



The beneficial effects of breastfeeding children are well documented and include a lower risk for ear<sup>1-3</sup> and respiratory infections,<sup>4</sup> atopic dermatitis,<sup>5</sup> gastroenteritis,<sup>6</sup> necrotizing enterocolitis,<sup>7</sup> type 2 diabetes<sup>8</sup>, and sudden infant death syndrome (SIDS)<sup>9-14</sup>. For mothers, benefits of breastfeeding include decreased risk of breast<sup>15-17</sup> and ovarian cancer,<sup>18,19</sup> and type 2 diabetes.<sup>20</sup> Breastfeeding also benefits mothers by speeding the return of uterine tone,<sup>21,22</sup> stopping post-birth bleeding,<sup>21</sup> and temporarily suppressing ovulation, which aids the spacing of children.<sup>21,23</sup> Potentially there is still another benefit, which involves pediatric weight status.

The health of American children is being threatened by overweight and the conditions that may stem from this problem, such as elevated serum lipid and insulin concentrations,<sup>24,25</sup> elevated blood pressure,<sup>24</sup> type 2 diabetes,<sup>26</sup> and psychosocial problems.<sup>27</sup> This Research to Practice (R2P) brief explores the relationship between breastfeeding and pediatric overweight, and it specifically examines:

- The relationship between breastfeeding and lower risk of pediatric overweight and how this relationship may be influenced by factors such as duration, exclusivity, and age at follow-up.
- Possible explanations for the association of breastfeeding with reduced risk of pediatric overweight.
- Recent surveillance data on initiation, duration, and exclusivity of breastfeeding
- Research to Practice: Evidence-based interventions to promote breastfeeding.

## Research Review: Breastfeeding and Pediatric Overweight

In 1981, Kramer<sup>28</sup> reported a significantly reduced risk for overweight among children who were breastfed. Since that report, several studies have provided varying degrees of support for this effect. This variation may be due in part to differences in study design, the populations studied, sample size, definitions of breastfeeding and overweight, length of follow-up, reporting bias, and control of confounding factors. In 2004 and 2005, three groups of researchers, Arenz et al.,<sup>29</sup> Owen et al.,<sup>30</sup> and Harder et al.,<sup>31</sup> published the results of meta-analyses that examined the relation between breastfeeding and pediatric overweight using mostly studies conducted in developed countries. This R2P scientific brief will review the findings of these three meta-analyses.

Arenz et al.<sup>29</sup> were more restrictive than the other two groups, as they required population-based cohort, cross-sectional, or case-control studies; adjustment for at least three confounding variables; odds ratios (ORs) or relative risks; follow-up for 5 to 18 years; feeding mode reported; and use of one of three cutoffs of BMI (body mass index) percentile as their definition of obesity. Arenz et al.<sup>29</sup> included just nine studies, all published between 1997 and 2003.

Owen et al.<sup>30</sup> excluded duplicate reports of results but did not require an adjusted OR or control for covariates. They allowed any definition of overweight or obesity and included historical cohort, prospective cohort, cross-sectional, and case-control study designs. They also



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# META-ANALYSIS

*“A meta-analysis is a statistical analysis of a collection of studies, especially an analysis in which studies are the primary units of analysis. Meta-analysis methods thus focus on contrasting and combining results from different studies, in the hopes of identifying consistent patterns and sources of disagreement among those results.”<sup>44</sup>*

included some studies with a shorter follow-up than Arenz et al.<sup>29</sup> Owen et al.<sup>30</sup> included a total of 28 studies with 29 estimates of effect (one paper reported the results for two populations) published between 1970 and 2004.

Finally, Harder et al.<sup>31</sup> excluded any studies that did not report an OR and 95% confidence intervals (CI s) (or data to calculate them) or the duration of breastfeeding, or that did not compare breastfed to exclusively formula-fed infants. They included cohort and case-control study designs, permitted any definition of overweight or obesity, and did not require an adjusted OR or control for covariates. In addition, they included studies with a shorter follow-up than Arenz et al.<sup>29</sup> Harder et al.<sup>31</sup> included 17 studies published between 1979 and 2003.

Limitations of these meta-analyses include the use of observational studies, combining cross-sectional studies with longitudinal studies, differing definitions of overweight and obesity and anthropometric references, and analyses that did not always account for covariates. Because the three groups conducted their reviews during similar periods and included many of the same studies, it is not surprising that they reported similar findings.

## Is breastfeeding associated with a reduced risk of pediatric overweight?

Arenz et al.<sup>29</sup> and Owen et al.<sup>30</sup> both reported that initiation of breastfeeding was associated with a reduced risk of pediatric overweight. Arenz et al.<sup>29</sup> found that all nine<sup>32-40</sup> of the studies they included showed reduced odds for overweight among children who were breastfed in comparison with those never breastfed, although three of these<sup>38-40</sup> showed non-significant effects in the same direction. The meta-analysis of these nine studies showed initiation of breastfeeding resulted in a significant overall reduced risk of overweight (adjusted OR = 0.78, 95% CI = 0.71, 0.85) (Figure 1).<sup>29</sup>

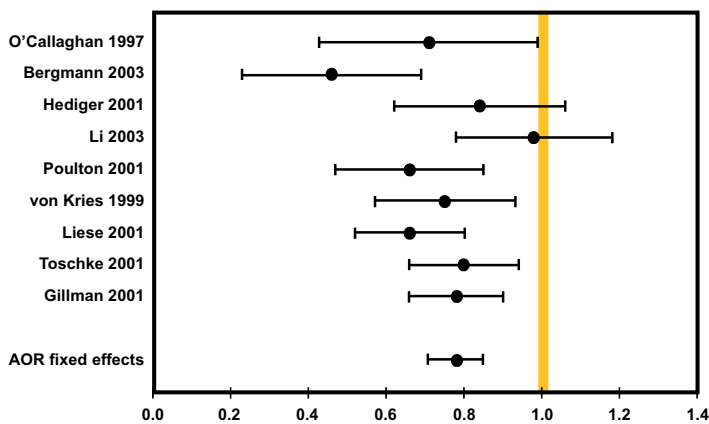
In the Owen et al.<sup>30</sup> review, 28 of 29 estimates showed a lower unadjusted OR of obesity among children who were breastfed than in those who were formula fed. Correspondingly, the meta-analysis found lower odds of obesity among the breastfed children than in the formula-fed children (unadjusted OR = 0.87, 95% CI = 0.85, 0.89). A subanalysis by Owen and colleagues of six studies<sup>32;33;37;39;41;42</sup> showed that when controlling for possible confounders, which included socioeconomic status, parental BMI, and maternal smoking, the significant inverse association between breastfeeding and odds of overweight among children remained but was reduced from 0.86 (95% CI = 0.81, 0.91) to 0.93 (95% CI = 0.88, 0.99).

## Does the duration of breastfeeding influence its association with pediatric overweight?

The duration of breastfeeding is inversely related to pediatric overweight. In Harder et al.,<sup>31</sup> the greater the duration of breastfeeding, the lower the odds of overweight. For each month of breastfeeding up to age 9 months, the odds of overweight decreased by 4%. This decline resulted in more than a 30% decrease in the odds of overweight for a child breastfed for 9 months when the comparison was with a child never breastfed.<sup>31</sup>

## Does exclusive breastfeeding have a stronger association with pediatric overweight than combined breastfeeding and formula feeding?

Exclusive breastfeeding indeed appears to have a stronger protective effect than breastfeeding combined with formula feeding, but more research is needed. In Owen et al.,<sup>30</sup> the four studies<sup>34;38;43;44</sup> that included exclusive breastfeeding groups showed a stronger protective effect compared to all their other studies combined (OR=0.76, 95% CI=0.70, 0.83). In the Harder et al.<sup>31</sup> review, the two studies<sup>35;38</sup> that documented exclusive breastfeeding also showed a stronger protective effect, decreasing the odds of overweight by 6% for each month of exclusive breastfeeding.



**Figure 1.** Effect of breast-feeding vs formula feeding on childhood obesity: covariate-adjusted odds ratios of nine studies and pooled odds ratio.

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## Does the association of breastfeeding with pediatric overweight diminish as the child gets older?

Studies suggest that the protection against overweight from being initially breastfed rather than being given formula may persist into the teenage years and adulthood. Among the 28 studies in the Owen et al.<sup>30</sup> review, the unadjusted OR for obesity among those who were breastfed was 0.50 for infants (95% CI=0.26, 0.94); 0.90 for young children (95% CI= 0.87, 0.92); 0.66 for older children (95% CI=0.60, 0.72); and 0.80 for adults (95% CI=0.71, 0.91). For adults, however, Owen et al.<sup>30</sup> were able to include only two studies.<sup>36;42</sup> In brief, the association between breastfeeding and overweight appears to remain with increasing age of the child.

In conclusion, breastfeeding is associated with a reduced odds of pediatric overweight; it also appears to have an inverse dose-response association with overweight (longer duration, less chance of overweight). While more research is needed, exclusive breastfeeding appears to have a stronger effect than combined breast and formula feeding, and the inverse association between breastfeeding and overweight appears to remain with increasing age of the child. The three meta-analyses reported in these review articles<sup>29-31</sup> suggest a 15% to 30% reduction in odds of overweight from breastfeeding. These results lead to the question: Why does breastfeeding result in a reduced risk of pediatric overweight?

## Why might breastfeeding be associated with reduced risk of pediatric overweight?

There are several possible explanations for why breastfeeding appears to reduce the risk for overweight, but conclusive evidence is not yet available. The studies presented in this brief are limited in that they are based on observational studies and cannot demonstrate causality. One possible explanation for why the literature indicates that breastfeeding reduces the risk of overweight is that the findings are not true but instead are the result of confounding. It may be that mothers who breastfeed choose a healthier lifestyle, including a healthy diet and adequate physical activity for themselves and their children. This healthier lifestyle could result in a spurious relationship between breastfeeding and reduced risk of overweight. The results of Arenz et al.<sup>29</sup> and Owen et al.,<sup>30</sup> however, suggest a true relationship between breastfeeding and reduced risk of overweight, because after adjusting for potential confounding variables, significant inverse associations remained. For example, Arenz et al.<sup>29</sup> reported a significant adjusted OR of 0.78 (95% CI: 0.71, 0.85) among nine studies that adjusted for at least three of the following confounding or

interacting factors: birth weight, parental overweight, parental smoking, dietary factors, physical activity, and socioeconomic status/parental education. Similarly, when Owen et al.<sup>30</sup> conducted a subanalysis of six studies that controlled for possible lifestyle confounders, the significant inverse association between breastfeeding and pediatric overweight remained, but it was smaller than in the unadjusted analysis. While randomized clinical trials are required to adequately test this relationship, it is unethical to randomize infants to a group with no breastfeeding because of breastfeeding's known health benefits.

There are several biological mechanisms by which breastfeeding may reduce the risk of overweight. First, because breastfed infants control the amount of milk they consume, their self-regulation of energy intake, which involves their responding to internal hunger and cues that they are full, may be better than that of bottle fed infants, who may be encouraged by external cues to finish a feeding.<sup>45</sup>



A second possibility pertains to insulin concentrations in the blood, which vary by feeding mode. Formula-fed infants have higher plasma insulin concentrations and a more prolonged insulin response.<sup>46</sup> Higher insulin concentrations stimulate more deposition of fat tissue, which in turn increases weight gain, obesity, and risk of type 2 diabetes.<sup>47</sup> Also, the high protein intake of formula-fed infants may stimulate the secretion of insulin.<sup>48</sup> A third possibility is that concentrations of leptin (the hormone that is thought to inhibit appetite and control body fatness) may be influenced by breastfeeding. One study found that after controlling for confounding variables such as BMI, children who had the highest intake of breast milk early in life had more favorable leptin concentrations relative to their fat mass.<sup>49</sup> In conclusion, there are several potential explanations for why breastfeeding appears to reduce the risk for overweight, but more research is needed in this area.



Table 1. Breastfeeding Rates Among 2004 Births by Select Maternal Characteristics, %					
Characteristic	Ever breastfed	Breastfed 6 months	Breastfed 12 months	Exclusive <sup>1</sup> Breastfeeding 3 months	Exclusive <sup>1</sup> Breastfeeding 6 months
US National	73.8	41.5	20.9	30.5	11.3
<b>Maternal Age, Year</b>					
Less than 20	55.8	17.2	8.6	16.8	6.1
20 to 29	69.8	35.0	16.7	26.2	8.4
30 or more	77.9	48.0	24.9	34.6	3.8
<b>Maternal Education</b>					
Less than High School	67.7	34.9	18.5	23.9	9.1
High School	65.7	32.2	16.8	22.9	8.2
Some College	75.2	40.9	18.5	32.8	12.3
College Graduate	85.3	55.8	28.2	41.5	15.4
<b>Maternal Marital Status</b>					
Married	79.6	48.3	24.5	35.4	13.4
Unmarried <sup>2</sup>	60.0	25.5	12.4	18.8	6.1

<sup>1</sup>Exclusive breastfeeding is defined in this study as ONLY breast milk - NO solids, no water, and no other liquids.  
<sup>2</sup>Unmarried includes never married, widowed, separated, and divorced.  
Source: National Immunization Survey, 2004 Births, Centers for Disease Control and Prevention, Department of Health and Human Services

### Breastfeeding rates in the United States

Despite its benefits for both mothers and infants, rates of breastfeeding in the United States remain suboptimal, especially among certain subpopulations (Table 1 and Table 2). Data from the CDC National Immunization Survey indicate that 74% of infants born in 2004 initiated breastfeeding, 42% continued to breastfeed for 6 months, and 21% were still breastfeeding at 12 months. Thirty-one percent of infants born in 2004 were exclusively breastfed for 3 months, and 11% were exclusively breastfed for 6 months.<sup>50</sup> Smaller percentages of infants born in 2004 to mothers with only a high school education (66%) and of

African American race (56%) initiated breastfeeding.<sup>50</sup> Goals in *Healthy People 2010* aim to increase rates so that 75% of all new mothers initiate breastfeeding, 50% continue for at least 6 months postpartum, 25% continue to breastfeed at least 1 year postpartum as well as that 60% practice exclusive breastfeeding through 3 months, and 25% practice exclusive breastfeeding through 6 months.<sup>51</sup> The U.S. has not yet met any of the five Healthy People 2010 breastfeeding goals. Thus evidence-based interventions to promote breastfeeding need to be implemented to increase these rates, particularly among subpopulations with the lowest rates.

**Breastfeeding Rates Among 2004 Births**  
Data from CDC National Immunization Survey

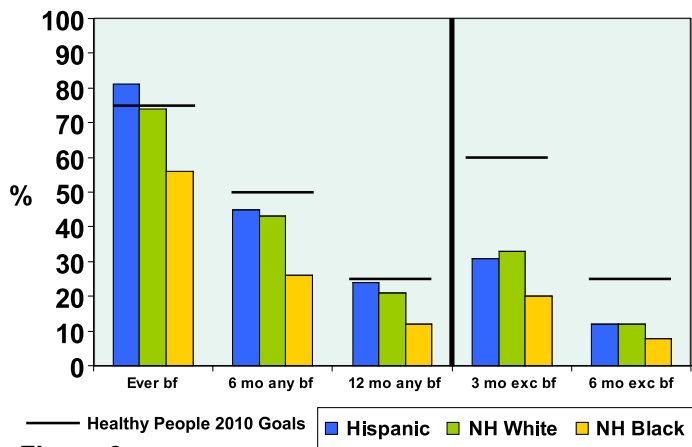
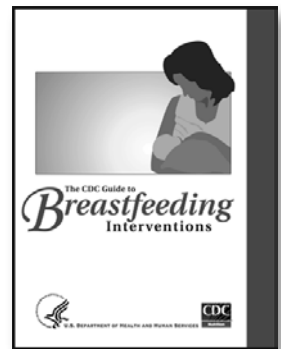


Figure 2.

### Research to Practice: Are there evidence-based interventions to promote breastfeeding?

Interventions to promote breastfeeding attempt to increase its initiation, exclusivity, and duration. The CDC Guide to Breastfeeding Interventions, which is a resource for program planners and policy makers,<sup>52</sup> provides a synthesis of the published peer review literature on the effectiveness of various interventions. The Guide includes two sections: 1) six evidence-based interventions whose effectiveness has been established, and 2) four interventions whose effectiveness has not been established.<sup>52</sup> In the first category, the evidence



must be significant, such as a Cochrane systematic review concluding effectiveness of an intervention. The Cochrane Library is a comprehensive collection of up-to-date information on the effects of health care interventions. In the second category the evidence is limited, such as no systematic review or an intervention that is not found to be effective standing alone but has been evaluated when included as a component of an effective multifaceted intervention.

## EVIDENCE-BASED INTERVENTIONS

The six interventions with evidence of effectiveness are:

- Maternity care practices
- Support for breastfeeding in the workplace
- Peer support
- Educating mothers
- Professional support
- Media and social marketing

### Maternity Care Practices

Maternity care practices refer to the events immediately before, during, and after labor and delivery that take place in the hospital or other birthing facility. Experiences and practices during the first hours and days of life are influential in how likely breastfeeding is to be initiated, and they also influence feeding practices after mother and child leave the hospital. Therefore, it is essential that breastfeeding be supported during this time through established policies and practices within the medical facility. There is significant evidence that making changes in maternity care at the institutional level can increase rates of breastfeeding initiation and lengthen its duration. Some ideas for improving maternity care practices include:

- Pay for training for hospital staff on breastfeeding, especially in hospitals serving low-income families.
- Examine and evaluate current policies and regulations in maternity care facilities; update if necessary.
- Establish links between maternity facilities and networks in the community that support breastfeeding.
- Sponsor a meeting of key decision makers at maternity care facilities to highlight the importance of evidence-based breastfeeding practices.
- Implement a program within a facility using incremental change – choose one practice that needs to be changed and work toward adjusting it to be evidence based and supportive of breastfeeding.

### Support for Breastfeeding in the Workplace

Working outside the home or working full-time is associated with lower rates of breastfeeding initiation

and shorter duration.

Because the majority of new mothers work full-time, and as they often return to work within a few months of childbirth, it is important that the workplace environment be supportive of breastfeeding. Research supports the effectiveness of lactation support programs at the workplace in promoting breastfeeding. Some ideas for encouraging support at the workplace are as follows:

- Provide educational materials to employers outlining the benefits (to both employees and employers) of a supportive work environment for breastfeeding.
- Establish a model program for lactation support in your state health department or organization.
- Promote legislation to mandate or incentivize programs at the work site that support lactation.
- Create recognition programs for employers who support their breastfeeding employees.

### Peer Support

Women tend to rely on their social networks, especially their friends and other mothers, for advice on rearing children. Peer support programs train women who are currently breastfeeding or have breastfed in the past to counsel other women. These programs have been shown to be effective, both on their own and as part of a larger program, in increasing the initiation and duration of breastfeeding. Here are some ideas for implementing peer support programs:

- Fund one full-time position in the state to coordinate peer counseling services for women not eligible for WIC (Special Supplemental Nutrition Program for Women, Infants and Children).
- Create or expand the coverage of peer counseling programs within WIC. Improve the quality of existing peer counseling programs by increasing contact hours, enhancing training, and initiating prenatal visits earlier.
- Use an International Board Certified Lactation Consultant (IBCLC) to support and supervise peer counselors.

### Educating Mothers

Although many women have an understanding of the benefits associated with breastfeeding, most new mothers do not have information or knowledge about the actual act of breastfeeding an infant. Research supports the idea that educating pregnant women and new mothers



about breastfeeding is one of the most effective ways to increase initiation of this practice and its duration in the short term. Here are some ideas for educating women:

- Fund training for people within local health departments who work with women of childbearing age to educate mothers about breastfeeding.
- Encourage organizations of health professionals to provide training in education about breastfeeding for their members who provide services to women of childbearing age.
- Incorporate education on breastfeeding into women's programs such as family planning, teen pregnancy, and women's health.
- Encourage childbirth educators to include evidence-based education on breastfeeding as an integrated component of their curricula.
- Encourage health plans to routinely offer prenatal classes on breastfeeding to their members.



## Professional Support

Health professionals (doctors, nurses, lactation consultants, etc.) give support to mothers both during their pregnancy and after their hospital stay. The focus of this support is counseling, encouragement, and managing lactation crises. Research indicates that support by professionals can increase breastfeeding duration, and professional support combined with education can increase both initiation and short-term duration. Steps for encouraging professional support might be:

- Work with Medicaid and insurance commissioners in your state to make sure lactation support is included in standard, reimbursable perinatal care.
- Fund the establishment of sustainable walk-in breastfeeding clinics staffed by IBCLCs.
- Fund a program in which IBCLCs provide breastfeeding support to pregnant adolescents as part of their educational courses on parenting.
- Develop a resource directory of local services providing lactation support that are available to new mothers.
- Integrate lactation support services with home visitation programs so that lactation problems are identified early and mothers are referred to appropriate help.

## Media and Social Marketing

Research suggests that media campaigns, specifically those using television commercials, can improve attitudes toward breastfeeding and increase initiation. In addition, social marketing campaigns, which use established principles in commercial marketing to encourage healthy behaviors or support behavioral change,<sup>53</sup> have been shown to increase initiation and duration as well as to improve perceptions of community support for breastfeeding.<sup>52</sup> Social marketing campaigns are comprehensive and multifaceted, and rely on many different strategies, including media campaigns, to support behavior change. Here are some ideas to promote breastfeeding using media and social marketing:

- Identify experts who can pitch stories to the media that highlight breastfeeding.
- Provide materials from WIC's Loving Support National Breastfeeding Promotion Program to interested local physicians, schools, clinics, hospitals, and child care centers.

## INTERVENTIONS: EFFECTIVENESS NOT ESTABLISHED

The four interventions listed in the CDC Guide to Breastfeeding Interventions for which there is limited evidence can be described as follows:

1. Using countermarketing techniques and the World Health Organization *International Code of Marketing of Breast-Milk Substitutes* to limit the negative effect of the commercial marketing of infant-feeding products.
2. Improving through professional education the knowledge, skills, and attitudes of health care providers related to breastfeeding
3. Increasing public acceptance of breastfeeding.
4. Providing assistance to breastfeeding women through professionally staffed hotlines or other informational resources.

Although evidence of effectiveness is limited for these interventions, CDC does not discourage their implementation. If these interventions are used, we encourage a strong and thorough evaluation so that the findings can be added to the evidence base.

This Research to Practice brief gives a very broad overview of the 10 interventions described in the CDC Guide to Breastfeeding Interventions. For a detailed summary of the interventions, including their definition, rationale, evidence of effectiveness, description and characteristics, examples of programs, potential action steps and resources, visit CDC's breastfeeding web site (<http://www.cdc.gov/breastfeeding/resources/guide.htm>) to download the Guide or order a free printed copy.

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