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Long-Term Effects of Breastfeeding Compared with
Alternative Food Sources: A Systematic Review

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Author Note

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Abstract

The topic of the long-term impact of breast milk and alternative foods on the health status of children continues to be a focus of discussion and research. The aim of this systematic review was to describe and appraise evidence about the effects of breast feeding on health outcomes in children four years and older. Seventeen studies about on infant feeding were identified using Google Scholar and scholarly databases through The University of Akron. Google Scholar, CINAHL, and MEDLINE PLUS methods of searching were utilized, incorporating keywords, i.e., “breastfeeding” AND “cognitive development;” “obesity,” “intelligence,” and “immune system.” Based on appraisal of seventeen research reports, children, 4 years and older, who were breastfed during infancy, had improved outcomes compared to those who used alternative food. Specifically, children who were breastfed for longer than 6 months were more likely to have lower body mass index, protective factors against the risk for diabetes, increased scores of several intelligence tests, and healthier mental health assessments. Each study was critically appraised based on sample size, validity and reliability, and general findings compared to current research. Based on the analysis, it is recommended that nurses strongly promote breastfeeding for a minimum of the first six months of infants’ lives.

The American Academy of Pediatrics (2012) recommends breastfeeding exclusively for the first six months of infants' lives, but to continue for twelve months if still desired by mom and baby. The World Health Organization (2015) also recommends exclusively breastfeeding up to six months of age with continued breastfeeding along with appropriate complementary foods up to two years of age or beyond. Despite consistent findings about the short-term benefits of breastfeeding, women are not breastfeeding for the recommended six months minimal (American Academy of Pediatrics, 2012). Each year roughly 3,999,400 children are born in the United States (Martin et al., 2011). The Center for Disease Control and Prevention (CDC) surveys breastfeeding practices in the United States to monitor progress over time and identify priority areas that need attention. In 2011, 81.1% of newborns were breastfed at birth, however this percent decreased to only 51.8% at 6 months, and 30.7% are breastfed at 12 months (CDC, 2018). Healthy People 2020 goals for breastfeeding includes increasing the proportion of infants who are breastfed exclusively at all to 81.9%, breastfed for at least 6 months to 60.6%, breastfed for 12 months to 34.1% (CDC, 2018). Infants living in the southeast are less likely to be breastfed at 6 months than infants living in other areas of the country. In the United States, infants in rural areas are less likely to ever be breastfed than infants living in urban areas (CDC, 2018). Fewer non-Hispanic black infants (69.4%) are ever breastfed compared with non-Hispanic white infants (85.9%) and Hispanic infants (84.6%) (CDC, 2018). Infants eligible for and receiving the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) are less likely to ever be breastfed (76.7%) than infants eligible, but not receiving WIC (83.3%), and infants ineligible for WIC (91.7%) (CDC, 2018). Younger mothers (aged 20 to 29 years) are less likely to ever breastfeed (80.4%) than mothers aged 30 years or older (85.3%) (CDC, 2018).

Women may not breastfeed for as long as recommended for many reasons. Many women decide whether or not to breastfeed or use alternative methods early on in the pregnancy (Kramer, Matush, Vanilovich et al., 2007). Formula is also heavily advertised (Jenkins & Foster, 2014), which can make it appear to be the better option to mothers who are uneducated about the benefits

of breast milk. Another reason women may not be breastfeeding is because this requires them to be present during all feeding times or to pump milk to feed their children (Hennessy, Polek, &, Reynolds, 2014). All of these factors contribute to women not breastfeeding their newborns or not breastfeeding for at least six months. Other factors that affect the decisions to breastfeed include: issues with lactation and latching, concerns about infant nutrition and weight, taking medications while breastfeeding, unsupportive workplace policies and lack of parental leave, and lack of family support (Odom, Scanlon, Perrine, & Grummer-Strawn, 2013).

Breastfeeding for less than six months is a problem (Holme, Lancashire, & MacArthur, 2010) because the shorter- and longer-term effects of breastfeeding may not be maximized for babies. Shorter-term effects of exclusively breastfeeding in the first six months of life include decreased morbidity for babies due to diarrhea, gastrointestinal and allergic disease, and respiratory infection (Kramer et al., 2007). Along with understanding shorter-term outcomes of breastfeeding, it is also important to describe and critically appraise evidence about longer-term effects of breastfeeding. For example, evidence about longer-term effects may support nursing assessments to include history of breastfeeding especially if higher risks for ailments, such as obesity, or diabetes are associated with how people were fed when they were babies. Increased understanding about longer-term effects of breastfeeding may also support more education to postpartum mothers about the shorter and long-term effects of breastfeeding which could assist mothers in making better informed decision about the diets of their children. The purpose of this systematic review is to identify and critically appraise the evidence about the longer-term effects of breastfeeding versus alternate sources of nutrition on outcomes of children four years and older. With this information healthcare professionals may be able to more effectively educate new mothers and monitor for disease risk factors. Recommendations for practice and research will be proposed based on the appraisal of evidence. For the purpose of this paper, breastfeeding will be defined as feeding infants milk produced by mothers' mammary glands, whether it be directly fed to infants; pumped and then fed to infants; or from

a different lactating mother. Alternate sources of nutrition include any form of nutrition not produced from a lactating mother. The systematic review PICOT question reflects the breastfeeding dilemma by asking: In children, what are the effects of the length and type of breastfeeding compared to no breastfeeding on the physical health and emotional well-being at four years and older?

Methods

A literature search was conducted using search engines, such as Google Scholar and scholarly databases through The University of Akron. Google Scholar, CINAHL, and MEDLINE PLUS methods of searching were utilized, incorporating keywords, i.e., “breastfeeding” AND “cognitive development;” “obesity,” “intelligence,” and “immune system,” To narrow results and find recent articles, the publication years were narrowed from 2007 to 2017. When reviewing literature, each article was evaluated with the PICOT question in mind to determine relevance. Each letter in PICOT stands for relevant concepts; P for patient population; I for intervention of interest; C for comparison of interest; O for outcome of interest; T for time (Schmidt & Brown, 2015). The studies were evaluated for purpose statements, research questions, clinical practice settings, sampling methods, sample sizes, designs, levels of evidence, findings, conclusions, practice and research implications, and limitations of the findings, which were all compiled into a Table of Evidence matrix (see appendix). The study researchers used samples of children, four years and older, and compared outcomes of those that were breastfed to those that were not, relating back to the PICOT question. The intervention of interest included exclusively breastfed, mixed fed, or exclusively non-breastfed.

In addition, reference of recent meta-analyses on the topic of breastfeeding benefits which cited recent, sound studies relevant to the PICOT question, were reviewed in attempts to thoroughly search the current literature (Horta & Victoria, 2013). When selecting publications, the focus was on whether or not breastfeeding was the independent variable and if researchers examined the outcomes of breastfeeding in children four years and older.

Studies in peer-reviewed, reputable journals from the United States were given preference; however, to maintain a comprehensive look at the current research, studies conducted outside the United States were also identified. This systematic review was primarily guided by research studies that were primary sources, high quality, and with large samples. Since breastfeeding is currently recommended to mothers as a standard of care (World Health Organization, 2015) and since randomly assignment to groups would be unethical, most studies were non-experimental, lacking group randomization or a control group. Furthermore, to avoid bias, studies were selected based on if they answered the PICOT question, not based on the results of the study or how they answered the PCOT question. The literature search did identify research studies with conflicting results, and that inconsistency will be presented in the Review of Literature. Sample size, population, sampling method, and consistency of results were all considered when determining the validity and reliability of the studies.

Review of the Literature

Some longer-term effects or associations of breastfeeding that researchers have examined include: (1) obesity, (2) physical health, (3) intelligence and cognitive development and abilities, and (4) mental health. Studies have been conducted in a multitude of countries with a variety of populations. While the majority of researchers do find that breastfeeding is beneficial in the longer-term, some also do not find longer-term benefits to breastfeeding in certain areas. Based on the collection of studies, the review of literature includes sections about outcomes of and associations with obesity, physical health, cognitive abilities, and mental health, in children four years and older.

Obesity. Physically, breastfeeding has been widely studied in relation to obesity. Although findings have been inconsistent, most have found that breastfeeding is correlated with lower obesity prevalence or lower body mass index (Hansstein, 2016; Hennessy et al., 2014; McDade & Metzger, 2010), especially in boys (Fujiwara, Jwa, & Kondo, 2014). Specifically,

children who were breastfed were found to have an 8.9% lower risk of obesity between the ages of two to five years on a global scale (Hansstein, 2016). Being breastfed for more than six months was associated with a 48% reduction in the risk of obesity in children by the age of nine years in America (Hennessy et al., 2014). Furthermore, McDade and Metzger (2010) studied 976 children (488 sibling pairs), age range from 9 to 19 years old nationally across the United States and found that those who were breastfed had BMIs that were .39 standard deviation lower than siblings who had not been breastfed. This effect was equivalent to a difference of more than 13 pounds for a 14-year-old child of average height, based on the average BMIs for 14-year-old males at 16.5-23.4 and for 14-year-old females the average at 16.3-24 (McDade & Metzger, 2010). In McDade and Metzger (2010), the application of a sibling fixed-effects model provides stronger evidence of a causal relationship considering children from the same family may have similar environments, eating habits, and lifestyle patterns. Kramer et al. (2007) examined a cluster randomized sample of 17,406 children, ages 3 months to 6.5 years, in 31 Belarusian maternity hospitals and their affiliated clinics and found no breastfeeding associations with anthropometric measurements, including BMI, skinfold thickness, and waist and hip circumferences at 6.5 years of age. Although these findings were inconsistent, breastfeeding is generally related to lower obesity rates and body mass index globally in boys, from 2 to 5 years old, and nationally in United States in siblings, ages 9 to 19 years old (Hennessy, et al., 2014; McDade & Metzger, 2010)

Researchers who examined breastfeeding and obesity had large samples (range of 8,357 to 41,572), making findings more valid and reliable (Fujiwara et al., 2014; Kramer et al., 2007). Furthermore, all researchers, except for Kramer et al. (2007), generated level 6 evidence from single descriptive studies; Kramer et al. (2007) generated level 2 from a randomized controlled trial. Most of these studies were conducted in countries other than the United States (Fujiwara et al., 2014; Hansstein, 2016; Hennessy et al., 2014; McDade & Metzger, 2010), and therefore findings may not be representative of the United States population. Parental style and education

system variation must also be examined as potential confounders, even with sample of 8,356 to 41,572 (Fujiwara et al., 2014; Kramer et al., 2007).

Physical health. Researches have investigated breastfeeding and physical health, such as strength, diabetes, cardiovascular disease, and biomarkers of blood pressures, inflammation, and cardiovascular health (Béghin et al., 2011; Evelein et al., 2011; Kramer et al., 2007). Artero, Espana, Ortega, Romero et al. (2010) studied physical strength via standing long jump performance in 2,567 adolescent girls, ages 12-17 years. Girls who were breastfed as infants were found to have half the risk of having poor performance (below the 5th percentile) versus girls who were never breastfed. Sperling (2008) found that breastfeeding may be protective against risk for diabetes in the 247 United States children who were studied from preschool to adulthood. In relation to cardiovascular health, breastfeeding was found to have no effects on systolic or diastolic blood pressure (Kramer et al., 2007), inflammatory status (Béghin et al., 2011), and cardiovascular elastic modulus and distensibility (Evelein et al., 2011). However, Evelein et al. (2011) studied 306 children who were breastfed exclusively in infancy, specifically for 3 to 6 months; at 5 years old these children had greater carotid-intima media thickness than those formula-fed, although implications for later life remain uncertain. In summary, findings about effects of breastfeeding on physical health are conflicting with some researchers reporting positive physical health outcomes in older children who had been breastfed (Artero et al., 2010; Evelein et al., 2011; Sperling, 2008) and others reporting no differences in physical health, regardless of breastfeeding status (Béghin et al., 2011; Evelein et al., 2011; Kramer et al., 2007). Researches had samples ranging from 247 to 306 children (Evelein et al., 2011; Kramer et al., 2007), except for Artero et al. (2010) who used a sample of 2,567 girls. Most of these studies were conducted in the United States (Evelein et al., 2011, Kramer et al., 2008; Sperling, 2008).

Cognitive Abilities. Researchers have also examined breastfeeding in relation to cognitive development and abilities in older children. Some researchers have found that

breastfeeding correlated with scoring higher on several intelligence tests in children, four years and older (Holme et al., 2010; Isaacs et al., 2011; Kramer et al., 2008; Quigley et al., 2012). Quigley et al., (2012) reported that breastfed children, at five years of age, scored two points higher on British Ability Scales, compared with those not breastfed. At 6.5 years old, breastfed children scored 5.9 points higher on a full-scale IQ and scored higher on Wechsler Abbreviated Scales of Intelligence, compared to children that were not breastfed. Similarly, Isaac et al. (2011) revealed that breastfed boys scored higher in verbal IQ sections, compared with non-breastfed boys. Furthermore, Holme et al. (2010) found that breastfed children scored 5.49 points higher in total IQ at the age of nine; however, this difference became nonsignificant when confounding variables, such as maternal and socio-economic characteristics, were controlled. In contrast, Jenkins and Foster (2014) studied 10,7000 children and found that breastfeeding only showed minute effects on cognitive development at four years old with no overall benefits on cognitive abilities.

Of the studies on cognitive development and abilities, all were longitudinal studies (Aboud, Kramer, Mironova et al., 2008; Foster, & Jenkins 2014; Holme et al., 2010; Isaacs et al., 2011; Quigley et al., 2012), including Aboud et al. (2008) which used cluster-randomization, as well as longitudinal trial with multiple collection points. Similar to the obesity results, parental style and education system variation must also be examined as potential confounders, even in samples of 17,046 and 11,879 (Aboud et al., 2008; Quigley et al., 2012).

Though there are a few well-designed studies that support breastfeeding benefits for cognitive intelligence and cognitive ability and development, the studies overall may not be an adequate representation of the benefits to the population due to limitations, which include non-randomization (Jenkins & Foster, 2014), and smaller samples (Holme et al., 2010; Isaacs et al., 2011; Quigley et al., 2012). It is difficult to correlate these longer-term effects because of confounding variables such as maternal and socioeconomic characteristics that affect cognitive intelligence and ability regardless of breastfeeding.

Mental health. Researchers have studied breastfeeding and mental health. Some studies showed correlations between breastfeeding and healthier mental assessment scores (Hennessy et al., 2014; Oddy et al., 2010). Breastfeeding for three to six months was associated with a 26% reduction in the risk of abnormal scores on the Strengths and Difficulties Questionnaire in children, age nine years (Oddy et al., 2010; Hennessy et al., 2014). This questionnaire measures physiological attributes, emotional symptoms, conduct problems, hyperactivity/inattention, peer relationships or problems, and prosocial behaviors. At ages of 14, children, who were breastfed for greater than 6 months, had lower Child Behavior Checklist T scores. In addition, breastfeeding duration was found to be associated with mental health morbidity. The Child Behavior Checklist is a widely used questionnaire to assess behavioral and emotional problems, and it is often used as a diagnostic screen for emotional, behavioral, and social problems (Oddy et al., 2010). Although the studies had samples of 1,695 and 8357 respectively, lack of generalizability may be related to non-randomized sampling (Hennessy et al., 2014; Oddy et al., 2010) and validity of information recall from mothers (Hennessy et al., 2014).

Appraisal of Evidence

General findings. In a systematic review, it is important to incorporate information from valid and reliable studies using good designs and methods, therefore generating higher levels of evidence as well as evidence that is valid and reliable. Eleven of the research studies used descriptive designs, which does not include experiments, but rather were descriptive, identifying the relationships between variables, determining predicative values, and examining prevalence of conditions, behaviors, health, and other attributes. Furthermore, regarding infants being breastfed or using formula, it would not be ethically sound to randomly assign infants to different types of feeding groups, as researchers have found that feeding styles may affect infants' lifelong development.

Four research studies used cohort and randomized controlled designs (Aboud et al., 2008; Foster, & Jenkins 2014; Kramer et al., (2007); Quigley et. al, 2012). One study did use an

experimental intervention which led to an increase in exclusive breastfeeding at three months and a significantly higher prevalence of any breastfeeding at all ages up to and including 12 months (Aboud et al., 2008). While the majority of studies were conducted in the United States, some studies were not conducted in the United States or were global (Artero et al., 2010; Béghin et al., 2011; Fujiwara et al., 2014; Hansstein, 2016; Hennessy et al., 2014; Kramer et al., 2007; McDade & Metzger, 2010).

Sample size. Another important factor for ensuring external validity is adequate sample size to ensure statistical conclusion validity. A study's external validity is the degree to which the study's results can be applied and generalized to other populations, sites, and historical times (Schmidt & Brown, 2015). External validity may first be threatened by samples that do not properly represent the population or are affected by the effects of selection. If the sample does not properly represent the population, it can be difficult to generalize the results to the population, another setting, or another point in time (Schmidt & Brown, 2015). This systematic review included research studies that were primary sources with large samples, ranging from 976 to 41,572 participants (Fujiwara et al., 2014; McDade & Metzger, 2010). Three studies were limited by smaller samples, which could have less valid results for the population (Béghin et al., 2011; Holme et al., 2010; Isaacs et al., 2011). Across these studies, Holme et al. (2010) alone stated that their sample was not representative of their population due to bias. Studies that are not representative of their population should be repeated using a larger sample and sampling methods that decrease the incorporation of bias.

Validity and reliability. Different instruments were used throughout the studies which could affect validity and reliability. Most studies included cross-sectional data collection via surveys that were hard copy, electronically, or both. Cross-sectional data collection studies are considered a reliable and valid source of evidence since multiple outcomes can be studied and they are good for descriptions and formation of hypothesis for future studies (Barratt & Kirwan, 2009). Cross-sectional studies can be descriptive or analytical, and they are concerned with

prevalence (Barratt & Kirwan, 2009) or analysis of data from one point in time. Weaknesses of cross-sectional studies using convenience sampling includes bias that can come from different characteristics of those who decide to participate or respond in comparison to the population as a whole. In a cross-sectional study, all factors such as exposure, outcome, and cofounders are measured simultaneously (Barratt & Kirwan, 2009). Cofounding variables can make it difficult to determine cause and effect because relationships or associations between variables are being studied.

Researchers of many studies admitted to outside factors that may affect their results. Outside factors, like maternal and socioeconomic characteristics and maternal mental and physical well-being, have significant impact on cognitive abilities in children as they continue to develop through childhood (Holme et al., 2010; Reynolds, 2014). Jenkins and Foster (2014) also stated that outside factors such as home environment and level of education affect cognitive abilities in children later in life as well. Factors that affect overall body strength include gestation and current age, birth weight, sexual maturation, fat mass, parental weight status, smoking, and general amount of vigorous physical activity (Artero et al., 2010). Another factor to be considered when assessing the validity and reliability of a study is experimental groups. One study included an experimental group that received breastfeeding promotion and an intervention modeled on the Baby-Friendly Hospital Initiative by the World Health Organization and UNICEF. In this study pediatricians administering the Wechsler Abbreviated Scale of Intelligence (WASI) were not blinded to the experimental vs control intervention status of the children they examined, thereby affecting the study validity (Aboud et al., 2008).

Another consideration for research findings is if the child was exclusively breastfed or had a combination of breastfeeding and formula feeding. Exclusive breastfeeding exposure is a more precise measure of the true effects of the long-term benefits of breastfeeding. McDade and Metzger (2010) reported a lack of information of breastfeeding exclusivity and duration. There is also a variety of studies that differed in breastfeeding duration or the length of time a child was

breastfed. Studies that measured breastfeeding duration of at least six months or longer overall had more consistent results (Artero et al., 2010; Béghin et al., 2011; Fujiwara et al., 2014; Quigley et al., 2012). Five studies were used that studied breastfeeding duration of three to six months (Evelein et al., 2011; Hansstein, 2016; Hennessy et al., 2014; Kramer et al., 2008; Oddy et. al, 2010). While there is a difference in breastfeeding duration across studies, the majority of the studies recommended breastfeeding for at least some time due to the overall beneficial effects on the health of children.

One threat to the internal validity of these studies included dropout rates. One study reported participants not completing follow up evaluations which may have affected findings (Kramer et al., 2008). Another limitation discussed by researchers of only two studies was that the mother's breastmilk was not collected which leads to a lack of biochemical data. Without collecting the breastmilk, the nutrients and bioactive components that aid in the benefits of development were not identified and evaluated (Oddy et al., 2010; Quigley et al., 2012). In every study it is important for researchers to report their methods for data collection to be able to determine the validity and reliability of the study. Nearly every study in this systematic review included extensive details regarding the methods of data collecting. Therefore, these studies allow readers to critically appraise the validity and reliability of studies and findings. Most studies have included details of the tools used to measure variables, describing tools as valid and reliable measures which have maintained the internal validity of the study.

Synthesis

Overall, breastfeeding has been found to have many positive effects on the growth and development of children. The results of these studies add evidence to support the longer-term benefits of breastfeeding in the overall health of children at 4 years old and older. This information can support nurses being more proactive in more effectively educating women and promoting breastfeeding. Breastfeeding has been shown to have multiple positive benefits in children who were breastfed for longer than 6 months. These benefits include increased

likelihood to have lower body mass index, protective factors against the risk for diabetes, increased scores of several intelligence tests, and healthier mental health assessments. There have been minimal reports of little to no difference among those who were breastfed versus formula fed in relation to inflammatory status in adolescents, however, breastfeeding has many benefits beyond inflammatory status so breastfeeding is still recommended (Béghin et al., 2011). The current state of science regarding to the outcomes of breastfeeding in early and late childhood indicates that breastfeeding has significant positive effects on a child's growth and development.

Recommendations

Due to the consistency of findings supporting the longer-term positive effects of breastfeeding, it is recommended that nurses encourage breastfeeding. Breastfeeding, regardless if mixed with formula or only incorporated for a short amount of time, should be encouraged since researchers have identified many benefits to the overall health of children as they continue to grow and develop (Fujiwara et al., 2014). Providing information about breastfeeding and its benefits should be implemented in multiple ways to help ensure successful teaching to new mothers. Nurses should educate mothers on both short- and longer-term effects of breastfeeding children using evidence-based information. Nurses should also teach the mothers how to initiate breastfeeding through demonstrations and visual aids (World Health Organization, 2015). Mothers should be referred to resources after they leave the hospital to help build support networks as well as clinic-base follow-up care for the mothers and newborns. Breastfeeding support should be a standard of care from midwives, obstetricians, family physicians, nurse practitioners and pediatricians. Mother should be encouraged to ask for help with breastfeeding and it is important to aid the mother to have the time and flexibility to breastfeed once she leaves the hospital.

While breastfeeding is important to encourage, it is essential to acknowledge that some complications, such as latching problems, engorgement, plugged milk ducts, and mastitis, may occur that can prevent mothers or children from being able to breastfeed (World Health

Organization, 2015). In these cases, nurses should encourage mothers to administer breastmilk via bottle or use alternative foods if necessary. If mothers are not able to breastfeed for various reasons, nurses should be supportive and encouraging so mothers feel as little discouragement as possible. If mothers of newborns are not able to breastfeed, nurses should assist in finding other feeding options to maintain a healthy nutritional level.

Implication for Future Research

While performing this Systemic Review, some findings were limited due to many studies being self-reported information from mothers, the route of breastmilk delivery not included, and the breastmilk not collected to study the biochemical data (Béghin et al., 2011; Evelein et al., 2011; Fujiwara et al., 2014; Hansstein, 2016; Oddy et al., 2010; Quigley et al., 2012). More limitations included lack of control for confounding variables that may affect the health and development throughout children's lives. The limitation on research into the adolescent age group may be due to the numerous confounding variables that affect health throughout a lifetime. These confounding variables include sexual maturity, smoking behaviors of the parent and child, physical activity level, maternal and paternal education level, parenting approaches, stability of the home environment, and the socioeconomic status of the family (Hennessy, et al., 2014; Holme et al., 2010; Jenkins & Foster, 2013). However, research should continually be done to gain additional knowledge and understanding of the longer-term effects of breastfeeding including use of alternative foods. Further research in other populations and developing countries may also provide additional evidence on the long-term effects of breastfeeding.

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Appendix

APA formatted reference [1]	Purpose statement. Research Question[2]	Clinical Practice Setting, Sampling methods, sample size[3]	Design, Level of Evidence[4]	Findings, Conclusion[5]	Practice and Research Implications[6]	Limitations of Findings[7]
<p>1 V�rier, C. P., Duhamel, A., B�ghin, L., Diaz, L., Warnberg, J., Marcos, A., & ... Gottrand, F. (2011). Breastfeeding in Infancy Is Not Associated with Inflammatory Status in Healthy Adolescents. Journal Of Nutrition, 141(3), 411. doi:10.3945/jn.110.128249</p>	<p>Purpose Statement: To Examine the effect of breastfeeding for six months or longer and increased risk of cardiovascular disease. Research Question: Does breastfeeding for six months or longer increase or decrease the risk of cardiovascular disease in adulthood?</p>	<p>Clinical Practice Setting: Parenteral Records (Medical Records) with blood sample Sampling Methods: Volunteers from Healthy Lifestyle in Europe by Nutrition and Adolescence Study Sample Size: 484 European urban adolescents</p>	<p>Design: This is a cross-sectional study Healthy Lifestyle in Europe by Nutrition and Adolescence study. Level of Evidence: Evidence from single descriptive</p>	<p>Breastfeeding as an infant for 6 months or greater did not have a lower circulating inflammatory marker concentration than those who had never been breastfed.</p>	<p>Results suggest that breastfeeding for the first six months of life has little to no effect on inflammatory status in adolescents. Breastfeeding has many benefits beyond inflammatory status so it is still recommended.</p>	<p>Variables self reported by parents. Small sample size, no randomized group assignment. No control group or comparison group with no manipulating variable.</p>

<p>2 Hansstein, F. V. (2016). The impact of breastfeeding on early childhood obesity: Evidence from the national survey of children's health. <i>American Journal Of Health Promotion, 30(4), 250-258.</i></p>	<p>Purpose Statement: To examine breastfeeding initiation and duration and its effect on obesity in children aged 2 to 5. Research Question: Does history of breastfeeding affect obesity in children aged 2 to 5?</p>	<p>Clinical Practice Setting: Interview Sampling Methods: Subsample of cross sectional data of the 2003 National Survey of Children's Health Sample Size: 8207</p>	<p>Design: Longitudinal nonexperimental Level of evidence: Evidence from Single Descriptive</p>	<p>breastfed children had 5.3% higher probability of being normal weight and 8.9% lower probability of being obese compared to children who had never been breastfed</p>	<p>Results suggest breastfeeding for at least three months to protect against obesity</p>	<p>All variables self reported No randomized group assignment No control/ comparison group no manipulation of variable</p>
<p>3 Jwa, S. C., Fujiwara, T., & Kondo, N. (2014). Latent protective effects of breastfeeding on late childhood overweight and obesity:</p>	<p>Purpose Statement: To examine the potentially latent effect of breast milk on childhood obesity. Research Question: Does breastfeeding have a latent</p>	<p>Clinical Practice Setting: Questionnaires mailed Sampling Methods: Questionnaires/fo llow ups obtained when children were age: 6 mos., 1.5, 2.5, 3.5, 4.5, 5.5, 7 and 8 years</p>	<p>Design: Longitudinal survey Level of Evidence: Evidence from single descriptive</p>	<p>Findings, Conclusion: Boys who breastfed for at least 6 mos. showed more BMI reduction compared to boys who were formula-fed. Similar findings to girls, but not</p>	<p>Practice and Research Implications: Breastfeeding, regardless if mixed with formula or only incorporated for a short amount of time, should still be encouraged since it has</p>	<p>Limitations: Parent-reported answer validity; study only included Japanese born children. Childhood obesity is limited to Western countries, and few reports from</p>

<p>a nationwide prospective study. <i>Obesity</i> (<i>Silver Spring, Md.</i>), 22(6), 1527-1537. doi:10.1002/oby.20735</p>	<p>effect on the growth trajectory and BMI of children?</p>	<p>old.. Sample Size: 41572 Japanese born children</p>		<p>statistically significant. When comparing breastfeeding duration, longer duration is associated less likely with obesity, and is more evident in later childhood.</p>	<p>protective effects on BMI trajectory and obesity. A standardized protocol should be implemented when measuring height and weight. Potential mechanisms that affect BMI should also be studied.</p>	<p>Asian countries. No randomized group assignment No control/ comparison group no manipulation of variable</p>
<p>4 Reynolds, D., Hennessy, E., & Polek, E. (2014). Is breastfeeding in infancy predictive of child mental well-being and protective against obesity at 9 years of age?. <i>Child: Care, Health And Development</i>, 40(6), 882-890.</p>	<p>Purpose statement: To examine whether being breastfed (at all or exclusively) in infancy is a predictor of mental well-being and protective against risk of obesity at age 9 Research question: Is breastfeeding in infancy predictive of child</p>	<p>Clinical Practice Setting: Interview Sampling method: 9-year-olds in the Growing Up in Ireland (GUI) study, a nationally representative cohort study of children living in the Republic of Ireland. Sample size: 8357</p>	<p>Design: cross-sectional data, cohort study Level of evidence: Evidence from Single Descriptive</p>	<p>Breastfeeding was associated with a 26% reduction in the risk of an abnormal SDQ score (0 is normal, 2+ is abnormal). Breastfed for 11-25 weeks was associated with a 36% reduction in the risk of obesity Breastfed for 26 weeks or longer was associated with a 48% reduction in the</p>	<p>Results suggest that pediatricians, general practitioners and breastfeeding lobby groups should promote breastfeeding to decrease a child's risk for obesity and poor mental wellbeing</p>	<p>no manipulation of variable No randomized group assignment No control/ comparison group Data regarding breastfeeding by mothers was retrospectively recalled Past maternal mental well-being not controlled for, only current</p>

doi:10.1111/cch.12126	mental well-being and protective against obesity at 9 years of age?			risk of obesity		
5 Artero, E. G., Ortega, F. B., España-Romero, V., Labayen, I., Huybrechts, I., Papadaki, A., & ... De Henauw, S. (2010). Longer Breastfeeding Is Associated with Increased Lower Body Explosive Strength during Adolescence.	<p>Purpose Statement: To examine the association between breastfeeding duration and cardiorespiratory fitness, isometric strength, and explosive strength during adolescence.</p> <p>Research Question: Does breastfeeding increase lower body explosive strength?</p>	<p>Clinical Practice Setting: Parental questionnaire</p> <p>Sampling Methods : Healthy Lifestyle in Europe by Nutrition in Adolescents aged 12.5-17.5 years old were included.</p> <p>Sample Size: 2567 girls from the Healthy Lifestyle in Europe</p>	<p>Design: Cross Sectional</p> <p>Level of evidence: Evidence from single descriptive</p>	<p>In adolescents who were breastfed for 3–5 mo or ≥ 6 mo, the risk of having a standing long jump performance below the 5th percentile was reduced by half compared with those who were never breastfed. Longer breastfeeding was associated with higher performance in</p>	<p>The results of this study showed that lower body explosive strength was increased with breastfeeding. Breastfeeding is encouraged for at least 6 months to increase lower body strength during adolescence.</p>	<p>potential confounders: gestational and current age, birth weight, sexual maturation, fat mass, fat-free mass, maternal education, parental weight status, country, smoking behavior, and days of vigorous physical activity. No randomized group assignment, control group</p>

<p>Journal Of Nutrition, 140(11), 1989. doi:10.3945/jn.110.123596</p>				<p>standing long jump tests.</p>		<p>no manipulation of variable.</p>
<p>6 Jenkins, J. M., & Foster, E. M. (2014). The Effects of Breastfeeding Exclusivity on Early Childhood Outcomes. American Journal Of Public Health, 104(S1), S128. doi:10.2105/AJPH.2013.301713</p>	<p>Purpose Statement: To examine the relationship between breastfeeding exclusively on children's health and cognitive outcomes. Research Question: Does breastfeeding have a positive outcome on children's health and cognitive outcomes at ages 2 and 4 years old?</p>	<p>Clinical Practice Setting: Parent interview and child assessment Sampling Methods: Birth cohort of children in the United States Sample Size: 10,700 children born in the United States</p>	<p>Design: Early Childhood Longitudinal Study. Level of evidence: Longitudinal cohort study</p>	<p>Results showed some small effects of breastfeeding on key outcomes at age 4, but nothing earlier. Effects appeared to be concentrated in reading and cognitive outcomes. Overall, there was no exclusive benefit.</p>	<p>Results revealed little or no effect of breastfeeding exclusivity and duration on key child outcomes. Small significance shown at 4 years old, so breastfeeding still encouraged by pediatricians.</p>	<p>Potential Confounding factors: Home environment, level of education at school. no control/comparison on group no randomized sample.</p>

<p>7 Holme, A., MacArthur, C., & Lancashire, R. (2010). The effects of breastfeeding on cognitive and neurological development of children at 9 years. Child: care, health and development, 36(4), 583-590.</p>	<p>Purpose Statement: To examine whether breastfeeding is associated with later difference in children's cognitive and neurological development. Research Question: Do children who were breastfed have higher IQ scores?</p>	<p>Clinical Practice Setting: Interview Sampling Methods: Assessed by psychologist in selected schools Sample Size: 128</p>	<p>Design: Longitudinal Level of evidence: Evidence from single descriptive</p>	<p>Breastfeeding was significantly associated with higher total, verbal and visual IQ scores in children. Results revealed total IQ was 5.49 points higher in breastfed children, but became invalid after confounding variables accounted for.</p>	<p>Encouraging parents to breastfeed could increase child's cognitive and neurological abilities</p>	<p>Maternal and socioeconomic characteristics have a great impact on child's cognitive abilities. Small sample size No control/experimental group</p>
<p>8 Oddy, W. H., Kendall, G. E., Li, J., Jacoby, P., Robinson, M., De Klerk, N. H., ... & Stanley, F. J. (2010). The long-term effects of breastfeeding on child and adolescent</p>	<p>Purpose Statement: "To determine whether there was an independent effect of breastfeeding on child and adolescent mental health" (pg. 568) Research Question: How did breastfeeding</p>	<p>Clinical Practice Setting: Questionnaires, interviews, clinical examinations Sampling Methods: Women who met the criteria were enrolled in the Western Australian Pregnancy</p>	<p>Design: longitudinal study Level of Evidence: Single Descriptive</p>	<p>Findings, Conclusions: Children that were breastfed for >6mos. had significantly lower CBCL T scores. A shorter period an infant was breastfed is associated with increased mental health morbidity.</p>	<p>Practice and Research Implications: Encouraging parents to breastfeed could have long-term benefits on the child's mental health.</p>	<p>lack of biochemical data since breast milk wasn't collected; Much of data was non-random samples No Control/experimental Group</p>

<p>mental health: a pregnancy cohort study followed for 14 years. <i>The Journal of pediatrics</i>, 156(4), 568-574.</p>	<p>affect children’s mental health at different times of their lives based on the CBCL?</p>	<p>Cohort Study at a hospital. It tracked their children for 14 years. Follow ups collected at ages: 2, 5, 8, 10, 14. Sample Size: 1695</p>				
<p>9 Evelein, A. M., Geerts, C. C., Visseren, F. L., Bots, M. L., van der Ent, C. K., Grobbee, D. E., & Uiterwaal, C. S. (2011). The association between breastfeeding and the cardiovascular system in early childhood. <i>The</i></p>	<p>Purpose Statement: “To determine the cardiovascular effects of exclusive breastfeeding in early childhood” (pg. 712) Research Question: Does breastfeeding and the duration an infant breastfeeds have an effect on carotid-intima media thickness (CIMT) and arterial stiffness?</p>	<p>Clinical Practice Setting: In clinic Sampling Methods: This study is part of a larger birth-cohort that initially studied wheezing illnesses, but got extended to cardiovascular research. The birth cohort was used to gather infant data. Questionnaires, follow-up visits and ultrasonography used. When the</p>	<p>Design: Cross-sectional study Level of Evidence: Evidence from Single Descriptive</p>	<p>Findings, Conclusion: Those only breastfed for 3-6mos. had greater CIMT than those formula-fed. Elastic modulus and distensibility had no significant differences between breastfed and formula fed children. Fewer infections by was observed in breastfed children.</p>	<p>Practice and Research Implications: Implications remain uncertain. Longer follow-up is needed to see if there’s decreased CIMT in later life. The relatively low cholesterol concentrations in older subjects might be from cholesterol programming from infancy when breastfed.</p>	<p>Limitations: nonrandomized; Parental recall bias when answering questions; low sample size</p>

<p><i>American journal of clinical nutrition, 93(4), 712-718.</i></p>		<p>children were five years old, their CIMT and arterial stiffness were measured. Sample Size: 306</p>				
<p>10 Kramer, M.S., Aboud, F., Mironova, E., et al. (2008). Breastfeeding and Child Cognitive Development : New Evidence From a Large Randomized Trial. Archives of</p>	<p>Purpose Statement: To assess whether prolonged and exclusive breastfeeding improves children's cognitive ability at age 6.5 years Research Question: Do children that are breastfed exclusively have greater cognitive</p>	<p>Clinical Practice Setting: Belarusian maternity hospitals. Tests and interviews Sampling Methods: Children from hospitals enrolled after birth during from 6/17/96, to 12/31/97 Sample Size: 17046</p>	<p>Design: Cluster-randomized trial Level of evidence: Evidence from Randomized controlled trial</p>	<p>Intervention lead to a large increase in breastfeeding at 3 months (43.3% of mothers) versus the control group (6.4% of mothers). Experimental group had higher means on all . the Wechsler Abbreviated Scales of Intelligence</p>	<p>Our results, based on the largest randomized trial ever conducted in the area of human lactation, strongly suggest that prolonged and exclusive breastfeeding improves cognitive development as measured by IQ and teachers' academic ratings</p>	<p>pediatricians administering the WASI were not blinded to the experimental vs control intervention status of the children they examined Age of study</p>

<p>General Psychiatry- (JAMA Psychiatry), 65(5), 578-584.</p>	<p>ability at the age of 6.5?</p>			<p>measures. 95% confidence intervals Full Scale IQ: +5.9 (-1.0 to +12.8) Verbal IQ: +7.5 (+0.8 to +14.3) Performance IQ: +2.9 (-3.3 to +9.1) Teacher's academic ratings were higher for the experimental group for reading and writing</p> <p>no beneficial effects for other outcomes (eg, blood pressure, skinfold thicknesses, allergies and asthma, dental caries, or child behavior)</p>	<p>at age 6.5 years (pg 5) Breastfeeding should be promoted in industrialized societies for the cognitive benefits.</p>	
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<p>11 Mayer-Davis, E. J., Dabella, D., Lamichane, A. P., D'AGOSTIN O, R. B., Liese, A. D., Thomas, J., & Hamman, R. F. (2008). Breast-Feeding and Type 2 Diabetes in the Youth of Three Ethnic Groups. <i>Epidemiology and H</i>, 470-475.</p>	<p>Purpose Statement: Breast-feeding may have protective benefits against type 2 diabetes in youth. Research Question: Does breastfeeding lead to a decrease risk of type 2 diabetes?</p>	<p>Clinical Practice Setting: SEARCH Clinical sites. Oral glucose test and interview. Sampling Methods: Selected from primary care provider offices. Sample Size: 247</p>	<p>Design: Case Control Study Level of Evidence: SEARCH Case-Control Study</p>	<p>Findings Conclusion: Breastfeeding appears to be protective against development of type 2 diabetes in youth.</p>	<p>Results suggested that participants without diabetes were breastfed for a longer duration than the particular participants with diabetes. Breastfeeding should be encouraged by pediatricians to decrease risks of type 2 diabetes.</p>	<p>Not randomized Small sample size.</p>
<p>12 Kramer, M.S., Matush, L., Vanilovich, I., et al. (2007). Effects of prolonged and exclusive breastfeeding on child height,</p>	<p>Purpose statement: To assess whether an intervention about breastfeeding brings about differences in anthropometric measurements at the age of 6.5</p>	<p>Clinical Practice Setting: Belarusian maternity hospitals. Tests and interviews Sampling Methods: Children from hospitals enrolled after birth during</p>	<p>Design: Cluster-randomized trial Level of evidence: Evidence from Randomized controlled trial</p>	<p>Findings: No effects on height, body mass index, waist or hip circumference, triceps or subscapular skinfold thickness, systolic or</p>	<p>Research Implications: Breastfeeding may not affect anthropometric measurements of the child later into life.</p>	<p>Age of study Obesity difference between children from the united states vs belarusian children</p>

<p>weight, adiposity, and blood pressure at age 6.5 y: evidence from a large randomized trial. <i>American Journal of Clinical Nutrition</i>, 86, 1717–21</p>	<p>years. Research Question: Does an intervention to promote breastfeeding affect children's height, weight, adiposity, and blood pressure at age 6.5 years?</p>	<p>from 6/17/96, to 12/31/97 Sample Size: 17046</p>		<p>diastolic blood pressure Conclusion: Previous studies that have found a correlation between breastfeeding and anthropometric measurements may have not been as sound.</p>		
<p>13 Metzger, M. W., & McDade, T. W. (2010). Breastfeeding as obesity prevention in the United States: a sibling difference model. <i>American journal of human biology</i>, 22(3), 291-296.</p>	<p>Purpose statement: To see if breastfeeding affects childhood obesity Research Question: Does breastfeeding have an effect on BMI when comparing sibling-pairs between 9-19, with a mean of 14 years old?</p>	<p>Clinical Practice Setting: n/a Sampling methods: Data was drawn from PSID's Child Development Supplement. Sample size: 976 children (488 sibling pairs)</p>	<p>Design: Longitudinal nonequivalent control group pretest-posttest design survey Level of Evidence: single descriptive</p>	<p>Findings, Conclusion: When comparing a breastfed sibling to their non-breastfed sibling, the breastfed child had a BMI of .39 standard deviations lower than their sibling, equating to more than 13 lbs. for an average 14-yr. old height.</p>	<p>Practice and Research Implications: Women should be encouraged to breastfeed since it may prevent their child's likelihood of obesity.</p>	<p>Low sample size, lack of information whether breastfed children were breastfed exclusively; selection bias (though reduced with fixed-effects model); not randomized</p>

<p>14 Quigley, M. A., Hockley, C., Carson, C., Kelly, Y., Renfrew, M. J., & Sacker, A. (2012). Breastfeeding is associated with improved child cognitive development: a population-based cohort study. <i>The Journal of pediatrics</i>, 160(1), 25-32.</p>	<p>Purpose statement: To examine association in cognitive development and breastfeeding by the age of 5. Research Question: Does duration of breastfeeding have an effect on the average British Ability Scales Test in children age 5?</p>	<p>Clinical Practice Setting: Interview Sampling methods: Children and parents were recruited from the Millennium Cohort Study. Questions/follow ups gathered from parents whose children were then: 9 months, 3, 5 and 7 years old. Sample size: 11,879 babies (11,101 term & 778 preterm babies)</p>	<p>Design: longitudinal cohort study Level of Evidence: Evidence from cohort study</p>	<p>Findings, Conclusion: Term babies: 2-pt score difference between never breastfed babies and breastfed for 6 mos. babies. Breastfeeding associated with at least a one-point score increase, but no correlation with breastfeeding duration. Preterm babies: lower mean scores than term babies, but associated with point increases compared to never breastfed. At age 5, breastfed term and preterm babies were months ahead cognitively compared to never breastfed babies.</p>	<p>Practice and Research Implications: Cognitive development might be delayed by not breastfeeding, so encouraging mothers to incorporate breastmilk is a must. This is most important in preterm babies. A larger study that includes detailed infant feeding data is needed to understand causality.</p>	<p>Limitations of Findings: Not randomized; data on scores were not standardized, so it cannot be compared with other studies; route of breast milk delivery not taken into account; breast milk not collected</p>
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<p>15 Isaacs, E. B., Fischl B. R., Quinn, B. T., et al. (2010). Impact of breast milk on intelligence quotient, brain size, and white matter development. Pediatric Research, 67(4), 357–362. doi:10.1203/PDR.0b013e3181d026da</p>	<p>Purpose statement: To examine if there is a relationship between breastmilk and cognitive status Research Question: Is there a relationship between breastmilk and cognitive status?</p>	<p>Clinical Practice Setting: Hospital, Interview Sampling methods: From mothers who wanted to breastfeed but needed supplementary feeding sample size: 50</p>	<p>Design: Randomized Longitudinal Study Level of Evidence: Evidence from Single Descriptive</p>	<p>Findings, Conclusion Percentage of breast milk fed was correlated with total brain volume, white matter volume, verbal IQ (and, with boys, all IQ). White matter volume was correlated with Verbal IQ. No relationship with breast milk and grey matter was seen in females.</p>	<p>Further research needs to be done on the topic, since this is a crude study with a small sample size</p>	<p>No experimental design Restricted to preterm infants Small sample size No control/comparison group, MRIs taken during different ages for different patients with no baseline MRI scanning no use of blinding</p>
<p>NEW STUDIES</p>	<p>Purpose Statement and Research Question</p>	<p>Clinical practice setting, sampling methods, sample size</p>	<p>Design, level of evidence</p>	<p>Findings And conclusions</p>	<p>Practice and research implications</p>	<p>Limitations of findings</p>

<p>15. Hopkins, D., Steer, C. D., Northstone, K., & Emmett, P. M. (2015). Effects on childhood body habitus of feeding large volumes of cow or formula milk compared with breastfeeding in the latter part of infancy. <i>American Journal Of Clinical Nutrition</i>, 102 (5), 1096-1103. doi:10.3945/ajcn.114.100529</p> <p>http://eds.a.ebscohost.com/eds/detail/de</p>	<p>Purpose: Examine the effects of breastfeeding different types of milk in late infancy on child growth.</p> <p>Research: Is the lack of breast milk related to obesity development.</p>	<p>Setting: Clinical measurements of weight, height, and BMI</p> <p>Methods: Longitudinal Cohort study that collected food records at 8 mo of age were used to determine type and amount of milk consumed.</p> <p>Size: 1112 term, singleton children from Avon Longitudinal Study of parents and children UK</p>	<p>Design: Longitudinal cohort study.</p> <p>Evidence: Evidence from single descriptive study</p>	<p>Conclusions: Cow milk fed children were heavier than breastmilk fed children from 8 months to 10 years of age. The max weight difference was at 18 months of age. The feeding of high volumes of cow milk in late infancy is associated with faster weight and height gain than is BM feeding. The feeding of bottle-fed infants with high volumes of cow milk in late infancy may have a persisting effect on body habitus through childhood.</p>		<p>Adjustments for current energy and protein intakes did not attenuate the growth differences observed.</p>
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<p>tail?vid=10&sid=8809b418-22a8-4083-9304-011aca203f3e%40sessionmgr4009&bdata=JnNpdGU9ZWRzLWxpdmU%3d#AN=110815336&db=rzh</p>						
<p>16. Buchowski, M., matthews, C., Cohen, S. S., Signorello, L. B., Blot, W. J., Larson, C. O., & ... Buchowski, M. S. (n.d). Parity and Breastfeeding in Relation to Obesity among Black and White Women in the Southern Community Cohort</p>	<p>Purpose Statement: This research sought to describe associations among parity, breastfeeding, and adult obesity in black and white women in the southeastern United States.</p> <p>Research Question:</p>	<p>Clinical Practice Setting:</p> <p>Sampling Method: Self reported BMI and weight change since age 21 in association with parity and breastfeeding.</p> <p>Sample Size: 7986 white women and 23,198 black women age 40-79 years old.</p>	<p>Dsign: Cross Sectional</p> <p>Level of Evidence:</p>			

<p>Study. Journal Of Womens Health, 18(9), 1323-1332.</p> <p>http://eds.a.ebscohost.com/eds/pdfviewer/pdfviewer?vid=9&sid=688008f8-ebcd-4a90-8aec-1583c63578f1%40sessionmgr4006</p> <p>This is for women after they breastfeed, not the effects in children.</p>						
<p>17. Owen, C., Martin, R., Whincup, P., Smith, G., & Cook, D. (2005). Effect of infant</p>	<p>Purpose Statement: To examine the influence of initial infant feeding on obesity later in</p>	<p>Clinical Practice Setting:</p> <p>Sampling Method: Meta-Analysis</p>	<p>Design: A systematic review of published studies from Medline and Embase from 1980 onward.</p>	<p>61 studies reported. Of these, 28 (298900 Subjects) provided odds ratio estimates. In</p>	<p>Overall, our results suggest that breastfeeding is protective against obesity, although the precise magnitude of the association remains unclear. Increasing uptake of breastfeeding could form an important part of population strategies to prevent obesity. Several</p>	<p>Confounding is therefore an important possibility, and maternal factors are of particular potential importance. Low maternal social class and maternal obesity are related to a tendency to formula feed and to greater risk of obesity among offspring.^{5,8} Birth size</p>

<p>feeding on the risk of obesity across the life course: a quantitative review of published evidence. Pediatrics, 115(5), 1367-1377.</p> <p>http://pediatrics.aappublications.org/content/115/5/1367.full</p>	<p>life. Research Question: Does breast feeding decrease the risk of obesity later in life?</p>	<p>Sample Size: 3600 unduplicated reference.</p>	<p>Level Of Evidence: Systematic Review</p>	<p>these breastfeeding was associated with a reduced risk of obesity, compared with formula feeding.</p>	<p>biological mechanisms may explain the association. Breastfeeding affects intakes of calories and protein,⁴⁸ insulin secretion,⁴⁹ and modulation of fat deposition and adipocyte development.⁴ If the effects of breastfeeding are sustained through either habituation or more-complex programming mechanisms, then the association could persist into adult life, as our results suggest. The consistency of the association with increasing age (as observed in the analyses) suggests that the protective effects of early breastfeeding are independent of dietary and physical activity patterns that emerge in later life. In investigating the presence of a dose-response relationship, it was possible to show, from published data, only that prolonged breastfeeding was associated with an additional reduction in obesity, compared with any breastfeeding in the same studies. Additional data are needed to examine systematically the effects of duration of breastfeeding on obesity in adulthood. Additional studies are also needed to examine the effects of confounding and publication biases in more detail. Additional evidence regarding the effects of</p>	<p>may also be an important confounder, especially because lower mean birth weight may be associated with formula feeding and with an increased risk of later central obesity.^{5,47} The effect of confounding by maternal factors and birth weight may exaggerate an association between breastfeeding and obesity. In a subset of studies that examined the effect of adjustment for these factors, the association between breastfeeding and reduced risk of obesity was markedly attenuated.</p>
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					<p>confounding factors on the relationship between breastfeeding and obesity, from both published and unpublished studies, is needed. Studies involving populations for which breastfeeding is socially patterned in a way that is different from that for European or North American populations (the predominant source of studies in the present meta-analysis) would be particularly valuable. Follow-up data for participants in randomized, controlled trials of breastfeeding promotion would provide particularly reliable evidence of the association.⁵⁰ To address the influence of publication biases, additional data on the relationship between breastfeeding and obesity from large unpublished studies are needed, especially for adults. In addition, examination of the relationship of breastfeeding to markers of average adiposity in the comparison groups (for example, mean BMI) would supplement usefully the information on the prevalence of obesity provided in this study. While more data on these issues and on the relationship between duration of breastfeeding and obesity are being obtained, the case for breastfeeding is already</p>	
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					<p>strong and well established, based on a combination of other short- and long-term benefits, including improved neural and psychosocial development,51,52 less allergic disease,53 and potentially lower blood cholesterol levels in later life.54</p>	
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