, such as high blood pressure, diabetes, and heart disease, are important risk factors that need to be addressed even before women conceive and continue beyond delivery by including provision of comprehensive care referrals postpartum to step up the next pregnancy for success. Although there is convincing evidence about the benefits of lifestyle interventions that include nutrition education and promotion of physical activity to reduce the burden of noncommunicable diseases such as diabetes and cardiovascular disease, most of these studies have focused on high-risk individuals or older adults,[15,16] and there is an urgent need to test and integrate effective interventions for women during the reproductive years.

BOX 1— Priority Areas for Improving Women's Nutrition

- Increased focus on women's nutrition across the continuum of preconception, pregnancy, and postpartum
- Greater focus on implementation science and equity to decrease disparities in women's health and nutritional status
- Implementation of strategies that address the dual burden of malnutrition, especially overnutrition and micronutrient malnutrition
- Innovations to strengthen health systems and ensure timely access to quality care for women

FUTURE DIRECTIONS

The next frontier requires a greater focus on implementation science and equity to decrease disparities in women's health and nutritional status and use a life-cycle approach that begins in early childhood through the school-age years and early adulthood. Globally, efforts are underway to improve the health and nutritional status of adolescent girls and to find ways to encourage health checkups for women before they become pregnant. Strategies that address the dual burden of malnutrition that includes both under- and overnutrition and micronutrient malnutrition are urgently needed and should include approaches that focus on the food environment and promote healthy lifestyles that address both diet quality and quantity and physical activity.

Last but not least, interventions are needed to strengthen health systems that will ensure timely access to quality antenatal and postpartum care, combined with targeted interventions for high-risk groups and innovative strategies that prioritize preconception nutrition and access to health and family planning resources. Finding effective

ways to increase access to routine annual health checkups that include the identification of risk factors such as overweight and obesity, prediabetes, hypertension, and anemia, which could result in complicated pregnancies followed by quality postpartum care, are urgently needed.

In conclusion, although there is a need to continue to support current efforts to ensure timely and early access to quality antenatal and postpartum care for all pregnant and lactating women, an increased focus on women's health and nutrition with a commitment to improve preconception care is needed to improve the health and well-being of current and future generations. AJPH

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What Will It Take to Improve Breastfeeding Outcomes in the United States Without Leaving Anyone Behind?

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Supporting breastfeeding is one of the most cost-effective interventions that countries, including the United States, can make to improve maternal and child health outcomes. This commentary addresses why it is crucial for the United States to invest more in breastfeeding support ensuring that the needs and wants of people of color and other socio-economically disadvantaged groups are met.

IMPORTANCE OF BREASTFEEDING

Breastfeeding should be prioritized as a key component of a healthy food and nutrition system that is essential for advancing food security and nutrition, public health, and economic development in all countries. This is because, regardless of the level of socioeconomic development of nations, breastfeeding offers numerous well-documented health benefits to infants and children, such as reduced neonatal mortality, incidence of infectious diseases and childhood obesity risk, and improved cognitive development. Furthermore, it reduces the risk of major noncommunicable diseases among women, including breast and ovarian cancer, hypertension, cardiovascular disease, and type 2 diabetes.

BREASTFEEDING INEQUITIES

A recent international comparison of large-scale breastfeeding programs shows that even though breastfeeding promotion and support programs have been implemented and breastfeeding outcomes continue to improve in the United States, there is still a lot of room for improvement.[1] According to the Centers for Disease Control and Prevention (CDC), in the United States, between 2008 and 2018, the proportion of women who were choosing to initiate breastfeeding increased from 74.6% to 83.9%, exclusive breastfeeding through 6 months increased from 14.6% to 25.8%, and the prevalence of breastfeeding at 12 months increased from 23.4% to 35.4%. Furthermore, there are strong breastfeeding inequities experienced by women of color and women of lower socioeconomic status largely driven by socioeconomic and ethnic/racial inequities in breastfeeding in the country. In the United States, almost 60% of women do not breastfeed for as long as they would like, and women of color are much less likely to meet their breastfeeding goals. Indeed, among women enrolled in the Supplemental Nutrition Program for Women Infants and Children (WIC), Black and Hispanic women are much less likely than their White counterparts to meet their breastfeeding goals.[2] As recently seen in the United States, women who rely on formula may be subject to the added stress from formula shortages, whether they are a result of formula recalls or supply chain issues in the context of an oligopoly-like structure of the infant formula industry, and this crisis has affected women of color much more than White women. Why these inequities exist and what can be done to address them are the focus of this editorial.

BARRIERS FOR IMPROVING BREASTFEEDING

Breastfeeding outcomes can be improved by addressing breastfeeding protection, promotion, and support through intersectoral multicomponent policies and programs that operate across layers of the social-ecological model.[3] When it comes to breastfeeding protection, women and families need access to paid maternity and paternal leave for a reasonable amount of time and workplace breastfeeding accommodations. Furthermore, parents, other caregivers, and families need to be protected against exploitative marketing

practices from the breast milk substitutes (BMS) industry.[4,5] Unfortunately, the United States remains the only high-income country without a federal mandate for paid maternity leave; as a result, many women return to work very soon after giving birth, especially lower-income women and women of color. Furthermore, women of color and those of lower socioeconomic status are more likely to be employed in part-time positions in service sector jobs that do not make accommodations for pumping or breast milk storage, another structural barrier that undermines breastfeeding equity.

In addition, the United States is the only country that voted against the 1981 World Health Organization (WHO) Code for Marketing of Breastmilk Substitutes, and there is evidence that BMS companies specifically target commercial milk formula marketing to families of color with infants and young children. This ubiquitous marketing is delivered via traditional and social media, product placement in stores, and even through health care providers. It often targets women because they are pregnant and in the early postpartum period, when they can be quite psychoemotionally vulnerable, strongly undermining the confidence that women have in their ability to breastfeed.[4,5] Marketing efforts also include touting health benefits of BMS that are not supported by scientific evidence. In addition, marketing of toddler milks that are totally unnecessary, expensive, and rich in added sugars is particularly concerning, because regular cow's milk is recommended for the vast majority of 12–24-month-old children.[6] There is also strong evidence that US corporations, including the BMS industry and manufacturers of other ultraprocessed foods, alcoholic beverages, biotechnology, pharmaceuticals, chemicals, plastics, and electronic gaming are engaged together in well-organized lobbying efforts to undermine the WHO regulation proposals, including those designed to restrict BMS marketing,[4,7] thus negatively affecting breastfeeding and other public health outcomes globally.

Regarding promotion, the global experience indicates that behavior change social marketing campaigns are effective at improving breastfeeding behaviors.[1] However, on the one hand, previous attempts by the United States government have not yielded expected results, because they have been marred by controversy regarding the decision of the government to avoid discussion of the risks of not breastfeeding in campaign messaging.[8] On the other hand, the WIC Loving Support Campaign has lacked the resources and depth needed to have a stronger impact on breastfeeding outcomes.[9] One of the biggest challenges has been that even though WIC personnel are strongly supportive of breastfeeding, funding for meeting the breastfeeding counseling demand is quite limited in the context that WIC is the largest distributor of free infant formula in the world. Hence, it is not surprising that WIC participants have the lowest breastfeeding rates in the United States, even when compared against their low-income counterparts not enrolled in the program. This represents a major concern of inequity because WIC serves low-income families and ethnic/racial groups that have historically been discriminated against and are overrepresented in the program that serves more than half of the births every year in the United States. In essence, WIC is a program that strongly endorses breastfeeding while providing easy access to free infant formula in an environment where families are being bombarded with quite aggressive and predatory marketing.[4–6] Marketing strategies include targeting women and families during pregnancy and the very early postpartum period, which is quite concerning because it has been established that early introduction of infant formula is a strong risk factor for the premature termination of breastfeeding.[10]

ENABLING THE BREASTFEEDING ENVIRONMENT

All women should have access to qualified breastfeeding counseling and support beginning in pregnancy and continuing throughout the perinatal and postnatal periods. The Baby Friendly Hospital Initiative Ten Steps are effective at improving breastfeeding outcomes[3]; thus, it is encouraging that, according to the CDC, the proportion of babies born in Baby Friendly Hospitals in the United States has increased from 4.5% in 2011 to 28.9% in 2021, and this initiative has been shown to improve breastfeeding outcomes across groups while reducing inequities.[3] To ensure the continuum of breastfeeding care quality, breastfeeding support should be delivered through maternity facilities in partnership with community-based organizations following community-engaged approaches that are culturally sensitive and respect the dignity of all clients. Women of color in the United States often feel that providers do not listen to them or feel disrespected when trying to talk about infant feeding

choices.[11,12] Similar sentiments have been expressed by low-income rural White women in the United States (Seiger et al., p. S797). There is evidence that, among women of color, stereotyping, discrimination, and structural racism may play a role in the lack of attention that providers pay to their breastfeeding intentions and needs.[11,12] Furthermore, there is a lack of ethnic/racial diversity among providers they have contact with, and the great majority have not received antiracism and trauma-informed care preservice or in-service education and training.

Black women in the United States have a much higher risk than White women of delivering premature newborns. They need to benefit much more from the knowhow on how to effectively feed these newborns with their own breast milk or with donor milk obtained through certified human milk banks. Breastfeeding reduces the risk of necrotizing enterocolitis, which is a major cause of mortality among premature babies and fosters, and this is key for the cognitive development of infants born prematurely.

MOVING FORWARD

Given the need to further improve breastfeeding outcomes in the United States while reducing ethnic/racial inequities and protecting women from predatory marketing practices of formula producers, ensuring infants' food security and good nutrition, it is crucial for the US government to lead and invest much more in enabling large-scale sustainable multicomponent and multilevel programs through specific actions of a comprehensive and inclusive agenda (Box 1).

BOX 1— Governmental Actions Recommended for Improving Breastfeeding Outcomes and Reducing Racial/Ethnic Inequities in the United States

Breastfeeding protection
• Pass legislation to mandate paid maternity leave for at least 14 weeks (ideally 18 weeks) as recommended by the International Labor Organization. Also consider providing paternal leave for the first weeks after birth.
• Establish a task force to determine how the FDA and other agencies can regulate the unchecked marketing of infant formula and other commercial milk formula products.
• Conduct a consensus study through a neutral authoritative body to understand how to improve breastfeeding outcomes among WIC participants, given that while supporting breastfeeding it distributes massive amounts of free infant formula.
Breastfeeding promotion and support
• Launch a behavior change communications campaign co-designed with communities of color to call for all of society to support breastfeeding women and to make breastfeeding across settings (including in public) the social norm.
• Incentivize permanent reimbursements from government and private insurance for breastfeeding counseling services provided by community health workers or peer counselors to maternity facilities and community organizations.
• Form a task force to make recommendations on how schools of medicine, nursing, and allied health professions can substantially strengthen their breastfeeding education and training curricula, including antiracism and trauma-informed care content.
• Improve funds for research and expansion of certified human milk bank services in the United States.
• Design a public health emergency preparedness plan to support breastfeeding during public health emergencies such as the COVID-19 pandemic. The risks of not breastfeeding for the baby under emergency conditions should be clearly communicated to the public.
Monitoring and evaluation
• Enhance breastfeeding data collection through national food and nutrition monitoring systems, including BRFSS and NHANES, paying special attention to having representative samples from women of color. The capacity to collect data on infant feeding outcomes among premature infants should also be enhanced.
• Increase funding for large-scale multicomponent and multilevel breastfeeding programs implementation research through PCORI and federal agencies such as NIH, CDC, and USDA.

Note. BRFSS = Behavioral Risk Factors Surveillance System; CDC = Centers for Disease Control and Prevention; FDA = United States Food and Drug Administration; NHANES = National Health and Nutrition Examination Survey; NIH = National Institutes of Health; PCORI = Patient-Centered Outcomes Research Institute; USDA = United States Department of Agriculture; WIC = Supplemental Nutrition Program for Women Infants and Children.

Although it is encouraging that, under the leadership of the CDC and other federal agencies, the United States continues to make strides in improving breastfeeding outcomes, further improvements and reduction in inequities will require strong, proactive leadership from the US government. This will require addressing persistently powerful structural barriers embedded in our market-driven political and economic systems that prioritize profits over public health. The recent second White House Conference on Hunger, Nutrition, and Health is providing the United States with a once-in-a-lifetime opportunity to ensure that, as a society, we make the case that breastfeeding should be a national priority as one of the key elements for improving food systems, public health, and early childhood development. We need to support the right that women have to breastfeed their children for as long as

they want to or as long as it is recommended. Let's take this opportunity to contribute to improve health, as well as food and nutrition security, for all. Personalized nutrition for optimal health begins with breastfeeding! AJPH

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To Protect Young Children's Health, Limit Marketing and Ubiquity of Unhealthy Foods and Beverages

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Children need nutritious food to thrive and grow up healthy. Equally important, unhealthy products high in added sugars, saturated fats, and sodium have no place in a healthy diet. Parents need to be able to identify, find, and purchase healthy foods for their children and avoid unhealthy products. Yet parents, especially those with low incomes or living in marginalized communities, are exposed to unhealthy food environments that make providing healthy foods for their families difficult. Unhealthy food environments are created by a food industry whose primary goal is maximizing profits and shareholder returns, not promoting diet quality and health. To increase revenues and market share, food and beverage corporations create, promote, and sell far too many unhealthy, ultraprocessed products. Over the past two decades, the availability and consumption of these foods has increased dramatically. Ultraprocessed foods account for two thirds of total energy consumption among US children aged two to 19 years.[1] Children's consumption of ultraprocessed food is associated with weight gain, other measures of adiposity, and potentially additional cardiometabolic risks.[2]

Sugar-sweetened beverages (SSBs) are a prominent ultraprocessed food. They are ubiquitous, heavily marketed, and inexpensive. Because they are made from low-cost ingredients, they generate healthy profits. Yet SSBs are unhealthy for the children who consume them, increasing their risk of diabetes, heart disease, poor oral health, and overweight over the life course.[3] Early life exposure to added sugars leads to taste preference for sweets, driving future excessive consumption. Some manufacturers have replaced added sugars with low-calorie sweeteners, yet their long-term safety for children is unknown and they maintain habit-forming product sweetness. Fruit drinks, the most commonly consumed SSB among toddlers, are a top source of added sugars.[4]

Toddler milks, another product with added sugars, are marketed as milk substitutes that offer health, immune system, and developmental benefits to toddlers, although evidence supporting these benefits is lacking. They contain more sugar and less protein and calcium than whole cow's milk. The American Academy of Pediatrics notes that they are "unnecessary and potentially harmful to young children" and recommends avoiding them (https://bit.ly/3AwG7ce). Industry began producing and aggressively marketing toddler milks as women increasingly turned to breastfeeding to nourish their children and sales of infant formula declined.

Leading health organizations recommend that beverages consumed by children aged birth to two years have no added sugars (https://bit.ly/3y1lvr1). Preferred beverages are water and plain milk. However, by age two years, a third of children consume a SSB on a given day and a quarter consume fruit drinks.[5] Among children aged 12 to 24 months who drink SSBs, consumption is about eight ounces per day. Disparities in consumption are concerning. Black children and children from low-income households consume more SSBs than do White and affluent children.[6] Toddler milk sales have grown in recent years, rising 2.6-fold between 2006 and 2015 and subsequently increasing more slowly.[7]

Manufacturers of cereals and other added sugar products also target children. For example, Kellogg's has aggressively marketed Baby Shark cereals to younger children; the product contains 15 grams of added sugar per serving, 60% of the American Heart Association's limit for children aged two years and older.

Why do sales and consumption of these unhealthy products persist? A major driver is aggressive and misleading marketing. A study of the exposure of parents of children younger than

18 years to advertising for fast foods and sugary beverages in five higher income nations found that the highest level of exposure is in the United States, with 80% of parents exposed to one or more advertising medium.[8] Spending on advertising for toddler milk grew fourfold between 2006 and 2015.[7] The pervasive promotion of unhealthy foods and beverages via mass media, digital platforms, social influencers, and billboards constitutes a form of predatory marketing that is a ripe target for policy action to improve children's diets.

Misleading and deceptive claims and imagery on advertising and packaging create confusion among parents about the healthfulness of fruit drinks and toddler milks. Fruit drink packages commonly feature images of fruit, make claims about nutrients (e.g., vitamin C, absence of sugar) and the presence of natural ingredients and "real" juice without disclosing actual juice content (often < 10%), and downplay the addition of low-calorie sweeteners.[9] Such claims lead parents to incorrectly believe that fruit drinks are healthy beverages. Toddler milks also feature nutrition and health claims (e.g., promotes brain development) unsupported by scientific evidence.[10]

Countermarketing media campaigns are one promising approach to addressing the marketing of unhealthy products, building on the experience of tobacco prevention and control efforts. Countermarketing has been defined as "communications strategies designed to reduce the consumption of unhealthy products by exposing the motives and denormalizing marketing activities initiated by the producers."[11(p120)]

In this issue of *AJPH*, Harris et al. (p. S807) describe an online study that tested the effectiveness of two short videos in changing attitudes, beliefs, and purchase intentions related to fruit drinks and toddler milks among a group of caregivers of children aged 9 to 36 months. The videos provided information to counteract misperceptions about the beverages by highlighting ingredients such as added sugars and low-calorie sweeteners, calling out misleading health claims, and offering healthy beverage choice recommendations from trusted messengers (e.g., pediatricians). The videos significantly reduced caregivers' intentions to serve both drinks, with a greater effect on toddler milks. They also reduced caregivers' positive attitudes about the beverages and about food and beverage companies. Study strengths included its randomized controlled trial design and the diversity of participants. Limitations included a primary outcome of purchase intent rather than actual or even simulated purchases and a post-intervention study design with no baseline measures. Unlike tobacco and other SSB countermarketing initiatives, these videos did not directly call out

BOX 1— A Bakers' Dozen of Policy Options to Reduce Promotion and Availability of Unhealthy Food to Children Younger Than 2 Years

1. Develop and enforce more stringent rules for restricting false and misleading advertising and health claims, including removal of unfounded structure/function claims and misleading imagery and inclusion of appropriate disclaimers to enable parents to make informed food choices.
2. Use the consumer protection power of state attorneys general to file lawsuits against false, deceptive, and misleading advertising of foods and beverages for consumption by children.
3. Ban "junk food" advertising online and on television before 9 p.m. following the lead of the United Kingdom.
4. Allow only advertisements for healthy products on public property, such as mass transit, schools and school buses, and other public venues.
5. Strengthen FDA labeling requirements to make food labels a more useful tool for parents by requiring: (1) nutrition or health warning front of package labels on products high in added sugars, saturated fats, and sodium; (2) front of package labels on fruit drinks that disclose percentage fruit juice, amount of added sugars, and presence of low-calorie sweeteners; and (3) front of package labels on toddler milks that disclose ingredients and amounts of added sugars and saturated fats.
6. Set stronger standards for formulation and marketing of toddler milks.
7. Mobilize child and health professional organizations to advocate for restrictions on predatory marketing to parents and children.
8. Enforce and further expand the Children's Online Privacy Protection Rule to limit digital and social media marketing to young children.
9. Expand the use of antitrust rules to reduce monopoly concentration in the food industry, thereby limiting resources for marketing and addressing lack of competition on price and quality.
10. Impose taxes on unhealthy products (including toddler milks, fruit drinks and other sugar-sweetened beverages) and dedicate revenues to promoting early childhood health and development.
11. Adopt healthy food retail policies that encourage the promotion of healthy products and restrict marketing and availability of unhealthy ones.
12. Eliminate federal corporate tax deduction for the marketing of unhealthy foods and beverages.
13. Encourage child health providers to educate parents about the importance of restricting unhealthy food consumption in first 1000 days of life and how to recognize marketing tactics that encourage unhealthy food choices.

industry behavior as deceptive or explicitly seek to diminish brand loyalty.

Although countermarketing may be a valuable part of a portfolio of strategies to reduce the impact of marketing unhealthy foods, it alone will not be sufficient. Implementing countermarketing on a scale that can compete with industry marketing will be challenging given the substantial resources required, although using social media channels may prove to be a low-cost, feasible option.[12] Fortunately, the implementation of a suite of policies, regulatory actions, and legal interventions that include countermarketing, taxation, and front-of-package warning labels could make a real difference in counteracting the marketing of unhealthy beverages to parents of younger children (Box 1). Together, these strategies could begin to denormalize the production, marketing, and sales of these products for children. Over time, these approaches could be extended to all ultraprocessed foods and to other populations. As shown by the tobacco control movement, these strategies could change the acceptability of predatory marketing and other harmful industry practices, creating a social climate more conducive to stronger public health protections.

We cannot tolerate a food system that encourages parents to supply their children with unhealthy foods and beverages. In a society committed to ensuring a healthy future for all of its children, food companies would not be able to urge parents to buy products for their children known to contribute to premature death, preventable illnesses, and lifetime health problems. We owe it to our children to protect them by adopting a comprehensive set of actions to reduce exposure to unhealthy foods and beverages. AJPH

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The USDA's Actions to Promote and Elevate Nutrition Security During the First 1000 Days

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In March 2022,[1] the secretary of agriculture Thomas Vilsack announced the US Department of Agriculture (USDA) Actions on Nutrition Security, which outlines our department's commitment to prioritizing bold nutrition security efforts that will help ensure all US children and families have consistent access to safe, healthy, affordable foods essential to optimal health and well-being.[2] Without question, poor nutrition is a leading cause of illness in the United States and is responsible for more than 600 000 deaths per year—a problem that is getting worse and disproportionately affecting historically underserved communities.[3,4] These disparities start early and are in part driven by structural barriers; for example, the breastfeeding rate among women of color continues to be significantly less than that of White women.[5] Often, racial disparities stem from structural racism in food access, education, housing, health care, and employment and have been exacerbated by the COVID-19 pandemic.[6]

We highlight how the USDA and hopefully all our allies in the field of public health can make a difference. USDA's nutrition security work builds on and complements our long-standing efforts to address food insecurity but is different. The concept of nutrition security—unlike food security—explicitly recognizes we are all not maintaining an active, healthy life given the increasing rise in the coexistence of food insecurity and diet-related chronic diseases, and it emphasizes a focus on equity, which is consistent with President Biden's goal to advance racial equity. Some examples of how the USDA is applying an equity lens to our nutrition security efforts include expanding online shopping options for participants in the Supplemental Nutrition Assistance Program (SNAP) and the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC); bridging language barriers to nutrition education resources and recipes; reaching underserved populations; and bringing together diverse partners to foster healthy food options.[1] Specific to supporting tribal sovereignty, the USDA is taking historic steps to promote traditional food ways, Indian Country food and agriculture markets, and Indigenous health through foods tailored to American Indian/Alaska Native dietary needs.

Ensuring nutrition security during the critical time from pregnancy through a child's second birthday is woven throughout our nutrition security approach, highlighting USDA's commitment to ensuring access to nutritional supports during this time.[1] Women who are pregnant or postpartum, infants, and toddlers require nutritional supports that can improve lifetime health.[7] The USDA supports these populations through several long-standing nutrition assistance programs administered by our Food and Nutrition Service, including improving and updating the WIC food package; strengthening the Child and Adult Care Food Program (CACFP)—a federal program that reaches more than 4.2 million children each day through participating child care centers; expanding the scope of the *Dietary Guidelines for Americans* (*DGA*) to focus on these critical life stages; reevaluating the Thrifty Food Plan, which serves as the basis for calculating SNAP benefits; and ensuring access to nutrition benefits in rural and remote areas.

With a whole-of-department approach, we are using all our resources for nutrition assistance, which totaled $163 billion in fiscal year (FY) 2022.[8] Our current and future responses are connected to the COVID-19 public health emergency and congressional authorities, which might end as the public health emergency–related waivers end. We are working with Congress and other stakeholders to help us transition out of the pandemic, recognizing the implications of waivers that might not be extended. We are also actively working to engage our MyPlate National Strategic Partners—which include large, national organizations such as health care organizations, media outlets, grocery retailers, health professional

associations, restaurant chains, and food manufacturers—on ways to promote and elevate nutrition security. In addition, we aim to enhance and build new partnerships across a variety of sectors, including antihunger, faith-based, health care, and public health.

Using our four pillars, our engagement strategy aims to build awareness of our relevant activities and identify ways to engage with the USDA or other complementary approaches: (1) providing meaningful nutrition support from pregnancy to birth and beyond; (2) connecting all Americans with healthy, safe, affordable food sources; (3) developing, translating, and enacting nutrition science through partnership; and (4) prioritizing equity every step of the way.

MEANINGFUL SUPPORT

The USDA's efforts include revising the WIC food package based on National Academies of Sciences, Engineering and Medicine recommendations[9] and the latest edition of the *DGA*,[10] which are the cornerstones of federal nutrition policy. WIC has become one of the most successful nutrition intervention policies for improving maternal and child health for those who are at nutrition risk (e.g., medically based risks such as anemia and diet-based risks such as inadequate dietary pattern) and living in or near poverty.[7] Through WIC, we also provide nutrition counseling and breastfeeding promotion; in FY 2021, we supported 1.4 million breastfeeding participants through 9000 WIC clinics across the country. As Congress directed in the 2018 Farm Bill (Pub L No. 115–334)—and with the express support of President Biden's January 22, 2021, executive order—we reevaluated the Thrifty Food Plan. Based on our reevaluation, SNAP benefits were increased by 21% or about $36.24 per person per month. The reevaluation resulted in the first permanent increase to the purchasing power of SNAP benefits since the Thrifty Food Plan was introduced 45 years ago. SNAP helps support more than 42 million Americans each month, nearly half of whom are children.[11]

HEALTHY FOODS

With congressional authority, we were able to expand access to and increase consumption of healthy food through the temporary increase in the WIC monthly cash value benefit, used to purchase fruits and vegetables, to $35 monthly for women and children for up to four months in the American Rescue Plan of 2021 (Pub L No. 117–2). The FY 2022 continuing resolution extended that increase, shifting the monthly amounts to $25 for children, $43 for pregnant and postpartum women, and $47 for fully and partially breastfeeding women, which are all substantially higher than the standard amount of $9 for children and $11 for women.

As part of the USDA's efforts to provide nutritionally balanced, low-cost or free meals to children each school day, the USDA has made significant strides in working with industry on providing lower sodium foods in school meals; these efforts have ripple effects for the CACFP. Research indicates that, following the recent changes to the CACFP meal pattern, children participating in the program consumed meals and snacks with higher nutritional quality and had higher intakes of vegetables, whole grains, and dairy.[12]

COLLABORATIVE ACTION

As directed by the 2014 Farm Bill (Pub L No. 113–79), we expanded *DGA* to include infants and toddlers (from birth to 2 years) and are offering additional guidance for women who are pregnant, beginning with the 2020–2025 edition. We also provide resources through our Team Nutrition program to help implement these recommendations across the federal nutrition safety net, for example, by equipping the CACFP operators with tools that make it easy to serve nutritious meals to children attending childcare centers and day care homes. We plan to continue a life stage focus in the 2025–2030 edition of the *DGA* and to continue to bolster our implementation of the *DGA* across the Food and Nutrition Service's programs. By translating the science from the *DGA*'s process using a life stage lens into our nutrition education and promotion resources like MyPlate.gov, which provides consumer-oriented messages based on the latest edition of the *DGA*, we can help families and those who support parents and children focus on the quality of what they eat. This may ultimately help reduce diet-related diseases, such as diabetes and heart disease, that disproportionately affect historically underserved communities.

EQUITABLE SYSTEMS

Prioritizing equity includes our efforts noted earlier to support tribal sovereignty through demonstration projects that empower tribal nations to select Indigenous foods for their Food Distribution on Indian Reservation Program food packages and to purchase directly from tribal producers. In addition, we are working to ensure that much needed nutrition benefits are available in rural and other hard-to-reach areas through Emergency Food Assistance Program Reach and Resiliency grants.

These grants will help build infrastructure to expand the Emergency Food Assistance Program's reach into remote, rural, tribal, and low-income areas the program currently underserves. These efforts are fundamental to supporting early interventions that promote healthy eating.

Another component of our equity focus is ensuring participation in our nutrition assistance programs because less than 6 out of 10 who are eligible for WIC are enrolled in the program (https://bit.ly/3wfLg6a).

And although participation is high among infants, it falls off as children get older. With a historic investment of $390 million from the American Rescue Plan Act of 2021 (Pub L No. 117–2), the USDA is working to improve WIC outreach, innovation, and modernization. This work includes improving the in-store shopping experience, creating easier program entry, and testing new technological solutions that improve and streamline the participant experience, such as improving the WIC certification or enrollment process. Going forward, we anticipate more insights from our new USDA Equity Commission, which is charged with evaluating our programs and services and providing recommendations on how we can reduce barriers to accessing them.

CONCLUSIONS

As we continue to ensure that the benefits from our federal nutrition assistance programs are meaningful, accessible, and equitable and to use every available resource to put healthy foods within reach of *all* Americans, we recognize that the USDA alone cannot improve nutrition security. To be successful, we need to effectively and efficiently engage and collaborate with external stakeholders to make progress and build back better. We hope you can join us! AJPH

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1000 Days of Good Nutrition: In the United States or Abroad, It Is About Equity, Evidence, and Leadership

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The first 1000 days, from pregnancy through a child's second birthday, is a critical window of opportunity for good nutrition for mothers and children. This concept was a highlight of the foundational 2008 series on Maternal and Child Undernutrition, which focused on low- and middle-income countries.[1] I applaud the same concept being applied in the United States. Domestic and global nutrition have often been perceived as dichotomous, but, as presented in the articles in this *AJPH* supplement, it is striking to see how similar the gaps, opportunities, and root cause of inequity are in both settings, as well as the need for evidence-informed leadership to drive change.

GLOBAL POTENTIAL TO SURVIVE AND THRIVE

When I started in public health nutrition four decades ago, child growth was assessed relative to the US National Center for Health Statistics references, and there was often conjecture regarding whether these were applicable globally. Landmark studies across the world have shown that growth patterns are similar when mothers', infants', and young children's nutritional and health needs are met.[2,3] In the United States and globally, inequity is the fundamental driver of our failure to enable all children to realize their potential.[4] A key 2021 series states, "Socioeconomic inequalities persist as a major distal determinant of undernutrition, as shown by between-country and within-country analyses."[5] Although average differences across countries are declining, "economic inequality has grown within many countries."[6] Evidence-informed leadership, in the United States and globally, is essential to secure nutrition equity and provide an environment where all children can achieve their potential.

Although the relative manifestation of malnutrition in terms of undernutrition, micronutrient deficiencies, and overweight and obesity may differ between the United States and other countries, there are key lessons to drive progress that are applicable everywhere.

FAILING TO DELIVER IN THE UNITED STATES AND ABROAD

Access to good health and nutrition services for mothers and children in the first 1000 days is essential but neglected. In this supplement, Hamner et al. (p. S817) and Jefferds et al. (p. S826) lay out key gaps in the United States. Globally, it is recognized that the peak incidence of stunting and wasting occurs in the first 6 months of life, in part already existing at birth, and that low birth weight prevalence has declined slowly.[4] In the United States, deficiencies of essential nutrients before conception and during pregnancy continue to pose a public health burden. These are stark reminders of how systems globally and in the United States fail to provide adequate nutrition to women during this critical period.

Breastfeeding is the optimal source of infant nutrition, and achieving nearly universal breastfeeding would avert more than 800 000 child deaths and 20 000 maternal deaths and would yield significant economic benefits. The 2016 breastfeeding series concluded that the world is still not providing a supportive and enabling environment for most women who want to breastfeed, despite known interventions, policies, and programs.[7] In the United States, the Maternity Practices in Infant Nutrition and Care Survey[8] and the Breastfeeding Report Card[9] are excellent examples of strengthening the continuum of care required to support breastfeeding, and they are contributing to improving breastfeeding practices.

Good nutrition in the first 1000 days requires both food and health systems to deliver nutritious food and nutrition services. However, in the United States and globally, both are failing. Worldwide,

only 29% of children aged 6–23 months benefit from minimum dietary diversity,[10] and stark socioeconomic disparities in children's quality of diet persist.[11] In 2020, almost 3.1 billion people worldwide, including 4.9 million in the United States, could not afford a healthy diet, 112 million more than in 2019.[12] Hamner et al. highlight gaps in the health system in the United States, and others have underscored the failure of health systems to deliver critical nutrition solutions in low- and middle-income countries.[4] These preexisting inequities and failure to deliver are being exacerbated by the COVID-19 pandemic, the climate crisis, and conflict, including the global food crisis driven by Russia's invasion of Ukraine.[12–15]

DESIGNING WITH DATA

To address inequities and buffer the most nutritionally vulnerable from shocks, social protection programs have an increasingly important role to play. However, to be effective, they need to be designed purposefully. Globally, there is an increasing body of evidence on key design elements that improve nutrition outcomes.[16,17] The accompanying editorial by Bleich and Dean (p. S773) provides important guidance for the United States.

To effectively respond to the continued global crisis of malnutrition, we need appropriate and timely data to drive priorities. However, in the United States and globally, major data gaps remain, most acutely for micronutrient status; quality and affordability of safe, diverse, and nutritious diets; and coverage of key nutrition services.[4] Hamner et al. and Jefferds et al. underscore data gaps in the United States. The Demographic and Health Surveys Program is an essential platform for nutrition data across low- and middle-income countries, and updates in 2019 are a step change in improving relevance, number, and quality of nutrition-related indicators.[18]

According to the 2021 Global Nutrition Report, we are off track to meet the World Health Assembly nutrition targets and all diet-related noncommunicable disease targets. The challenges to reach these targets, both in the United States and globally, can seem daunting. However, there is also a growing body of evidence from a number of countries showing that change is possible.[19–21] The recurring theme in these examples is that political leadership is necessary to drive progress. For example, research into Senegal's impressive reductions in stunting, a condition that had largely been invisible to decision-makers, link back to a major 2001 policy decision creating a Nutrition Coordinating Unit in the prime minister's office that drew in all relevant ministries and facilitated robust nutrition policies and programs.[22]

THE WAY FORWARD

We are at a critical crossroads for nutrition in the first 1000 days, both in the United States and around the world. However, there is reason for optimism, thanks to President Biden's announcement of domestic and global commitments at the United Nations Food Systems Summit; the US government's global financial and policy and domestic policy announcements at the Tokyo Nutrition for Growth Summit; the endorsement of the US Government Global Nutrition Coordination Plan by the US secretaries of state, agriculture, and health and human services, the United States Agency for International Development administrator, and chief executive officers of the Development Finance Corporation, Millennium Challenge Corporation, and Peace Corps; and the first White House Conference on Hunger, Nutrition, and Health in 50 years being organized in September this year.[23–26]

Our partners stand with us, as evidenced by the 66 partner governments, mainly from low- and middle-income countries, that made robust commitments at the Nutrition for Growth Summit and by the African Union adopting nutrition as the theme for 2022.[27,28] We know that all children everywhere have the potential to survive and thrive when provided adequate nutrition. Solutions are at hand at home and globally, and US leadership on nutrition for mothers and children in the first 1000 days is more important now than ever. AJPH

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Leveraging Federal, State, and Facility-Level Early Care and Education Systems and Providers Toward Optimal Child Nutrition in the First 1000 Days

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Early childhood is a critical period in the development, growth, and health of children. Many infants and toddlers in the United States spend time in nonparental early care and education (ECE) arrangements, which include care from child-care centers, family child-care homes, family members, and neighbors, or a combination of these providers. As of 2019, 14% of infants (0–12 months of age) and 27% of toddlers (1–2 years) participated in a center-based care arrangement; however, these statistics do not account for children cared for in family child-care homes, which are also an important source of care for this age group.[1]

Children spend much of their time in the care of ECE providers, with infants and toddlers who attend ECE centers spending an average of 32 hours per week there,[2] and it is recommended that children who attend an ECE program full time consume at least one half to two thirds of their daily calories at the program.[3] ECE settings are therefore critical nutrition contexts to consider when helping children establish lifelong healthy dietary behaviors.

Several scientific and expert consensus guidelines have helped advance our collective understanding of best practices when it comes to what and how to feed young children, including the *Dietary Guidelines for Americans*,[4] the Healthy Eating Research feeding guidelines for infants and toddlers,[5] and the Healthy Eating Research healthy beverage recommendations for young children.[6] Also, *Caring for Our Children (CFOC)*, created by the National Resource Center for Health and Safety in Child Care and Early Education, outlines standards for a multitude of topics in ECE settings including breastfeeding and nutrition.[7] Together, these guidelines help parents and caregivers understand important nutrition topics such as maintaining breastfeeding, providing opportunities for children to consume a diverse array of nutrient-dense foods, and engaging in feeding practices that allow children to communicate their hunger and fullness cues.

The ECE system in the United States is complex, layered, and decentralized, with providers connected to information and resources through sometimes overlapping federal, state, and local programs.[8] These can include federal and state programs and polices such as ECE subsidies, state licensing regulations, state quality improvement programs, and accrediting organizations. Over the past decade, with support from federal and state agencies, nongovernmental partners, and the research community, efforts have been undertaken and progress has been made to incorporate standards that support early child nutrition and feeding (ECNF) into national and state systems[9,10] and to support ECE providers in the use of best-practice ECNF guidelines. However, opportunities exist to strengthen these efforts.

This work takes place within the dynamic nature of the ECE sector. For example, permanent closures of ECE programs before the COVID-19 pandemic, with 97 000 licensed US family

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child-care homes closing between 2005 and 2017,[11] and temporary and permanent closures during the pandemic may have disproportionally affected the country's most vulnerable families and children.[12] ECE programs can provide strong nutritional environments for children; however, not all families who want ECE care can access it, and thus improving access to quality ECE care also merits attention and consideration. Finally, the pandemic brought to light many issues within the ECE system, and as such there has been renewed attention to supporting and strengthening this important setting.

Our objective here is to document strategies at the federal, state, and local levels to support ECE providers' use of ECNF best practices (Box 1). We also aim to highlight opportunities to monitor and study existing programs and policies as a means of better leveraging investments in and possibilities to codesign research and programs with ECE providers to further advance children's optimal nutrition during the first two years of life.

FEDERAL-LEVEL PROGRAMS AND POLICIES

Many federal agencies support early childhood efforts, including the Administration for Children and Families through important programs such as the Child Care and Development Fund (CCDF)[14] and the Head Start and Early Head Start programs. The CCDF is the primary federal program providing subsidies to help low-income families afford child care, supporting child development and contributing to family well-being. These federal programs are large; for example, the CCDF serves approximately 1.3 million children. However, this is about 15% of those who are eligible under federal law.[15]

Head Start and Early Head Start, which promote school readiness among children 5 years or younger from low-income families, served 1 047 000 children in that age group and pregnant women in 2018–2019, with approximately 25% of these children 0 to 2 years old.[16] On the basis of their funded enrollment, Head Start programs have the capacity to serve about 10% of infants and toddlers from families below the federal poverty threshold.[17]

BOX 1— Examples of Federal, State, and Program-Level Actions Supporting Early Childhood Nutrition and Feeding in ECE Settings and Opportunities to Strengthen Efforts

Level	Type of Action	Examples	Areas of Opportunity
Federal	Programmatic	CACFP CDC investments within the Spectrum of Opportunities for Obesity Prevention in ECE ACF investments such as the Child Care Development Fund and the Head Start Program	Understand reasons providers do not participate in federal programs such as CACFP and ways to address barriers to participating, which can be used to inform interventions to improve participation Create surveys and surveillance systems to better understand ECNF in ECE programs
	Standards/policies	CACFP meal pattern requirements Caring for Our Children	Improve understanding of uptake of federal and national guidelines, co-designed with providers and aggregated at the state level
State	Programmatic	TA networks Statewide Go NAPSACC	Train TA networks on ENCF and study models of diffusion Assess uptake of Go NAPSACC in different types of ECE settings and assess needs
	Standards/policies	State licensing regulations QRIS standards PD hours around early childhood nutrition (required or optional)	Continue to monitor and encourage uptake of ECNF practices in state licensing Develop ongoing QRIS monitoring plans Understand use of PD, how PD affects practices, and whether there are unmet PD needs
ECE program	Programmatic	Breastfeeding recognition programs Use of evidence-based interventions such as Go NAPSACC Support for ECE provider knowledge of ECNF best practices	Assess ongoing and new ECNF recognition programs Monitor and assess whether there is equitable use of Go NAPSACC according to ECE capacity, urbanicity, and other factors Co-design interventions to support ECE providers' knowledge and use of ECNF guidelines
	Policy	Written ECE program policies that support breastfeeding and infant feeding ECNF professional development and training for staff (required or optional)	Study interventions or TA models that assist ECE programs in improving written policies and ECNF environments Provide training/PD for staff

Note. ACF = Administration for Children and Families; CACFP = Child and Adult Care Food Program; CDC = Centers for Disease Control and Prevention; ECE = early care and education; ECNF = early childhood nutrition and feeding; Go NAPSACC = Nutrition and Physical Activity Self-Assessment for Child Care; PD = professional development; QRIS = quality rating and improvement system; TA = technical assistance. For more examples, see CDC's Spectrum of Opportunities.[23]

Although these programs are vital to low-income families, our subsequent emphasis is on two other federal agencies—the US Department of Agriculture (USDA) and the Centers for Disease Control and Prevention (CDC)—because these agencies are most focused on nutrition and health in children.

US Department of Agriculture

The Child and Adult Care Food Program (CACFP) is a federal nutrition program that reimburses nutritious meals and snacks for 4.2 million children in ECE programs each day.[18] Participation in the CACFP among ECE programs has been associated with provision of more nutritious meals for children.[19,20] In 2017, CACFP meal pattern requirements were updated to include serving more fruits and vegetables, fewer solid fats and added sugars, and more whole grains, further improving the quality of what children were being served. The update also included resources to support implementation as well as several "optional best practices" to further promote ECNF (e.g., practices to support breastfeeding such as providing a quiet, private area at the ECE facility for parents to breastfeed).[21]

Despite the numerous positive effects of CACFP participation on ECE programs and participating children,[20,22] evidence suggests that the CACFP is underused and that ECE providers find the administrative burden of participation to be high.[23] A better understanding of why providers do not participate in the CACFP and ways to address administrative barriers to involvement could be used to inform interventions to improve participation.

Centers for Disease Control and Prevention

The CDC's Spectrum of Opportunities Framework for Obesity Prevention in ECE (CDC Spectrum) helps state agencies and their ECE partners consider nine policy and system levers to improve the nutrition, physical activity, and breastfeeding environments in ECE facilities.[13] The CDC is currently providing funding and technical assistance to 32 states to use CDC Spectrum as a blueprint to advance their work.

STATE-LEVEL PROGRAMS AND POLICIES

Examples of CDC Spectrum state policy levers are advancing state ECE licensing regulations and improving quality rating and improvement systems (QRISs) by including nutrition, physical activity, breastfeeding support, and screen time limits in state licensing or standards.

State Licensing Regulations

States adopt regulations that delineate the requirements licensed ECE providers must follow to legally operate, making licensing an important policy lever for influencing the health of millions of young children attending licensed ECE programs. States can prioritize the health of infants and toddlers attending ECE programs by adopting infant feeding and nutrition regulations that fully align with current *CFOC* standards and guidance.[10] From 2010 to 2018, 39 states adopted regulations affecting infant feeding, nutrition, physical activity, or screen time limits (https://nrckids.org/HealthyWeight).

A 2010 to 2018 national study assessing center-based licensing regulations showed that feeding best practices aligned with national *CFOC* infant feeding and nutrition standards had high uptake among states, meaning that numerous states had adopted these standards into their licensing regulations.[10] For example, in 2010, only two states had adopted regulations requiring age-appropriate introduction to solid foods, but, by 2018, 30 states included this best practice in their center-based licensing regulations. Also, prohibiting provision of fruit juice to children younger than 12 months was not included in any state's regulations in 2010, but 29 states had fully included the restriction in their licensing regulations by 2018.

Federal nutrition standards and meal pattern requirements, such as those contained in the CACFP, can be used by states to improve nutritional quality for not only children from lower-income households but all children enrolled in licensed ECE programs.[24] States can set more comprehensive dietary standards by adopting licensing regulations that require providers to follow current CACFP standards and guidance regardless of program participation. As of 2018, 23 states required all licensed ECE providers to adhere to CACFP guidance, irrespective of program participation or reimbursement.[10] Because CACFP meal pattern standards undergo scientific review and revision, they represent a gold standard by which states can set minimum requirements for licensed child-care providers.[10,25]

State Quality Rating and Improvement Systems

Layering ECNF best practices into QRIS systems is a lever for states to support early child nutrition.[13] QRISs systematically assess, improve, and communicate

the level of quality of ECE programs. In 2015, 38 states operated statewide QRISs, and 27 of these systems included obesity prevention standards.[26] Of the 11 infant feeding best practices contained in the *CFOC*, only one related to encouraging and supporting breastfeeding onsite was included in multiple state QRIS systems; however, it is important to note that QRIS standards in states may have changed since 2015.

State Monitoring

CDC's investments using the Spectrum as a blueprint to support state system change levers are described in the ECE State Indicator Report.[9] This 2016 compilation report gathered data from a variety of sources because no single state-level monitoring system fully captures this type of progress. Monitoring systems for state-level ECNF policies and systems to monitor individual ECE facilities and practices with respect to ECNF would help both federal and state agencies understand where investments are needed. CDC's Childcare Survey of Activity and Wellness was piloted in four states in 2021 to show the feasibility of implementing state surveys assessing the practices of individual ECE facilities. That survey augmented data collected nationally among CACFP-participating centers through the USDA's 2016–2017 Study of Nutrition and Activity in Child Care Settings. The UDSA plans to repeat the survey in 2022–2023.

ADDITIONAL PROGRAM SUPPORT OPPORTUNITIES

ECE providers are trusted caregivers and can be a source of information for parents. In addition to policy levers at the federal and state levels, additional support for providers could help enhance their understanding of implementation best practices related to breastfeeding and ECNF.[8] However, this should be done carefully in collaboration with providers and without placing an undue burden on them.

Dissemination Tools

One way providers can learn about these practices is through tools developed as part of dissemination of guidelines. For example, the Healthy Eating Research infant and toddler feeding guidelines are among the few sets of guidelines that highlight ECE as a key setting for advancing responsive feeding and ECNF. They also provide user-friendly resources including handouts and videos on key topics such as responsive feeding for infants and young children. However, it is unknown how much uptake there has been of these guidelines and resources by ECE providers and whether there are additional provider needs. Also, resources and guidelines are available for ECE providers who participate in the CACFP, but, as noted, not all providers participate in this program.

Professional Development

Professional development is an opportunity for ECE providers to learn about ECNF best practices and advance their knowledge and skills on the topic. Health systems, national organizations (e.g., Penn State Better Kid Care), and states themselves have created online modules on breastfeeding, nutrition, and responsive feeding. Although these modules address logistical barriers providers face, including lack of time to attend in-person training, few data exist on the effects of this training on practice or whether there are additional training or resource needs.

Recognition Programs

Recognition programs are another way to advance the training and knowledge of ECE providers regarding key ECNF issues. States use branded recognition programs to officially recognize ECE facilities that meet a set of predetermined criteria in particular topic areas, and staff training can be included as part of the recognition requirements. A recent peer-reviewed publication showed that 15 states had programs designated as breastfeeding friendly, largely because of the efforts of state health departments and other breastfeeding stakeholders.[27] These types of initiatives can increase ECE providers' confidence in their breastfeeding knowledge, attitudes, and practices. Support for such programs at the state and local levels and efforts to include both high- and low-resource ECE programs can help address disparities.

Use of Evidence-Based Interventions

The polices of individual ECE programs play an important role in shaping providers' day-to-day practices and create environments that are either supportive or unsupportive of breastfeeding and ECNF. One evidence-based intervention for facilities, the online Go NAPSACC program (Nutrition and Physical Activity Self-Assessment for Child Care), is cost effective,[28] is publicly available, and has been shown to improve childhood obesity.[29] Go NAPSACC aims to improve the nutrition and physical activity environments and policies of ECE facilities and includes a module specific to breastfeeding and infant feeding. The intervention is currently licensed for use in 22 states and has been used by more than 6270 ECE

programs. Also, many states have embedded Go NAPSACC into state systems such as QRISs, recognition programs, and professional development systems. Challenges related to the intervention remain, however, including cost (approximately $30 000 for a statewide license) and the need for trained and certified technical assistance providers to help ECE programs reach intended outcomes.

Interventions to improve nutrition can be resource intensive and can be overwhelming for already-overburdened ECE programs with many competing needs. Programs may need additional support to maximize ECNF improvements and ensure that implementation of interventions does not exacerbate disparities between high- and low-resource facilities.

As noted, ECE providers are essential and trusted people in infants' and toddlers' lives. However, efforts could be strengthened to ensure that providers can gain the skills needed to support and advance ECNF in the first two years of life.

IMPLEMENTATION SCIENCE RESEARCH GAPS AND OPPORTUNITIES

Despite a growing evidence base on behavioral and health outcomes of parent-based feeding interventions,[30] research on infant and toddler interventions in ECE settings, including implementation research on what works to support ECE providers in implementing ECNF practices, is limited.[31] Participatory co-design of research efforts (e.g., collaboratively identifying components of effective ECE interventions and policies) can help researchers understand the acceptability of their interventions for busy ECE providers.

Researchers can also consider contextual factors and organizational capacities of ECE programs and explore greater tailoring of interventions to the identities of providers and the children and families they serve. For example, factors such as cultural food preferences, child-rearing traditions, race/ethnicity, and socioeconomic status may affect intervention acceptability and implementation. Finally, developing ECNF interventions and programs in collaboration with businesses (ECE programs) and workers (providers) can help ensure that intervention components are part of daily work routines and are not overly burdensome or costly to programs or providers, potentially improving fidelity and uptake by providers.

CONCLUSION

Research demonstrates the health and social benefits of high-quality ECE in the United States.[32] We have outlined the interconnected layers of federal, state, and ECE program-level policies and highlighted a framework developed by the CDC outlining policy levers and ways to support ECE providers in advancing ECNF. With increased attention to the importance of ECE, additional federal investments during the COVID-19 pandemic (approximately $2 billion for Head Start[33] and $38 billion to the CCDF[34]), and concerted efforts to stabilize and elevate ECE programs, it is an opportune time to leverage investments, programs, and policies to further advance child health and optimal nutrition in ECE settings during the first years of life. AJPH

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CONFLICTS OF INTEREST

The authors have no conflicts of interest to disclose.

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Diagnosing Racism in Public Health: The Turnkey to Effective Interventions

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Just as nutrition during the first 1000 days of a child's life is important for development and lifetime health, a child's place of birth and family socioeconomic characteristics are determinants of lifetime well-being and life expectancy. These are structural factors, often shaped generations in advance of any specific birth, that can lead to misdiagnosing the causes and effects of health and well-being.

Consider the following summary of factors affecting life expectancy in 65 662 census tracts across the United States in 2018:

> Certain demographic qualities—high rates of unemployment, low household income, a concentration of Black or Native American residents and low rates of high school education—affected life expectancy in most neighborhoods. (https://bit.ly/3cHPc97)

This assessment conflates socioeconomic attributes with demographic identity, as if being Black or Native American itself limited life expectancy. The reason this seems to be true in the United Sates is the historical and specific exclusion of Black, Native American, and other non-White populations from the benefits of public investment in education, health care, neighborhood infrastructure, nutritional security, and other social and structural determinants of health.

The historical antecedents are the contest for, and appropriation of, the wealth-building "factors of production" of orthodox economic theory: land and labor. The contest for land took the form of explicit government campaigns of displacement and genocide of an estimated 5 to 10 million Native Americans in the present continental United States. This was implemented over a period of two centuries and was accompanied by the subsequent redistribution of those assets through laws such as the various Homestead Acts. Concomitantly, the contest for the labor of enslaved Africans and their descendants was waged over a period of 243 years. During this time, their labor was legally appropriated—labor with an estimated value of $5.9 to $14.2 trillion in 2009 dollars (https://bit.ly/3Qd9kxq). Note that this means that other people benefited and built wealth from the land and labor of Native Americans and enslaved Africans and their descendants.

The discriminatory cultural values of that era, which enabled and rationalized this systematic appropriation of wealth, were crisply articulated by Senator Stephen Douglas during his debates with Abraham Lincoln for the senatorial contest of 1858:

> In my opinion this government of ours is founded on the White basis. It was made by the White man, for the benefit of the White man, to be administered by White men, in such manner as they should determine. . . . I am opposed to taking any step that recognizes the negro man or the Indian as the equal of the White man. (https://bit.ly/3cFWGtd)

This behavior was exacerbated after the Indian Wars and the passage of the Thirteenth Amendment (ending slavery) by converting surviving Native Americans into "wards of the state" and removing them to reservations and by methodically excluding African Americans from housing, education, and access to credit. These populations' capacity to flourish in the aggregate was thereby limited. During the 20th century, policies that were intended to reduce poverty and elevate the standard of living of the population continued to actively discriminate against Native Americans, African Americans, and the successive waves of immigrant laborers who took the place of the formerly enslaved in the agricultural, construction, and hospitality industries.

The result was that the gap in wealth, well-being, and the social determinants of health widened between White and non-White groups during the 20th century.[1] The stark contrast in present wealth, homeownership, educational attainment, access to nourishing foods, and life expectancy between these demographic groups is therefore the expected result of these explicit intentions, policies, and actions.[2–4] In developed cash economies—where the majority of people do not produce their

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own food—food access, food security, and nutritional quality are direct correlates of economic standing. Consequently, factors that constrain and limit economic standing result in nutritional insecurity, with cascades of consequences for socioeconomic attainment.[5,6]

Well-intentioned programs to ensure proper nutrition, development, and health during the first 1000 days of our lifetimes must acknowledge that not all children and families have equal starting points and that the reason for this is a history of explicitly racist policies and culture in the United States. The "racial reckoning" that the nation has experienced since summer 2020 indicates that our contemporary culture still grapples with the fundamental inconsistency between the racist foundations and norms of the nation and the largely unsupported propaganda about "equal opportunity" and "equality under the law." A society that consistently reproduces income disparities across generations and that just happens to concentrate poverty and the attendant food and nutrition insecurity among populations of color—at over twice the poverty rate for Blacks and Hispanics as that of non-Hispanic Whites[7,8]—is certainly not providing equal opportunity for all. Clearly, such outcomes are socially engineered.[9]

Failure to recognize this leads to futile interventions conflating the state of being inherently poor, uneducated, food insecure, and unhealthy with being made poor, uneducated, food insecure, and unhealthy. By contrast, proceeding from the recognition of historical and extant structural racism, researchers and health professionals can move from espousing "equality" to actively working toward, and producing, equity and justice. This means redressing the discriminatory history and behaviors that have produced today's health disparities. Health interventions, policies, and programs will be more effective when social diagnoses and prescriptions are more accurate by virtue of being more truthful. AJPH

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CONFLICTS OF INTEREST

The author declares no known conflicts of interest.

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Breast Milk Feeding of Infants at Birth Among People With Confirmed SARS-CoV-2 Infection in Pregnancy: SET-NET, 5 States, March 29, 2020–December 31, 2020

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Objectives. To describe prevalence of breast milk feeding among people with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection during pregnancy and examine associations between breast milk feeding, timing of maternal infection before delivery, and rooming-in status during delivery hospitalization.

Methods. We performed a retrospective cohort study using data from Massachusetts, Minnesota, Nebraska, Pennsylvania, and Tennessee of whether people with confirmed SARS-CoV-2 infection during pregnancy in 2020 initiated breast milk feeding at birth.

Results. Among 11 114 (weighted number) people with SARS-CoV-2 infection in pregnancy, 86.5% (95% confidence interval [CI] = 82.4%, 87.6%) initiated breast milk feeding during birth hospitalization. People with infection within 14 days before delivery had significantly lower prevalence of breast milk feeding (adjusted prevalence ratio [APR] = 0.88; 95% CI = 0.83, 0.94) than did those with infection at least 14 days before delivery. When stratified by rooming-in status, the association between timing of infection and breast milk feeding remained only among infants who did not room in with their mother (APR = 0.77; 95% CI = 0.68, 0.88).

Conclusions. Pregnant and postpartum people with SARS-CoV-2 infection should have access to lactation support and be advised about the importance of breast milk feeding and how to safely feed their infants in the same room. (*Am J Public Health*. 2022;112(S8):S787–S796. https://doi.org/10.2105/AJPH.2022.307023)

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Breast milk is the best source of nutrition for most infants.[1] During the COVID-19 pandemic, maternity care practices were affected by infection prevention and control (IPC) measures implemented to protect patients and health care providers (e.g., mother–infant separation, decreased access to lactation services).[2] However, data describing frequency and factors associated with breast milk feeding practices of people with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection in the United States were limited.

Recommendations regarding mother–infant contact and direct breastfeeding varied greatly early in the COVID-19 pandemic and changed rapidly over time. In the absence of direct evidence about the risk of SARS-CoV-2 transmission from mothers to infants

and the severity of SARS-CoV-2 infection in infants, in February 2020, the Centers for Disease Control and Prevention (CDC) and the American Academy of Pediatrics (AAP) recommended considering separation of infants from mothers with suspected or confirmed COVID-19 and providing expressed breast milk for feeding.[3] As more data accumulated on the risk of transmission of SARS-CoV-2 from mothers to their infants, especially when appropriate IPC measures were taken,[4,5] the AAP and the CDC updated recommendations in July and August 2020 to encourage rooming-in and breastfeeding, with precautions taken to protect the infant, including hand hygiene and mask use for breastfeeding mothers with SARS-CoV-2 infection.[6,7] Understanding the impact of the COVID-19 pandemic and risk communications on breast milk feeding is critical to inform public health recommendations, health care practices, and lactation support services.

We sought to report prevalence of breast milk feeding among people with SARS-CoV-2 infection during pregnancy, assess trends in breast milk feeding and rooming-in status over the course of the COVID-19 pandemic, and identify characteristics associated with breast milk feeding. We also sought to examine the association between breast milk feeding and timing of maternal SARS-CoV-2 infection in pregnancy before delivery and whether the association differed when stratified by rooming-in status.

METHODS

The Surveillance for Emerging Threats to Mothers and Babies Network (SET-NET) is a collaboration between the CDC and health departments to conduct longitudinal surveillance of pregnant people and their infants to understand the effects of emerging and reemerging threats, including COVID-19.[8] We found people with SARS-CoV-2 infection during pregnancy through reporting of pregnancy in COVID-19 surveillance or linkages of COVID-19 surveillance data with local data systems (e.g., vital statistics) to determine pregnancy status.

The SET-NET inclusion criteria indicated that a person had to have a laboratory-confirmed SARS-CoV-2 infection (i.e., positive molecular testing) during pregnancy and to have delivered between January 20, 2020 and December 31, 2020. We included data reported to the CDC as of December 3, 2021 in this analysis. We restricted inclusion for this analysis to live births from 5 states collecting data on breast milk feeding: Massachusetts, Minnesota, Nebraska, Pennsylvania, and Tennessee. We excluded people with multiple gestation pregnancies because of known decreased rates of breast milk feeding.[9] We also excluded infants who died on the date of delivery because of the limited chance that breast milk feeding could be initiated. The surveillance period from January 20, 2020 through December 31, 2020 restricted this analysis to only include Alpha, Beta, and Gamma variants. COVID-19 vaccination was not available to the majority of the included population at this time.

We defined being fed breast milk if the infant was ever given colostrum or breast milk from their birth mother, even once, including feeding directly at the breast or by bottle, syringe, or other method during the birth hospitalization. This did not include donor milk. We obtained breast milk feeding information from the birth certificate or medical records. We categorized the timing of maternal infection before delivery (determined by date of first positive SARS-CoV-2 molecular test during pregnancy) as within 14 days or more than 14 days before delivery. We chose the 14-day window to reflect practices and recommendations for isolation and quarantine procedures early in the COVID-19 pandemic. We obtained rooming-in status of mother and infant during the birth hospitalization from medical record abstraction and indicated any rooming-in during the birth hospitalization period.

The covariates we explored were maternal age at infection, maternal race/ethnicity, health insurance at the time of delivery, maternal education, trimester of SARS-CoV-2 infection, maternal COVID-19 disease severity (as previously defined in Galang et al.[10]), labor and delivery characteristics, preterm birth, and neonatal intensive care unit (NICU) admission.[11,12] We classified maternal COVID-19 disease severity criteria as asymptomatic, mild, moderate to severe, or critical from state-reported data from case report forms or maternal medical records. Given previous published reports of racial/ethnic disparities in breastfeeding initiation,[13] we included maternal race/ethnicity as a covariate as a marker of larger health inequities, but we did not assume it to be an independent or biologically plausible explanatory variable.

Of the 5 included states, Minnesota, Nebraska, and Pennsylvania conducted medical record abstraction for all eligible cases; we gave these records a weight of 1.0. Massachusetts and Tennessee implemented random sampling approaches for medical record abstraction. We weighted sampled cases from Massachusetts and Tennessee to account for selection probability and nonresponse for each state.[14] We report weighted prevalence of breast milk feeding by selected maternal, labor

and delivery, and infant characteristics. We also present weighted prevalence of breast milk feeding by month of delivery and rooming-in status stratified by timing of maternal infection, and we used interaction terms to test for statistical differences in trends over time by timing of maternal infection. We estimated adjusted prevalence ratios (APR) and 95% confidence intervals (CIs) for breast milk feeding by Cox regression using constant time at risk to examine timing of maternal infection before delivery and controlling for maternal age, maternal race/ethnicity, health insurance at delivery, and gestational age of infant, which are known risk factors for not initiating breast milk feeding. Because maternal education is a strong predictor of breast milk feeding but was highly missing from 1 state, we fit a second model controlling additionally for maternal education as a sensitivity analysis. We also stratified by rooming-in status to examine differences in the association between breast milk feeding and timing of maternal infection. We conducted analyses using SAS 9.4 software (SAS Institute, Cary, NC) and survey procedures to account for sampling.[15]

RESULTS

The 5 states reported data on 4618 people with SARS-CoV-2 infection in pregnancy and their singleton live-born infants, which after weighting was 11 114 people and their infants. Deliveries included in our analysis occurred between March 29, 2020 and December 31, 2020. Pregnant people were most commonly aged 25 to 29 years (30.8%) and 30 to 34 years (28.8%). Most were reported as non-Hispanic White (46.9%) or Hispanic or Latina (28.4%), 48.2% had Medicaid as their health insurance at delivery, and 31.8% had some college education (Table 1). Maternal infections were identified in the first trimester for 25.5%, in the second trimester for 32.4%, and in the third trimester for 42.1% of people (Table 2). The median time between maternal SARS-CoV-2 infection and delivery was 95.8 days (interquartile range [IQR] = 30.1 days, 175.8 days; data not shown), with 81.9% of people infected more than 14 days before delivery and 18.1% within 14 days before delivery. Among the infants, 69.3% were born via vaginal birth, 91.7% had a gestational age of at least 37 weeks, and 14.6% were reported to have been admitted to the NICU (Table 1).

Overall, 86.5% (95% CI = 82.4%, 87.6%) of mothers reported feeding breast milk to their infant during the birth hospitalization (Table 1). The age distribution was not statistically different between mothers who provided breast milk and those who did not. Mothers with Medicaid and those of non-Hispanic Black race/ethnicity had a lower prevalence of breast milk feeding than did those with private insurance or of other race/ethnicities. Mothers with less education had a lower prevalence of breast milk feeding than did those with college or more education. Mothers whose infants were born preterm or were admitted to the NICU also had a lower prevalence of breast milk feeding relative to mothers of term infants or mothers whose infant was not admitted to the NICU. In addition, mothers who had SARS-CoV-2 infection within 14 days before delivery or had critical illness within 14 days before delivery had a lower prevalence of breast milk feeding than did mothers with infection more than 14 days before delivery or mothers with asymptomatic, mild, or moderate to severe COVID-19.

After adjusting for maternal age, maternal race/ethnicity, health insurance status at delivery, and gestational age of infant, mothers with SARS-CoV-2 infection within 14 days before delivery were less likely to feed breast milk than were mothers with SARS-CoV-2 infection more than 14 days before delivery (APR = 0.90; 95% CI = 0.85, 0.96; Table 3). Results were similar in the secondary analysis when adjusting additionally for education (APR = 0.89; 95% CI = 0.82, 0.97).

Overall, 76.3% (95% CI = 73.3, 79.3) of mothers roomed in with their infants. Prevalence of breast milk feeding was significantly higher among mothers who roomed in with their infants than among those who did not (89.4% vs 77.6%; Table 1). Among mothers who did not room in with their infants, those with SARS-CoV-2 infection within 14 days before delivery were less likely to feed breast milk than were mothers with SARS-CoV-2 infection more than 14 days before delivery (APR = 0.77; 95% CI = 0.68, 0.88; Table 3). Results were similar when adjusting additionally for education (APR = 0.79; 95% CI = 0.67, 0.92). However, among mothers who did room in, there was no association between timing of maternal infection before delivery and breast milk feeding (APR = 0.96; 95% CI = 0.89, 1.04).

In April and May 2020, prevalence of breast milk feeding among people with SARS-CoV-2 infection within 14 days before delivery was less than 70%, which was significantly lower than breast milk feeding prevalence among those with SARS-CoV-2 infection more than 14 days before delivery, but differences in prevalence of breast milk feeding were not significantly different in June through December of 2020 (Figure 1). March 2020 births were not included in Figure 1 because of small numbers. The frequency of rooming-in was lowest early in

TABLE 1— Maternal, Labor and Delivery, and Infant Characteristics Associated With Breast Milk Feeding of Infants at Birth Among People With Confirmed SARS-CoV-2 Infection During Pregnancy: SET-NET, 5 US States, March 29, 2020–December 31, 2020

	Overall		Breast Milk Feeding During Birth Hospitalization		No Breast Milk Feeding During Birth Hospitalization		
	No.	Weighted %[a] (95% CI)	No.	Weighted %[b] (95% CI)	No.	Weighted %[b] (95% CI)	*P*[c]
Overall	4618[d]		4081	86.5 (82.4, 87.6)	537	13.5 (10.7, 15.8)	
Age, y							.21
< 25	1023	23.0 (20.0, 25.9)	879	85.1 (81.3, 89.0)	144	14.9 (11.0, 18.7)	
25–29	1423	30.8 (27.4, 34.1)	1255	83.7 (77.4, 90.1)	168	16.3 (9.9, 22.6)	
30–34	1364	28.8 (25.7, 31.9)	1224	90.5 (88.1, 92.9)	140	9.5 (7.1, 11.9)	
≥ 35	794	17.5 (14.6, 20.4)	712	86.8 (79.6, 94.1)	82	13.2 (5.9, 20.4)	
Not reported	14		11		3		
Race/ethnicity							.002
Hispanic or Latina	1313	28.4 (25.8, 31.1)	1142	86.5 (83.8, 89.2)	171	13.5 (10.8, 16.2)	
Non-Hispanic Asian	304	4.3 (3.6, 5.0)	236	83.4 (78.7, 88.2)	68	16.6 (11.8, 21.3)	
Non-Hispanic Black	826	17.9 (15.0, 20.8)	724	77.7 (68.8, 86.7)	102	22.3 (13.3, 31.2)	
Non-Hispanic White	1950	46.9 (43.2, 50.6)	1778	90.0 (86.1, 94.0)	172	10.0 (6.0, 13.9)	
Non-Hispanic multiple or other race[e]	134	2.4 (1.7, 3.1)	121	85.8 (73.8, 97.8)	13	14.2 (2.2, 26.2)	
Not reported	91		80		11		
Health insurance at delivery							.005
Private	2227	46.5 (42.9, 50.2)	2053	90.4 (86.6, 94.2)	174	9.6 (5.8, 13.4)	
Medicaid	1884	48.2 (44.6, 51.9)	1581	82.4 (78.4, 86.5)	303	17.6 (13.5, 21.6)	
Other and self-pay/none	404	5.2 (3.8, 6.7)	354	86.1 (79.2, 93.1)	50	13.9 (6.9, 20.8)	
Not reported	103		93		10		
Maternal education							< .001
Less than high school	404	15.1 (12.5, 17.6)	326	82.7 (77.3, 88.1)	78	17.3 (11.9, 22.7)	
High school	524	24.1 (20.2, 28.0)	425	75.5 (66.6, 84.4)	99	24.5 (15.6, 33.4)	
Some college	631	31.8 (27.3, 36.3)	541	84.2 (77.3, 91.2)	90	15.8 (8.8, 22.7)	
College or greater	612	29.1 (24.6, 33.5)	579	96.0 (94.0, 98.0)	33	4.0 (2.0, 6.0)	
Not reported	2447		2210		237		
Prenatal care appointments							.18
Yes	4518	99.3 (98.9, 99.7)	4005	86.6 (84.0, 89.3)	513	13.4 (10.7, 16.0)	
Number of visits (median, IQR)		10.3 (8.3, 12.1)		10.6 (10.2, 11.0)		9.4 (7.4, 11.3)	
No	35	0.7 (0.3, 1.1)	25	75.3 (55.0, 95.6)	10	24.7 (4.4, 45.0)	
Unknown	65		51		14		
Induction of labor							.89
Yes	1828	40.1 (36.5, 43.7)	1635	86.8 (81.6, 91.9)	193	13.2 (8.1, 18.4)	
No	2758	59.9 (56.3, 63.5)	2420	86.3 (83.6, 89.1)	338	13.7 (10.9, 16.4)	
Not reported	32		26		6		
Mode of delivery							.93
Vaginal delivery	3241	69.3 (66.1, 72.4)	2874	86.4 (83.2, 89.6)	367	13.6 (10.4, 16.8)	
Cesarean delivery	1372	30.7 (27.6, 33.9)	1203	86.7 (82.1, 91.2)	169	13.3 (8.8, 17.9)	
Not reported	5		4		1		
Gestational age at birth (median, IQR)		39.0 (38.0, 39.8)		39.1 (38.3, 39.8)		38.9 (37.74, 39.3)	
Term (≥ 37 wk)	4234	91.7 (89.7, 93.7)	3784	86.9 (84.1, 89.7)	450	13.1 (10.3, 15.9)	.16

Continued

TABLE 1— Continued

	Overall		Breast Milk Feeding During Birth Hospitalization		No Breast Milk Feeding During Birth Hospitalization		
	No.	Weighted %[a] (95% CI)	No.	Weighted %[b] (95% CI)	No.	Weighted %[b] (95% CI)	*P*[c]
Preterm (< 37 wk)	382	8.3 (6.3, 10.3)	295	82.1 (75.4, 88.8)	87	17.9 (11.2, 24.6)	
Unknown/not reported	2		2		0		
NICU admission							
Yes	477	14.6 (12.2, 17.0)	360	78.0 (71.0, 84.9)	114	22.0 (15.1, 29.0)	< .001
No	3804	85.4 (83.0, 87.8)	3440	90.2 (89.0, 91.5)	364	9.8 (8.5, 11.0)	
Not reported	340		281		59		
Roomed in with mother							
Yes	2178	76.3 (73.3, 79.3)	1990	89.4 (86.2, 92.6)	188	10.6 (7.4, 13.8)	< .001
No	672	23.7 (20.7, 26.7)	519	77.6 (72.6, 82.6)	153	22.4 (17.4, 27.4)	
Not reported	1768		1572		196		

Note. CI = Confidence Interval; IQR = interquartile range; NICU = neonatal intensive care unit; SARS-CoV-2 = severe acute respiratory syndrome coronavirus 2; SET-NET = Surveillance for Emerging Threats to Mothers and Babies Network. The states studied were Massachusetts, Minnesota, Nebraska, Pennsylvania, and Tennessee.

[a]Weighted % is calculated as a column percentage.
[b]Weighted % is calculated as a row percentage.
[c]Comparing breast milk feeding during delivery hospitalization to no breast milk feeding during delivery hospitalization; *P* value calculated using χ^2 test; the Fisher exact test used for expected cell counts < 5.
[d]Weighted n = 11 114.
[e]Other race category composed of American Indian or Alaska Native and Native Hawaiian or Pacific Islander, which were reported too infrequently to calculate reliable estimates.

the pandemic, with only 24.5% of people with infection within 14 days before delivery and 40.7% of those with infection more than 14 days before delivery rooming-in with their infants in April of 2020. Frequency of rooming-in increased for both groups over time, but people with infection within 14 days before delivery remained less likely to room in during later months than did those who had infection identified more than 14 days before delivery. Results from interaction testing indicated that the trends over time for both rooming-in and breast milk feeding did not differ by timing of maternal infection relative to delivery (*P* = .63 and *P* = .98, respectively).

DISCUSSION

We found a significantly lower prevalence of initiation of breast milk feeding among people with confirmed SARS-CoV-2 infection within 2 weeks before delivery. Among mothers who roomed in with their infants, the timing of infection before delivery had less of an effect on the prevalence of breast milk feeding after controlling for characteristics associated with breast milk feeding, including maternal age, race/ethnicity, gestational age, and education. Among mothers who did not room in, however, we continued to see a significant reduction in prevalence of breast milk feeding for those with infection closer to delivery. Given how little was known about the impact of SARS-CoV-2 infection and the concern about potential adverse impacts on the infant, separation of mothers from infants for IPC precautions could have led to less breast milk feeding initiation or less support for mothers with SARS-CoV-2 infection earlier in the pandemic and among mothers with infection closer to delivery. Breast milk feeding and rooming-in appeared to improve later in the pandemic, when the recommendations were updated to emphasize the importance of following safety precautions while breast milk feeding.

Statewide breast milk feeding prevalence reported during the majority of 2020 was similar to baseline prevalence estimates of the 5 included states from SET-NET: 83% of infants were ever fed any breast milk.[16] Disparities in breastfeeding initiation exist among people with lower education status, of younger age, and of Black race.[1,12,13] These characteristics are also associated with an increased risk of SARS-CoV-2 infection.[17] In this analysis, we found that

TABLE 2— Maternal SARS-CoV-2 Timing and Severity Characteristics Associated With Breast Milk Feeding of Infants at Birth Among People With Confirmed SARS-CoV-2 Infection in Pregnancy: SET-NET, 5 US States, March 29, 2020–December 31, 2020

	Overall		Breast Milk Feeding During Birth Hospitalization		No Breast Milk Feeding During Birth Hospitalization		
	No.	Weighted %[a] (95% CI)	No.	Weighted %[b] (95% CI)	No.	Weighted %[b] (95% CI)	*P*[c]
Overall	4618[d]		4081	86.5 (82.4, 87.6)	537	13.5 (10.7, 15.8)	
Trimester in which maternal SARS-CoV-2 infection occurred							.53
1st	861	25.5 (21.7, 29.3)	792	87.1 (79.4, 94.8)	69	12.9 (5.2, 20.6)	
2nd	1555	32.4 (29.0, 35.8)	1404	88.5 (84.2, 92.8)	151	11.5 (7.2, 15.8)	
3rd	2199	42.1 (38.8, 45.4)	1882	84.5 (82.1, 87.0)	317	15.5 (13.0, 17.9)	
Not reported	3		3				
Timing of maternal SARS-CoV-2 infection before delivery, d							< .001
> 14	3486	81.9 (80.1, 83.8)	3165	88.3 (85.2, 91.5)	321	11.7 (8.5, 14.8)	
≤ 14	1010	18.1 (16.2, 19.9)	810	78.1 (74.2, 82.1)	200	21.9 (17.9, 25.8)	
Unknown	122		106		16		
Severity of COVID-19							
Asymptomatic infection	624	18.3 (15.9, 20.7)	537	83.5 (78.8, 88.2)	87	16.5 (11.8, 21.2)	.53
Mild	1073	57.1 (52.7, 61.6)	941	84.9 (79.2, 90.6)	132	15.1 (9.4, 20.8)	
Moderate/severe	476	21.9 (17.6, 26.1)	417	84.4 (73.7, 95.1)	59	15.6 (4.9, 26.3)	
Critical	84	2.7 (1.9, 3.5)	54	70.7 (58.9 ,82.4)	30	29.3 (17.6, 41.1)	
Insufficient information	2361		2132		87	16.5 (11.8, 21.2)	
Severity of COVID-19 in 14 d of delivery							
Asymptomatic infection	378	49.4 (43.7, 55.1)	313	80.9 (74.5, 87.2)	65	19.1 (12.8, 25.5)	.005
Mild	149	33.8 (28.0, 39.6)	116	78.4 (70.2, 86.7)	33	21.6 (13.3, 29.8)	
Moderate/severe	67	12.1 (8.5, 15.8)	54	80.2 (68.2, 92.2)	13	19.8 (7.8, 31.8)	
Critical	33	4.7 (2.8, 6.5)	10	42.8 (22.3, 63.2)	23	57.2 (36.8, 77.7)	
Insufficient information	627		493		134		

Note. CI = confidence interval; SARS-CoV-2 = severe acute respiratory syndrome coronavirus 2; SET-NET = Surveillance for Emerging Threats to Mothers and Babies Network. The states studied were Massachusetts, Minnesota, Nebraska, Pennsylvania, and Tennessee.

[a]Weighted % is calculated as a column percentage.
[b]Weighted % is calculated as a row percentage.
[c]Comparing breast milk feeding during delivery hospitalization to no breast milk feeding during delivery hospitalization; *P* value calculated using χ^2 test; the Fisher exact test used for expected cell counts less than 5.
[d]Weighted n = 11 114.

TABLE 3— Prevalence of Breast Milk Feeding During Delivery Hospitalization by Timing of Maternal Infection Before Delivery, Overall and Stratified by Rooming-in Status, Among People With Confirmed SARS-CoV-2 Infection in Pregnancy: SET-NET, 5 US States, March 29, 2020–December 31, 2020

	Unadjusted		Adjusted Model 1[a]		Adjusted Model 2[b]	
	Unweighted No.	PR (95% CI)	Unweighted No.	APR (95% CI)	Unweighted No.	APR (95% CI)
Timing of maternal infection before delivery, d						
>14		1 (Ref)		1 (Ref)		1 (Ref)
≤14	4496	0.88 (0.83, 0.94)	4351	0.90 (0.85, 0.96)	2062	0.89 (0.82, 0.97)
Timing of maternal infection before delivery by rooming-in status						
Roomed in with infant, d						
>14		1 (Ref)		1 (Ref)		1 (Ref)
≤14	2160	0.96 (0.89, 1.04)	2072	0.98 (0.89, 1.06)	662	0.98 (0.86, 1.12)
Did not room in with infant, d						
>14		1 (Ref)		1 (Ref)		1 (Ref)
≤14	661	0.77 (0.68, 0.88)	634	0.77 (0.68, 0.89)	310	0.79 (0.67, 0.92)

Note. APR = adjusted prevalence ratio; CI = confidence interval; PR = prevalence ratio; SARS-CoV-2 = severe acute respiratory syndrome coronavirus 2; SET-NET = Surveillance for Emerging Threats to Mothers and Babies Network. The states studied were Massachusetts, Minnesota, Nebraska, Pennsylvania, and Tennessee.

[a]Model 1 was adjusted for maternal age, maternal race/ethnicity, health insurance status at delivery, and gestational age.
[b]Model 2 was adjusted for maternal age, maternal race/ethnicity, health insurance status at delivery, gestational age, and education.

breast milk feeding was also lowest among people with fewer years of education and of Black race. It should be noted that disparities in breast milk feeding both in this report and previously published works are the result of historical injustices, larger social determinants, and lack of equitable societal support of breastfeeding practices.[12] The compounding disparities present before the COVID-19 pandemic, as well as those seen in COVID-19 morbidity and mortality by race/ethnicity, emphasize the continued need for focused and culturally relevant breastfeeding promotion efforts in tandem with education regarding breast milk feeding practices in the setting of COVID-19. Variations in frequency of breast milk feeding followed known demographic and birth characteristics, including a lower frequency among mothers enrolled in Medicaid and with lower education levels as well as among infants born preterm, admitted to the NICU, or who did not room in.[1]

Previous studies have demonstrated that infants rooming-in with their mothers encourages initiation of the infant being fed breast milk, and rooming-in is recommended by numerous public health and clinical organizations to support breastfeeding.[1,18–21] Although early recommendations included consideration for temporary separation of mothers with COVID-19 from their newborns, multiple studies have now found low incidence of SARS-CoV-2 infection among infants born to people with SARS-CoV-2 infection[22] and low risk of transmission from mother to infant when appropriate IPC is followed.[23] Since August 2020, AAP and CDC recommendations have encouraged rooming-in and breastfeeding with the use of appropriate IPC measures (e.g., masks, hand hygiene) as well as access to lactation support and support for maintaining milk expression when separation is necessary.[6,7]

Although most infants who test positive for SARS-CoV-2 have mild symptoms or are asymptomatic, severe disease does occur rarely.[24,25] In addition to the numerous well-documented benefits of breastfeeding to both mothers and infants,[1] accumulating evidence suggests that antibodies against COVID-19 are present in the breast milk of mothers with SARS-CoV-2 infection. Multiple reports have now described detection of SARS-CoV-2–specific IgA and IgG in breast milk after infection.[26,27] Breast milk has not been found to contain any SARS-CoV-2 virus particles that can cause infection, and thus, there has been no documented risk of transmission through breast milk.[26] Although it is unclear exactly what level of protection against postnatal SARS-CoV-2 infection these antibodies may provide for infants receiving breast milk, there is a large

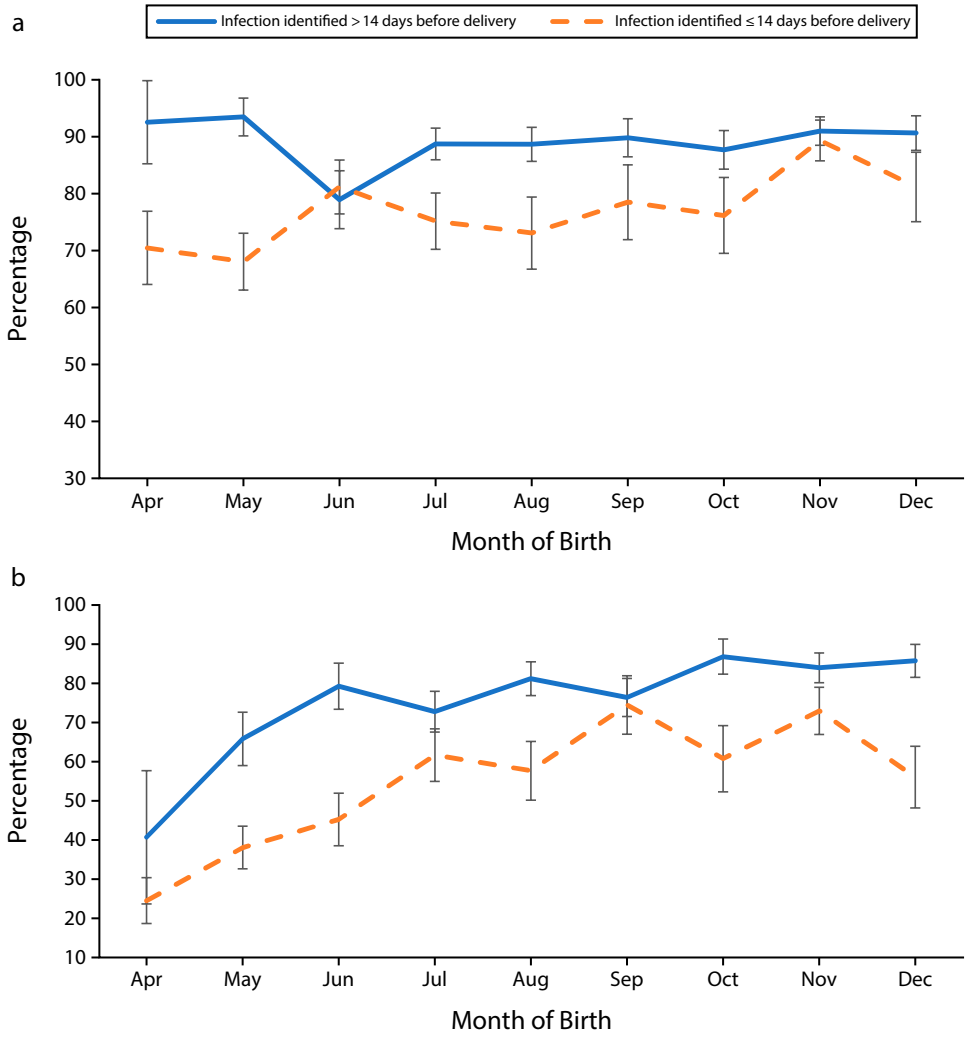

FIGURE 1— Percentage of (a) Breast Milk Feeding and (b) Rooming-in Status During Delivery Hospitalization Among People With Confirmed SARS-CoV-2 Infection During Pregnancy by Month of Birth and Timing of Maternal Infection Before Delivery: 5 US States, Surveillance for Emerging Threats to Mothers and Babies Network, April 1, 2020–December 31, 2020

Note. SARS-CoV-2 = severe acute respiratory syndrome coronavirus 2. The states studied were Massachusetts, Minnesota, Nebraska, Pennsylvania, and Tennessee. March 2020 data are not reported because of small numbers. Whiskers indicate 95% confidence intervals.

body of existing evidence that breast milk feeding reduces infants' risk of respiratory tract infections.[28,29]

Limitations

There are several limitations to note. First, important predictors of maternal breast milk feeding initiation such as marital status, previous initiation of breast milk feeding, skin-to-skin care, and lactation counseling and support are not included in the SET-NET data set. Also, about half of the people in our study did not have enough information available for us to be able to classify disease severity, which may be an important factor in the ability or decision to initiate breast milk feeding. Thus, residual confounding may exist. Second, we were not able to assess or control for facility-level factors that may influence breastfeeding initiation or social determinants of breastfeeding, such as familial support, implicit biases of health care providers, or racism experienced in the health care setting.

Third, SARS-CoV-2 testing or screening practices have varied over the course of the pandemic, complicating interpretation of trends over time. Fourth, medical record abstraction is an ongoing process and might not have been completed for all selected people because of delays in reporting. It is unclear how the addition of these

records might change the findings. Finally, this analysis was limited to breast milk feeding practices at birth hospitalization. It did not account for initiation after birth hospitalization and further follow-up of this cohort is needed to assess the full impact of SARS-CoV-2 infection on breast milk feeding practices over time.

Public Health Implications

All pregnant people, including those with SARS-CoV-2 infection, should be counseled on the benefits of breast milk feeding and rooming-in, the low risk of transmission of SARS-CoV-2 from mothers to infants, and how to safely provide breast milk to their infants with appropriate IPC measures if they have SARS-CoV-2 infection. Health care providers and health care facilities should ensure that people with SARS-CoV-2 infection are supported to feed breast milk. AJPH

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E. L. Lewis, K. R. Woodworth, V. T. Tong, and S. M. Gilboa conceptualized the analysis and drafted the initial article. A. N. Smoots, E. O. Olsen, and V. T. Tong carried out analyses. E. O. Olsen calculated sampling weights. M. Yazdy, H. Shephard, L. Sizemore, H. Wingate, P. Dzimira, B. Reynolds, M. Lush, E. L. Fuchs, K. Ojo, and S. Siebman acquired data. All authors interpreted data, reviewed and revised the article, approved the final article as submitted, and agree to be accountable for all aspects of the work.

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CONFLICTS OF INTEREST

The authors of this article have no conflicts of interest to disclose.

HUMAN PARTICIPANT PROTECTION

This activity was reviewed by the CDC and was conducted consistent with applicable federal law and CDC policy; the activity constitutes a public health surveillance activity deemed not to be research as defined in 45 CFR part 46, 21 CFR part 56; 42 USC Sect. 241(d); 5 USC Sect. 552a; 44 USC Sect. 3501 et seq.

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Barriers to Providing Lactation Services and Support to Families in Appalachia: A Mixed-Methods Study With Lactation Professionals and Supporters

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Objectives. To understand the barriers and facilitators that lactation professionals and supporters (LPSs) in the Appalachian region of the United States experience when providing services and support to families.

Methods. We used a mixed-methods explanatory sequential design with a survey of LPSs in Appalachia (March–July 2019), followed by semistructured interviews with LPSs (January–April 2020). We summarized survey responses descriptively and analyzed interview transcripts thematically.

Results. The survey was completed by 89 LPSs in Appalachia. We conducted semistructured interviews with 20 LPSs. Survey participants most commonly identified challenges with other health care providers, hospital practices, and non–medically indicated supplementation as barriers. Interview participants described challenges with clients' families not supporting breastfeeding, difficulty reaching clients, limited numbers of LPSs, and lack of racial/ethnic diversity among LPSs. LPSs identified the need for training in lactation and substance use, mental health, and birth trauma, and supporting lesbian, gay, bisexual, transgender, queer or questioning, plus (LGBTQ+) families. LPSs described social media and telehealth as both facilitators and barriers. Social support from other LPSs was a facilitator.

Conclusions. LPSs in Appalachia face various challenges. Addressing these challenges has the potential to improve the lactation support and services families in Appalachia receive. (*Am J Public Health*. 2022;112(S8):S797–S806. https://doi.org/10.2105/AJPH.2022.307025)

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The benefits of breastfeeding are well-documented and extend to the infant, breastfeeding parent, family, and society.[1] As such, breastfeeding is a public health priority in the United States and is included in national health objectives, such as Healthy People 2030, and is emphasized in the latest *Dietary Guidelines for Americans*. Along with the American Academy of Pediatrics, the *Dietary Guidelines for Americans* recommend exclusive breastfeeding for the infant's first 6 months, followed by continued breastfeeding alongside the introduction of complementary foods until 12 months or longer. In the United States, the majority of infants initiate breastfeeding (84.1%), but the prevalence of continued breastfeeding declines precipitously by 6 months (58.3%), with an even lower prevalence of exclusive breastfeeding at 6 months (25.6%).[2]

Breastfeeding support provided by professionals or peer supporters can increase breastfeeding duration and exclusive breastfeeding.[3] Lactation providers and supporters (LPSs) include International Board Certified Lactation Consultants (IBCLCs); other certified lactation providers (e.g., Certified Lactation Counselors, Lactation Specialists, Breastfeeding Counselors); and peer counselors through the Special Supplemental

Nutrition Program for Women, Infants, and Children (WIC) or La Leche League (a breastfeeding training, advocacy, and education nongovernmental organization). Each category of LPS has unique training, areas of expertise, and scopes of practices.[4]

LPSs provide services and support in a variety of settings including home visits, hospitals, private practices, health departments, and nonprofit organizations. LPSs are important health care providers as labor and delivery staff, family physicians, and pediatricians may not be trained or confident to provide clinical or social support for breastfeeding.[5,6] Interventions using LPSs have documented increases in breastfeeding initiation and an improved prevalence of any and exclusive breastfeeding.[4] Despite evidence of the effectiveness of LPSs and their important role in public health efforts to improve breastfeeding in the United States, little is known about the experience of LPSs in providing support and the factors that facilitate or impede their success. Previous studies have described the experiences of IBCLCs in Florida[5]; WIC breastfeeding peer counselors in Alaska[7]; health care professionals, including some IBCLCs, in New York State[6]; and health care professionals who supported lactation during the COVID-19 pandemic,[8] but the experiences of LPSs in the Appalachian region of the United States have not been described in the literature.

The Appalachian region consists of 420 counties spanning 13 states in the eastern United States ranging from New York to Mississippi, including all of West Virginia.[9] The Appalachian region is not a monolith and should not be defined by poverty or ethnicity.[10] While substantial economic progress has been made over the last 5 decades, notable disparities and inequities persist. In a 2017 report of health disparities in Appalachia,[11] the region performed better than the nation overall for 8 of 41 indicators (including the prevalence of HIV and excessive drinking), but poorer for 33 indicators, including a higher prevalence of poverty, mortality from all causes examined (e.g., heart disease, cancer), obesity, physical inactivity, infant mortality, and low birth weight. Several of these disparities (e.g., poverty, secondary education, obesity, and low birth weight) are associated with poorer breastfeeding outcomes,[1] while others (e.g., risk of heart disease or cancer) may be reduced through increases in the prevalence of any and exclusive breastfeeding.[4]

Breastfeeding prevalence in Appalachian counties has historically been lower than in the rest of the United States.[12] County-level data are not currently available. Using data from the 2020 US Breastfeeding Report Card, which reports feeding practices among infants born in 2017, the prevalence of exclusive breastfeeding at 3 months was 38% in states with counties in Appalachia compared with 47% in the United States overall and 21% versus 26% for exclusive breastfeeding at 6 months.[2] The objective of this study was to comprehensively understand the barriers and facilitators that LPSs experience when providing lactation services and support to families in Appalachia.

METHODS

Appalachian Breastfeeding Network (ABN) leadership and academic researchers partnered on the design and implementation of this study. ABN is a nonprofit organization. Its leadership includes a board and state representatives who are LPSs. Their leadership and members are LPSs working in clinical, community, public health, and academic settings with varied lactation and health credentials and experiences. ABN was created to bring multiple professions together for 1 common mission: "to work towards transformation of breastfeeding culture in Appalachia by providing empowerment and education to increase access to care" (https://bit.ly/3BCEHwt). ABN hosts a 24-hour breastfeeding hotline, is creating an education program for hospital staff, runs a social media campaign to empower parents, and hosts an annual conference. With commitments to racial equity and gender inclusivity, ABN provides scholarships for Black aspiring lactation professionals, waives full membership fees for any Black individual, and rebranded its social media campaign to be inclusive of all parents.

Design

We used an explanatory sequential design,[13] first conducting a quantitative cross-sectional survey followed by qualitative semistructured interviews. The survey provided a preliminary understanding of barriers LPSs in Appalachia face and findings informed the development of the semistructured interview guide to further explore topics identified in the survey.

Sample

ABN distributed the survey link via direct e-mail and ABN social media platforms (i.e., Facebook, Instagram, Twitter) to more than 400 ABN members; it received 130 responses. Of these, 13 were incomplete and 28 were from individuals outside of Appalachia, resulting in a final sample of 89 LPSs who were members of ABN and lived or worked in a county in Appalachia.

During the survey, participants were invited to participate in a follow-up, semistructured interview; 43 participants agreed to be contacted. Through frequent debriefings with the data collectors, we determined that after conducting 20 interviews we achieved a variety of perspectives from the study population and topic saturation had been reached. Interview participants received a $15 gift card.

Data Collection

We developed data collection tools based on ABN priorities and previous literature.[5] The survey included 30 multiple-choice, ranking, and open-ended questions about sociodemographic characteristics, paid or volunteer breastfeeding and lactation support experience in Appalachia, barriers LPSs experience when supporting families, and perspectives on ABN initiatives. (The survey is available as a supplement to the online version of this article at https://ajph.org.) The survey was administered between March 10, 2019, and July 17, 2019, using Qualtrics Online Survey Software (version March 2019, Qualtrics, Provo, UT). Informed consent was obtained electronically at the start of the survey. Research assistants with training in qualitative research conducted semistructured phone interviews following an interview guide that was developed by using survey results (available as a supplement to the online version of this article at https://ajph.org). Interviews were conducted between January 2020 and April 2020, lasted between 30 and 75 minutes, and were audio-recorded and transcribed verbatim. Verbal consent was obtained at the start of the interview.

Data Analysis

Using survey data, we calculated descriptive statistics in Stata version 16 (StataCorp LP, College Station, TX) for all sociodemographic characteristics; we cross-tabulated barriers by WIC employment status (any vs none) and lactation certification. We categorized lactation certifications as (1) IBCLCs, who complete extensive coursework, training, and at least 300 clinical practice hours; (2) other lactation certifications including Certified Lactation Counselors, Certified Lactation Specialists, and Certified Breastfeeding Counselors, who complete 40 hours of training; WIC breastfeeding peer counselors and La Leche League Leaders, which requires training and personal breastfeeding experience; and (3) no lactation certification, which includes individuals who provide lactation support through their job or volunteer work but do not have a lactation credential (e.g., doula, home visitor, support group facilitator).

We uploaded interview transcripts to ATLAS.ti version 8 (Scientific Software Development, Berlin, Germany) and conducted thematic analysis. We developed deductive codes based on the interview guide and applied them to the transcripts. After this initial coding pass, the first author listened to the interviews and made memos of emerging themes and her positionality. These themes were discussed by the authors, additional inductive codes were created, and a second coding pass was made. A separate coding report was generated for each of the common barriers identified in the survey and each of the emergent barriers identified in the interviews. Next, the first author created a separate matrix for each barrier in which illustrative quotes were tabulated by certification type and employment in WIC. Study authors separately reviewed the coding reports and matrices and then met as a team to discuss key themes while periodically consulting the president of ABN.

Reflexivity

Most of the academic researchers are outsiders to Appalachia and benefit from systems of oppression and may fail to fully grasp structural and systemic barriers identified by participants. The members of the academic research team are predominately White, similar to the sample, but given that topics of racial/ethnic representation and systemic marginalization were identified, authors sought to situate the findings in context by discussing works by Black and Latinx LPSs and researchers. All academic researchers attended events hosted by Appalachian organizations to improve contextual understanding. One of the academic researchers was an IBCLC and another was a certified lactation counselor, improving the analysis and interpretation of LPS data. The ABN president co-designed the study and was engaged in the analysis and manuscript preparation to avoid misinterpretation or misrepresentation of participants' experiences.

RESULTS

Participant characteristics are presented in Table 1. As part of their lactation work or volunteer activities, 92.1% of survey participants reported providing lactation counseling, support, and education to clients and families; 52.8% implemented breastfeeding programs; 47.2% trained other providers or program staff in lactation; and 4.5% conducted breastfeeding and lactation research.

TABLE 1— Characteristics of Lactation Providers and Supporters According to Participation in the Survey (March–July 2019) and Semistructured Interviews (January–April 2020): Appalachia, United States

	Survey Respondents (n = 89), No. (%) or Mean ±SD	Interview Respondents (n = 20), No. (%)
Age, y[a]		
18–34	36 (40.4)	10 (52.6)
35–54	40 (44.9)	6 (31.6)
≥ 55	13 (14.6)	3 (15.8)
Gender		
Genderfluid/nonbinary	2 (2.2)	1 (5.0)
Women	87 (97.8)	19 (95.0)
Self-Identified race/ethnicity[b]		
Black/African American	1 (1.1)	3 (15.0)
Hispanic/Latina/x	1 (1.1)	0 (0)
More than one race/ethnicity/origin	3 (3.4)	0 (0)
White	84 (94.4)	16 (80.0)
Prefer not to say	0 (0)	1 (5.0)
Years involved in breastfeeding work		
0–5	37 (41.6)	6 (30.0)
6–19	31 (34.8)	9 (45.0)
≥ 20	21 (23.6)	5 (25.0)
Certification[c]		
IBCLC	29 (32.6)	10 (50.0)
Other lactation certification(s)	42 (47.2)	7 (35.0)
Breastfeeding USA Counselor	2 (2.25)	0 (0)
Certified Breastfeeding Counselor	1 (1.1)	0 (0)
Certified Lactation Counselor	29 (32.6)	6 (30.0)
Certified Lactation Specialist	11 (12.4)	1 (5.0)
La Leche League Leader	12 (13.5)	2 (10.0)
WIC peer counselor	16 (18.0)	3 (15.0)
No lactation certification	18 (20.2)	3 (15.0)
State		
Alabama	. . .	1 (5.0)
Georgia	4 (4.5)	1 (5.0)
Kentucky	3 (3.4)	2 (10.0)
Maryland	1 (1.1)	. . .
North Carolina	8 (9.0)	1 (5.0)
Ohio	34 (38.2)	7 (35.0)
Pennsylvania	1 (1.1)	. . .
Tennessee	7 (7.9)	. . .
Virginia	15 (16.9)	4 (20.0)
West Virginia	16 (18.0)	4 (20.0)

Continued

Top Barriers Identified in the Survey

Survey participants selected several barriers that influenced their ability to provide lactation support to families in Appalachia. The top 5 barriers selected were:

1. challenges with other providers (84.3%), which included lack of awareness about services, failing to support breastfeeding, or failing to refer to LPSs;
2. hospital-related challenges (84.3%), which included hospital practices and policies during labor, delivery, and postpartum;
3. non–medically indicated supplementation (77.5%);
4. clients' partners, families, or social networks who were not supportive of breastfeeding (69.7%); and
5. addressing clients' negative views about breastfeeding (61.8%; Figure 1).

Participants selected barriers differently on the basis of lactation certification type and WIC employment status (Table 2). IBCLCs more often reported challenges with reaching clients and time constraints. LPSs with other or no lactation certifications more often reported challenges with clinical aspects of lactation (e.g., preterm infants, clients with obesity, substance use), which IBCLCs are trained to support. Participants who worked at WIC more often reported challenges with clients' partners, families, or social networks not supporting breastfeeding and clients' negative breastfeeding views.

Interview Themes Confirming Survey Results

Interview participants echoed and expounded on several barriers

TABLE 1— Continued

	Survey Respondents (n = 89), No. (%) or Mean ±SD	Interview Respondents (n = 20), No. (%)
County coverage		
Serves more than 1 county	43 (48.3)	. . .
No. of counties served	3.8 ±0.6	. . .

Note. IBCLC = International Board Certified Lactation Consultant. We only included survey data in our analysis from participants who completed all relevant survey questions. It is possible that participants who did not complete all survey questions indicated they were interested in being interviewed and therefore were included in the interview data but not the survey data.

[a]Only 19 interview participants reported their age.
[b]Participants were asked to select from a list during the survey. During interviews, it was an open-ended question. We chose to group interview participants to protect their anonymity when they identified more specifically (e.g., country of origin).
[c]Participants were able to select more than 1 certification.

selected in the survey. Themes from the interviews confirming these barriers are presented in Box 1, and illustrative quotes (Q#) are in Table A (available as a supplement to the online version of this article at https://ajph.org). Differences by certification type and WIC employment status were less prominent in interviews compared with the survey. Across all categories, LPSs reported feeling undervalued by other health care providers who do not refer clients to LPSs (Q1) or who contradict the advice of LPSs. LPSs across certification types and WIC employment status also described challenges reaching clients (Q4–Q8) and referred to Appalachia as a "breastfeeding desert" because of the limited number of LPSs (Q6).

Many LPSs in this study described the challenges of being the sole LPS for multiple counties, which limited their time to adequately counsel every family and contributed to feelings of pressure to meet everyone's needs (Q4). LPSs also reported the challenge of not being compensated for time spent supporting clients outside of working hours (Q8). A lack of support from clients' partners, families, and social networks was particularly salient among WIC-employed LPSs but was also relevant for those not employed by WIC (Q2, Q3). Challenges with cross-cultural communication and language barriers (Q9) was most relevant for LPSs with other lactation certifications and non-WIC LPSs. Counseling clients about issues related to substance use and lactation was most relevant for LPSs with an IBCLC certification and in WIC (Q10).

Emergent Barriers Reported During Interviews

Interview participants noted additional barriers that were not represented in the survey. Emergent themes are presented in Box 1 and illustrative quotes are in Table B (available as a supplement to the online version of this article at https://ajph.org). Systemic lack of racial/ethnic representation among LPSs (Q11) was identified as a barrier, especially by non-WIC LPSs and those with other lactation certifications. LPSs also mentioned the need for contextually relevant counseling materials. LPSs with IBCLCs or other lactation certifications identified challenges supporting clients that experienced previous trauma or health challenges, birth trauma,[14] and mental health challenges (Q12).

LPSs also described their lack of experience and preparation to counsel lesbian, gay, bisexual, transgender, queer or questioning, plus (LGBTQ+) families about chestfeeding, relactation, and induced lactation. LPSs with other lactation certifications noted that breastfeeding classes fail to train or train incorrectly about how to support all families to feed human milk (Q13). LPSs across all certification types and WIC-employment status shared wanting to support LGBTQ+ clients, but not knowing how (Q14).

LPSs with other lactation certifications talked about wanting to pursue the IBCLC certification but described the barriers to obtaining the credential (Q18). IBCLCs discussed how challenges obtaining funding for breastfeeding support in their county make it difficult to provide sustainable care to their clients (Q19).

Facilitators Reported During Interviews

While LPSs were asked about facilitators, the discussion of barriers was more salient. A facilitator that was reported across all LPS categories was relying on the informal social network of LPSs when LPSs encounter challenges or need advice (Q20). Social media, call lines, and telehealth were discussed as potential facilitators in places where care is spread out or difficult to access, acknowledging the benefit of the ABN 24-hour hotline (Q15). However, LPSs also noted limitations when hands-on care is needed (Q16) and social media's potential to spread false information (Q17).

DISCUSSION

This mixed-methods study reveals challenges LPSs experience providing

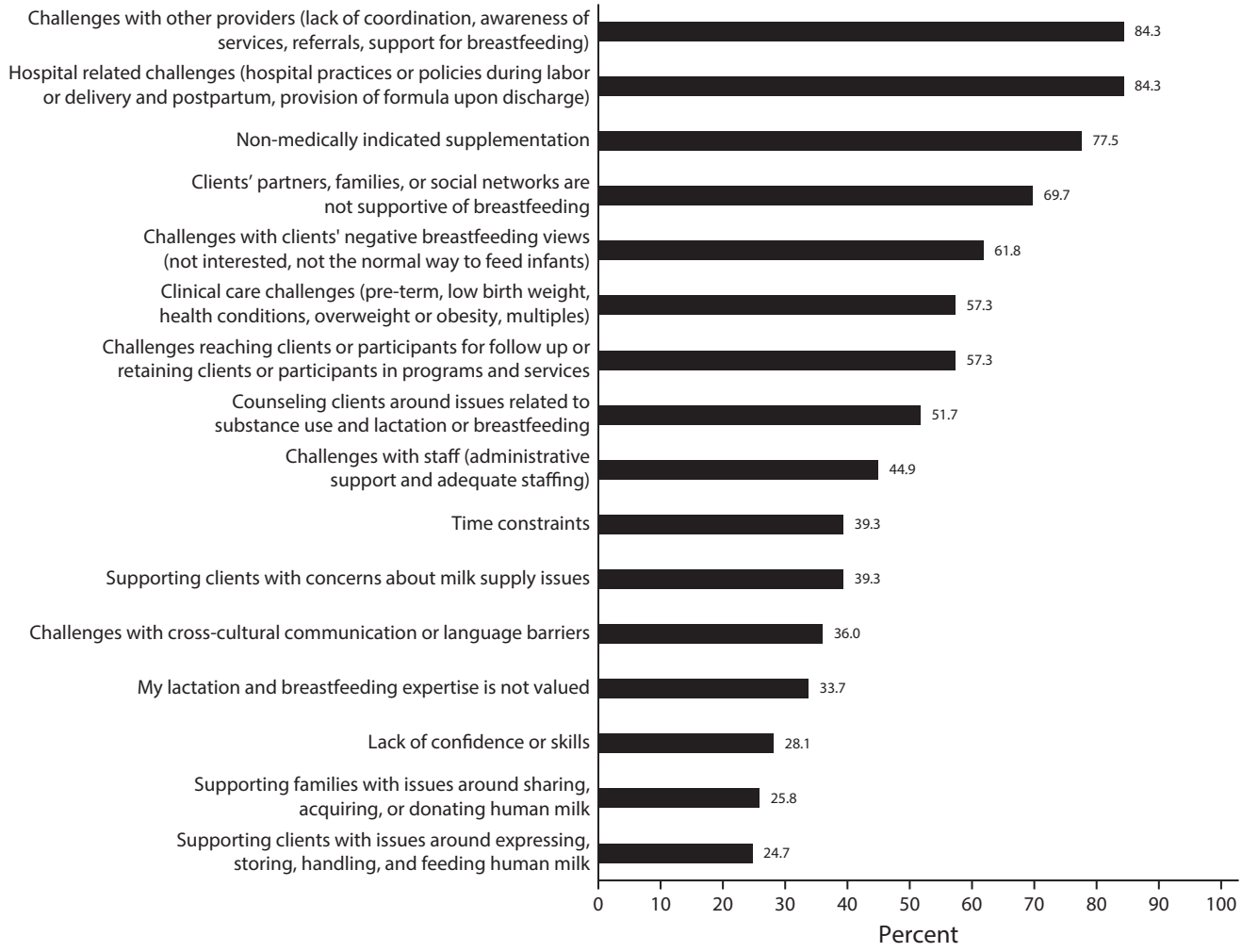

FIGURE 1— Proportion of Survey Respondents Who Reported Personally Experiencing Selected Barriers When Providing Lactation or Breastfeeding Support to Clients: Appalachia, United States, March–July 2019

Note. Survey respondents could select multiple barriers.

breastfeeding and lactation support to families in Appalachia and contributes to the limited literature that has explored the perspectives of LPSs. While our findings reinforce barriers that have been documented among LPSs in other contexts, such as challenges with other health care providers and hospital practices and difficulty reaching clients,[5–7] unique themes related to providing breastfeeding support in Appalachia emerged, which include limited numbers of LPSs in the region, systemic lack of racial/ethnic representation among LPSs, and training needs related to supporting clients who experienced birth trauma or have mental health issues, supporting LGBTQ+ families, and counseling clients about substance use and lactation.

LPSs described challenges with other health care providers who undervalue and undermine their expertise or delay clients' access to skilled lactation support. Failure of other providers to properly refer clients to lactation services has been documented in other studies. Incorporating breastfeeding and lactation content into medical and nursing school curricula may improve feeding recommendations and referrals.[5,6]

Lack of social support from family and community members is a well-documented barrier to breastfeeding.[15,16] LPSs in this study described challenges providing lactation support to clients when partners and family members were not supportive or engaged. There are limited examples from the United States in the peer-reviewed literature of interventions to engage fathers and grandmothers[17–21] to support breastfeeding, and none are in Appalachia. Effective, contextually

TABLE 2— Barriers Experienced by Survey Respondents Providing Lactation and Breastfeeding Support to Clients in Appalachia, United States, by WIC Employment Status and Lactation Certification: March–July 2019

Barrier	Total (n = 89), %	WIC Employment Status, %		Lactation Certification, %		
		WIC (n = 31)	Non-WIC (n = 58)	IBCLC (n = 29)	Other (n = 42)	None (n = 18)
Challenges with other providers (e.g., nurses, pediatricians)	84.3	90.3	81.0	89.7	85.7	72.2
Hospital practices and policies during labor and delivery and postpartum	84.3	87.1	82.8	79.3	83.3	94.4
Non–medically indicated supplementation	77.5	77.4	77.6	72.4	81.0	77.8
Clients' partners, families, or social networks are not supportive of breastfeeding	69.7	83.9	62.1	65.5	78.6	55.6
Clients' negative breastfeeding views (e.g., not interested in breastfeeding, breastfeeding is not normal way to feed infants)	61.8	74.2	55.2	55.2	69.0	55.6
Clinical care challenges (e.g., preterm, low birth weight, clients with obesity, multiples)	57.3	61.3	55.2	37.9	69.0	61.1
Challenges connecting with, reaching, and following up with clients	57.3	61.3	55.2	65.5	54.8	50.0
Lack of training on counseling clients about substance use and lactation	51.7	51.6	51.7	34.5	64.3	50.0
Lack of administrative support and adequate staffing	44.9	45.2	44.8	44.8	47.6	38.9
Time constraints	39.3	41.9	37.9	51.7	35.7	27.8
Difficulty supporting clients with concerns about milk supply	39.3	35.5	41.4	20.7	40.4	44.4
Lack of knowledge, confidence, or skills to support clients effectively	37.1	41.9	34.5	10.3	57.1	33.3
Challenges with cross-cultural communication or language barriers	36.0	38.7	34.5	44.8	38.1	16.7
My lactation and breastfeeding expertise is not valued	33.7	25.8	37.9	41.4	23.8	44.4
Challenges supporting families with sharing, acquiring, or donating human milk	25.8	19.4	29.3	17.2	33.3	22.2
Challenges supporting clients with expressing, storing, handling, and feeding human milk	24.7	19.4	27.6	17.2	38.1	5.6

Note. IBCLC = International Board Certified Lactation Consultant; WIC = Special Supplemental Nutrition Program for Women, Infants, and Children. Survey respondents could select multiple barriers.

appropriate strategies that LPSs can use to engage families to support breastfeeding and lactation are needed.

In the survey, more than half of LPSs selected difficulty reaching clients as a challenge, which was also a prominent theme in the interviews. Appalachia is predominately rural, and clients have reported barriers to accessing breastfeeding care.[22] Other studies have reported that LPSs experience time constraints,[5–7] but serving large geographic, and especially rural, areas likely exacerbates this challenge. LPSs described telehealth and social media as helpful for reaching clients and addressing access challenges, as well as challenging for providing lactation support.

Participants in the current study have similar feelings to WIC breastfeeding peer counselors in Alaska, who described the benefits of texting and online support groups in improving their clients' breastfeeding success but also wanted to have in-person contact with clients.[7] In a meta-analysis of studies examining digital health interventions versus usual care, Web-based technologies significantly improved exclusive breastfeeding initiation and duration, and breastfeeding attitudes and knowledge.[23] Telehealth has the potential to address the distance-to-care barrier faced by many individuals in Appalachia but comes with its own barriers including limited Internet access and availability of services outside of usual business hours.[24] The COVID-19 pandemic necessitated the use of remote lactation support

BOX 1— Themes and Key Findings From Semistructured Interviews With Lactation Professionals and Supporters (LPSs): Appalachia, United States, January–April 2020

Themes	Key Findings From Interviews[a]
Themes that reinforce survey results about barriers	
My lactation expertise is not valued	Other health care providers undervalue LPSs and fail to refer, which leads to confusion for clients or prevents clients from receiving services (Q1)
Clients' partners, families, or social networks do not support breastfeeding	Partners and family members are highly influential, but often do not support breastfeeding (Q2) Difficulty establishing rapport with families, particularly grandmothers, when client is the first in the family to breastfeed (Q3)
Connecting with, reaching, or retaining clients	One LPS often serves multiple counties, which constrains the number of clients they can see and contributes to "breastfeeding deserts"[b] (Q4, Q6) Inconvenient and limited hours for lactation services (e.g., WIC agency hours, timing of support groups) limit ability of LPSs to provide support (Q7) Clients do not always answer phones and numbers change often (Q5) LPSs have to balance tradeoffs between wanting to do more within context of low compensation and other family and life demands (Q8)
Cross-cultural communication and language barriers	Lack of LPSs who speak Spanish, limited availability of translators, and challenges using translators (Q9)
Counseling clients about substance use and lactation	Lack of data, knowledge, resources, and experience counseling clients about substance use and lactation (Q10)
Additional themes that emerged from interviews	
Systemic lack of racial/ethnic representation	Limited numbers of LPSs and other health care providers of color (Q11) Poor outreach to families of color; LPSs do not look like clients (Q11) Support groups perceived as not welcoming to families of color (Q11)
Challenges supporting mental health, abuse, and birth trauma[c]	Lack of training and resources for how to discuss or refer to mental health services (Q12)
Desire to support LGBTQ+ families	Lack of experience (Q14) and training (Q13) counseling LGBTQ+ clients about chestfeeding, relactation, and induced lactation
Social media and telehealth are facilitators and barriers	Social media, call lines, and telehealth facilitate support in places where care is spread out or difficult to access; ABN has a 24-hour hotline (Q15) Telehealth has limitations when "hands on" care is needed (Q16) Social media can be a source of false information (Q17)
Strong peer networks are facilitators	LPSs are able to contact other LPSs in their area or through ABN to troubleshoot challenges they face (Q20)
Limited funding influences support provided	Limited grant funding available for offices where LPSs work (Q19) Among non-IBCLCs, the time and expense of pursuing advanced lactation education and training (i.e., IBCLC certification) is time- and cost-prohibitive (Q18)

Note. ABN = Appalachian Breastfeeding Network; IBCLC = International Board Certified Lactation Consultant; LGBTQ+ = lesbian, gay, bisexual, transgender, queer or questioning, plus; WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.
[a]Illustrative quotes are represented as "(Q#)" and presented in Tables A and B (available as supplements to the online version of this article at https://ajph.org).
[b]Participants used the term "breastfeeding deserts" to refer to the lack of LPSs and lactation services in their area.
[c]Leinweber et al. (2020) define birth trauma as an "experience of interactions and/or events directly related to childbirth that caused overwhelming distressing emotions and reactions; leading to short and/or long term negative impacts on a woman's health and wellbeing."[14(p5)]

services and identified promising strategies, but concerns about the need for in-person support continued.[8]

Participants described the lack of racial/ethnic diversity and representation among LPSs as barriers to providing lactation support to families of color in Appalachia. Racism, discrimination, and bias have a negative impact on the provision of and access to lactation support throughout the United States.[25,26] All categories of interview participants discussed the need for LPSs who reflect the clients they are serving. This need was especially prominent among non-WIC interview participants, which may be because WIC breastfeeding peer counselors are meant to reflect the communities they serve.[7] Increasing the number of LPSs of color, and specifically IBCLCs of color, is a priority,[16,27,28] and barriers to IBCLC certification rooted in systemic racism must be eliminated.[28] Black-led community-based organizations have made immense contributions to narrowing breastfeeding disparities,[26] and efforts are underway to increase the number of Black IBCLCs.[27] The number of Black and Latinx residents of Appalachia is increasing, fueling much of the population growth in the region.[29] Continued and expanded efforts to address

inequities faced by Black, Latinx, and other systemically excluded families in Appalachia are essential.

LPSs identified 3 areas in which they need further training, resources, and support: counseling about substance use and lactation (particularly among IBCLCs working in WIC), supporting clients with mental health challenges and birth trauma, and counseling LGBTQ+ families about chestfeeding, induced lactation, and relactation. While LPSs were compassionate and wanted to help address these challenges, an important piece to appropriate care,[30] they did not have the expertise or knowledge of where to seek information. There is a lack of research to inform evidence-based guidelines for providing care around substance use and lactation, and more research that focuses on counseling is needed.[31] Trauma-informed approaches to lactation care are needed,[32] but not widely used. Appropriate training and resources are also needed to ensure the care and advice provided to LGBTQ+ clients who want to chestfeed or breastfeed is accurate and caring.[33,34] The current guidelines provided by the Academy of Breastfeeding Medicine[35] provide an important starting point for LPSs to educate themselves and be reminded of the importance of affirming counseling, but the majority of resources for lactation are hetero- and cisnormative.[35] LPSs need training on each of these topics that reflect their role and scope of practice.

Limitations

Study limitations include the use of a convenience sample of ABN members, which may not reflect the experiences of LPSs in Appalachia who are not affiliated with ABN or did not participate in our survey. This study lacked diversity in participants as the majority of LPSs in our study were White. Our findings are missing important details about the experiences and needs of LPSs from systemically excluded groups. Future research in Appalachia should prioritize the experiences of LPSs of color.

The study's strengths include that it was conducted in partnership with and according to the goals of the ABN and included perspectives from a variety of LPSs from different states. The use of mixed methods allowed for a more holistic understanding of the barriers faced by LPSs in Appalachia. The quantitative data highlight potential priority concerns, and the qualitative data provide critical first-hand experience and a more in-depth understanding of the barriers LPSs experience. Finally, this study focused on the experiences of LPSs, which are often left out of breastfeeding research despite playing an integral role.[5,7]

In this study, LPSs identified several barriers to providing lactation and breastfeeding services and support to families in Appalachia that must be addressed. This includes increasing the number of LPSs in rural areas and LPSs of color, as well as addressing barriers to IBCLC certification. The experiences of LPSs with telehealth suggest the need to test the effectiveness of digital health interventions, developed in partnership with communities, to increase access to and use of lactation support in "breastfeeding deserts." LPSs also need continuing education to support families dealing with substance use and mental health issues and provide appropriate counseling to LGBTQ+ families. Some LPSs benefited from informal support from other LPSs; formalizing networks of support within states and regions could extend this support to other LPSs. Addressing the barriers that LPSs identified has the potential to improve the lactation support and services that families in Appalachia receive.

Public Health Implications

Despite myriad benefits of breastfeeding, families face multilevel barriers to meeting their infant feeding goals, particularly in Appalachia. Services and support from LPSs can improve breastfeeding practices, but this research documents critical barriers LPSs face in providing such care in Appalachia. These barriers limit efforts to improve infant feeding practices. There is a need to increase the number of LPSs in Appalachia, increase the number of Black and Latinx LPSs, and provide training in mental health, counseling LGBTQ+ families, and substance use disorders for LPSs at every level. AJPH

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CONTRIBUTORS

S. L. Martin and S. A. Hutchinson designed this research. G. Foster and R. Sideek collected the data. E. R. Seiger, S. L. Martin, H. M. Wasser, G. Foster, and

R. Sideek analyzed the data. S. A. Hutchinson contributed to data interpretation. E. R. Seiger, S. L. Martin, H. M. Wasser drafted the article. All authors reviewed, revised, and approve of the article.

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CONFLICTS OF INTEREST

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HUMAN PARTICIPANT PROTECTION

This study was reviewed by the University of North Carolina at Chapel Hill institutional review board and determined to be exempt from further review. All human participants provided informed consent.

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Effects of Sugary Drink Countermarketing Videos on Caregivers' Attitudes and Intentions to Serve Fruit Drinks and Toddler Milks to Young Children

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Objectives. To test the effects of countermarketing videos addressing common misperceptions about ingredients and claims on children's sugary drinks.

Methods. We conducted an online randomized controlled experiment in January 2021 with US caregivers (n = 600) of young children (aged 8–37 months) to assess the effects of watching countermarketing versus control videos on intentions to serve sugary and healthy drinks (6-point scales) and attitudes (10-point scales) about fruit drinks and toddler milks.

Results. The countermarketing videos significantly reduced positive attitudes about fruit drinks (mean difference = 0.92) and toddler milks (mean difference = 2.10), reduced intentions to serve both (mean difference = 0.50 and 0.92, respectively), and increased intentions to serve plain milk (mean difference = 0.52) versus control videos (all *P*s < .001). Intentions differed by individual characteristics, but the videos remained effective after we controlled for these characteristics. Moreover, the videos were more effective for toddler milks versus fruit drinks, and effects on fruit drink intentions were greater for Black versus White caregivers and caregivers of children aged 24 months or younger.

Conclusions. A countermarketing campaign aimed at diverse caregivers of young children designed to correct misleading children's drink marketing presents a promising public health approach for reducing sugary drink consumption in the first 1000 days. (*Am J Public Health*. 2022;112(S8):S807–S816. https://doi.org/10.2105/AJPH.2022.307024)

Reducing high levels of sugary drink consumption by young children represents a critical public health goal to prevent obesity and other diet-related diseases. Consumption of sugary drinks increases rapidly from 9% of infants (6–12 months) to 46% of children aged 2 to 4 years.[1] Higher sugary drink consumption, especially fruit drinks, among Black children also contributes to health disparities affecting their communities.[2] The first 1000 days is a critical time to establish healthy dietary preferences, and sugar consumption at this age may condition long-term sweet preferences and reduce acceptance of plain milk and water.[1,3,4] Therefore, experts recommend public health strategies to promote water and plain milk and reduce sugary drink consumption among infants and toddlers.[2,5] Media campaigns to educate consumers about health consequences of sugary drink consumption have successfully reduced soda sales,[6] and a media campaign aimed at parents of young children could also help reduce sugary drink consumption during the first 1000 days.

Two sugary drink categories raise special concerns for young children. Fruit drinks (fruit-flavored drinks with added sugar, nonnutritive sweeteners,

or both and little or no juice) represent the majority of sugary drinks consumed by children aged younger than 5 years[1] and the greatest source of added sugar in the diets of toddlers.[7] Although toddler milks (typically milk-based powdered beverages containing added sugars and vegetable oil) are a relatively recent product category, more than 40% of toddler caregivers reported serving toddler milk,[8] and volume sales almost tripled over 10 years (2006–2015).[9] In addition to added sugar, toddler milks contain less protein and more sodium and cost more than plain cow's milk[2]; thus, health experts recommend against serving them.[5]

Marketing also contributes to misperceptions of product healthfulness and benefits.[10–13] Parents often believe that popular brands of children's fruit drinks are healthy[10] and that toddler milks provide nutrition not available from other food and drinks.[8] Parents look for nutrition-related claims such as "vitamin C" and "real/natural" when choosing children's drinks,[10] which average 4 such claims on product packages.[14,15] Child-development claims on toddler milk packages, together with common advertising messages, also imply benefits for children's growth, cognitive development, and picky eating.[16] Moreover, cross-branding of fruit drinks and toddler milks with healthier products (100% juice and infant formula) contributes to misperceptions about product healthfulness and confusion between different drinks offered by the same brands.[11,17] Caregivers' trust in infant formula brands also spills over as trust and positive attitudes about cross-branded toddler milks.[11]

Therefore, an educational campaign aimed at caregivers of young children (9–36 months), the age when most first consume sugary drinks, may be an effective strategy for reducing consumption. Focus groups with parents of infants and toddlers identified common misunderstandings about fruit drinks and toddler milks that led to misperceptions about the healthfulness of these products for young children, including confusion about product ingredients, what qualifies as a "sugary drink," and incorrect inferences about the meaning of product claims.[11] In the groups, participants received information to correct these misperceptions, which led to more negative attitudes about the drinks and some anger at companies for their misleading marketing tactics.

In this study, we tested the effects of viewing 2 short videos designed to counteract common misperceptions about fruit drinks and toddler milks that could be disseminated on social media. We hypothesized that viewing these videos would reduce positive attitudes about fruit drinks and toddler milks and intent to serve these drinks. We also tested whether they increased parents' intent to provide plain milk or water and reduced positive attitudes about companies. We also explored potential individual differences in video effectiveness.

METHODS

We conducted an online randomized controlled experiment with 600 US caregivers of young children (aged 9–36 months) in January 2021. Participants were randomly assigned to view either 2 sugary drink countermarketing videos or 2 control videos. They then completed a survey to assess effects of viewing the countermarketing videos compared with the control group (the Video Experiment Survey is available as a supplement to the online version of this article at https://www.ajph.org). The study was registered with AsPredicted.org (https://aspredicted.org/blind.php?x=KB7_W7M).

Participants

An online panel company (InnovateMR)[18] invited panel members with a child aged 9 to 36 months to participate, with quotas for Hispanic and Black (150 participants each) and oversampling of Asian American caregivers. InnovateMR recruits panel members from diverse online sources through banner ads on social media and special-interest Web sites. It provides points for participation on the panel to be redeemed as online gift cards. InnovateMR sent an e-mail to eligible panel members with a link to the survey via Qualtrics survey software (Qualtrics, Provo, UT). Interested panel members first read a screen that provided the study information and checked a box to indicate agreement to participate.

Stimuli

The sugary drink countermarketing videos were adapted from a previously successful healthy eating campaign aimed at parents of infants.[19] Addressing caregivers of toddlers, the videos presented information to counteract common misperceptions about children's fruit drinks and toddler milks in a positive and entertaining manner. The fruit drink video provided information about ingredients, including added sugar, fruit juice, and diet sweetener content. The toddler milk video defined the products and stated that they contain added sugar, cost 4 times as much as plain milk, and their marketing claims are not supported by science.

Both videos stated that pediatricians do not recommend them and concluded with the message that plain milk and water are the only drinks that toddlers need. Pretesting with an online sample of caregivers (n = 146) confirmed understanding of video messages (unpublished data).

The control videos conveyed information about limiting screentime and caregivers co-viewing screens with their child. They were selected to match the sugary drink videos in tone, age of child, and production quality. All videos were less than 60 seconds and designed to be shared on social media. See Appendix (available as a supplement to the online version of this article at https://www.ajph.org) for screenshots of the videos in both conditions. The actual videos are available at https://uconnruddcenter.org/healthydrinksfortoddlers.

Survey and Measures

After completing eligibility screening questions, participants provided information about their 9- to 36-month-old child. If they had more than one child in this age range, they were instructed to answer questions about the child whose name came first in the alphabet. They first answered questions to assess frequency of serving fruit drinks, toddler milks, plain water, plain and flavored milk, and other sugary drinks to their young child in the past week, and their own consumption of sugary drinks. Responses ranged from "Never" to "3 or more times per day" (7-point scale). To disguise the intent of the survey, participants answered similar questions about their child's use of TV and other screens.

Participants were then randomly assigned to view the countermarketing or control (screentime) videos. After watching each video, participants rated how much they liked the video; if they thought it was boring, believable, informative, and relevant; and if they would share it on social media. Responses ranged from strongly disagree (1) to strongly agree (6). Following viewing of both videos, all participants then answered questions to measure the dependent variables in the experiment, including behavioral intentions, attitudes, and normative beliefs about fruit drinks and toddler milks. Participants in both conditions answered similar questions about their child's TV viewing and other screen usage and attitudes and normative beliefs about screen usage.

Participants answered 5 questions each to assess attitudes about fruit drinks and toddler milks using 10-point semantic differentiation scales: from harmful to beneficial, foolish to wise, bad to good, inconvenient to convenient, and waste of money to good value for money. Next, participants indicated whether they planned to serve fruit drinks and toddler milks to their child in the next month and their plans to serve more plain water and plain milk. Those who had reported serving fruit drinks, toddler milks, or both in the past month also indicated whether they planned to cut back on serving the drink. Three normative belief questions asked whether family, friends, and community members often serve fruit drinks or toddler milks to their young children. Participants then indicated agreement with 3 positive statements about food and beverage companies and the importance of looking closely at nutrition labels. Responses to behavioral intentions, normative beliefs, and other attitude questions ranged from strongly disagree (1) to strongly agree (6). Finally, participants provided demographic information.

All questions were adapted from measures used in previous studies, including frequency of serving drinks,[20] ratings of public service videos,[21,22] and attitude, behavioral intentions, and normative beliefs questions.[21,23] Pretesting with a small convenience sample (n = 20) confirmed that survey questions were clear and easy to answer.

Analyses

We averaged participants' responses (from harmful to beneficial, foolish to wise, and bad to good) to create positive attitude scales for fruit drinks (Cronbach's $\alpha = 0.96$) and toddler milks (Cronbach's $\alpha = 0.96$). We also averaged answers to the normative beliefs questions to create scales for fruit drinks (Cronbach's $\alpha = 0.90$) and toddler milks (Cronbach's $\alpha = 0.92$), as well as the food company attitude questions (Cronbach's $\alpha = 0.84$). Responses to convenience, value, and nutrition label questions remained as separate variables.

Categorical variables used in the analysis included caregiver gender, education, Hispanic ethnicity, race, and participation in Supplemental Nutrition Assistance Program (SNAP) and Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). Children's ages were coded into 3 groups: 8 to 12 months, 13 to 24 months, and 25 to 37 months. We excluded participants who provided a birth date for their child that was more than 1 month outside of the specified age ranges (i.e., < 8 or > 37 months) from the final sample. Participants who reported serving fruit drinks or toddler milks to their child 1 or more times in the past week were coded as "served fruit drinks" or "served toddler milks," respectively.

We used the χ^2 test to assess equal random assignment of individual characteristics between conditions. We used the independent sample *t* test to measure differences between conditions in video ratings and all dependent variables. We calculated effect sizes by using Cohen's *d*. We used multivariate analyses of variance to explore potential individual differences and interaction effects on intent to serve fruit drinks and toddler milks, with condition and different demographic characteristics as fixed factors.

RESULTS

Of the 1330 panel members who responded to the survey invitation, 587 declined to participate or did not meet eligibility criteria. An additional 107 participants did not complete the survey, 24 answered questions about a child who did not meet the age range requirements, and 12 were excluded for implausible responses: an 81% completion rate. The Consort Flow Diagram is available as a supplement to the online version of this article at https://ajph.org. The final sample (n = 600) was two thirds female, and approximately one third had a 4-year college degree or higher (Table 1).

Quotas ensured a diverse sample: 26% self-identified as Hispanic, and less than one half identified as White race only. Approximately one third each participated in SNAP and WIC. Of the children described in the survey, 20% were 12 months or younger, with the remainder approximately evenly divided between 13 to 24 months and 25 to 37 months. Overall, 66% reported serving fruit drinks to their child in the past week, and 50% reported serving toddler milks. Serving fruit drinks increased with child's age (χ^2[2, n = 600] = 19.78;

TABLE 1— Demographic Characteristics of Survey Participants (n = 600): United States, January 2021

	Frequency (%)[a]
Condition	
Control (screentime videos)	298 (49.7)
Experiment (sugary drink countermarketing videos)	302 (50.3)
Caregiver characteristics	
Gender	
Male	163 (27.2)
Female	414 (69.0)
Age, y	
18–24	96 (16.0)
25–34	318 (53.0)
≥ 35	184 (30.7)
Education	
High school or less	161 (26.8)
Some college or 2-y degree	223 (37.2)
4-y college degree	135 (22.5)
Higher or professional degree	80 (13.3)
Born in United States	536 (89.3)
Hispanic ethnicity	155 (25.8)
Race	
White only	276 (46.0)
Black only	195 (32.5)
Asian only	60 (10.0)
Mixed or other	47 (7.8)
SNAP participation	209 (34.8)
WIC participation	205 (34.2)
Child characteristics	
Age, mo	
8–12	122 (20.3)
13–24	231 (38.5)
25–37	247 (41.2)
Gender	
Boy	295 (49.2)
Girl	304 (50.7)
Sugary drink provision (in past week)	
Served fruit drinks to their child, by age, mo	
8–12	62 (50.8)
13–24	152 (65.8)
25–37	183 (74.1)
Served toddler milks to their child, by age, mo	
8–12	73 (59.8)
13–24	126 (54.5)
25–37	100 (40.5)
Caregiver drank a sugary drink	503 (83.8)

Note. SNAP = Supplemental Nutrition Assistance Program; WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.
[a]Not all percentages add up to 100% because of missing responses.

$P < .001$, whereas serving toddler milks decreased with age (χ^2[2; n = 600] = 15.57; $P < .001$). Nearly all participants (84%) reported that they themselves had consumed sugary drinks in the past week.

Equal numbers of participants were randomly assigned to watch the screen-time videos (control condition; n = 298) and the sugary drink countermarketing videos (experimental condition, n = 302). Comparisons of demographic characteristics by condition demonstrated successful random assignment (all Ps > .22), with 1 exception. More participants in the control condition participated in WIC (37.6%) compared with the experimental condition (30.8%; χ^2[1, n = 600] = 3.07; $P = .08$), although this difference was not statistically significant.

Evaluations of the control and sugary drink videos did not differ on liking, believability, informativeness, likelihood to share, and relevance (all Ps ≥ .47). Participants were less likely to rate the countermarketing videos as boring (mean = 1.44 out of 6; SD = 1.37) compared with the control videos (mean = 1.64; SD = 1.33; $t(598) = 1.86$; $P = .06$), although this difference was not statistically significant. Averaged video attitudes did not differ; participants rated both the control videos (mean = 4.86; SD = 0.82) and the countermarketing videos (mean = 4.89; SD = 0.85) positively, and overall ratings did not differ by condition ($P = .65$).

Effects of Viewing Countermarketing Videos

Watching the sugary drink videos had the hypothesized effects on most dependent variables (Table 2). The countermarketing videos significantly reduced caregivers' overall positive attitudes about fruit drinks (mean difference = 0.92; 95% confidence interval [CI] = 0.52, 1.32) and toddler milks (mean difference = 2.10; 95% CI = 1.67, 2.53), as well as perceptions of product convenience and value. Watching the countermarketing videos also reduced positive attitudes about food and beverage companies (mean difference = 0.26; 95% CI = 0.06, 0.45). Effect sizes ranged from small (Cohen's $d \leq 0.28$) for reductions in food and beverage company attitudes and fruit drink convenience to large (Cohen's $d \geq 0.69$) for reductions in value and positive attitudes about toddler milks.[24]

The sugary drink countermarketing videos also significantly reduced intentions to serve both fruit drinks (mean difference = 0.50; 95% CI = 0.22, 0.77) and toddler milks (mean difference = 0.92; 95% CI = 0.63, 1.21). Effect size was greater for reduced intent to serve toddler milks versus fruit drinks. Among caregivers who reported serving the drinks in the past week, the countermarketing videos significantly increased intentions to cut back on toddler milks (mean difference = 0.62; 95% CI = 0.24, 1.00), and increased intentions to cut back on fruit drinks, but the difference was not statistically significant (mean difference = 0.24; 95% CI = −0.18, 0.67). Viewing the countermarketing videos also significantly increased intentions to serve more plain milk (mean difference = 0.52; 95% CI = 0.30, 0.87), and increased intentions to serve more water, but the difference was not statistically significant (mean difference = 0.17; 95% CI = −0.03, 0.37; $P = .10$).

The videos did not significantly affect normative beliefs about serving either drink nor agreement that it is important to look closely at nutrition labels for children's drinks.

Potential Individual Differences in Video Effects

Across all individual characteristics tested, main effects of watching the sugary drink videos remained significant, indicating that the videos reduced intent to serve these drinks across diverse demographic groups. However, exploratory analyses identified some individual differences in intent to serve fruit drinks (Table 3) and toddler drinks (Table 4).

WIC participants reported higher intent to serve fruit drinks (mean = 3.61; 95% CI = 3.37, 3.84) compared with nonparticipants (mean = 3.27; 95% CI = 3.10, 3.43), but differences in intent to serve toddler milks were not significant. Caregivers who currently served fruit drinks also reported significantly higher intentions to serve the product (mean = 3.99; 95% CI = 3.84, 4.13) than those who did not serve them (mean = 2.20; 95% CI = 1.99, 2.40), and caregivers who served toddler milks (mean = 4.33; 95% CI = 4.06, 4.40) had higher intentions to serve them versus those who did not (mean = 2.20; 95% CI = 2.03, 2.37). Caregivers' intent to serve fruit drinks increased with child's age (mean = 3.06; 95% CI = 2.76, 3.36 [8–12 months] vs mean = 3.62; 95% CI = 3.41, 3.83 [25–37 months]). Intent to serve toddler milks declined by child's age, but the difference was not statistically significant (mean = 3.45; 95% CI = 3.12, 3.78 [8–12 months] vs mean = 3.02; 95% CI = 2.79, 3.24 [25–37 months]). Black caregivers also reported higher intentions to serve fruit drinks (mean = 3.68; 95% CI = 3.44, 3.91) compared with White caregivers (mean = 3.30; 95% CI = 3.10, 3.50). However, Black and White caregivers did not differ in intent to serve toddler milk products, and intent to serve both products did not differ by Hispanic ethnicity.

TABLE 2— Effects of Viewing Sugary Drink Countermarketing Videos: United States, January 2021

	Screentime Videos (Control; n = 298), Mean (SD)	Sugary Drink Videos (Experiment; n = 302), Mean (SD)	*t*(598)	*P*	Cohen's *d*
Attitudes about fruit drinks (1–10 scale)[a]					
Overall positive[b]	5.67 (2.48)	4.74 (2.50)	4.53	< .001	0.37
Convenient	6.62 (2.72)	5.81 (3.00)	3.46	.001	0.28
Good value	5.71 (2.83)	4.58 (2.89)	4.86	< .001	0.40
Attitudes about toddler milks (1–10 scale)[a]					
Overall positive[b]	6.98 (2.36)	4.88 (2.93)	9.66	< .001	0.79
Convenient	6.67 (2.71)	4.92 (3.27)	7.15	< .001	0.58
Good value	6.27 (2.86)	4.18 (3.19)	8.44	< .001	0.69
Intent to serve (1–6 scale)[c]					
Fruit drinks[d]	3.63 (1.69)	3.13 (1.70)	3.58	< .001	0.29
Toddler milks[d]	3.67 (1.78)	2.75 (1.86)	6.18	< .001	0.51
Cut back on fruit drinks[e]	4.01 (1.46)	4.25 (1.43)	1.69	.09	0.17
Cut back on toddler milks[e]	3.52 (1.73)	4.14 (1.63)	3.20	< .01	0.37
More water[d]	4.83 (1.23)	5.00 (1.24)	1.66	.10	0.14
More plain milk[d]	4.27 (1.53)	4.75 (1.50)	3.92	< .001	0.32
Normative beliefs (1–6 scale)[c,f]					
Fruit drinks	4.42 (1.27)	4.41 (1.27)	0.11	.92	0.01
Toddler milks	3.82 (1.50)	3.62 (1.56)	1.60	.11	0.13
Other attitudes (1–6 scale)[c]					
Food and beverage companies (overall positive)[g]	3.90 (1.13)	3.64 (1.29)	2.62	.01	0.21
Importance of reading nutrition labels[h]	4.93 (1.18)	5.03 (1.15)	1.06	.29	0.09

[a]Semantic differentiation scale, "I think serving [fruit drinks/toddler milks] to my child is. . ."
[b]Average of harmful to beneficial, foolish to wise, bad to good.
[c]Agreement scale (1 = strongly disagree to 6 = strongly agree).
[d]"In the next month, I plan to serve [fruit drinks/toddler milks/more water/more plain milk] to my child."
[e]"In the next month, I plan to cut back on serving [fruit drinks/toddler milks] to my child" was asked among those who reported serving fruit drinks (n = 397) or toddler milks (n = 299) in the past week.
[f]Average of "Members of my family," "My friends," and "Members of my community" "often serve [fruit drinks/toddler milks] to their young children."
[g]Average of "Food and beverage companies" "make nutritious products for children," "care about children's health," and "make it easy for parents to make healthy choices for their kids."
[h]"It's important to look closely at the nutrition label on the drinks I buy for my child."

The only significant interaction between individual characteristics and video condition occurred in the model that assessed intent to serve fruit drinks by race. The effect of countermarketing videos on intent to serve fruit drinks was greater for Black versus White caregivers (mean difference = 0.78 and 0.12, respectively). The interaction between condition and child's age for intent to serve fruit drinks indicated that effects of the countermarketing videos may decline with child's age, but it was not statistically significant. However, there were no other significant interactions between individual characteristics and condition for intent to serve fruit drinks and no interactions for toddler milks. Therefore, the countermarketing videos similarly reduced intentions to serve the products across most demographic groups.

DISCUSSION

Viewing videos designed to educate caregivers of young children about the healthfulness of fruit drinks and toddler milks significantly reduced positive attitudes about these drinks and intentions to serve them to their child. The videos also reduced positive attitudes about food and drink companies, indicating a potentially effective countermarketing message. Countermarketing campaigns that highlight industry manipulation of consumers and negative health consequences of marketing practices have been used effectively to counteract tobacco advertising and can

TABLE 3— Intent to Serve Fruit Drinks: Effects of Sugary Drink Countermarketing Videos by Individual Characteristics, United States, January 2021

	Mean (95% CI)		Main Effect, F (*P*)		
	Control	Experiment	Individual Characteristic	Condition	Interaction, F (*P*)
WIC status			F(1596) = 15.60 (.02)	F(1596) = 26.99 (.002)	F(1596) = 0.72 (.62)
Participant (n = 205)	3.80 (3.48, 4.11)	3.42 (3.08, 3.76)			
Nonparticipant (n = 395)	3.53 (3.28, 3.77)	3.01 (2.78, 3.23)			
Served in past month			F(1596) = 199.75 (< .001)	F(1596) = 17.43 (< .001)	F(1596) = 0.23 (.63)
Yes (n = 397)	4.22 (4.01, 4.43)	3.75 (3.55, 3.96)			
No (n = 203)	2.49 (2.21, 2.77)	1.90 (1.61, 2.19)			
Child age group, months			F(2594) = 5.20 (.006)	F(1594) = 18.45 (< .001)	F(2594) = 2.79 (.06)
8–12 (n = 122)	3.62 (3.21, 4.01)	2.51 (2.07, 2.95)			
13–24 (n = 231)	3.53 (3.23, 3.84)	3.00 (2.69, 3.31)			
25–37 (n = 247)	3.73 (3.42, 4.04)	3.51 (3.22, 3.79)			
Ethnicity			F(1596) = 0.97 (.32)	F(1596) = 6.69 (.01)	F(1596) = 1.16 (.28)
Hispanic (n = 155)	3.62 (3.25, 3.99)	3.38 (2.99, 3.77)			
Non-Hispanic (n = 445)	3.63 (3.41, 3.86)	3.06 (2.83, 3.27)			
Race			F(1467) = 7.57 (.02)	F(1467) = 8.55 (.004)	F(1467) = 4.39 (.04)
Black (n = 203)	4.07 (3.74, 4.40)	3.29 (2.95, 3.63)			
White (n = 284)	3.36 (3.09, 3.64)	3.24 (2.96, 3.52)			

Note. CI = confidence interval; WIC = Special Supplemental Nutrition Program for Women, Infants, and Children. Intent to serve fruit drunks assessed with "In the next month, I plan to serve fruit drinks to my child." Responses ranged from 1 (strongly disagree) to 6 (strongly agree).

potentially address misleading food marketing practices as well.[25] Our results confirm that videos that provide accurate information about product ingredients and address potentially misleading marketing claims used to promote fruit drinks and toddler milks may help reduce widespread provision of these sugary drinks to young children.[11]

Although the videos reduced behavioral intentions and positive attitudes about both types of sugary drinks, effect sizes were consistently higher for toddler milks. This finding supports other studies showing widespread confusion about toddler milks.[8,11,17] It also suggests that factors beyond misperceptions about product healthfulness may explain caregivers' decisions to serve fruit drinks. Previous research has shown that widespread availability, low cost, and provision and consumption by other family members all contribute to high levels of fruit drink consumption by young children.[26–28]

The videos reduced intentions to serve both fruit drinks and toddler milks when we controlled for a range of individual characteristics, including caregivers who currently served the products and across age groups, indicating that these messages resonated with a wide audience of caregivers. However, they appeared to be more effective with caregivers of infants and young toddlers (8–24 months) compared with older toddlers (25–37 months), which confirms the importance of reaching infant caregivers with messages about avoiding sugary drinks before their child develops a strong preference for sweet drinks.[2] The videos also affected Hispanic and non-Hispanic caregivers similarly, but the videos were significantly more effective in reducing intent to serve fruit drinks for Black versus White caregivers. Therefore, countermarketing messages, such as these, may provide an opportunity to reduce high levels of sugary drink consumption by Black children and address health disparities affecting communities of color.[2]

The videos were somewhat less successful in encouraging healthy drinks than discouraging sugary drinks. They increased intentions to serve more plain milk, but not plain water. Intent to serve more plain water may be subject to ceiling effects as it was higher than other intentions in the control condition. However, this finding may also indicate that caregivers do not consider water to be a substitute for fruit drinks or toddler milks and that providing

TABLE 4— Intent to Serve Toddler Milks: Effects of Sugary Drink Countermarketing Videos by Individual Characteristics, United States, January 2021

Individual Characteristics	Mean (95% CI)		Main Effect, F (*P*)		Interaction, F (*P*)
	Control	Experiment	Individual Characteristic	Condition	
WIC status			F(1596) = 0.33 (.86)	F(1596) = 36.06 (< .001)	F(1596) = 0.32 (.57)
Participant (n = 205)	3.74 (3.40, 4.08)	2.71 (2.34, 3.08)			
Nonparticipant (n = 395)	3.62 (3.36, 3.89)	2.77 (2.52, 3.02)			
Served in past month			F(1596) = 271.70 (< .001)	F(1596) = 58.16 (< .001)	F(1596) = 2.01 (.16)
Yes (n = 299)	4.78 (4.54, 5.03)	3.67 (3.43, 3.91)			
No (n = 301)	2.58 (2.34, 2.82)	1.82 (1.58, 2.06)			
Child age group, months			F(2594) = 2.61 (.008)	F(1594) = 35.44 (< .001)	F(2594) = 0.54 (.58)
8–12 (n = 122)	3.62 (3.21, 4.01)	2.51 (2.07, 2.95)			
13–24 (n = 231)	3.53 (3.23, 3.84)	3.00 (2.69, 3.31)			
25–37 (n = 247)	3.73 (3.42, 4.04)	3.51 (3.22, 3.79)			
Ethnicity			F(1596) = 0.89 (.35)	F(1596) = 28.68 (< .001)	F(1596) = 0.00 (.96)
Hispanic (n = 155)	3.78 (3.38, 4.17)	2.88 (2.46, 3.29)			
Non-Hispanic (n = 445)	3.63 (3.39, 3.87)	2.71 (2.47, 2.95)			
Race			F(1467) = 0.98 (.32)	F(1467) = 23.97 (< .001)	F(1467) = 0.33 (.56)
Black (n = 195)	3.63 (3.28, 3.99)	2.90 (2.54, 3.27)			
White (n = 276)	3.56 (3.27, 3.86)	2.64 (2.34, 2.94)			

Note. CI = confidence interval; WIC = Special Supplemental Nutrition Program for Women, Infants, and Children. Intent to serve toddler milks assessed with "In the next month, I plan to serve toddler milks to my child." Responses ranged from 1 (strongly disagree) to 6 (strongly agree).

information about reasons to reduce sugary drink consumption may not directly increase water consumption (or vice versa).

Moreover, the countermarketing videos did not change perceived descriptive norms about family, friends, and other community members often serving fruit drinks and toddler milks. The videos were not designed to specifically address these beliefs, but successful health behavior change may also require changing normative beliefs.[29] In this study, beliefs that others often serve fruit drinks was higher than beliefs about serving toddler milks; thus, efforts to reduce fruit drink consumption must specifically address these perceptions. In addition, the videos did not increase perceived importance of examining nutrition labels. This finding could also be attributable to ceiling effects but suggests that caregivers may not have confidence in their ability to obtain ingredient information by reading nutrition facts labels.

Limitations

Strengths of this study include a randomized controlled experimental design to assess causal effects of viewing countermarketing videos; control videos closely matched on likability, believability, informativeness, and relevance; inclusion of screentime survey questions to help disguise study intent and reduce demand effects; and data collection via mobile devices or computer to reproduce the digital environment where videos would be disseminated. However, this study does have limitations. Behavioral measures assessed changes in intent to serve drinks, not actual provision, and intentions expressed in an online experiment may not be representative of real-world behaviors. However, intentions can predict actual health behavior change.[29] In addition, quota sampling ensured a diverse sample, but the study did not have enough power to measure interactions between individual characteristics. Additional research is needed to assess how well the videos worked with caregivers of other underrepresented demographic groups, as well as whether changes in attitudes and behavioral intentions translate to actual sustained reductions in sugary drink provision.

Public Health Implications

Experts from leading US health organizations advise that promoting healthy

beverage consumption by young children, including avoiding sweetened fruit drinks and toddler milks, is a public health priority.[2,5] However, the majority of caregivers provide such drinks to their toddler-age children while common marketing practices mislead parents to believe these drinks are healthy and benefit their children.[8,10] This study demonstrates that a public health education campaign has the potential to reduce positive attitudes and intent to serve these products among diverse infant and toddler caregivers, as well as to address health disparities attributable to high sugary drink consumption by children in communities of color.[2] Moreover, countermarketing messages that demonstrate how companies take advantage of caregivers' desire to provide the best nutrition for their young children may also provide a powerful motivation to resist misleading marketing messages.[25,30]

However, widespread reductions in sugary drink provision to young children will likely require a full array of public health initiatives.[31] Education campaigns could also enlist health providers to address caregiver misperceptions about serving fruit drinks and toddler milks. The US Food and Drug Administration could strengthen labeling requirements, including requiring consistent reporting of added sugar, nonnutritive sweeteners, and juice content on fruit-flavored drink package fronts; establishing requirements for toddler milk labeling; and regulating potentially deceptive claims.[16,32] Companies should not market sweetened fruit drinks directly to children in advertising or through brand characters and other child-directed features on product packages.[16,32] Formula manufacturers should comply with the World Health Organization's Code of Marketing Breastmilk Substitutes and discontinue all direct-to-consumer marketing of infant formula and toddler milks.[33] Consumer education, regulation, and responsible marketing practices are all required to promote healthy beverage intake by young children. AJPH

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CONTRIBUTORS

J. L. Harris designed the study, supervised data collection, conducted data analysis, and wrote the first draft of the article. L. Phaneuf developed the survey, implemented data collection, and conducted preliminary data analyses. F. Fleming-Milici conceptualized the study, obtained funding, and supervised survey development and data collection. All authors provided revisions and approved the final article.

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The authors have no conflicts of interest to report.

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This study was determined to be exempt by the institutional review board of the University of Connecticut.

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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, B_6, and B_{12}, 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 research and public health surveillance, programs, and communication and dissemination efforts aimed at improving nutrition in the first 1000 days (Box 1).

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

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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CONFLICTS OF INTEREST

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

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Iron Deficiency in the United States: Limitations in Guidelines, Data, and Monitoring of Disparities

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Iron deficiency and the more severe sequela, iron deficiency anemia, are public health problems associated with morbidity and mortality, particularly among pregnant women and younger children. The 1998 Centers for Disease Control and Prevention recommendations for prevention and control of iron deficiency in the United States is old and does not reflect recent evidence but is a foundational reference for many federal, clinical, and program guidelines.

Surveillance data for iron deficiency are sparse at all levels, with critical gaps for pregnant women and younger children. Anemia, iron deficiency, and iron deficiency anemia are often conflated but should not be. Clinical guidelines for anemia, iron deficiency, and iron deficiency anemia give inconsistent recommendations, causing nonsystematic assessment of iron deficiency. Screening for iron deficiency typically relies on identifying anemia, despite anemia's low sensitivity for iron deficiency. In the National Health and Nutrition Examination Survey, more than 70% of iron deficiency is missed among pregnant women and children by relying on hemoglobin for iron deficiency screening.

To improve assessment and diagnosis and strengthen surveillance, better and more complete data and updated foundational guidance on iron deficiency and anemia are needed that consider new evidence for measuring and interpreting laboratory results. (*Am J Public Health*. 2022;112(S8):S826–S835. https://doi.org/10.2105/AJPH.2022.306998)

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Iron deficiency is associated with increased morbidity and mortality among high-risk population groups, particularly pregnant women and younger children.[1–4] US foundational guidance on preventing and controlling iron deficiency is dated or inconclusive,[5–8] and public health surveillance is limited. The US Preventive Services Task Force reports that there are insufficient data to recommend routine screening for iron deficiency in the absence of anemia.[7,8]

We describe the importance of adequate iron status for individuals, limitations in the Centers for Disease Control and Prevention's (CDC's) *Recommendations to Prevent and Control Iron Deficiency in the United States*,[5] evidence gaps, and barriers to improving surveillance. We also provide the prevalence of anemia, iron deficiency, and iron deficiency anemia for pregnant women and younger children based on available data, and we highlight efforts to strengthen surveillance estimates among high-risk groups.

During the first 1000 days of life, from pregnancy to a child's second birthday, iron requirements increase substantially to support blood volume expansion in pregnancy, build iron stores in the infant, and aid growth and brain development. Two thirds of the body's iron is stored in red blood cells as hemoglobin, which is used for oxygen transport, with the remaining one third used as a necessary cofactor for many enzymes affecting metabolism, immunity, and neurotransmitters.[9]

During pregnancy, red blood cell production increases about 40%, with a direct association between blood volume expansion and fetal growth.[10] Furthermore, the majority of child brain growth and development happens before age 2.[11] Iron is a key determinant of neural development, affecting

brain structures, neurotransmitter systems, and myelination of nerve fibers. When iron stores are low, iron is preferentially used for hemoglobin synthesis, leaving the brain at risk for the adverse effects of iron deficiency even in the absence of anemia.[3,12–14] Recent evidence also suggests that iron deficiency may be associated with reduced efficacy of some childhood vaccinations.[15] Among adults, iron deficiency is associated with reduced physical productivity and work capacity.[4]

Serum ferritin is an indicator of iron stores. As ferritin levels decline, hemoglobin concentration is reduced to an anemic level only at the end stage of severe iron deficiency (Figure 1). Recent evidence suggests that many pregnant women may have undiagnosed nonanemic iron deficiency.[17,18] Identifying and treating iron deficiency early may, therefore, prevent the long-term adverse effects associated with unrecognized deficiency[3,13] and stop the progression and more serious consequences associated with severe iron deficiency anemia. Anemia during pregnancy can result in poor fetal growth, preterm birth, and low birth weight for the infant, and risk of death for the mother and baby increases with anemia severity.[1,2,19,20]

Consequently, practices to assess anemia often focus on the prevention of severe shorter-term outcomes, such as risks associated with hemorrhage in childbirth, severe maternal morbidity, and mortality.[21]

Because iron deficiency is a leading, but not the only, cause of anemia,[4,19] iron deficiency, iron deficiency anemia, and anemia are frequently conflated, which is problematic. Furthermore, the criteria to diagnose iron deficiency, iron deficiency anemia, and anemia varies (Table A, available as a supplement to the online version of this article at https://www.ajph.org). Anemia is often used as a proxy for iron deficiency or iron deficiency anemia,[7,8] given the low cost and ease by which hematologic indicators can be measured with a point-of-care test. This practice persists despite more than 2 decades of evidence indicating that hemoglobin is not an efficient predictor of iron deficiency in the United States.[5] Relying on anemia screening leaves early stages of treatable iron deficiency unidentified and untreated; consequently, longer-term adverse outcomes of iron deficiency, such as impaired cognitive and motor development, may go unchecked.

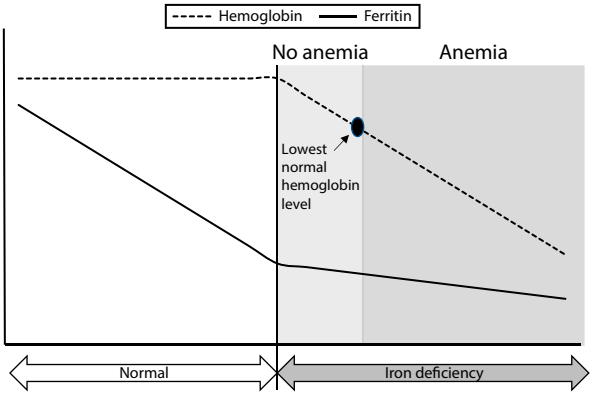

FIGURE 1— Relationship Between Ferritin and Hemoglobin

Source. Adapted from Guthrie and Picciano.[16]

Studies indicate that universal iron deficiency screening using ferritin may be cost effective compared with no screening or targeted screening.[22,23] The US Preventive Services Task Force guidelines focus on iron deficiency anemia screening and iron supplementation among asymptomatic pregnant women and children aged 6 to 24 months, not on iron deficiency.[7,8] Furthermore, foundational guidelines on screening for anemia, iron deficiency, and iron deficiency anemia are outdated[5,6] or inconclusive[7,8] and do not follow recent updated World Health Organization (WHO) guidance.[4,19] As a result, US clinical guidelines and practices vary widely.[1,6–8,24–29]

National prevalence data on anemia, iron deficiency, and iron deficiency anemia among infants, younger children, and pregnant women are limited. Prevalence data are almost nonexistent at the state and local levels, including, in the highest-risk subgroups (e.g., minority racial/ethnic groups and people with low incomes), infants who are exclusively breastfed and people who are in the third trimester of pregnancy.[24,30,31] Furthermore, the biochemical indicators and diagnostic thresholds used in clinical and surveillance settings vary, and they measure different aspects of iron metabolism; this creates inconsistency and complexity in understanding US iron status.[32–34] For example, Healthy People 2030 monitors total body iron index (TBII), which is calculated from ferritin and soluble transferrin receptor (sTfR) concentrations,[35] whereas sTfR has limited availability in clinical settings. Data sparsity and inconsistency limit the ability to monitor trends, direct interventions, evaluate programs and policies, reduce health inequities, and inform guidelines.

OUTDATED IRON DEFICIENCY GUIDANCE

The 1998 CDC recommendations for prevention and control of iron deficiency in the United States[5] is a foundational reference for many federal, clinical, and program guidelines[1,7,8,27,29]; however, it does not reflect the evidence available for both primary and secondary prevention of iron deficiency. The recommendations, published almost 25 years ago, were based on the recommendations of a 1993 Institute of Medicine report,[6] a 1994 expert panel convened by the CDC, and input from multidisciplinary experts. With the release of the *2020–2025 Dietary Guidelines for Americans*, which for the first time includes comprehensive guidelines for infants and children younger than 2 years, guidance on primary prevention of iron deficiency centering on diet has been recently reviewed and updated.[36] However, there remain key areas that lack updated foundational guidance for assessment and diagnosis of iron deficiency, including primary laboratory tests, thresholds defining deficiency, and interpretation of results. These are critical for informing and updating screening guidance, as current guidance relies on hematologic indicators known to lack sensitivity in identifying iron deficiency and focuses only on end-stage iron deficiency anemia, and so misses treatable iron deficiency.

Biomarkers to Assess Iron Status

Despite stating that serum ferritin is the most specific indicator available of depleted iron stores, the CDC recommendations propose multiple iron biomarkers reflecting various aspects of iron metabolism, including iron depletion, iron transport, iron-deficient erythropoiesis, and iron deficiency anemia, resulting in differences in iron deficiency identification and, consequently, clinical decisions and population prevalence (Table A).[5] Unclear criteria for defining iron deficiency increases complexity and limits consistency in tests used and diagnosis, so that clinical iron assessment in the United States is not systematic.[32–34] Recent reviews conclude that ferritin and hemoglobin are important or recommended when measuring uncomplicated iron deficiency (no inflammation or infection),[37] and other reviews additionally recommend C-reactive protein (CRP) in the context of inflammation.[14,38] In 2020, after following an evidence-based methodology,[39] the WHO updated their guidance recommending ferritin to assess the iron status of individuals and populations.[4]

Thresholds to Define Iron Deficiency

CDC recommendations for ferritin thresholds to define iron deficiency specify 15 or less micrograms per liter (μg/L) among people older than 6 months.[5] No rationale for this threshold among children is provided, and for women a single publication examining ferritin and bone marrow is cited. The American College of Obstetricians and Gynecologists recently increased their recommended ferritin threshold to define iron deficiency among pregnant women as from less than 10 μg/L to less than 30 μg/L,[1] based on a 90% probability that iron stores are depleted when ferritin is less than 30 μg/L, even in the absence of anemia.[38] In the 2020 guideline, the WHO determined that insufficient data were available to revise the ferritin thresholds of less than 12 μg/L for children younger than 5 years and less than 15 μg/L for individuals aged 5 years and older.[4] The WHO includes a ferritin threshold of less than 15 μg/L for pregnant women in the first trimester but no thresholds for later pregnancy. Furthermore, the WHO concluded that all the thresholds were supported by a low to very low certainty of evidence.

More recent publications have identified methods to derive ferritin thresholds based on physiologically linked processes reflecting multiple indicators of iron status and metabolism, such as the onset of iron-deficient erythropoiesis or upregulation of iron absorption from the diet.[40–44] Results obtained using these methods suggest that ferritin thresholds among healthy populations could be higher to identify treatable iron deficiency than those currently recommended by the WHO and the CDC. Evidence used to calculate TBII warrants revisiting, as the equation was validated in a small number of adults and the cutoff of less than 0 milligrams per kilogram[45] may need to be reexamined for pregnant women and children.

Influence of Inflammation and Infection

Ferritin is a positive acute phase protein strongly influenced by inflammation and infection that results in elevated ferritin values that may mask true iron deficiency.[4,5] CDC recommendations do not provide guidance on interpreting the effect of inflammation or infection on ferritin concentrations or using alternative indicators—guidance that is necessary for correctly interpreting results. Inflammation is common and thus may be especially important for those at high risk for both iron deficiency and inflammation or infection, such as younger children and those who are pregnant,

experience underweight or obesity, or have other chronic conditions.[46–48] Furthermore, acute phase proteins are known to increase with gestational age,[49,50] suggesting that when ferritin is used for testing, unidentified iron deficiency might be even higher among pregnant women in the second and third trimesters of pregnancy. Updated WHO guidance recommends that ferritin be assessed along with measures of inflammation (CRP and α-1-acid glycoprotein [AGP]) and that those assessing ferritin values account for the influence of inflammation and infection in both clinical and public health settings by following one of several suggested approaches.[4]

Anemia Assessment

In addition to iron deficiency guidance, the CDC has guidance on anemia assessment that needs to be revisited, considering new evidence in the decades since publication, including recommended laboratory tests, blood source, thresholds to define anemia, and interpretation of results. When screening for anemia to presumptively diagnose iron deficiency, the CDC recommends measuring either hemoglobin or hematocrit, while acknowledging that hemoglobin is the more direct and sensitive measure and that hematocrit declines only after hemoglobin has already decreased (Table A).[5]

The US Preventive Services Task Force states that there is insufficient evidence to recommend specific screening tests for iron deficiency anemia, but usually either hemoglobin or hematocrit is assessed first.[7,8] Professional medical organizations suggest measuring hemoglobin or hematocrit as a first step for anemia screening (Table A); their guidance could be driven by health objectives other than that of primarily identifying iron deficiency. For example, anemia during childbirth decreases tolerance for blood loss during delivery and increases the risk of hemorrhagic shock, cardiovascular failure, blood transfusion, and infection.[21,51]

Hemoglobin and hematocrit are frequently listed as interchangeable, but these indicators measure different hematologic processes. Hemoglobin is a direct measure of the iron-containing protein in red blood cells, which is critical for both red blood cell production and oxygen delivery to tissues. Hematocrit is a measure of the proportion of whole blood filled by red blood cells; red blood cell volume can also be influenced by other nutritional deficiencies, disease processes, and genetic blood disorders.[19] A recent study looked at the electronic health records (EHRs) of 1045 pregnant women with anemia who had both hemoglobin and hematocrit values and were assessed on the same day and seen in the first trimester. The study found that the concordance in identifying anemia with both tests was 45% and that agreement by anemia severity (i.e., mild; moderate or severe) was 37%.[52] Similar findings have been reported for other population groups in the United States, such as men in the military.[53] If hemoglobin and hematocrit are used interchangeably, they will frequently diagnose different people with anemia, leaving anemia and iron deficiency untreated in some individuals. Furthermore, prevalence estimates of anemia will differ depending on definitions. WHO 2017 guidance focuses primarily on hemoglobin to assess anemia.[19]

The CDC's recommended hemoglobin thresholds to define anemia for most population groups vary slightly from the WHO's guidance, whereas the recommendations for adjusting hemoglobin concentrations for elevation and smoking are the same (Table A). The WHO is in the process of reexamining evidence for the use of hemoglobin to assess anemia among individuals and populations to update their guideline. Since 2017, updated evidence has been presented at WHO technical consultations and during guideline development group meetings on analyzers and point-of-care devices (both invasive and noninvasive),[54,55] blood sources in different settings,[54,56] and adjustments to hemoglobin concentrations for elevation and smoking,[57,58] as well as for thresholds to define anemia for various population groups,[59,60] among other topics. Updating foundational guidance, systematizing recommendations on assessment and interpretation of laboratory results, and addressing guidance and data gaps can improve measurement and diagnosis and strengthen surveillance and prevalence estimates.

SURVEILLANCE GAPS AND PREVALENCE

National and state-level surveillance data gaps limit the ability to describe the problems of anemia and iron deficiency among high-risk population groups. The National Health and Nutrition Examination Survey (NHANES) produces nationally representative prevalence estimates of anemia and iron deficiency published in 2-year cycles, and these data are used to monitor the iron indicators for Healthy People 2030.[35] There is currently no state surveillance system producing state representative estimates for either anemia or iron deficiency, although state-level anemia data (and data for the District of Columbia, US territories, and Indian tribal organizations) are available every

2 years for low-income pregnant and postpartum women and children included in the Special Supplemental Nutrition Program for Women, Infants, and Children Participant and Program Characteristics survey (WIC-PC).[29]

NHANES measures hemoglobin, ferritin, sTfR, and CRP, but the number of children aged 12 to 23 months included in each 2-year cycle is small (~150) and no blood is collected among infants younger than 12 months; dietary transitions are known to be associated with increased risk of iron deficiency among children younger than 24 months.[61,62] NHANES stopped oversampling pregnant women in 2007 to 2008; sample sizes during each 2-year cycle are so small (~50 women) that reliable estimates by race and Hispanic origin or trimester can only be produced by combining data over approximately 10 years. Sample sizes for pregnant women and children aged 12 to 23 months limit the ability to monitor trends, particularly among higher-risk subgroups, and even with combining multiple survey cycles many estimates are still considered unreliable and not reportable. Oversampling pregnant women and younger children is a possible strategy, but feasibility needs to be determined.

The risk of both anemia and iron deficiency increases with gestational age, but the trimester of pregnancy is no longer collected after NHANES 2013–2014. Including pregnancy trimester in future NHANES cycles would support the monitoring of trends in disparities that occur in the third trimester. Because of funding gaps, iron indicators were not measured in some years (e.g., no ferritin and sTfR assessment during NHANES 2011–2014) or were not measured in younger children (e.g., no sTfR assessment among children younger than 3 years in NHANES 1999–2002). Similarly, CRP has not been measured consistently in all age groups over time, limiting the ability to adjust for inflammation and infection, particularly among children. Data on AGP has been lacking, but surplus specimens from NHANES 2015–2018 are being analyzed for AGP, and both CRP and AGP are now assessed in NHANES 2021–2022. Geographic location data are restricted to reduce risk of disclosure, so adjusting for the influence of elevation on hemoglobin values is challenging, potentially limiting identification of anemia among those residing at higher elevations.[5]

Anemia and Iron Deficiency Prevalence

For national anemia and iron deficiency prevalence estimates among pregnant women, NHANES data from 1999 to 2010 and from 2015 to 2018 show a positive increasing trend in anemia (*P* value for trend = .046; Table 1; supplementary text describes methods, available as a supplement to the online version of this article at https://www.ajph.org). The WHO defines public health problem severity thresholds for anemia based on hemoglobin[19] and iron deficiency based on ferritin[4] (Table A). This anemia prevalence meets the criteria for a mild public health problem.[19] During the same period, iron deficiency (inflammation-adjusted ferritin[63]) trends show no improvement (*P* for trend = 0.26), signifying a moderate public health problem. The prevalence of iron deficiency identified by ferritin was double that of TBII. Among those with iron deficiency identified by ferritin, inflammation-adjusted ferritin, or TBII, the percentages of women who also had anemia were identified. For those identified by ferritin, 19.5% (95% confidence interval [CI] = 13.1, 27.4) had anemia; by inflammation-adjusted ferritin, 19.5% (95% CI = 13.3, 27.0) had anemia; and by TBII, 30.4% (95% CI = 19.9, 42.6) had anemia. This indicates that approximately 70% to 80% or more of pregnant women with treatable iron deficiency are missed by relying on hemoglobin alone as a screen for iron deficiency.

There are important disparities by race and Hispanic origin and trimester of pregnancy (Table 1). Both anemia and iron deficiency are highest among non-Hispanic Black women and third trimester pregnant women, with iron deficiency prevalence for both indicating moderate public health problems. Data are too limited to report prevalence by trimester among race and Hispanic origin groups. Overall, iron deficiency anemia was rare (inflammation-adjusted ferritin and hemoglobin = 4.3% 95% CI = 3.0, 6.3).

Among children aged 12 to 23 months, anemia varied little between NHANES 2003–2010 and 2015–2018 (*P* for trend = .43) and is indicative of a mild public health problem (Table 2; supplementary text describes methods). Trends in iron deficiency (ferritin < 15 μg/L) were also stable over that period (*P* for trend = .10). Among the 563 children aged 12 to 23 months in NHANES 2003–2006 and 2015–2018 where CRP was measured, iron deficiency (ferritin < 15 μg/L) was 16.6% (95% CI = 13.2, 20.6) and inflammation-adjusted iron deficiency (inflammation-adjusted ferritin[63] < 15 μg/L) was 27.4% (95% CI = 22.9, 32.2), with the latter meeting the criteria of a moderate public health problem. Not using inflammation-adjusted ferritin among children aged 12 to 23 months results in a meaningful amount of treatable iron deficiency being missed in this group.

Using a physiologically based ferritin threshold of less than 20 μg/L to identify

TABLE 1— Prevalence of Anemia per Hemoglobin and Iron Deficiency per Ferritin, Inflammation-Adjusted Ferritin, and Total Body Iron Index Among Pregnant Women Aged 15–49 Years: United States, NHANES 1999–2010 and 2015–2018

	No.	Anemia, % (95% CI)	Iron Deficiency (Ferritin < 15 µg/L),[a] % (95% CI)	Iron Deficiency (Ferritin adjusted < 15 µg/L),[b] % (95% CI)	Iron Deficiency (TBII < 0 mg/kg),[c] % (95% CI)
Total (1999–2010, 2015–2018)[d]	1371	7.5 (5.5, 10.0)	20.9 (17.7, 24.5)	22.7 (19.4, 26.4)	10.8 (8.7, 13.3)
Survey years					
1999–2002	567	5.3 (2.8, 8.9)	16.5 (12.4, 21.3)	20.0 (15.0, 25.7)	8.5 (6.1, 11.5)
2003–2006	585	6.6 (3.0, 12.4)[e]	22.4 (17.3, 28.1)	23.0 (17.9, 28.7)	13.2 (9.8, 17.3)
2007–2010	113	9.6 (4.7, 17.0)	20.8 (12.7, 31.1)	21.4 (13.4, 31.4)	8.6 (3.1, 18.1)[e]
2015–2018	106	11.1 (5.8, 18.6)	26.9 (16.4, 39.6)	28.5 (18.3, 40.6)	13.3 (7.1, 22.0)
Trimester[d]					
1st	178	2.3 (0.5, 6.4)[e]	5.2 (2.4, 9.9)[e]	5.2 (2.4, 9.9)[e]	3.3 (1.1, 7.5)[e]
2nd	345	4.3 (1.3, 10.0)[e]	17.6 (12.0, 24.6)	18.1 (12.4, 25.0)	8.6 (5.0, 13.5)
3rd	323	12.4 (7.2, 19.6)	33.6 (25.9, 42.0)	34.6 (26.8, 42.9)	20.1 (14.0, 27.5)
Unknown	525	8.3 (5.5, 11.9)	21.8 (16.7, 27.6)	24.9 (19.6, 30.8)	10.3 (7.2, 14.2)
Race and Hispanic origin[d]					
Non-Hispanic White	570	3.6 (1.6, 6.9)[e]	15.9 (11.8, 20.7)	17.5 (13.0, 22.8)	7.7 (5.3, 10.7)
Non-Hispanic Black	222	18.0 (12.0, 25.3)	32.7 (23.7, 42.7)	34.8 (25.9, 44.6)	17.4 (11.2, 25.2)
Mexican American	400	7.4 (4.0, 12.5)	25.6 (20.6, 31.1)	27.0 (21.9, 32.5)	14.0 (9.8, 19.1)
Other	179	11.0 (5.5, 19.0)	22.4 (14.2, 32.6)	24.9 (16.6, 34.9)	12.1 (6.1, 20.8)

Note. CDC = Centers for Disease Control and Prevention; CI = confidence interval; NHANES = National Health and Nutrition Examination Survey; TBII = total body iron index. Counts (No.) are unweighted. Anemia defined as smoking-adjusted hemoglobin < 11.0 grams per deciliter (g/dL) during first, third, or unknown trimester, and < 10.5 g/dL during second trimester. Trimester was not collected during 2015–2018, thus all are categorized as unknown. Hemoglobin is not elevation adjusted, as NHANES does not report these data. Smoking adjustments and trimester thresholds to define anemia and thresholds to define iron deficiency using serum ferritin are based on CDC.[5] Ferritin and soluble transferrin receptor were not assessed during 2011–2014. All analyses were weighted and accounted for the complex survey design.

[a]Thresholds to define iron deficiency from CDC. Ferritin was not inflammation adjusted.[5]
[b]Thresholds to define iron deficiency from CDC.[5] Ferritin inflammation adjusted using regression-based approach with C-reactive protein based on Namaste et al.[63]
[c]TBII based on Cook et al.[45]
[d]All survey years combined.
[e]Estimate considered unreliable based on National Center for Health Statistics Data Presentation Standards for Proportions (www.cdc.gov/nchs/data/series/sr_02/sr02_175.pdf).

iron deficiency based on new emerging evidence,[40,42] the prevalence almost doubles to 30.5%, reflecting a moderate public health problem even before adjusting for inflammation. Among those with iron deficiency identified by ferritin less than 15 µg/L, only 12.3% (95% CI = 6.6, 20.3) also had anemia; by ferritin less than 20 µg/L, 7.1% (95% CI = 3.9, 11.7) had anemia; by TBII, 18.5% (95% CI = 10.3, 29.4) had anemia. These findings indicate that more than 80% to 90% of children with treatable iron deficiency are missed by relying on hemoglobin alone to screen for iron deficiency.

Disparities by race and Hispanic origin in anemia and iron deficiency are evident, with the highest anemia prevalence among non-Hispanic Black children (10.7%), signifying a mild public health problem. Mexican American children had the highest iron deficiency prevalence across all indicators, indicating a moderate public health problem (Table 2). Overall, iron deficiency anemia was rare (2.0%; 95% CI = 1.0, 3.5).

Alternatives for Pregnancy Surveillance

Because iron deficiency surveillance during pregnancy is limited, alternative data sources, such as WIC-PC and EHRs, may help fill data gaps. WIC-PC, conducted by the US Department of Agriculture every other year, is a census of persons certified to receive WIC.[64] Anemia, not iron deficiency, screening is part of WIC certification; hemoglobin or hematocrit is reported from clinical

TABLE 2— Prevalence of Anemia per Hemoglobin and Iron Deficiency per Ferritin (Different Thresholds) and Total Body Iron Index Among Children Aged 12–23 Months: United States, NHANES 2003–2010 and 2015–2018

	No.	Anemia, % (95% CI)	Iron Deficiency (Ferritin < 15 µg/L)[a] % (95% CI)	Iron Deficiency (Ferritin < 20 µg/L),[b] % (95% CI)	Iron Deficiency (TBII < 0 mg/kg),[c] % (95% CI)
Total (2003–2010, 2015-2018)[d]	881	4.7 (3.4, 6.4)	16.2 (13.4, 19.4)	30.5 (27.3, 34.0)	10.3 (8.1, 12.8)
Survey years					
2003–2006	295	4.6 (1.9, 9.2)[e]	18.2 (12.9, 24.5)	30.9 (24.8, 37.5)	14.2 (9.1, 20.6)
2007–2010	320	3.6 (1.9, 6.3)	17.0 (12.8, 22.0)	31.3 (25.5, 37.5)	8.6 (4.9, 13.6)
2015–2018	266	6.0 (3.4, 9.5)	13.7 (9.0, 19.6)	29.5 (24.1, 35.4)	6.5 (3.7, 10.3)
Race and Hispanic origin[d]					
Non-Hispanic White	276	2.4 (1.0, 5.0)	14.1 (9.7, 19.5)	31.5 (25.9, 37.4)	7.1 (4.0, 11.5)
Non-Hispanic Black	207	10.7 (6.7, 16.0)	12.1 (7.5, 18.1)	20.6 (14.7, 27.7)	11.1 (6.6, 17.0)
Mexican American	249	4.1 (2.0, 7.4)[e]	23.6 (18.4, 29.5)	36.3 (30.3, 42.7)	15.1 (10.9, 20.1)
Other	149	7.7 (2.9, 16)[e]	18.3 (11.2, 27.4)	29.7 (21.1, 39.6)	14.2 (8.5, 21.7)

Note. CDC = Centers for Disease Control and Prevention; CI = confidence interval; NHANES = National Health and Nutrition Examination Survey; TBII = total body iron index. Counts (No.) are unweighted. Hemoglobin is not elevation adjusted, as NHANES does not report these data. Threshold to define anemia based on CDC.[5] Soluble transferrin receptor was not assessed during 1999–2002 and 2011–2014. C-reactive protein was not assessed 1999–2002 and 2007–2010. All analyses were weighted and accounted for the complex survey design.

[a]Ferritin not inflammation adjusted. Thresholds to define iron deficiency based on CDC.[5]
[b]Ferritin not inflammation adjusted. Thresholds to define iron deficiency based on Mei Z et al.[42]
[c]TBII based on Cook et al.[45]
[d]All survey years combined.
[e]Estimate considered unreliable based on National Center for Health Statistics Data Presentation Standards for Proportions (www.cdc.gov/nchs/data/series/sr_02/sr02_175.pdf).

documentation in a specified time or measured at the WIC clinic.[29] Data limitations include that they are not representative of all pregnant women in the United States, nor all pregnant women who meet income eligibility for WIC. Benefits include that sample sizes are large and can provide state-based estimates of anemia stratified by demographic characteristics (e.g., in 2018 overall the WIC-PC sample size was 609 775 pregnant women[31] compared with 106 pregnant women in NHANES 2015–2018).

In an analysis of WIC-PC trends, anemia among pregnant women showed a steady increase in prevalence from 10.1% in 2008 to 11.4% in 2018,[31] indicating a mild public health problem overall. Across 56 WIC state agencies (states and territories), a significant increase in prevalence was observed in 36 agencies, and a significant decrease was observed in 11 agencies. Consistent with NHANES, there were notable disparities by race/ethnicity and trimester of pregnancy. The highest anemia prevalence was among non-Hispanic Black women (> 20%), indicating a moderate public health problem. Among women with hemoglobin assessed in the third trimester, anemia prevalence was higher than 20% across women of all racial/ethnic groups and nearly 50% among non-Hispanic Black women. As WIC-PC reflects a population at high risk for iron deficiency and is a key source of data for pregnant women, it is important to continue monitoring these trends for pregnant and postpartum women and younger children.

EHR data can potentially answer identifiable data gaps, such as the prevalence of iron deficiency, health care provider practices, and the benefits and harms of screening and supplementation. EHR data vary in their data structure and content, (e.g., only outpatient visit data vs inpatient data, actual laboratory results or only *International Classification of Diseases* [*ICD*] diagnostic codes, data in text fields, or structured variables). Other factors that influence the availability of EHR data include clinical guidelines and workflow, protocols, processes, and practices in a given setting.

A recent analysis explored whether EHR data are a feasible data source for surveillance of anemia, iron deficiency, and iron deficiency anemia in pregnancy and provider practices[52] and for

filling data gaps identified by the US Preventive Services Task Force.[8] Provider practices explored included screening patterns, tests ordered, use of *ICD* codes, and use of iron supplements and prescriptions. This study of 41 991 pregnant women in their first trimester found that first trimester anemia screening measured by hemoglobin or hematocrit was nearly universal (93%).

Overall, anemia prevalence was low (3%); similar to data from NHANES and WIC-PC, non-Hispanic Black women had an anemia prevalence that was 2 to 5 times (10.9%) higher than did any other racial/ethnic group. Among pregnant women with anemia, less than 19% had ferritin assessed; among those without anemia, about 3% had it assessed. Less than 0.1% had CRP assessed, limiting the ability to account for the influence of inflammation or infection on ferritin. Among women with iron status assessed, 90% had ferritin assessed. It is unknown why more than 80% of women with anemia did not have ferritin measured but providers potentially assumed a presumptive diagnosis of iron deficiency anemia.[1]

Prescribing iron supplementation or advice for over-the-counter supplementation was not readily available in the EHR data. Laboratory test results were required, as the use of *ICD* codes was not a reliable indicator of laboratory-confirmed anemia prevalence. Among those with measured ferritin, regardless of anemia status, 48% had iron deficiency (i.e., ferritin of < 15 µg/L). Among women with both a determination of anemia and a measure of ferritin, the prevalence of iron deficiency and iron deficiency anemia was 27% and 7%, respectively.[52] The study concludes that EHR may potentially be used as a surveillance source for anemia. However, a standard case definition of anemia is required (e.g., low hemoglobin, low hematocrit, or both low).[52] With scant and selective screening for iron deficiency, the study concludes that EHR data cannot be used for surveillance of first trimester iron deficiency based on current practices in this EHR setting.

For EHR data to be used for surveillance of iron deficiency and iron deficiency anemia in pregnancy, the following are needed: laboratory test results, a systematic assessment of iron status, and the use of clear and consistent case definitions. An additional data source to explore to confirm whether data availability and provider practices differ in a larger EHR data source is IQVIA. This source has recent ambulatory EHR data that is national in scope and includes more than 80 million patients (IQVIA E360TM SaaS Platform; https://bit.ly/3KEjOov).

Another possibility is to explore working with clinical settings that serve higher-risk populations as a source of data (either existing routinely available data or primary data collection), such as federally qualified health centers or others, for iron deficiency and iron deficiency anemia prevalence; screening, diagnosis, and treatment practices; and over-the-counter micronutrient supplementation prescribing and dispensing practices. Laboratory innovations, such as the development of point-of-care ferritin and CRP devices, if the Food and Drug Administration approved and adopted them, could result in changes to clinical practices that increase the screening and diagnosis of iron deficiency. The federal government working with partners and clinical professional organizations could also strengthen and systematize screening practices and surveillance. Ultimately, a viable data source for surveillance will require a consistent assessment of iron status and case definitions.

CONCLUSIONS

Iron deficiency, iron deficiency anemia, and anemia assessment are related and can reflect a spectrum of severity. However, the lack of updated and specific guidelines results in treating them as interchangeable proxies for screening, which is problematic because it results in the pragmatic use of anemia to assess iron deficiency even though anemia is not sensitive for identifying iron deficiency in the United States versus directly assessing iron status. Consequently, results do not identify, and thus do not address, the vast majority of treatable iron deficiency in the US context. Foundational guidelines influencing clinical practice recommendations for assessment and diagnosis of iron deficiency need to be updated. Given the age of the CDC guideline, the available evidence relevant to the assessment and diagnosis of iron deficiency warrants revisiting the guidelines, especially those for laboratory assessment, thresholds for ferritin and hemoglobin (including by gestational age), and data adjustments and interpretation. Based on CDC standards required to develop evidence-based guidelines,[65] the first step to assess the need for an updated foundational guideline for assessment and diagnosis of iron deficiency and anemia has been met. AJPH

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CONFLICTS OF INTEREST

The authors have no conflicts of interest to disclose.

HUMAN PARTICIPANT PROTECTION

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