



# Breastfeeding initiation and duration and child health outcomes in the first baby study

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## ABSTRACT

Despite the known benefits of breastmilk, associations between breastfeeding and child overall health outcomes remain unclear. We aimed to understand associations between breastfeeding and health outcomes, including child weight, through age 3. Analysis included women ( $N = 3006$ ) in the longitudinal, prospective First Baby Study from 2009 to 2014. For this analysis, breastfeeding initiation and duration were measured using self-reported data from the 1-, 6- and 12-month surveys; child illnesses were analyzed from the 6-, 12-, and 24-month interviews; height and weight at age 3 were used to determine overweight/obese ( $\geq 85$ th percentile) and obese ( $\geq 95$ th percentile). Adjusted logistic regressions were utilized to determine significance. Greater duration of breastfeeding was associated with fewer reported acute illnesses at 6 months ( $p < 0.001$ ) and fewer diarrheal illness/constipation episodes at 6, 12, and 24 months ( $p = 0.05$ ) in adjusted analyses. Fewer breastfed children, compared to non-breastfed children, were overweight/obese (23.5% vs. 37.8%;  $p = 0.032$ ) or obese (9.1% vs. 21.6%;  $p = 0.012$ ) at age 3. Breastfeeding duration was negatively associated with overweight/obese (never breastfed: 37.8%, 0–6 months: 26.9%, > 6 months: 20.2%;  $p = 0.020$ ) and obesity (never breastfed: 21.6%, 0–6 months: 11.0%, > 6 months: 7.3%;  $p = 0.012$ ). Overall, our findings support the hypothesis that duration of breastfeeding is associated with fewer reported acute illnesses at 6 months of age and diarrheal illness and/or constipation episodes at 6, 12, and 24 months. Additionally, results from our study suggest a protective effect of breastfeeding from childhood overweight/obesity, as children who received breastmilk for 6 months or longer had lower odds of overweight/obesity at age 3 years.

## 1. Introduction

Breastfeeding rates in the U.S. have steadily increased over the past decade, but remain well below the WHO Global Nutrition Targets for 2015 which established an exclusive breastfeeding target rate of 50% up to 6 months of age (Centers for Disease Control and Prevention, 2017). The 2016 National Immunization Survey indicated that only 21.9% of mothers were exclusively breastfeeding at 6 months postpartum and 29.2% were breastfeeding at 1 year (World Health Organization, 2014). The short-and long-term benefits of breastfeeding

on infant health is well evidenced and includes reduced incidence of childhood illnesses, acute otitis media, severe lower respiratory tract infections, asthma, constipation, gastrointestinal infection, and eczema (Ip et al., 2007; Duijts et al., 2010; Bowatte et al., 2015; Turco et al., 2014; Silvers et al., 2012).

Although extensive research supports the medical benefits of breastfeeding, research examining the relationship between breastfeeding and infant weight has generated conflicting results (Brion et al., 2011). Over the past three decades, childhood obesity rates in America have tripled, and today, nearly one in three children in America is

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overweight or obese (Ogden et al., 2014). Worldwide obesity has more than doubled since 1980 and in 2014, 41 million children under the age of 5 were overweight or obese (Ogden et al., 2014). As a result of this epidemic, research on the prevention of childhood obesity, including breastfeeding research, has elicited much scientific interest (Uwawzuoke et al., 2017). Differences in overweight/obesity risk in breastfed versus non-breastfed infants are likely influenced by differences in maternal sociodemographic factors such as race and education, as well as maternal health (e.g., overweight/obesity) which is seldom reported or controlled for in published studies (Lefebvre and John, 2014). Furthermore, information on duration of breastfeeding is not always reported, thus the optimal duration of breastfeeding necessary to reduce the likelihood of a child being overweight/obese remains unknown (Oken et al., 2017).

The primary aim of this secondary data analysis from the First Baby Study (FBS) was to investigate potential associations between the initiation and duration of breastfeeding on parent-reported childhood illnesses and child weight. We hypothesized that children who were breastfed for the recommended 6 months or longer, would have fewer parent reported illnesses at 6, 12, and 24 months of age and a lower likelihood of overweight/obesity at 3 years.

## 2. Methods

### 2.1. Study design

FBS was a longitudinal prospective study that involved prenatal and postnatal interviews with mothers through child age 3 years. The primary outcome of the FBS was to investigate the effect of mode of first delivery (vaginal vs. cesarean section) on subsequent childbearing outcomes (Kjerulff et al., 2013). Participant interviews occurred during pregnancy, between 30 and 42 weeks gestation, and included questions assessing sociodemographic factors. The 1-month postpartum telephone interview focused on the events of labor and delivery. Follow-up telephone interviews were conducted at 6, 12, 18, 24, 30, and 36 months postpartum. The study was approved by the Institutional Review Board of the Penn State College of Medicine as well as at participating hospitals throughout Pennsylvania. Additional details about the study design are previously published (Kjerulff et al., 2013).

### 2.2. Participants

Recruitment of study participants occurred from January 2009 through April 2011. Participants were recruited via clinic and community-based methods (e.g., study brochures displayed in offices, clinics, community health centers and mailed to potentially eligible women by a Medicaid insurer; internet postings; childbirth classes, hospital tours). Trained study recruiters determined eligibility in-person or by telephone. The final sample size of women who completed both the baseline and 1-month postpartum interview was 3006. The flow chart of study participation at each data collection stage can be seen in Fig. 1. Eighty-eight women were missing data on breastfeeding duration and were excluded from this secondary analysis, resulting in a sample size of 2918 women. Fig. 1 provides details of sources of missing data at the 6, 12, 24, and 36 months data collection stages. There were 2423 women who participated in the 36-month survey, for a retention rate of 80%. Although the mothers were sent detailed instructions as to how to measure the height and weight of their first child prior to the 36-month survey, only 1653 reported both height and weight at the 36-month survey. Among the sample of 2918 mother-child pairs available for this secondary analysis, 1629 reported the height and weight of the child, as seen in Fig. 1.

### 2.3. Study variables

#### 2.3.1. Breastfeeding

Breastfeeding initiation and duration were obtained by maternal self-report at 1, 6 and 12 months postpartum. Because the FBS did not distinguish the dyadic behavior in which infants obtain breast milk, “breastfeeding” was defined as an infant receiving breast milk, regardless of exclusivity (added formula or solid foods) or method of feeding (breast or bottle). For breastfeeding initiation, mothers were asked at the 1-month interview, “Have you ever breastfed or tried to breastfeed your baby?”. If they responded “no” they were coded as “never breastfed” ( $n = 251$ ). Additionally, one woman had missing data at the 1-month interview but reported at the 6 month interview that she had never breastfed or tried to breastfeed, so she was also categorized as “never breastfed”, for a total of  $n = 252$ . Breastfeeding duration categories included “never breastfed”, “breastfed 0–6 months”, and “breastfed > 6 months”, derived from maternal responses at 1-, 6- and 12-month interviews as to the length of time they reported breastfeeding.

#### 2.3.2. Reported child illnesses

Child illnesses were reported every 6 months, from 1 month to 36 months of age, with mothers reporting whether or not their child had experienced the following illnesses in the past 4 weeks: cough or cold; respiratory infection (respiratory flu, asthma, bronchiolitis, respiratory syncytial virus (RSV); ear infection; fever of  $\geq 100.4^{\circ}\text{F}$  for  $\geq 24$  h; constipation; diarrhea; diaper rash; allergic reaction to new food; eczema; and/or asthma (Kjerulff et al., 2013). For this analysis, cough/cold, respiratory infection, ear infection and fever were combined and termed “acute illnesses”. If the mother reported that her child experienced one or more of these four conditions in the previous four weeks we categorized the child as having had an acute illness. Constipation and diarrhea were combined and termed “diarrheal illness/constipation”. If the mother reported that her child experienced one or both of these conditions in the previous four weeks the child was categorized as having had diarrheal illness/constipation.

#### 2.3.3. Body mass index

Children's height and weight were measured and reported by mothers at the 36-month postpartum interview (Kjerulff et al., 2013). Body mass index (BMI) values were calculated and the 2000 US Centers for Disease Control and Prevention Growth charts were used to categorize three sets of weight variables: underweight/healthy weight ( $< 85$ th percentile), overweight/obese ( $\geq 85$ th percentile), and obese ( $\geq 95$ th percentile) (Kuczmarski et al., 2000).

#### 2.3.4. Confounding variables

Potential confounding variables included maternal age (i.e., categorized as 18–24, 25–29, 30–36 years), race (white vs. non-white), education (high school degree or less, some college, college degree or higher), relationship status (married, living with partner, not partnered or not living with partner), smoking in pregnancy (yes, no), gestational weight gain (GWG) exceeding guidelines (yes, no), pre-pregnancy BMI category (normal and underweight, overweight, or obese) and gestational age (late preterm, early term, or term and post-term). With the exception of gestational age (obtained from birth certificate records), confounding variables were self-reported during the baseline telephone interview. Further, birth certificate data was also used in cases where data were missing or implausible. Confounding variables were carefully chosen to reflect variables that have been suggested in previous literature to affect breastfeeding and child health outcomes including childhood illnesses and obesity (Ip et al., 2007; Guo et al., 2015). Using IOM recommendations for GWG, women were categorized as exceeding or not exceeding the recommended GWG for their respective pre-pregnancy BMI categories (IOM and NRC, 2009). Gestational age at the time of delivery (in weeks) and pre-pregnancy BMI were included as

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