

2004

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### Recommended Citation

McKenna, Ashley R. (2004) "Breast Feeding and Childhood Obesity," *International Journal of Global Health and Health Disparities*, 3(1), 73-79.

Available at: <https://scholarworks.uni.edu/ijghhd/vol3/iss1/8>

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McKenna: Breast Feeding and Childhood Obesity  
**BREAST-FEEDING AND CHILDHOOD OBESITY**

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Obesity is an epidemic in today's "obesogenic" society, a society that encourages excess food consumption but also idealizes thinness (Golan & Crow, 2004). One at-risk population that is gathering much attention, and much concern, is children. Obesity is the most frequent nutritional disorder in children (von Kries et al., 1999). Recent numbers indicate that the prevalence of obesity in children (ages six-11) has doubled, from seven percent in 1980 to 15.3 percent in 2000; the prevalence for adolescents (ages 12-19) has tripled, from five percent in 1980 to 15.5 percent in 2000 (AOA, 2004).

Being overweight or obese as a child brings with it many associated health problems. Diabetes among youth is a growing concern. The American Diabetes Association released a statement declaring that studies have reported that eight to 45 percent of the new diagnoses of diabetes among children were for type 2 diabetes (ADA, 2000). There is also a high risk of being overweight as an adult; thus, the risks of hypertension, coronary heart disease (von Kries et al., 1999), high blood pressure and orthopedic problems increase (Hodges, 2003). Additionally, an overweight child may suffer from social rejection and low self-esteem (Hodges, 2003).

As the problem grows, fingers point to a variety of causes: the fast-food industry's marketing to the young, eating habits of children, sweetened beverages and lack of physical activity in the schools, and increased time spent on the Internet or watching television. Socioeconomic status and the environment in which a child grows up are other causative factors. As a complement to exploring what is leading to obesity among youths, it is also important to study what can be done to prevent obesity.

Research is beginning to show that the risk of childhood obesity may be decreased as early as birth. There is a growing body of literature that claims that breast-feeding, as opposed to formula-feeding, is a protective factor against obesity later in life. It is a simple prevention strategy that can have long-lasting benefits. The purpose of this review is to critically examine studies, which support the positive relationship between the introduction of breast feeding and the risks of obesity (Armstrong & Reilly, 2003; von Kries et al., 1999; Toschke et al., 2002), and the dose-response relationship as demonstrated by the duration of breast feeding (Grummer-Strawn & Zuguo, 2004; Wallace, 2001).

This review also intends to look at research that claims the association has not been established conclusively. Inconsistency in definitions and measures of obesity, methodological problems in study design (Clifford, 2003), biases due to confounding factors, and weakness in statistical associations (Victora et al., 2003; Li, Parsons, & Power, 2003) have been cited as reasons for caution in interpretation of results. Each of these issues will be explored in greater detail.

*Studies supporting the association*

INTRODUCTION OF BREAST-FEEDING

Three studies found that the introduction of breast-feeding reduces the risk of obesity among children. The introduction of breast-feeding refers to feeding breast milk at any point. The first study was conducted by Armstrong, Reilly, and the Child Health Information Team (2003). They investigated a cohort of 52,394 Scottish children born in 1995 or 1996 who also took part in the Child Health Surveillance Program. After excluding those for whom no demographic information was available, 32,200 (62 percent) children were included in the study. Children were classified according to feeding habits: 25 percent were exclusively breast-fed, seven percent were fed breast milk and formula, and 68 percent were exclusively formula-fed.

The prevalence of obesity was determined at 39-42 months; obesity was defined as a BMI (body mass index) of 18.4 kg/m<sup>2</sup> (95th percentile) or higher. After adjusting for possible confounders such as socioeconomic status, sex and birth weight, breast-feeding was shown to be associated with a reduction of risk for obesity. The odds of obesity for those who were formula-fed were 70 percent higher than those who were breast-fed (Armstrong et al., 2003). These findings suggest breast-feeding is associated with a reduction in childhood obesity risk.

Armstrong's study was a well-done cohort study. The sample size was large enough to provide power to the study. The greatest limitation was the lack of information on confounding factors besides those obtained as part of the Child Health Surveillance Program. However, they were able to adjust for socioeconomic status, which the researchers feel is likely to be the most likely confounders (Armstrong, 2003).

A second study was conducted by von Kries and colleagues. The researchers took a cross-sectional sample of 13,345 five- and six-year old children in Germany who participated in a mandatory health examination at the time of school entry. Using a combination of the examination and a questionnaire completed by the parents, data were collected on height, weight, early feeding, diet and lifestyle factors. The outcome variable was the condition of being overweight or obese. Overweight was defined a BMI above the 90th percentile, obesity was above the 97th percentile (1999).

Information on breast-feeding was available for 9,206 children. Four thousand, twenty-two had never been breast-fed; 5,184 had ever been breast-fed. The resulting prevalence of being overweight or obese among those who were never breast-fed was 12.6 percent and 4.5 percent, respectively. Prevalence among those who were ever breast-fed was 9.25 and 2.8 percent. Additionally, a logistic regression model of confounding variables shows that higher level of parental education, premature birth and low birth weight were inversely associated with being overweight or obese. Maternal smoking during pregnancy and the child having his or her own bedroom were positively correlated. The findings of this research support the claim that there is a consistent, protective effect of breast-feeding on the risk of being overweight or obese later in childhood (von Kries et al., 1999).

This study also benefits from the power of its size. However, as in Armstrong's study, a number of possible confounding variable were not included in the analysis. Also, because the parents were asked to recall an event that occurred five to six years prior to the survey, the data may not be completely accurate.

Toeschke and colleagues conducted a cross-sectional survey to collect data on 33,768 children, aged six to fourteen, in the Czech Republic. The fifth Nationwide Anthropometric Survey of Children and Adolescents included a physical examination

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and a parents' questionnaire. The examination measured height and weight of the children. Body mass index was calculated, with overweight being defined as a BMI above the 90th percentile and obesity defined as a BMI above the 97th percentile. The questionnaire gathered information of breast-feeding (never, less than one month, one to three months, three to six months, and more than six months), parental educational attainment, parental BMI, maternal smoking, birth weight, television watching, having siblings, physical activity and consumption of fruits (2002).

A statistical analysis showed that the prevalence of obesity was 3.2 percent in breast-fed children compared to with 4.4 percent in non-breast-fed children. After adjusting for confounding variables, the effect of ever breast-feeding was significant with an odds ratio of 0.80 for both overweight and obesity. The study also found that variables such as a high level of educational attainment, having siblings and physical activity appeared protective.

Toeschke and colleagues conducted a well-done cross-sectional survey. The strengths of the study include its size, completeness and the wide range of risk factors for childhood obesity for which information had been collected. Again, the retrospective nature of data collection may have caused misclassification of breast-feeding duration.

### DURATION OF BREAST-FEEDING

Other studies have shown that the longer the duration of breast-feeding, the greater the protection against obesity. Two studies demonstrate this association. The first of these is a study done by Grummer-Strawn and Mei. They conducted a cross-sectional survey of 177,304 children who had taken part of the Centers for Disease Control and Prevention (CDC) Pediatric Nutrition Surveillance System. From 1988 to 1997, data was collected on children who had attended public health clinics at least once per year up to age five. Height and weight measurements were taken, and included gender, race/ethnicity and birth weight. Also, researchers gathered information on breast feeding, and risk factors during pregnancy, such as mother's age, educational attainment, self-reported pre-pregnancy weight, height as measured at the first prenatal visit, weight gain during pregnancy, and postpartum smoking from maternal pregnancy records (2004).

Breast feeding duration was categorized into six groups: never, less than one month, one to two months, three to five months, six to 11 months, and more than 12 months. Being overweight was defined as, at the age of four, having a BMI-for-age above the 95th percentile based on the CDC growth reference (Kuczmarski et al., 2000). A logistic regression on the odds of being overweight for each of the breast-feeding categories was conducted. The researchers controlled for gender, race/ethnicity, birth weight and pregnancy risk factors (Grummer-Strawn and Mei, 2004).

The results of this study show that the rate of overweight at age four was highest for children who were never breast-fed or were breast-fed for less than one month. Rate of being overweight decreased as duration of breast-feeding increased. The odds ratio of being overweight for a child who was breast-fed for more than 12 months compared to one who was never breast-fed was 0.76 (0.53-1.08). In testing for interactions between breast-feeding and other variables, only the interaction between breast-feeding and race/ethnicity was statistically significant; prolonged breast-feeding protective against being overweight only among non-Hispanic white children (Grummer-Strawn and Mei, 2004). Even though it only showed a significant association for one ethnic group, the studied demonstrates the benefit of longer durations of breast-feeding.

of the population. All children were of low-income status; therefore, it is not easily generalizable to the population as a whole. It had a large sample size, controlled for a large number of confounding variables, and was one of a few studies to look at long duration of breast-feeding. Unfortunately, the sample was only of low-income children.

A second cross-sectional survey conducted by researchers at Harvard found an association between the duration of breast-feeding and reduction of the risk of obesity. The researchers analyzed questionnaires filled out by 8,186 girls and 7,155 boys, ages nine to 14, who participated in the Growing Up Today Study. Data on the duration of breast-feeding was also collected from the children's mothers, who were part of the Nurse's Health Study II. Sixty-two percent of the children were "only or mostly" fed breast milk during the first six months; 31 percent were "only or mostly" fed formula. Less than half were breast-fed for at least seven months; about one-third were breast-fed for three months or less (Wallace, 2001).

The researchers found that among the mostly breast-fed group about four percent of the girls and seven percent of the boys were overweight, compared to six percent of the girls and 11 percent of the boys fed mostly formula. Additionally, four percent of the girls and seven percent of the boys who were breast-fed for seven months or more were overweight; about six percent of the girls and 12 percent of the boys breast-fed for only three months or less were overweight. Even after adjusting for risk factors such as physical activity and watching television the study found that those infants who were given more breast milk than formula, or were breast-fed longer, had about a 20 percent lower risk of being overweight in later years (Wallace, 2001).

The Harvard study suffered from the same recall bias as Armstrong's study. The children surveyed were between the ages of 9 to 14; parental recollection of breast-feeding practices may have easily been misclassified.

## STUDIES REFUTING THE ASSOCIATION

A number of reasons have been given as to why the association between breast-feeding and a reduction in childhood overweight and obesity is inconclusive. Clifford points out that most of the studies on the topic are observational studies with differing methodologies of varying rigor (2003). Obviously, it is unethical to conduct a randomized controlled trial, withholding breast-feeding from one population. However, retrospective assessments of breast-feeding practices are subject to recall bias.

A second problem among breast-feeding and obesity studies is the discrepancy in definitions and criteria. Among the studies it is not clear whether the standard breast-feeding definitions and guidelines of the World Health Organization are used; few studies distinguish between exclusive and non-exclusive breast-feeding (Clifford, 2003). Additionally, confounding factors were measured by differing criteria. For example, socioeconomic status could be measured by father's occupation, maternal education, highest level of education by either parent or household income.

Finally, the age at which measurements for overweight and obesity were taken vary among the studies. The ages of participants in the studies reviewed for this paper range from 39 months (Armstrong et al., 2003) to 18 years (Victora et al., 2003). This is not to say that obesity at any one age should be emphasized more than another, but conformity among the studies might create a consensus on the whether or not there is a protective element of breast-feeding (Clifford, 2003).

## WEAK STATISTICAL ASSOCIATION

Victora and colleagues conducted a cohort study on the association between the duration of breast-feeding and measures of body composition in adolescents. The researchers recruited 3,037 male infants born during 1982 in Pelotas, Brazil. Data was collected at follow-ups in 1983, 1984 and 1986. Information was gathered on breast-feeding practices, monthly family income, maternal education, pre-pregnancy body mass, smoking during pregnancy, birth weight, gestational age, physical activity and type of diet. In 2000, 2,250 (74.1 percent) of the cohort were examined as they registered for the army. One hundred forty-three of the original cohort were known to have died, and another 37 refused to participate (2003).

Participants were weighed and measurements were taken on height and skin folds. Being overweight was defined as a BMI at or above the 85th percentile; obesity at or above the 90th percentile. Statistical analysis found no significant associations occurring between duration of breast-feeding and prevalence of overweight. Adjusting for confounding factors confirmed the lack of association. (Victora et al., 2003).

There are two main limitations for Victora et al.'s study. First of all, over 20 percent of original study sample was lost to follow up over the 18-year period. It cannot be said if those lost were similar or different from those who remained in the study. The second limitation is that there is no data available for women. The study included only men; results cannot be generalized to the entire population.

Li, Parsons and Power conducted a cross-sectional study using data from the offspring of the 1958 British birth cohort who had children by 1991. Information on the duration of breast-feeding; BMI; and confounding factors such as birth weight, mother's smoking during pregnancy and social class was available for 2,631 children. Obesity was defined as a BMI above the 95th percentile (2003).

The researchers found that 207 (7.9 percent) children were obese. Although mean BMI and obesity were lower in those breast-fed for two to three months than for those breast-fed for a week, the finding was not significant. Adjustment for confounding factors did not alter the findings. It has been suggested that any effect of breast-feeding may be limited to a critical period or depend on other factors (Li, Parsons, & Power, 2003).

Li, Parsons and Power's study would have been improved with a larger sample size. Also, the children included in the study ranged in age from four to 18. Confounding variables may differ across the ages. Recall bias could also have led to inaccurate information of breast-feeding duration, particularly among the parents of the older children.

## SUMMARY AND CONCLUSIONS

This review of the literature regarding the association between breast-feeding and childhood obesity suggests that although there may be a relationship, the strength of that relationship is not always significant. One must exhibit caution in the interpretation of the studies. Obesity is a multidimensional condition. While a relationship between breast-feeding and a reduction in childhood obesity may exist, it would be foolish to assume that this is a direct, causal relationship. The confounding genetic and environmental variables have not been, and possibly, cannot be adequately controlled for. In fact, the number of factors that contribute to obesity may not even be fully known or understood enough to control for. The interplay among these factors is something that future research will need to consider.

There is a need for further research on the protective factor of breast-feeding against childhood obesity. Researchers should keep three key points in mind. First of

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sample sizes would also help to adjust for confounding variables. Many factors contribute to obesity. It is imperative that researchers concern themselves with the fullest extent of possible contributors. In addition to the size, the set of definitions used by the researchers can impact the study. Variation existed among the studies on notions such as the length of time breast-feeding was measured and whether or not the exclusivity of breast-feeding was taken into account. The World Health Organization has developed a set of recommendations regarding breast-feeding: infants should be breast fed for at least two years with weaning foods added at six months (WHO, 2001). It is not clear if the studies whether these standard definitions were used.

The final key idea is that the results of retrospective studies can be affected by recall bias. Prospective studies would help to reduce this problem. It would be unethical to conduct a randomized control trial, assigning one group to breast-feeding and another to bottle-feeding, but it would be possible to track the feeding practices in a cohort of newly born infants. Of course, a study of this design, and with a sufficiently large sample size, would not be without a sufficiently large price tag. However, the information gathered from the study would be invaluable to a society battling the explosive epidemic of obesity.

Breast-feeding has long been the feeding method recommended by health care practitioners. The benefits it provides the both the child and the mother are numerous. It would be advantageous to say that breast-feeding has been shown to effectively reduce the risk of childhood obesity at a time when obesity is becoming a national epidemic. Unfortunately, that statement cannot be supported by the research. Breast-feeding is a wonderful practice that should be practiced and supported. It just should not be thought of as the answer to obesity problem.

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