



## The Internet Journal of Allied Health Sciences and Practice

<http://ijahsp.nova.edu>

A Peer Reviewed Publication of the College of Allied Health & Nursing at Nova Southeastern University

*Dedicated to allied health professional practice and education*

<http://ijahsp.nova.edu> Vol. 6 No. 3 ISSN 1540-580X

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### Breastfeeding Helps Prevent Two Major Infant Illnesses

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**CITATION:** Story, L., Parish, T. Breastfeeding helps prevent two major infant illnesses. *The Internet Journal of Allied Health Sciences and Practice*. July 2008, Volume 6 Number 3.

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#### ABSTRACT

**Background:** Breastfeeding has been shown to reduce morbidity and mortality rates due to gastrointestinal and respiratory illnesses in children worldwide. Components of breast milk give the breast milk its protective mechanism against childhood illnesses. Additionally, breast milk is economical, costing parents nothing financially. **Objective:** To provide evidence to healthcare providers regarding the protective effects of breast milk against the incidence of gastroenteritis and pneumonia in infants. **Methods:** Fifteen published studies were reviewed regarding the effect of breastfeeding on the incidence of gastrointestinal and/or respiratory illnesses. Studies ranged from six months to twelve years in length, comparing the incidence of illnesses between breast and formula fed infants. Databases used were MEDLINE, PubMed, Cochrane Library, DynaMed, and CINAHL. **Results:** The majority of studies found a statistically significant reduction in the incidence of gastrointestinal and respiratory illnesses. Research shows breastfeeding for any length of time is beneficial. Breastfed infants are less likely to visit doctors or be admitted for illnesses. **Conclusion and Recommendations:** Studies have consistently reported a decrease in the incidence of diarrhea and lower respiratory tract infections in breastfed infants. By breastfeeding, mothers are providing a natural form of nourishment, reducing long-term healthcare cost, eliminating formula cost, and nurturing a bond with her child. As clinicians, recommendations should be made to soon-to-be parents regarding the importance of breast milk during routine obstetric and pediatric visits.

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#### INTRODUCTION

According to the World Health Organization (WHO) and the American Academy of Pediatrics, breastfeeding for at least six months can decrease worldwide infant mortality due to diarrhea, respiratory illness, and other infectious diseases by up to 55%.<sup>1</sup> Among these, pneumonia “is the leading cause of death in children under five years old worldwide.”<sup>2</sup> Bacterial gastroenteritis tends to cause a secretory diarrhea. This can produce severe dehydration, particularly in young children, and is one of the leading causes of death in underdeveloped countries.<sup>3,4</sup> These two illnesses account for a great number of physician visits and hospitalizations with “33,698 infants between 1 and 11 months of age [being] hospitalized with [lower respiratory illness]...in 1992.”<sup>1(p. 870)</sup> By decreasing the prevalence of gastroenteritis and pneumonia, “hospitalization rates, health expenditure, and mortality as a result of these infections” can be dramatically reduced.<sup>6</sup>

Critics of breastfeeding’s role in reducing disease have suggested confounding variables play a major role in the decreased morbidity and mortality rates. They believe mothers of breastfed infants “differ from mothers who formula-feed in ways which might alter their infant’s risk for illness.”<sup>7</sup> Newburg concurs there are other factors that may play a role in the infant’s rate of illness; however, the components of breast milk are major contributors to decreased morbidity rates in breastfed infants.<sup>8</sup> By reviewing literature from studies comparing breastfed versus bottle fed children on the prevalence of gastroenteritis and

pneumonia, one will provide medical professionals information to educate soon-to-be mothers on the benefits of breast milk over artificial nutrition.

### **Components of milk**

Wright, Bauer, Naylor, Sutcliffe, and Clark reported a 32-72% reduction in the incidence of pneumonia and a 15% reduction in gastroenteritis after an intervention promoting breastfeeding in a study on a Navajo reservation in New Mexico. In their paper, Wright, Bauer, Naylor, Sutcliffe, and Clark<sup>7</sup> discuss the conclusions of a study conducted by Mata et al. (1988) ten years earlier. They cite Mata's conclusion that "neonatal mortality and morbidity attributable to diarrhea, sepsis, bronchopneumonia, and meningitis declined after breastfeeding promotion in Costa Rica."<sup>7</sup> Because a child's immune system is immature, the mother's milk provides protection against "enteric and other diseases."<sup>8</sup> Colostrum, or foremilk, and breast milk contain elements that protect infants from illnesses of the respiratory and gastrointestinal tract. Human milk contains components which "inhibit the attachment of *Streptococcus pneumoniae* and *Haemophilus influenzae* to host cell surface receptors."<sup>3</sup> Research performed by Hanson et al. shows that immune complexes in breast milk help to initiate and stimulate the child's immune system.<sup>9</sup> Oligosaccharides, immunoglobulin A (IgA), lactoferrin, and other immune cells provided from the mother's milk have been shown to protect the child from infection.<sup>7,10</sup> These elements of breast milk provide protective mechanisms from childhood illnesses such as gastroenteritis and pneumonia.

### **IgA**

Colostrum and human milk contain an abundant amount of IgA.<sup>11</sup> These antibodies are produced by the mother when "microbes, foods, and other antigenic material passing through the gut [are] sampled by the special M cells covering the Peyer's patches and deliver it to the antigen-presenting cells and lymphocytes in the Peyer's patches."<sup>9</sup> B lymphocytes are stored producing IgA dimers with the addition of J chains late in pregnancy. IgA is secreted from the mammary and other exocrine glands during lactation.<sup>9</sup> IgA prevents the attachment of bacteria and viruses to the mucosal epithelium cells that would potentially cause infection.<sup>10</sup> Hanson et al. states "the milk [secretory IgA] antibodies protect against...microbes like *Vibrio cholerae*, enterotoxigenic *Escherichia coli* (ETEC), *Campylobacter*, *Shigella*, and *Gardia lamblia*," all causes of gastrointestinal diseases.<sup>9</sup> IgA comprises one aspect of breast milk that provides protection to infants from infection.

### **Oligosaccharides**

Human milk contains an extensive amount of oligosaccharides. This form of nourishment accounts for "12g/L of mature milk and approximately 22g/L of colostrums."<sup>12</sup>(p. 980S) Breast milk "oligosaccharides...[can] inhibit the attachment of *Streptococcus pneumoniae* and *Haemophilus influenzae* to host cell surface receptors"<sup>3,12</sup> These sugars also prevent the attachment of pneumococci, therefore stopping infections of these pathogens.<sup>9</sup> These sugars attach to external guanylyl cyclase receptor allosterically near the receptor for the bacteria such as Enterotoxigenic *E. coli* (ETEC), causing an increase in cyclic guanosine monophosphate (cGMP) intracellularly. If this step were not to occur, "chloride channels are able to function normally, allowing the resorption of fluid from the intestinal lumen and thereby preventing the secretory problem normally induced" by ETEC.<sup>13</sup> Though research has provided evidence of the pathophysiology of the oligosaccharides regarding infant gastrointestinal disease, research has not shown that this mechanism works for pneumonia.

### **Lactoferrin**

Lactoferrin accounts for a third important component of breast milk. Being the main protein in human milk, this nourishment acts as a microbicidal agent killing bacteria and viruses.<sup>9</sup> Lactoferrin amounts to approximately two to four grams per liter of breast milk.<sup>10</sup> Hanson et al. discussed research showing oral lactoferrin as a protective agent of *E. coli* infected rats against urinary tract infection. Based on the study, lactoferrin was found in the urine revealing a connection between rats that received the protein orally and a reduction in the incidence of urinary tract infection.<sup>9</sup> The microbicidal effects of lactoferrin add to the protective factor of breast milk.

### **Other Components of Breast Milk**

Other bioactive components of milk consist of B lymphocytes, T lymphocytes, immunoglobulin G (IgG), immunoglobulin M (IgM), neutrophils, and eosinophils.<sup>11</sup> The maternal lymphocytes are transferred to the infant via the milk and are absorbed, giving the child his/her mother's "immunologic information."<sup>10</sup> Islam et al. found the mean concentration of IgG in colostrum to be 0.10 +/- 0.02 gm/L and the mean concentration of IgM to be 0.47 +/- 0.09 gm/L. Additionally, researchers concluded the ratio of IgA to IgM to be 60:5. In this study, researchers also concluded the amount of macrophages and neutrophils found in the breast milk are "equivalent to blood neutrophils in terms of phagocytosis and killing of pathogens."<sup>11</sup> Based on the research above, one could reasonably conclude that the benefits of breast feeding on infant immune status and the resulting decrease in significant illnesses are well established. For this reason, breast-feeding should be encouraged in all mothers who are able.

## METHODOLOGY

The information contained in this article was obtained from the review of fifteen articles published between the years 1997-2007. Research discussed the effect of breastfeeding on the incidence of gastrointestinal and/or respiratory illnesses. The length of the studies ranged from six months to twelve years. The number of infants in the studies ranged from 170-2602. These articles were retrieved from the following databases: MEDLINE, PubMed, Cochrane Library, DynaMed, and CINAHL.

## DISCUSSION

On review of fifteen studies, seven discussed the effect of breast versus formula feeding on both respiratory and gastrointestinal illnesses. Six studies investigated the relationship between breastfeeding and respiratory illnesses, and two studies focused on the effect of breast milk feedings on diarrheal illnesses in infants. Seven of the fifteen studies are prospective cohort studies. The mean number of infants in these seven studies is 1254. These seven studies discuss the duration (in months) the infant received breast milk, supplemental nutrition such as juice or formula, and the incidence of lower respiratory tract infection (LRTI) inclusive of pneumonia or gastrointestinal illness inclusive of gastroenteritis/diarrhea. These studies excluded households where someone smoked, children with chronic infections, and infants born to mothers with respiratory illnesses. The infants included in these studies were classified into one of two ways: 1. exclusively breastfed (receiving only the mother's milk), predominantly breastfed (receiving 50-90% breast milk with supplemental nourishment), partially breastfed (receiving 1-50% breast milk with supplemental nourishment), and not breastfed (receiving no breast milk as nourishment); or 2. breastfed less than 4 months, from 4-6 months, greater than 6 months, fully breastfed the entire first 12 months of life, or never breastfed. Researchers obtained information from the mothers via mailed questionnaire or in-person interviews.<sup>3,6,7,13-16</sup>

Five out of six prospective cohort studies found a significant reduction in the incidence of LRTIs in infants who were breastfed with p values less than 0.05.<sup>3,6,7,14,16</sup> Wright, Bauer, Naylor, Sutcliffe, and Clark concluded the percent change in the incidence of pneumonia was 32% with a p value of 0.04 following the breastfeeding promotion to the Navajo people in Shiprock, NM.<sup>7</sup> Cushing et al. found "full breastfeeding was associated with a significant reduction in risk of" lower respiratory illness.<sup>14</sup> One of the prospective cohort studies did not find significant evidence that breastfeeding reduced the incidence of non-wheezing lower respiratory illness.<sup>15</sup> Three prospective cohort studies also found a reduction in the morbidity and mortality of diarrhea with breastfed children.<sup>3,6,13</sup> Arifeen et al. concluded that the "highest risk group for diarrhea deaths included infants who were either not breastfed or who received, in addition to breast milk, other energy-containing foods" in Bangladesh children.<sup>13</sup> Talayero et al. found admissions were "4.91 times higher among infants who never received [full breast milk] and 2.45 times higher among those who received [breast milk] for <4 months."<sup>6</sup> Additionally, these investigators found breastfeeding to be a statistically significant protective agent against gastrointestinal illness.<sup>6</sup> López-Alarcón, Villalpando, & Fajardo examined whether breastfeeding reduces the risk of diarrhea and acute respiratory illness, and concluded an increase in the risk of diarrhea in formula fed infants. Investigators also found the duration of diarrhea to be longer in the formula fed newborns.<sup>3</sup>

Galton Bachrach, Schwarz, and Bachrach conducted a meta-analysis of 33 studies examining 4525 infants. Researchers reviewed studies where infants were breastfed from two to nine months of life, and participants were excluded for "pulmonary complications when hospitalization was not required, as well as reports of hospitalizations for upper respiratory tract disease."<sup>17</sup> Newborns who were sick and those infants with chronic illness were also excluded. However, those infants in homes where someone smoked were not excluded. During the review of the 33 studies, researchers defined lower respiratory illness inclusive of pneumonia.<sup>17</sup> Galton Bachrach, Schwarz, and Bachrach results state, "breastfeeding for four or more months appears to diminish the risk of respiratory hospitalization in infancy to one third or less risk observed in formula-fed infants."<sup>17</sup> This group of researchers concluded exposure to smoking did not reverse the benefit of breastfeeding on the number of hospitalization due to lower respiratory tract illness.<sup>17</sup>

Ball and Wright also conducted a meta-analysis of two studies consisting of 1588 infants investigating how breastfeeding affected the incidence of gastrointestinal illness and LRTIs while examining the healthcare cost incurred due to these illnesses. Children born needing "oxygen/ventilator after [six] hours of life or [with] major congenital anomalies...of the chest or lung, symptomatic congenital heart disease, congenital heart disease, or any severe systematic disease" were excluded.<sup>5</sup> Infants were also removed from the study if weighing less than 2500 grams at birth. Children were followed for the first 12 years of life.<sup>5</sup> Ball and Wright explored the healthcare cost incurred by breastfed versus formula fed infants. Investigators examined the incidence of illness based on hospital visits, doctor office visits, and prescriptions filled. Researchers concluded: Compared with 1000 infants who were breastfed exclusively for  $\geq 3$  months, the never-breastfed group experienced 60 more episodes of [lower respiratory illness]...[and] 1,053 more episodes of gastrointestinal illness. For 1,000 never-breastfed infants, there were > 609 excess prescriptions and 80 excess hospitalizations, relative to 1,000 infants breastfed exclusively for [three] months."<sup>5</sup> In addition to increased expenses due to office visits, hospitalizations, and/or prescriptions, parents also incur the cost of formula versus free milk provided by the human body.

The United Kingdom Millennium Cohort Study (2007) is a retrospective cohort study of 15,890 infants born in 2000-2002 to determine the effect of breastfeeding on the incidence of LRTI and diarrhea in the first 8 months of life. Infants of multiple birth, less than 37 weeks gestation at birth, greater than 37 weeks gestation admitted to the intensive care unit at birth, and babies with breathing problems at birth were excluded from this study. Neonates were classified as exclusively breastfed, partially breastfed, and not breastfed. Researchers obtained interviews regarding the child's first 8 months of life via interview at approximately the child's ninth month.<sup>18</sup> The Promotion of Breastfeeding Intervention Trial (PROBIT), a clustered randomized study, also assessed the effect of breastfeeding on the incidence of gastrointestinal and respiratory illness. The study consists of 16,491 full term infants who weighed at least 2500 grams at birth without comorbidities at birth. Infants were seen monthly for routine visits as well as acute visits for 1 year. This study was conducted between June 1996-December 1997.<sup>20</sup> Bhandari et al. also conducted a randomized cluster study in Haryana, India, of 1115 infants from January 1, 1998 until March 31, 2002. Investigators of this and the PROBIT studies randomly chose a subset of the population to which they endorsed breastfeeding.<sup>19,20</sup>

In United Kingdom Millennium Cohort Study, researchers found a statistically significant reduction in the risk of hospitalization due to diarrhea and LRTI. Researchers "suggest that 53% of diarrhea hospitalizations... [and] 27% of LRTI hospitalizations could have been prevented each month by exclusive breastfeeding."<sup>18(e840)</sup> After interviewing 16,491 mothers, Kramer et al. found a 40% reduction in the risk of gastrointestinal illness during the first year of life in the intervention group in PROBIT.<sup>20</sup> In a similar intervention conducted in the state of Haryana, India, researchers found less children who had incidence of diarrhea in the past seven days at the three (p value = 0.028) and six month (p value = 0.037) visits in the intervention group; additionally, investigators noted a decrease in the number of medical office visits due to diarrhea in the intervention group compared to the control group.

César et al. examined all women in Pelotas, Brazil, for 1 year after delivery of their children in the city hospital in 1993 via a case-control study. Researchers wanted to determine "whether [breastfeeding] protects young children against pneumonia and whether this protection varies with age."<sup>2</sup> Infants born in 1993 diagnosed with pneumonia in the city hospital were included in the study. Researchers also visited the homes of these infants to conduct a questionnaire regarding type of milk consumed, supplements used, and occurrence of pneumonia. César et al. observed infants aged 1-3 months who were formula fed were 2.9 times more likely to be admitted for pneumonia than those neonates breastfed.<sup>2</sup> Additionally, researchers also determined the "relative risk of admission for pneumonia for infants receiving breast and formula milk or other fluids alone was 3.8 and 16.7, respectively, in comparison with infants who were exclusively breastfed."<sup>2</sup> Therefore, research confirms breastfeeding reduces the incidence of pneumonia in infants during the first year of life.

Chantry, Howard, and Auinger conducted a cross-sectional home survey across the United States from 1988-1994 of children aged 6-24 months regarding breastfeeding status.<sup>1</sup> Researchers wanted to determine if the protection against respiratory tract disease inclusive of pneumonia is dose dependent. Infants exposed to smoking were categorized based on exposure but were not excluded.<sup>1</sup> In this study, infants "fully breastfed 4 to ≤6 months were at greater risk for pneumonia than those who were fully breastfed for ≥ 6 months."<sup>1(p. 425)</sup> Based on these studies, researchers examined the effect of breastfeeding on the incidence of pneumonia in infants. Scariati, Grummer-Strawn, and Fein<sup>4</sup> conducted a similar longitudinal analysis on a cohort of 2,615 mother-infant pairs, sending questionnaires at one month intervals from 2-7 months in the United States. Researchers used the answers of the questionnaires to determine if breast milk protects infants from diarrhea and ear infections. Neonates exposed to smoking were not excluded in this study as well. Additionally, daycare status was recorded, but these individuals were not eliminated from the study.<sup>4,19</sup> In the longitudinal analysis of infants in the United States conducted by Scariati, Grummer-Strawn, and Fein,<sup>4</sup> researchers found an 80% increase in the risk of developing diarrhea in the formula fed children compared to breastfed infants. Investigators also found a "dose-response effect...specifically,...there was a small but steady increase in the risk of developing diarrhea as the amount of breast milk an infant received decreased."<sup>4</sup>

## CONCLUSION AND RECOMMENDATIONS

According to research completed on this topic, a protective relationship exists between breastfeeding and the incidence of diarrhea and pneumonia. Current recommendations by the World Health Organization and the American Academy of Pediatrics for new mothers is to breastfeed exclusively for the infants first six months of life.<sup>1,17</sup> This suggestion is based on research consistently identifying a defensive quality of human milk against lower respiratory and gastrointestinal illnesses. Immunoglobulin A, oligosaccharides, lactoferrin, and other immune cells are components of breast milk play a part in the immature immune system providing bactericidal, viricidal, and fungicidal properties to protect neonates during the first year of life. While providing this natural safety barrier to the child, breast milk costs the parents nothing financially and saves on healthcare expenses. Mothers could provide a natural form of nourishment while reducing long-term healthcare cost, reducing formula cost, and nurturing a bond with her child. These benefits need to be expressed to expectant parents.

While suggestions have been made regarding breastfeeding, no recommendations have been provided for clinicians to emphasize the importance of breastfeeding to expecting mothers. As healthcare professionals, education should be provided to soon-to-be parents about the protective nature of breast milk during initial obstetrical visits and reiterated on routine visits. Lactation counseling should be offered in the third trimester along with Lamaze training and during obstetrical visits. Lactation specialists should also be available in hospitals for questions or problems encountered before mothers leave the hospital. Pediatricians and family practitioners can also stress the benefits of breastfeeding during the initial pediatric visit in the hospital and at routine pediatric exams during the child's first year of life. While research has confirmed a relationship between breastfeeding and reduced incidence of pneumonia and gastroenteritis, healthcare providers need to emphasize the importance of breastfeeding one's children and the benefits to the entire family.

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