Disparities in Breastfeeding: Impact on Maternal and Child Health Outcomes and Costs

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Objective To estimate the disease burden and associated costs attributable to suboptimal breastfeeding rates among non-Hispanic blacks (NHBs), Hispanics, and non-Hispanic whites (NHWs).

Study design Using current literature on associations between breastfeeding and health outcomes for 8 pediatric and 5 maternal diseases, we used Monte Carlo simulations to evaluate 2 hypothetical cohorts of US women followed from age 15 to 70 years and their infants followed from birth to age 20 years. Accounting for differences in parity, maternal age, and birth weights by race/ethnicity, we examined disease outcomes and costs using 2012 breastfeeding rates by race/ethnicity and outcomes that would be expected if 90% of infants were breastfed according to recommendations for exclusive and continued breastfeeding duration.

Results Suboptimal breastfeeding is associated with a greater burden of disease among NHB and Hispanic populations. Compared with a NHW population, a NHB population had 1.7 times the number of excess cases of acute otitis media attributable to suboptimal breastfeeding (95% CI 1.7-1.7), 3.3 times the number of excess cases of necrotizing enterocolitis (95% CI 2.9-3.7), and 2.2 times the number of excess child deaths (95% CI 1.6-2.8). Compared with a NHW population, a Hispanic population had 1.4 times the number of excess cases of gastrointestinal infection (95% CI 1.4-1.4) and 1.5 times the number of excess child deaths (95% CI 1.2-1.9).

Conclusions Racial/ethnic disparities in breastfeeding have important social, economic, and health implications, assuming a causal relationship between breastfeeding and health outcomes. *(J Pediatr 2017;181:49-55).*

Racial and ethnic disparities in breastfeeding persist in the US and are most pronounced among non-Hispanic blacks (NHBs). In 2012, NHB women were less likely than non-Hispanic white (NHWs) women to initiate breastfeeding (66.4% vs 83.0%), to be breastfeeding exclusively at 3 months (33.4% vs 48.0%), and to be breastfeeding at 12 months (16.9% vs 32.8%). Hispanic women also have slightly lower breastfeeding rates than NHW women: (initiation: 82.4% vs 83%; 3-month exclusive: 40.3% vs 48.0%; 12 months: 27.9% vs 32.8%).[1] These disparities are particularly troubling because not breastfeeding is associated with an increased risk of poor health outcomes and premature death,[2,3] including health conditions that are more prevalent among NHBs such as sudden infant death syndrome (SIDS), type 2 diabetes, cardiovascular disease, and breast cancer.[4-6] Breastfeeding is also associated with reduced risk of prematurity-specific morbidities (eg, necrotizing enterocolitis [NEC]),[7] which is important because NHB women have a higher rate of premature, very low birth weight (VLBW) infants compared with other racial/ethnic groups.[8] In addition, studies have shown that black women are more likely than white women to receive formula in the hospital,[9,10] a known and modifiable risk factor for early weaning.[11]

Two recent analyses reviewed the efficacy of various interventions aimed at closing breastfeeding disparities[12,13]; however, the impact of breastfeeding disparities on health outcomes for racial/ethnic groups has never been evaluated. We sought to quantify the population disease burden and costs associated with suboptimal breastfeeding among NHW, NHB, and Hispanic populations.

Methods

We modeled disease outcomes and cost by race and ethnicity for a simulated cohort of women who turned age 15 years in 2002 and the children they bore, using census

ALL	Acute lymphoblastic leukemia
LRTI	Lower respiratory tract infection
MI	Myocardial infarction
NEC	Necrotizing enterocolitis
NHBs	Non-Hispanic blacks
NHWs	Non-Hispanic whites
NIS	National Immunization Survey
SIDS	Sudden infant death syndrome
VLBW	Very low birth weight

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Funded by W.K. Kellogg Foundation (P3024102). The authors declare no conflicts of interest.

http://dx.doi.org10.1016/j.jpeds.2016.10.028

estimates from 2002 and vital statistics data.[14-17] The year 2002 was selected as the starting point for our cohort to match peak childbearing years for the cohort with the year when the most current breastfeeding data was available (2012). Women were modeled from age 15 to 70 years to capture maternal outcomes and the children they bore were modeled from birth to age 20 years to capture only pediatric outcomes for children. The Institutional Review Board of Cambridge Health Alliance determined this study was exempt.

This study repeated the methods used in our previously described comprehensive cost analysis on maternal and pediatric disease.[18] Briefly, our previous methods included the following steps. Model variables were defined using existing published literature to estimate rates of breastfeeding, disease incidence and mortality,[6,19,20] association between breastfeeding and disease,[7,21-34] and costs of disease and mortality for the 8 pediatric diseases (acute lymphoblastic leukemia [ALL], acute otitis media, Crohn's disease, ulcerative colitis, gastrointestinal infection, lower respiratory tract infection [LRTI] requiring hospitalization, NEC, and SIDS), and 5 maternal diseases (breast cancer, premenopausal ovarian cancer, hypertension, type 2 diabetes mellitus, and myocardial infarction [MI]) that had the most robust, relevant literature that was generalizable to the US population (**Tables I-IV**; available at www.jpeds.com).[6,7,28,35-44] The cohort of women and all the children they bore were modeled using Markov-chain Monte Carlo simulation and cost accounting techniques by performing 10 000 simulations of 100 000 women. Next, the simulation models were repeated under 2 breastfeeding conditions: suboptimal mode, defined as rates of disease at 2012 rates of breastfeeding (**Table II**)[1] and optimal model, defined as rates of disease if 90% of mothers were able to breastfeed according to US medical recommendation.[45,46] Last, the difference in outcomes was calculated for the suboptimal model compared with the optimal model to estimate the population burden of suboptimal breastfeeding, assuming observed associations between lactation and maternal and pediatric disease outcomes are causal.

As previously described, our model accounted for the following characteristics: maternal age, maternal fertility pattern, infant birth weight, and infant gestational age (**Tables V-VII**; available at www.jpeds.com). The model assumed a maximum parity of 6 because only 1% of women have more than 6 children.[8,16,47] Optimal breastfeeding was defined at 90% because research demonstrates some dyads would be unable to achieve optimal breastfeeding for medical or social reasons.[48] Lastly, all costs were measured in 2014 US dollars and were discounted using a 2% discount rate, which reflects current US Federal Reserve policies on target inflation rates and low inflation rates (2009-present).[49,50]

For this study, we repeated the described methodology for the 3 largest racial and ethnic groups in the US: NHB, NHW, and Hispanic. The key model variables that changed in this analysis to reflect race and ethnicity specific estimates were population size, infant birth weight, breastfeeding rates, and fertility patterns. Specifically, this analysis used the following population size estimates for the distribution of 15-year-olds in 2002 by race and ethnicity: 1 259 336 NHW females, 292 374 NHB females, and 310 988 Hispanic females.[14,51] The rates of VLBW birth that were used were NHWs- 1.08%, NHBs-2.72%, and Hispanics-1.51% (**Table VIII**; available at www.jpeds.com).[8,15]

To define breastfeeding rates for each race and ethnicity, we used the final breastfeeding rates reported in the 2012 National Immunization Survey (NIS) for NHW, NHB, and Hispanic infants (**Table II**).[1] As there are no racial/ethnicity specific data available for preterm infants, we estimated race/ethnicity-specific preterm breastfeeding rates by multiplying the Rush University preterm initiation rate[52] by the ratio of the NIS race-specific initiation rate[1] to the NIS all-race initiation rate.[1] This approach is supported by birth certificate data suggesting that odds of breastfeeding initiation by race/ethnicity are similar for preterm and term infants.[53]

To define fertility pattern for each race and ethnicity, we used vital statistics. We accounted for difference in fertility pattern for each race and ethnicity because the timing and number of lifetime births varies among NHB, NHW, and Hispanic women (births per 1000 women aged 15-44 years: NHWs-58.6 , NHBs-65.0, and Hispanics-74.4).

We conservatively used population rates for mortality and assumed that there were no racial/ethnic differences in mortality once a woman or child developed a disease. Although existing literature would suggest there are differences, available data did not allow us to determine to what extent these differences in mortality reflect differences in breastfeeding rates, fertility rates, or other confounders.[54,55]

Our analysis was performed using Java SE Runtime Environment build 1.7.0_05-b06 (Oracle Corporation, Redwood Shores, California) for the Monte Carlo simulations and Microsoft Excel 2011 (Microsoft, Redmond, Washington) for the costing techniques. We calculated excess numbers of cases of disease and death for each racial/ethnic group (**Table IX**). We compared the absolute and relative differences in disease for each racial/ethnic group relative to NHWs and the absolute differences in costs relative to NHWs (**Tables X** and **XI**). Finally, we calculated costs individually by disease and type (**Table XII**; available at www.jpeds.com).

Results

For each population, we found that suboptimal breastfeeding was associated with significant differences in childhood disease cases for ALL, acute otitis media, gastrointestinal infection, LRTI requiring hospitalization, and NEC, as well as deaths from NEC and SIDS (**Table IX**). For maternal diseases, we similarly found that suboptimal breastfeeding was associated with more cases and deaths from breast cancer, type 2 diabetes, hypertension, and MI (**Table IX**). Other conditions varied by population: Ulcerative colitis cases were not significantly different among NHW or Hispanic groups; Crohn's disease cases were not different among NHW, and LRTI deaths were not significantly different among NHW. For all 3 populations, differences in ALL deaths, premenopausal ovarian cancer cases, and premenopausal ovarian cancer deaths were not statistically significant.