

Pumps: A Possible Tool to Promote More Equitable Lactation Outcomes

Deanna Nardella^{a,b,*}

^aNational Clinician Scholars Program, Department of Internal Medicine, Yale School of Medicine, New Haven, CT, USA;

^bDepartment of Pediatrics, Yale School of Medicine, New Haven, CT, USA

Pregnant individuals and infants in the US are experiencing rising morbidity and mortality rates. Breastfeeding is a cost-effective intervention associated with a lower risk of health conditions driving dyadic morbidity and mortality, including cardiometabolic disease and sudden infant death. Pregnant individuals and infants from racial/ethnic subgroups facing the highest risk of mortality also have the lowest breastfeeding rates, likely reflective of generational socioeconomic marginalization and its impact on health outcomes. Promoting breastfeeding among groups with the lowest rates could improve the health of dyads with the greatest health risk and facilitate more equitable, person-centered lactation outcomes. Multiple barriers to lactation initiation and duration exist for families who have been socioeconomically marginalized by health and public systems. These include the lack of paid parental leave, increased access to subsidized human milk substitutes, and reduced access to professional and lay breastfeeding expertise. Breast pumps have the potential to mitigate these barriers, making breastfeeding more accessible to all interested dyads. In 2012, The Patient Protection and Affordable Care Act (ACA) greatly expanded access to pumps through the preventative services mandate, with a single pump now available to most US families. Despite their near ubiquitous use among lactating individuals, little research has been conducted on how and when to use pumps appropriately to optimize breastfeeding outcomes. There is a timely and critical need for policy, scholarship, and education around pump use given their widespread provision and potential to promote equity for those families facing the greatest barriers to achieving their personal breastfeeding goals.

DRIVERS OF INEQUITIES SEEN AMONG US LACTATION RATES

In 2021, over 1200 women died within pregnancy and the first 42 days postpartum, while 20 000 infants died before their 1st birthday in the United States [1,2], an unthinkable number of lives and life-years lost. Despite having the highest healthcare spending per capita compared to other high-income countries, and touting cutting-edge biomedical innovation, US pregnant indi-

viduals experience morbidity and mortality rates that far exceed those of most other high-income nations [3-5]. US maternal mortality rates increased by roughly 15% in 2018-19, 18% in 2019-20, and 42% in 2020-21, with over 80% of deaths considered to be preventable [1,6]. US infant mortality (ie, death before 1 year) increased for the first time in two decades between 2021-22, a rise largely driven by a marked 9% increase in the rate of death due to maternal complications [2]. This reality underscores the integrated health of a mother and child and the critical

*To whom all correspondence should be addressed: Deanna Nardella, MD, National Clinician Scholars Program, Yale University School of Medicine, New Haven, CT; Email: deanna.nardella@yale.edu.

Abbreviations: WIC, Special Supplemental Nutrition Program for Women, Infants, and Children; ACA, the Patient Protection and Affordable Care Act; FMLA, Family Medical Leave Act.

Keywords: Breastfeeding, Lactation, Equity, Breast Pump, Maternal Mortality, Infant Mortality, Infant Nutrition

need for dyadic solutions.

Promoting breast/chest feeding among US dyads is one strategy worth strong consideration to address this crisis. Among the top drivers of maternal mortality is cardiovascular disease, and for infants, sudden unexpected infant death [7-9]. Breastfeeding has been associated with lower all-cause mortality and cardiometabolic risk for both mother and infant, as well as lower risk of sudden infant death [10-17]. A 2023 analysis of nearly 10 million US infants demonstrated that merely breastfeeding at the time of hospital discharge was associated with 33% fewer odds of infant mortality [18].

The dyadic mortality crisis disproportionately impacts communities that have been socially and economically marginalized, with non-Hispanic Black and Native American dyads experiencing the worst postpartum health outcomes [7,8,19-21]. In 2021, non-Hispanic Black and Native American women had mortality rates 2 to 3 times higher than non-Hispanic White mothers [1]. These inequities are mirrored among infants, with Native American and non-Hispanic Black infants having 2 and 2.5 times the rate of death before age 1 compared to non-Hispanic White infants, respectively [2]. These communities also have the lowest breastfeeding rates in the US [22]. Moreover, Hispanic dyads initiate breastfeeding at rates comparable to non-Hispanic White dyads (2019: 87.4% and 85.5%, respectively) [22], though are less likely to meet their personal goal of exclusive breastfeeding at 1 and 3 months postpartum [23]. There has been inequitable exposure between racial and ethnic groups over generations to breast milk's numerous benefits, including a protective effect on childhood brain development, asthma and infection risk, as well as a lower dyadic risk of hypertension, diabetes, and cancer, all conditions prevalent among communities that have been socioeconomically marginalized [11,12,24].

To address the rise in dyadic morbidity and mortality, as well as distribute the benefits of breastfeeding more equitably, a concerted, multisystem investment in the promotion of breastfeeding is needed, particularly within populations with low lactation rates. Investment in the study and implementation of appropriate breast pump use is one potential tool to support breastfeeding among communities with the greatest barriers to reaching their infant feeding goals.

HISTORICAL CONTEXT AND POLICIES THAT DRIVE INEQUITIES IN LACTATION

Longstanding social, political, and economic marginalization of racial and ethnic minority groups in the US has resulted in inequitable health care delivery, quality, and outcomes for these communities [25-27]. Regarding breastfeeding specifically, several US policies and so-

cioeconomic structures have both promoted formula use and failed to address barriers to breastfeeding. We must also acknowledge the broader impact of historical slavery and displacement of US racial and ethnic minority groups on present infant feeding practices. Though a brief overview of these concepts will follow, I recommend Andrea Freeman's book *Skimmed: Breastfeeding, Race, and Injustice* for those seeking comprehensive historical context around the relationship between racial injustice and infant feeding practices in the US [28].

Formula use has grown to be most prevalent among communities that have been socioeconomically marginalized, in part due to highly effective, targeted marketing strategies that disseminate persuasive disinformation to families [29-31]. A February 2023 Lancet article series provides a comprehensive analysis of marketing and lobbying strategies used by corporate manufacturers to expand formula use and undermine breastfeeding—including the emerging role of personalized digital marketing [29,32,33]. The US is one of the few high-resource countries that does not strictly regulate the marketing of breast-milk substitutes, and as a result, much misguided and convincing marketing reaches families, undermining efforts to meet individual and national breastfeeding goals [34].

Beyond navigating personalized marketing and misinformation around infant feeding options, many low-income US families gain access to highly subsidized formula through the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), a federal supplemental nutritional program that aims to prevent food insecurity among pregnant women and young children [35]. To be sure, WIC provides vital support to US families facing high risk of food insecurity. Yet, upon WIC's inception in 1974, rates of formula grew precipitously among low-income families. Today, WIC participants account for over 55% of all formula consumed in the US [36]. The use of formula among low-income populations across generations has left many communities with less peer and family knowledge around breastfeeding, influenced cultural infant feeding norms, and enhanced the vulnerability of these communities during national supply chain disruptions, as seen with the 2022 US Formula Shortage [31,37-40]. The rise in formula use among WIC participants over the last several decades is not driven by socioeconomic status alone, as participant breastfeeding outcomes differ by race/ethnicity [23] and between eligible participants versus eligible non-participants [41]. Additionally, non-Hispanic Black and Hispanic WIC participants are less likely to meet their breastfeeding goals at 3 months postpartum compared to non-Hispanic White participants [23], suggestive of the multifactorial and likely intersectional nature of inequitable lactation outcomes observed in the US today. To help

combat this reality, WIC has invested greatly in effective breastfeeding supports in recent years, including breastfeeding peer counselors [42], pump loan programs, and enhanced nutritional supplementation for breastfeeding families. These efforts are vital to mitigating the negative impact of longstanding formula subsidies on breastfeeding outcomes among participating families and should only continue to expand if sustained behavioral change around breastfeeding is desired.

Beyond policies that indirectly and directly promote formula use, suboptimal US breastfeeding rates are driven by insufficient protective policies and supportive socioeconomic structures to address breastfeeding barriers. Early return to work and poor access to lactation expertise have been identified as prevalent barriers among all lactating individuals but are particularly prevalent among dyads of racial and ethnic minority groups [43-45].

Nearly two-thirds of US women with a child under the age of 3 participate in the workforce [46]. Lack of paid leave from work during the immediate postpartum period is among the greatest barriers to breastfeeding facing US families [47]. Much data supports that parental leave after childbirth is associated with reduced maternal and infant morbidity and mortality, as well as the establishment of exclusive breastfeeding, increased downstream earning potential and workforce retention, increased infant vaccination rates, and reduced maternal medical and mental comorbidities [48-54]. The 1993 Family Medical Leave Act (FMLA) permits families to take parental leave after the delivery of a child [47]. Yet, a mere 56% of US families qualify for federal FMLA protections today, which is unpaid and reserved for employees who have worked for their employer for a certain number of hours [55]. These restrictions leave many families financially unable or legally ineligible to take leave after a child is born, with 60% of non-Hispanic Black and nearly 67% percent of Hispanic workforce members unable to take unpaid leave [52]. Slow progress is being made, with 13 US states currently offering paid leave [56]. Nonetheless, 2023 data from The Centers for Disease Control and Prevention (CDC) Pregnancy Risk Assessment Monitoring System (PRAMS) demonstrated that the return to work as a reason for not initiating lactation was most prevalent among non-Hispanic Black (20.8%) and Native American (26.6%) individuals [44]. Among those who did initiate breastfeeding, the return to work was reported by 24% and 16% of non-Hispanic Black and Native American women, respectively, as the reason for breastfeeding cessation [44]. Efforts to improve lactation rates for US families, particularly among those from historically marginalized communities, must address the notable barrier of paid parental leave.

Perhaps the most common barrier for US families to meeting their breastfeeding goals is timely and affordable

access to lactation expertise when encountering common lactation challenges [57]. To understand the scope of need, a nationally representative cohort of nearly 6 million women who breastfed for <10 weeks reported “not producing enough milk” (57.6%) and “baby had difficulty latching” (38.7%) as the most common reason for breastfeeding cessation [44]. These challenges are common and often addressable with timely access to lactation expertise. Yet formal lactation consultation is not currently a standard in routine obstetric or pediatric care and is not an affordable option for most families, particularly those who are uninsured or enrolled in public insurance [44,58]. As a result, many families end up mix-feeding (ie, feeding both formula and breast milk) when encountering lactation challenges [59], eventually transitioning to exclusive formula use for ease or due to unintended loss of milk supply [60].

Though barriers to meeting one’s personal breastfeeding goals are multifactorial in nature, the breast pump is one tool worthy of consideration to help mitigate these barriers and impact individual and national change.

BREAST PUMPS: A CRITICAL LACTATION SUPPORT TOOL FOR DYADS FACING THE MOST BARRIERS

In addition to improved policies and practices aimed at driving a paradigm shift in healthcare around breastfeeding support, the widespread provision and optimal use of breast pumps may confer great benefit to dyads facing the most barriers to lactation.

Though latching a baby directly to breast or chest is recognized as the optimal technique for infant feeding, this is not always feasible [61,62]. The early return to work, having latch difficulties with poor access to support, separation of the dyad for medical care, infant prematurity, or not latching a baby due to cultural norms or trauma are such examples. These barriers are more common among marginalized communities, who are less likely to qualify for unpaid FMLA, have less comprehensive coverage for lactation consultation, and have less access to peer, family, or community lactation support due to generations of formula use. Additionally, women from these communities are more likely to experience bias and discrimination from their healthcare team around their infant feeding goals [27,63], as well as suffer from perinatal cardiometabolic complications that could disrupt lactation, including pre-eclampsia [57,64,65], infant prematurity [66,67], and diabetes [68-70].

A breast pump could be the difference between meeting—or not meeting—one’s breastfeeding goals for dyads facing the above lactation challenges, biases, or gaps in care delivery. Examples include requiring a pump to maintain lactation after returning to work, using a pump

to increase or maintain one's milk supply while awaiting lactation support to help address pain or poor latch, extracting milk while a mother or baby is admitted to the hospital postpartum, or choosing to exclusively pump due to personal preference.

THE IMPACT OF LEGISLATIVE EFFORTS TO EXPAND PUMP ACCESS ON LACTATION OUTCOMES

The Patient Protection and Affordable Care Act (ACA) required coverage of breast pumps by private insurers and Medicaid enrollees in 2012 and 2014, respectively [71]. As a result, breast pumps have become nearly ubiquitous among breastfeeding families, with over 85% of lactating parents reporting pump use at some point in time [72,73]. A 2017 study demonstrated that the greatest increase in breastfeeding initiation after this mandate was appreciated among non-Hispanic Black and American Indian/Alaskan Native women, those with less formal education, and unmarried mothers, all populations that experience low breastfeeding rates [74]. Additionally, a 2008 study of WIC enrollees demonstrated that families who received an electric pump upon request sought formula at 8.8 months postpartum on average compared to an average of 4.8 months for families placed on a pump waitlist ($p < 0.001$) [75]. These studies suggest that pumps may confer an augmented benefit to dyads facing increased barriers to their lactation goals.

The widespread distribution of pumps following the ACA mandate has been accompanied by a rise in exclusive pumping [76-78]. A 2011 study found that women of lower socioeconomic status (education of some college or less; income less than \$35,000/year) were more likely to have never latched to the breast and exclusively pumped [77]. Though exclusive pumping can be an elective decision for some, its prevalence underscores larger racial, ethnic, and sociodemographic disparities in infant prematurity. Relevant factors include lack of available and affordable lactation support for early latch difficulties, access to paid leave from work, and accountability on the part of payers and health systems to ensure the provision of quality breastfeeding care and support for all families [79,80].

PUMP PROVISION DOES NOT GUARANTEE APPROPRIATE USE: MORE RESEARCH IS NEEDED

It must be noted that pumps are not without hazard or risk, and if used inappropriately can cause injury and may unnecessarily interrupt normal physiologic breastfeeding [81-83]. There is currently limited and mixed evidence regarding the association between breast pump use and

breastfeeding success [73,74,84-92]. Given the ubiquity of pump use among breastfeeding individuals today, understanding the ideal timing, frequency, and application of breast pump use is essential to avoid parental harm and develop evidence-based protocols in medicine. Future research is needed to build this understanding, including the ideal device required for a family's individual situation (manual, electric, hands free, hospital grade, etc.), as well as indications for and optimal timing of pump use to augment—and not hinder—breast milk supply. Studies are also needed to describe and examine pump use within specific subpopulations, such as those suffering from preeclampsia, diabetes, and infant prematurity, as well as working parents.

Despite successfully increasing pump access through federal policy, our nation's systems have fallen short of equipping patients and healthcare professionals with the knowledge necessary to ensure their appropriate use. A 2012 study found lower odds of breastfeeding past 2 months postpartum among mothers who received pump education from a physician or physician assistant (OR 0.58, 95% CI 0.36-0.93), and conversely, higher odds of breastfeeding beyond 2 months among those who learned about pumps from friends and relatives, or took a class (OR 1.70, 95% CI 1.13-2.55; OR 1.85, 95% CI 1.24-2.76, respectively) [93]. Health systems currently need evidence-based protocols for pump use to ensure their appropriate implementation, protect against their inappropriate overuse and patient harm, and standardize patient and provider pump education.

Ultimately, there is a timely and critical need for evidence-based, person-centered protocols and educational curricula around breast pump use given their ubiquity among US families, potential for harm if used inappropriately, and most importantly, their potential to facilitate more equitable breastfeeding outcomes for dyads with the lowest breastfeeding rates and highest health risk.

CONCLUSIONS AND NEXT STEPS

There is a maternal and infant health crisis within the US, with rising morbidity and mortality rates seen among all mother-infant dyads. Socially and economically marginalized communities, particularly non-Hispanic Black and Native American women, are disproportionately impacted by this rise in dyadic mortality. Breastfeeding promotion could prove highly effective at improving health outcomes for these high-risk groups, as it is known to be associated with a reduced risk of several conditions that drive dyadic mortality, including cardiovascular disease and sudden infant death. Though limited and conflicting data exists on the relationship between breast pumps and lactation outcomes overall, breast pumps have been shown to support breastfeeding exclusivity and duration

among dyads from marginalized communities. There is an emerging need for research to inform health policy, practice, and education around appropriate pump use to achieve equitable lactation outcomes for all mother-infant dyads.

REFERENCES

- Hoyert DL. Maternal Mortality Rates in the United States, 2021. NCHS Health E-Stats. Centers for Disease Control and Prevention. Online 2023 Mar [cited 2024 Feb 13]. Available from: <https://www.cdc.gov/nchs/data/hestat/maternal-mortality/2021/maternal-mortality-rates-2021.htm>. doi.org/https://doi.org/10.15620/cdc:124678.
- Ely DM, Driscoll AK. Infant mortality in the United States: Provisional data from the 2022 period linked birth/infant death file. National Center for Health Statistics. Vital Statistics Rapid Release; no 33. Hyattsville, MD: National Center for Health Statistics. 2023 Nov. doi.org/https://doi.org/10.15620/cdc:133699.
- Trends in health care spending. Chicago, IL: American Medical Association. [Internet] Updated 2023 Mar 20 [cited 2024 Feb 1]. Available from: <https://www.ama-assn.org/about/research/trends-health-care-spending>
- Wager E, McGough M, Rakshit S, Amin K, Cox C. How does health spending in the U.S. compare to other countries? Peterson-KFF Health System Tracker. Online 2024 Jan 23 [cited 2024 Feb 1]. Available from: <https://www.healthsystemtracker.org/chart-collection/health-spending-u-s-compare-countries/>
- Tikkanen R, Gunja M, FitzGerald M, Zephyrin L. Maternal Mortality and Maternity Care in the United States Compared to 10 Other Developed Countries. New York, NY: The Commonwealth Fund. Online 2020 Nov 18 [cited 2023 Nov 17]. Available from: <https://www.commonwealthfund.org/publications/issue-briefs/2020/nov/maternal-mortality-maternity-care-us-compared-10-countries>. <https://doi.org/10.26099/411v-9255>.
- Trost SL, Beauregard J, Chandra G, Njie F, Berry J, Harvey A, et al. Pregnancy-Related Deaths: Data from Maternal Mortality Review Committees in 36 US States, 2017-2019. Atlanta, GA: Centers for Disease Control and Prevention, US Department of Health and Human Services. Online (Bergh). 2022 Sep.
- Declercq E, Zephyrin L. Maternal Mortality in the United States: A Primer. New York, NY: The Commonwealth Fund. Online (Bergh). 2023 Dec;16. [cited 2023 Nov 17] Available from: <https://www.commonwealthfund.org/publications/issue-brief-report/2020/dec/maternal-mortality-united-states-primer>
- Four in 5 pregnancy-related deaths in the U.S. are preventable. CDC Newsroom Press Release. Atlanta, GA: Centers for Disease Control and Prevention. [Internet] Online 2022 Sept 19 [cited 2024 Feb 1]. Available from: <https://www.cdc.gov/media/releases/2022/p0919-pregnancy-related-deaths.html>
- Mortality I. Reproductive Health. Atlanta, GA: Centers for Disease Control and Prevention. [Internet] Reviewed 2023 Sept 13 [cited 2024 Feb 13]. Available from: <https://www.cdc.gov/reproductivehealth/maternalinfanthealth/infantmortality.htm>
- Oliveira V, Prell M, Cheng X. The Economic Impacts of Breastfeeding: A Focus on USDA's Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), ERR-261. Economic Research Service. Washington, DC: U.S. Department of Agriculture. 2019 Feb.
- Why It Matters. Breastfeeding. Atlanta, GA: Centers for Disease Control and Prevention. [Internet] Reviewed 2023 Jul 31 [cited 2024 Feb 13]. Available from: <https://www.cdc.gov/breastfeeding/about-breastfeeding/why-it-matters.html>
- Five Great Benefits of Breastfeeding. Division of Nutrition, Physical Activity, and Obesity. Atlanta, GA: Centers for Disease Control and Prevention. [Internet] Reviewed 2023 Sept 7 [cited 2024 Feb 1]. Available from: <https://www.cdc.gov/nccdphp/dnpao/features/breastfeeding-benefits/index.html>
- Stuebe AM, Schwarz EB, Grewen K, Rich-Edwards JW, Michels KB, Foster EM, et al. Duration of lactation and incidence of maternal hypertension: a longitudinal cohort study. *Am J Epidemiol*. 2011 Nov;174(10):1147–58.
- Magnus MC, Wallace MK, Demirci JR, Catov JM, Schmella MJ, Fraser A. Breastfeeding and Later-Life Cardiometabolic Health in Women With and Without Hypertensive Disorders of Pregnancy. *J Am Heart Assoc*. 2023 Mar;12(5):e026696.
- Perrine CG, Nelson JM, Corbelli J, Scanlon KS. Lactation and Maternal Cardio-Metabolic Health. *Annu Rev Nutr*. 2016 Jul;36(1):627–45.
- Tschiderer L, Seekircher L, Kunutsor SK, Peters SA, O'Keefe LM, Willeit P. Breastfeeding Is Associated With a Reduced Maternal Cardiovascular Risk: Systematic Review and Meta-Analysis Involving Data From 8 Studies and 1 192 700 Parous Women. *J Am Heart Assoc*. 2022 Jan;11(2):e022746.
- Yu J, Pudwell J, Dayan N, Smith GN. Postpartum Breastfeeding and Cardiovascular Risk Assessment in Women Following Pregnancy Complications. *J Womens Health (Larchmt)*. 2020 May;29(5):627–35.
- Ware JL, Li R, Chen A, Nelson JM, Kmet JM, Parks SE, et al. Associations Between Breastfeeding and Post-perinatal Infant Deaths in the U.S. *Am J Prev Med*. 2023 Nov;65(5):763–74.
- Harris E. US Maternal Mortality Continues to Worsen. *JAMA*. 2023 Apr;329(15):1248.
- Hill L, Artiga S, Ranji U. Racial Disparities in Maternal and Infant Health: Current Status and Efforts to Address Them. San Francisco, CA: Kaiser Family Foundation. [Internet] 2022 Nov 1 [cited 2023 Dec 14]. Available from: <https://www.kff.org/racial-equity-and-health-policy/issue-brief/racial-disparities-in-maternal-and-infant-health-current-status-and-efforts-to-address-them/>
- Fleszar LG, Bryant AS, Johnson CO, Blacker BF, Aravkin A, Baumann M, et al. Trends in State-Level Maternal Mortality by Racial and Ethnic Group in the United States. *JAMA*. 2023 Jul;330(1):52–61.
- Chiang KV. Racial and Ethnic Disparities in Breastfeeding Initiation — United States, 2019. *MMWR Morb Mortal Wkly Rep*. Atlanta, GA: Centers for Disease Control and

- Prevention. 2021 May 8;70(21):769–774. <https://doi.org/10.15585/mmwr.mm7021a1>.
23. Hamner HC, Beauregard JL, Li R, Nelson JM, Perrine CG. Meeting breastfeeding intentions differ by race/ethnicity, Infant and Toddler Feeding Practices Study-2. *Matern Child Nutr*. 2021 Apr;17(2):e13093.
 24. Dieterich CM, Felice JP, O’Sullivan E, Rasmussen KM. Breastfeeding and health outcomes for the mother-infant dyad. *Pediatr Clin North Am*. 2013 Feb;60(1):31–48.
 25. Gee GC, Ford CL. Structural Racism and Health Inequities. *Du Bois Rev*. 2011 Apr;8(1):115–32.
 26. Yearby R, Clark B, Figueroa JF. Structural Racism In Historical And Modern US Health Care Policy. *Health Aff (Millwood)*. 2022 Feb;41(2):187–94.
 27. Robinson K, Fial A, Hanson L. Racism, Bias, and Discrimination as Modifiable Barriers to Breastfeeding for African American Women: A Scoping Review of the Literature. *J Midwifery Womens Health*. 2019 Nov;64(6):734–42.
 28. Freeman A. *Skimmed: Breastfeeding, Race, and Injustice*. Redwood City (CA): Stanford University Press; 2019. [English]. <https://doi.org/10.1515/9781503610811>.
 29. Rollins N, Piwoz E, Baker P, Kingston G, Mabaso KM, McCoy D, et al.; 2023 Lancet Breastfeeding Series Group. Marketing of commercial milk formula: a system to capture parents, communities, science, and policy. *Lancet*. 2023 Feb;401(10375):486–502.
 30. Hastings G, Angus K, Eadie D, Hunt K. Selling second best: how infant formula marketing works. *Global Health*. 2020 Aug;16(1):77.
 31. DeVane-Johnson S, Woods-Giscombé C, Thoyre S, Fogel C, Williams R 2nd. Integrative Literature Review of Factors Related to Breastfeeding in African American Women: Evidence for a Potential Paradigm Shift. *J Hum Lact*. 2017 May;33(2):435–47.
 32. Pérez-Escamilla R, Tomori C, Hernández-Cordero S, Baker P, Barros AJ, Bégin F, et al.; 2023 Lancet Breastfeeding Series Group. Breastfeeding: crucially important, but increasingly challenged in a market-driven world [Erratum in: *Lancet*. 2023 Mar 18;401] [10380]. *Lancet*. 2023 Feb;401(10375):472–85.
 33. Baker P, Smith JP, Garde A, Grummer-Strawn LM, Wood B, Sen G, et al.; 2023 Lancet Breastfeeding Series Group. The political economy of infant and young child feeding: confronting corporate power, overcoming structural barriers, and accelerating progress. *Lancet*. 2023 Feb;401(10375):503–24.
 34. International Code of Marketing of Breast-Milk Substitutes. Geneva, Switzerland: World Health Organization. 1981, Jan 27 [cited 2024 Feb]. Available from: <https://www.who.int/publications-detail-redirect/9241541601>
 35. Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). Food and Nutrition Service. U.S. Department of Agriculture. [Internet] Updated 2024 Feb 5 [cited 2024 Feb 10]. Available from: <https://www.fns.usda.gov/wic>
 36. Infants in USDA’s WIC Program consumed an estimated 56 percent of U.S. infant formula in 2018. Economic Research Service. Washington, DC: U.S. Department of Agriculture. 2022 May 23 [cited 2024 Feb 1]. Available from: <https://www.ers.usda.gov/data-products/chart-gallery/gallery/chart-detail/?chartId=103970>
 37. Cernioglio K, Smilowitz JT. Infant feeding practices and parental perceptions during the 2022 United States infant formula shortage crisis. *BMC Pediatr*. 2023 Jun;23(1):320.
 38. Neuberger Z, Bergh K, Hall L. Infant Formula Shortage Highlights WIC’s Critical Role in Feeding Babies. Washington, DC: Center on Budget and Policy Priorities. Online 2022 Jun 22 [cited 2024 Feb 13]. Available from: <https://www.cbpp.org/research/food-assistance/infant-formula-shortage-highlights-wics-critical-role-in-feeding-babies>
 39. Gyamfi A, O’Neill B, Henderson WA, Lucas R. Black/African American Breastfeeding Experience: Cultural, Sociological, and Health Dimensions Through an Equity Lens. *Breastfeed Med*. 2021 Feb;16(2):103–11.
 40. Rabb K, Alikhani A, von Ash T, Risica PM. Examining Black Women’s Breastfeeding Experiences in the United States: A Scoping Review of Qualitative Studies. *Matern Child Health J*. 2023 Oct;27(10):1726–41.
 41. Zhang Q, Lamichhane R, Wright M, McLaughlin PW, Stacy B. Trends in Breastfeeding Disparities in US Infants by WIC Eligibility and Participation. *J Nutr Educ Behav*. 2019 Feb;51(2):182–9.
 42. Assibey-Mensah V, Suter B, Thevenet-Morrison K, Widanka H, Edmunds L, Sekhobo J, et al. Effectiveness of Peer Counselor Support on Breastfeeding Experiences in WIC-Enrolled Women. *J Nutr Educ Behav*. 2019 Jun;51(6):650–7.
 43. Jones KM, Power ML, Queenan JT, Schulkin J. Racial and ethnic disparities in breastfeeding. *Breastfeed Med*. 2015 May;10(4):186–96.
 44. Quintero SM, Strassle PD, Londoño Tobón A, Ponce S, Alhomsí A, Maldonado AI, et al. Race/ethnicity-specific associations between breastfeeding information source and breastfeeding rates among U.S. women. *BMC Public Health*. 2023 Mar;23(1):520.
 45. Tran V, Reese Masterson A, Frieson T, Douglass F, Pérez-Escamilla R, O’Connor Duffany K. Barriers and facilitators to exclusive breastfeeding among Black mothers: A qualitative study utilizing a modified Barrier Analysis approach. *Matern Child Nutr*. 2023 Jan;19(1):e13428.
 46. Employment Characteristics of Families - 2022. Bureau of Labor Statistics. Washington, DC: U.S. Department of Labor. Online 2023 April 19 [cited 2024 Feb 13]. Available from: <https://www.bls.gov/news.release/pdf/famee.pdf>
 47. Sheet F. #28B: FMLA leave for birth, placement, bonding, or to care for a child with a serious health condition on the basis of an “in loco parentis” relationship. Wage and Hour Division. Washington, DC: U.S. Department of Labor. 2023 April [cited 2024 Feb 1]. Available from: <http://www.dol.gov/agencies/whd/fact-sheets/28B-finla-in-loco-parentis>
 48. Nandi A, Jahagirdar D, Dimitris MC, Labrecque JA, Strumpf EC, Kaufman JS, et al. The Impact of Parental and Medical Leave Policies on Socioeconomic and Health Outcomes in OECD Countries: A Systematic Review of the Empirical Literature. *Milbank Q*. 2018 Sep;96(3):434–71.
 49. Heymann J, Sprague AR, Nandi A, Earle A, Batra P, Schickedanz A, et al. Paid parental leave and family well-being in the sustainable development era. *Public Health Rev*. 2017 Sep;38(1):21.
 50. Burtle A, Bezruchka S. Population Health and Paid Paren-

- tal Leave: What the United States Can Learn from Two Decades of Research. *Healthcare (Basel)*. 2016 Jun;4(2):30.
51. Webster JL, Paul D, Purtle J, Locke R, Goldstein ND. State-Level Social and Economic Policies and Their Association With Perinatal and Infant Outcomes [Erratum in: *Milbank Q*. 2022 Jun;100] [2]. *Milbank Q*. 2022 Mar;100(1):218–60.
 52. Sprague A, Earle A, Moreno G, Raub A, Waisath W, Heymann J. National Policies on Parental Leave and Breastfeeding Breaks: Racial, Ethnic, Gender, and Age Disparities in Access and Implications for Infant and Child Health. *Public Health Rep*. 2024;139(1):39–47.
 53. Bartel A, Rossin-Slater M, Ruhm C, Slopen M, Waldfogel J. The Impacts of Paid Family and Medical Leave on Worker Health, Family Well-Being, and Employer Outcomes. *Annu Rev Public Health*. 2023 Apr;44(1):429–43.
 54. Heshmati A, Honkaniemi H, Juárez SP. The effect of parental leave on parents' mental health: a systematic review. *Lancet Public Health*. 2023 Jan;8(1):e57–75.
 55. Williamson MW. FMLA Frequently Asked Questions. Wage and Hour Division. Family and Medical Leave Act. Washington, DC: U.S. Department of Labor [Internet] [cited 2024 Feb 13]. Available from: <https://www.dol.gov/agencies/whd/fmla/faq#2>
 56. The State of Paid Family and Medical Leave in the U.S. in. Washington, DC: center for American Progress. Online (Bergh). 2024;2024(Jan):17. [cited 2024 Feb 12] Available from: <https://www.americanprogress.org/article/the-state-of-paid-family-and-medical-leave-in-the-u-s-in-2024/>
 57. Callahan E, Kim JH, Bahnfleth C, et al. Racial and Ethnic Disparities in Human Milk Feeding in the United States: A Rapid Review Project [Internet]. Alexandria, VA: USDA Nutrition Evidence Systematic Review; 2023 Nov. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK597911/> <https://doi.org/10.52570/NESR.FNS2023.RR1>.
 58. Medicaid Coverage of Lactation Services. Centers for Medicare & Medicaid Services. Baltimore, MD: Department of Health and Human Services. 2012 Jan 10 [cited 2024 Feb]. Available from: https://www.medicare.gov/sites/default/files/medicaid/quality-of-care/downloads/lactation_services_issuebrief_01102012.pdf
 59. Monge-Montero C, van der Merwe LF, Tagliamonte S, Agostoni C, Vitaglione P. Why do mothers mix milk feed their infants? Results from a systematic review. *Nutr Rev*. 2023 Dec;nuad134. <https://doi.org/10.1093/nutrit/nuad134>.
 60. Michalopoulou S, Garcia AL, Wolfson L, Wright CM. Does planning to mixed feed undermine breastfeeding? *Matern Child Nutr*. 2023 Dec;e13610:e13610.
 61. Gardner H, Kent JC, Lai CT, Geddes DT. Comparison of maternal milk ejection characteristics during pumping using infant-derived and 2-phase vacuum patterns. *Int Breastfeed J*. 2019 Nov;14(1):47.
 62. Lucas A, Lucas PJ, Baum JD. Pattern of milk flow in breast-fed infants. *Lancet*. 1979 Jul;2(8133):57–8.
 63. Davis C, Villalobos AV, Turner MM, Long S, Lapinski MK. Racism and Resistance: A Qualitative Study of Bias As a Barrier to Breastfeeding. *Breastfeed Med*. 2021 Jun;16(6):471–80.
 64. Minhas AS, Ogunwole SM, Vaught AJ, Wu P, Mamas MA, Gulati M, et al. Racial Disparities in Cardiovascular Complications With Pregnancy-Induced Hypertension in the United States. *Hypertension*. 2021 Aug;78(2):480–8.
 65. Holdt Somer SJ, Sinkey RG, Bryant AS. Epidemiology of racial/ethnic disparities in severe maternal morbidity and mortality. *Semin Perinatol*. 2017 Aug;41(5):258–65.
 66. Anderson JG, Rogers EE, Baer RJ, Oltman SP, Paynter R, Partridge JC, et al. Racial and Ethnic Disparities in Preterm Infant Mortality and Severe Morbidity: A Population-Based Study. *Neonatology*. 2018;113(1):44–54.
 67. Parker MG, Stellwagen LM, Noble L, Kim JH, Poindexter BB, Puopolo KM; SECTION ON BREASTFEEDING, COMMITTEE ON NUTRITION, COMMITTEE ON FETUS AND NEWBORN. Promoting Human Milk and Breastfeeding for the Very Low Birth Weight Infant. *Pediatrics*. 2021 Nov;148(5):e2021054272.
 68. Otter G, Davis D, Kurz E, Hooper ME, Shield A, Samarawickrema I, et al. Promoting breastfeeding in women with gestational diabetes mellitus in high-income settings: an integrative review. *Int Breastfeed J*. 2024 Jan;19(1):4.
 69. Oza-Frank R, Gunderson EP. In-Hospital Breastfeeding Experiences Among Women with Gestational Diabetes. *Breastfeed Med*. 2017 Jun;12(5):261–8.
 70. Hebert LE, Nikolaus CJ, Zamora-Kapoor A, Sinclair KA. Gestational Diabetes and Breastfeeding Among Women of Different Races/Ethnicities: Evidence from the Pregnancy Risk Assessment Monitoring Surveys. *J Racial Ethn Health Disparities*. 2023 Aug;10(4):1721–34.
 71. Hawkins SS, Dow-Fleisner S, Noble A. Breastfeeding and the Affordable Care Act. *Pediatr Clin North Am*. 2015 Oct;62(5):1071–91.
 72. Labiner-Wolfe J, Fein SB, Shealy KR, Wang C. Prevalence of breast milk expression and associated factors. *Pediatrics*. 2008 Oct;122 Suppl 2:S63–8.
 73. Hawkins SS, Horvath K, Noble A, Baum CF. ACA and Medicaid Expansion Increased Breast Pump Claims and Breastfeeding for Women with Public and Private Insurance. *Womens Health Issues*. 2022;32(2):114–21.
 74. Kapinos KA, Bullinger L, Gurley-Calvez T. Lactation Support Services and Breastfeeding Initiation: Evidence from the Affordable Care Act. *Health Serv Res*. 2017 Dec;52(6):2175–96.
 75. Meehan K, Harrison GG, Afifi AA, Nickel N, Jenks E, Ramirez A. The association between an electric pump loan program and the timing of requests for formula by working mothers in WIC. *J Hum Lact*. 2008 May;24(2):150–8.
 76. Rosenbaum KA. Exclusive breastmilk pumping: A concept analysis. *Nurs Forum*. 2022 Sep;57(5):946–53.
 77. Keim SA, Boone KM, Oza-Frank R, Geraghty SR. Pumping Milk Without Ever Feeding at the Breast in the Moms-2Moms Study. *Breastfeed Med*. 2017 Sep;12(7):422–9.
 78. Demirci JR. The Rise and Coming of Age of the Electric Breast Pump. *J Perinat Neonatal Nurs*. 2019;33(4):288–90.
 79. Anders LA, Robinson K, Ohlendorf JM, Hanson L. Unseen, unheard: a qualitative analysis of women's experiences of exclusively expressing breast milk. *BMC Pregnancy Childbirth*. 2022 Jan;22(1):58.
 80. Felice JP, Geraghty SR, Quagliari CW, Yamada R, Wong AJ, Rasmussen KM. "Breastfeeding" without baby: A longitudinal, qualitative investigation of how mothers

- perceive, feel about, and practice human milk expression. *Matern Child Nutr.* 2017 Jul;13(3):e12426.
81. Qi Y, Zhang Y, Fein S, Wang C, Loyo-Berríos N. Maternal and breast pump factors associated with breast pump problems and injuries. *J Hum Lact Off J Int Lact Consult Assoc.* 2014;30(1):62-72; quiz 110-112. <https://doi.org/10.1177/0890334413507499>.
 82. Clemons SN, Amir LH. Breastfeeding women's experience of expressing: a descriptive study. *J Hum Lact.* 2010 Aug;26(3):258-65.
 83. Buckley KM. A double-edged sword: lactation consultants' perceptions of the impact of breast pumps on the practice of breastfeeding. *J Perinat Educ.* 2009;18(2):13-22.
 84. Gurley-Calvez T, Bullinger L, Kapinos KA. Effect of the Affordable Care Act on Breastfeeding Outcomes. *Am J Public Health.* 2018 Feb;108(2):277-83.
 85. Felice JP, Cassano PA, Rasmussen KM. Pumping human milk in the early postpartum period: its impact on long-term practices for feeding at the breast and exclusively feeding human milk in a longitudinal survey cohort. *Am J Clin Nutr.* 2016 May;103(5):1267-77.
 86. Yourkavitch J, Rasmussen KM, Pence BW, Aiello A, Ennett S, Bengtson AM, et al. Early, regular breast-milk pumping may lead to early breast-milk feeding cessation. *Public Health Nutr.* 2018 Jun;21(9):1726-36.
 87. Gregory EF, Butz AM, Ghazarian SR, Gross SM, Johnson SB. Met Expectations and Satisfaction with Duration: A Patient-Centered Evaluation of Breastfeeding Outcomes in the Infant Feeding Practices Study II. *J Hum Lact.* 2015 Aug;31(3):444-51.
 88. Bream E, Li H, Furman L. The Effect of Breast Pump Use on Exclusive Breastfeeding at 2 Months Postpartum in an Inner-City Population. *Breastfeed Med.* 2017 Apr;12(3):149-55.
 89. Jiang B, Hua J, Wang Y, Fu Y, Zhuang Z, Zhu L. Evaluation of the impact of breast milk expression in early postpartum period on breastfeeding duration: a prospective cohort study. *BMC Pregnancy Childbirth.* 2015 Oct;15(1):268.
 90. Mildon A, Francis J, Stewart S, Underhill B, Ng YM, Rousseau C, et al. Associations between use of expressed human milk at 2 weeks postpartum and human milk feeding practices to 6 months: a prospective cohort study with vulnerable women in Toronto, Canada. *BMJ Open.* 2022 Jun;12(6):e055830.
 91. Hoyt-Austin AE, Cheng JH, Moua H, Tancredi DJ, Chantry CJ, Kair LR. Providing Low-Income Women With a Manual Pump: A Pilot Study. *Hosp Pediatr.* 2023 Feb;13(2):115-24.
 92. Fewtrell M, Kennedy K, Lukoyanova O, Wei Z, Potak D, Borovik T, et al. Short-term efficacy of two breast pumps and impact on breastfeeding outcomes at 6 months in exclusively breastfeeding mothers: A randomised trial. *Matern Child Nutr.* 2019 Jul;15(3):e12779.
 93. Chen PG, Johnson LW, Rosenthal MS. Sources of education about breastfeeding and breast pump use: what effect do they have on breastfeeding duration? An analysis of the Infant Feeding Practices Survey II. *Matern Child Health J.* 2012 Oct;16(7):1421-30.