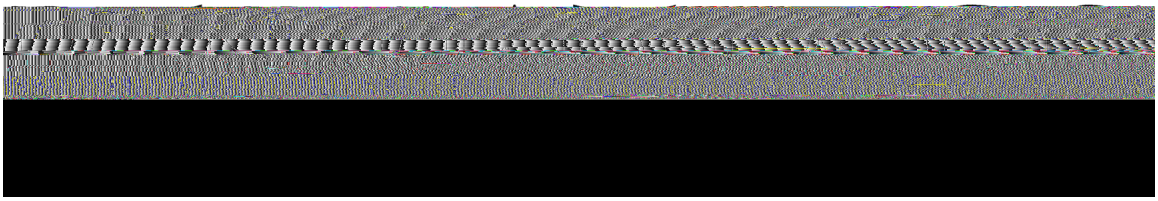

The Burden of Suboptimal Breastfeeding in the United States: A Pediatric Cost Analysis

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The Burden of Suboptimal Breastfeeding in the United States: A Pediatric Cost Analysis

WHAT•S KNOWN ON THIS SUBJECT: There have been several US cost analyses, with the last being a 2001 non–peer-reviewed study that showed a potential savings of $3.6 billion to increase current rates to Healthy People goals. All these studies have been somewhat limited in scope.

WHAT THIS STUDY ADDS: This study looked at more illnesses than previous cost analyses, and we used the comprehensive 2007 AHRQ report on the impact of breastfeeding on a variety of illnesses. We conclude that the yearly economic impact is $13 billion.

abstract

BACKGROUND AND OBJECTIVE: A 2001 study revealed that $3.6 billion could be saved if breastfeeding rates were increased to levels of the Healthy People objectives. It studied 3 diseases and totaled direct and indirect costs and cost of premature death. The 2001 study can be updated by using current breastfeeding rates and adding additional diseases analyzed in the 2007 breastfeeding report from the Agency for Healthcare Research and Quality.

STUDY DESIGN: Using methods similar to those in the 2001 study, we computed current costs and compared them to the projected costs if 80% and 90% of US families could comply with the recommendation to exclusively breastfeed for 6 months. Excluding type 2 diabetes (because of insufficient data), we conducted a cost analysis for all pediatric diseases for which the Agency for Healthcare Research and Quality reported risk ratios that favored breastfeeding: necrotizing enterocolitis, otitis media, gastroenteritis, hospitalization for lower respiratory tract infections, atopic dermatitis, sudden infant death syndrome, childhood asthma, childhood leukemia, type 1 diabetes mellitus, and childhood obesity. We used 2005 Centers for Disease Control and Prevention breastfeeding rates and 2007 dollars.

RESULTS: If 90% of US families could comply with medical recommendations to breastfeed exclusively for 6 months, the United States would save $13 billion per year and prevent an excess 911 deaths, nearly all of which would be in infants ($10.5 billion and 741 deaths at 80% compliance).

CONCLUSIONS: Current US breastfeeding rates are suboptimal

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As health care costs spiral higher, an updated estimate of the economic impact of breastfeeding would help in setting future breastfeeding policies. To date, there has not been a comprehensive pediatric cost analysis on US breastfeeding; most analyses have examined only 3 to 5 diseases and did not include most deaths.[1–5]

The most recent and widely cited US analysis, by Weimer[5] in 2001, examined the economic impact of breastfeeding for 3 diseases: necrotizing enterocolitis (NEC), otitis media (OM), and gastroenteritis. This government study revealed a potential savings of $3.6 billion if breastfeeding rates were increased from current rates to the Healthy People 2010 objectives for initiation and 6-month duration.[6]

Weimer used breastfeeding rates collected by the infant formula industry (64% in hospital and 29% at 6 months), because his analysis predated the collection of government data.[7] He assumed, incorrectly, that industry rates represented exclusive breastfeeding. In 2007, the Agency for Healthcare Research and Quality (AHRQ) produced a comprehensive analysis of the evidence for the impact of breastfeeding on a host of diseases of children and mothers.[8]

METHODS

We updated Weimer's figures by using the risk ratios from the AHRQ report along with more recent data on breastfeeding rates, disease incidence, and cost. Excluding type 2 diabetes, we analyzed all the diseases in offspring for which the AHRQ report found a risk reduction with any or exclusive breastfeeding: NEC, OM, gastroenteritis, hospitalization for lower respiratory tract infections (LRTIs) during infancy, atopic dermatitis (AD), sudden infant death syndrome (SIDS), childhood leukemia, childhood asthma, type 1 diabetes (T1D) mellitus, and obesity. We excluded type 2 diabetes, because the breastfeeding durations used in the AHRQ analysis were not clearly defined.

Overall Methodology

We used breastfeeding data from the 2005 birth cohort of the National Immunization Survey by the Centers for Disease Control and Prevention (CDC)[7] the most recent year for which final results have been reported. To define any breastfeeding, the survey asks respondents if they have "ever breastfed or fed breast milk." Exclusivity was defined as not having fed anything other than breast milk, including water, infant food, juice, formula, cow's milk, or sugar water. Duration was defined by asking how old the child was when he or she "completely" stopped breastfeeding or being fed breast milk.[9]

Following Weimer and others, those infants not classified as "breastfeeding" were classified as "nonbreastfeeding," 2 mutually exclusive categories.

We obtained the differential incidence of disease in breastfed and nonbreastfed subjects at the current rate of breastfeeding by using the following formula: $x \quad s/(br \quad 1 \quad b)$, where x is the incidence in nonbreastfed subjects, s is the overall incidence of the disease, b is the current breastfeeding rate, and r is the odds ratio (OR) in favor of breastfeeding. The incidence of disease in breastfed subjects is xr.

We used the same overall methods as Weimer. We calculated the numbers of breastfed infants and nonbreastfed infants by multiplying breastfeeding rates and nonbreastfeeding rates by the numbers of births in 2005. We used the 2 disease incidences to calculate the number of cases of disease in breastfed and nonbreastfed subjects, added these figures together, and then multiplied the total number of cases by the cost per case. We repeated all the calculations by using the breastfeeding rates specified in the Healthy People 2010 goals (Table 1) and rates of 80% and 90% compliance with medical recommendations (6 months of exclusive breastfeeding, with continued breastfeeding for at least 1–2 years of life).[10–12] Cost impact was determined by subtracting projected costs from current costs.

We included both direct and indirect costs for each disease, as well as the cost of premature death from NEC, SIDS, childhood asthma, childhood leukemia, LRTI, and T1D during childhood. We used the breastfeeding types and durations from the AHRQ conclusions for each disease. Following the AHRQ conclusions, we used "any breastfeeding" for 5 diseases, "exclusive breastfeeding" for 4

TABLE 1 Healthy People 2010 Goals for Breastfeeding, and Actual US Breastfeeding Rates From 2005 Reported in Final CDC Data From the National Immunization Survey

Type and Duration of Breastfeeding	Healthy People 2010 Goals, %	Actual Rates, 2005, %
Initiation/early postpartum	75	74.10
Exclusive breastfeeding at 2 d	(no goal)	55.60
Any breastfeeding at 6 mo	50	42.90
Any breastfeeding at 12 mo	25	21.50
Exclusive breastfeeding at 3 mo	40	32.10
Exclusive breastfeeding at 6 mo	17	12.30
Extrapolated any breastfeeding at 3 mo	62.50	58.50
Extrapolated exclusive breastfeeding at 4 mo	32.10	25.50
Extrapolated exclusive formula feeding at 3 mo	25	25.90

Shown are extrapolated rates referred to in the text.
Data source: Department of Health and Human Services. Breastfeeding among US children born 1999–2006, CDC National Immunization Survey. Available at: www.cdc.gov/breastfeeding/data/NIS_data/index.htm.

diseases, and both types for 1 disease (OM). For conditions of infancy, we used incidence in the first year of life.

Census data for 2005 showed 4.14 million live births and 80.8 million persons younger than 20 years.[13] All costs described here are in 2007 dollars, converted by using the Consumer Price Index.[14] Whenever possible, we used US cost and mortality data. When calculating the cost of years of treatment for chronic disease, we discounted costs to present value by using an inflation-free discount rate of 3%, because costs are expected to grow at least as fast as general inflation. We used the same cost for premature death used by Weimer, adjusted to 2007 dollars, or $10.56 million per death. Weimer used the labor-market approach (revealed-preference model), which reflects higher wages people demand for accepting risky jobs. Cost-of-death estimates vary widely, but our numbers are roughly in the middle of the range surveyed by Hirth et al,[15] adjusted for age and inflation.

Disease-Speci"c Methodology

Disease-specific methodology for all diseases are listed in Table 2.

Otitis Media

According to the AHRQ report, the OR of OM for exclusive breastfeeding for 3 or 6 months is 0.5 compared with exclusive formula feeding, and 0.77 for any breastfeeding compared with exclusive formula feeding. To be conservative, we used current breastfeeding rates at 3 months.[7] We used recent data that showed that the overall incidence is 1.9 episodes in children 6 to 11 months old.[16]

Recent government estimates of direct and indirect costs of OM average $291 per episode.[17]

We calculated the costs for exclusively breastfed (EBF), exclusively formula-fed (EFF), and the remaining infants (100% [EFF EBF]) for 3 months by using the appropriate ORs and then added these costs. For those not EBF or EFF, we used the ORs for "any breastfeeding." Any breastfeeding includes EBF infants, so that any EBF and EFF will total 100%. Our group of remaining infants excluded EBF infants and included weaned infants. Because we could not separate out partially breastfed and weaned infants, we used the conservative "any breastfeeding" ORs, underestimating the current cost.

Gastroenteritis

The AHRQ report highlighted a 2006 study that showed an OR of 0.36, which used almost no mixed-fed infants.[18] Recent data showed that the incidence of ambulatory visits in children younger than 1 year for gastroenteritis is 0.222,[19] with a hospitalization rate of 0.00298.[20] The average direct costs of a visit and hospitalization are $66.15 and $2395, respectively.[21] Outpatient indirect costs are $273, which includes time missed from work and personal expenses.[22] We conservatively assumed that the indirect costs for hospitalization would be the same. The number of deaths was too small to count reliably.[23]

Necrotizing Enterocolitis

We used the risk ratio of 0.42 from the meta-analysis performed by the AHRQ authors. In 2005, 6.71% of births were at low birth weight (LBW) (1500–2499 g), and 1.49% were at very low birth weight (VLBW) (1500 g).[24] In 2006, there were 1047 cases of NEC in LBW infants and 2554 in VLBW infants.[25] Hospital stays for NEC averaged 95 (medical) and 142 (surgical) days,[26] so we considered the infants to have been EBF for 3 months and compared that with the Healthy People goal of 40%.

A 2006 study[27] revealed that the initiation rate in infants born at 32 weeks' gestation was only 82% of that for term infants. We assumed that EBF rates in those infants most likely to get NEC are 82% of the EBF rates for term infants, or 26.3%.

We used a 2002 study[26] in which excess direct costs in VLBW infants were shown to be $260 506 for surgical NEC and $140 858 for medical NEC, compared with infants of similar weights without NEC. For the cost of NEC in LBW infants, we used Weimer's figure for surgical NEC: $150 406. Using the proportion of medical/surgical costs found in VLBW infants, we extrapolated the cost of medical NEC in LBW infants to be $81 219. We used an incidence of surgical NEC as 0.4 in LBW infants[28] and 0.43 in VLBW infants.[26] For indirect costs, we assumed that 1 parent would miss a half-day of work for the duration of the stay, at a cost of $38.3 per day (using average young adult wages of $28 000 per year[29]). We used a mortality rate of 5.8% in LBW infants and 20% in VLBW infants,[25] which is consistent with 2005 infant mortality data.[30]

Hospitalization for LRTI

The AHRQ report showed an OR of 0.28 for LRTI hospitalization for infants who were EBF for 4 months. Of 286 739 infectious-disease LRTI hl 406.surg.da Tc 0 -2

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used the lower number and assumed 6 years of treatment.

Sudden Infant Death Syndrome

The AHRQ authors performed their own meta-analysis and found an adjusted OR of 0.64 for any breastfeeding, but durations were not well defined. Given the significant effect of breastfeeding on SIDS and its resultant effect on overall infant death and costs, we felt that it was important to include SIDS in our analysis. A high-quality 2009 German study revealed that exclusively breastfeeding infants at 1 month reduced the risk by half, but any breastfeeding in the month before death reduced the risk by 71%,[36] which supports the hypothesis that lower arousal levels found in actively breastfeeding infants are protective. Approximately three-fourths of SIDS cases occur between 2 and 6 months of age. For

feeding at 6 months. To be conservative, we used the AHRQ OR of 0.64.

Childhood Asthma

The AHRQ report noted that any breastfeeding for 3 months lowers the overall risk of childhood asthma by 27%. The overall incidence of asthma in children is 0.127,[37] which we used as the cumulative incidence in the 2005 birth cohort, with a yearly cost of $773, excluding costs of deaths.[38] We assumed 10 years of treatment. The CDC has estimated that 200 people younger than 18 die annually,[39] and we assumed that this would be the cumulative incidence of death in the 2005 birth cohort.

Childhood Leukemia

The AHRQ report noted ORs of 0.80 and 0.85, respectively, for 6 months of any breastfeeding and the development of acute lymphocytic leukemia (ALL) and acute myelogenous leukemia (AML). There are now 3500 cases per year in people younger than 20.[40] The report's authors stated that 74% of leukemia is ALL, and for the purpose of this analysis, we assumed the remainder to be AML.[41] To calculate overall incidences, we divided the number of cases of each type of childhood leukemia by the population of persons younger than 20.[42] We used these figures to calculate the number of cases expected in the 2005 birth cohort, with an average direct cost per case of ALL of $136 444.[43] Cost data on AML has been sparse, but the literature suggests it is at least that much,[44] so we used this figure for all childhood leukemia. Indirect costs from lost parental wages were $17 172.[45] Five-year mortality rates for ALL and AML are 10.1% for children younger than 5 and 39.8% for children younger than 15, respectively.[40]

Type 1 Diabetes

The AHRQ reported an OR of 0.75 for any breastfeeding for 3 months. There are 15 000 new cases per year in people younger than 20 years.[46] We used this figure as the number of cases for the 2005 birth cohort. Direct costs are $4390 per year for children.[47] The American Diabetes Association has estimated direct yearly costs for diabetics at $11 744 per year, of which $6649 is attributable to diabetes.[48] The has CDC estimated that the direct and indirect costs for all diabetes is $174 billion/year, and 23.6 million people have the disease, averaging $7378 per person-year.[49] We used the CDC figure. We assumed 40 years of treatment, beginning after a 9-year latency.

In 2005, there were 97 deaths in persons younger than 20 that resulted from diabetes,[50] which we presumed were all because of T1D, so we assumed 97 deaths expected in the 2005 birth cohort.

Obesity

The AHRQ authors discussed the ORs from 3 meta-analyses in favor of breastfeeding, which ranged from a 4% risk reduction per month of breastfeeding (0.68 for 9 months),[51] to a meta-analysis that showed an OR of 0.93.[52] The latter article heavily depended on 1 very large study that revealed an adjusted OR at 3 to 6 months of 0.91 and 0.76 for more than 12 months.[53] To be conservative, we used 3 months of any breastfeeding with an

DISCUSSION

To our knowledge, this is the first peer-reviewed US cost analysis on breastfeeding since 1999 and the only analysis to include as many as 10 diseases. Riordan[1] analyzed 4 illnesses of infancy in the United States, and Ball and Wright [2] analyzed 3 by using US and Scottish subjects. Australian costs were analyzed in 2 studies.[60,61] Labbok[4] examined 5 types of diseases and the cost-effectiveness of breastfeeding, including costs of paid maternity leave, lactation support, and infant formula.

There remains a marked gap between medical recommendations around infant feeding and current US rates, which results in substantial economic impact, most of which comes from direct effects on the health and mortality of infants, along with a significant contribution from childhood obesity. Framed another way, the United States incurs $13 billion in excess costs annually and suffers 911 preventable deaths per year because our breastfeeding rates fall far below medical recommendations. Substantial gains could be made with exclusive breastfeeding for 4 months and any breastfeeding at 6 months.

assumptions, especially around costs and breastfeeding durations. To compensate, we erred on the side of conservative estimates. In addition, for the 4 diseases analyzed that used exclusive breastfeeding, we were unable to incorporate the effects of mixed feeding. We believe that true costs are higher, and excess deaths from SIDS are likely higher, given the compelling data published after the AHRQ report.[36] Following the AHRQ report, our study does not include costs for illnesses that are too mild to require a doctor's

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