

Breast feeding and obesity

The evidence regarding its effect on obesity is inconclusive

Papers pp 901, 904

In many developed countries childhood overweight and obesity have reached epidemic proportions.¹ Moreover, the sequelae of obesity are now seen in children.² Fortunately efforts are being made to understand the causes of overweight and obesity, and the part played by breast feeding is also being studied. The short term benefits of breast feeding are not doubted, and it is the safest, most economical, and most convenient way to promote infant health and nutrition on a global scale.³ Increasing evidence⁴⁻⁸ shows that having been breast fed may have longer term benefits, including prevention of obesity; but this evidence is uncertain.^{9,10} Two articles in this issue evaluate whether having been breast fed protects against later obesity.^{11,12} Neither finds evidence to say that it does. Why the contradictory findings? Although there is no easy answer to this question, the explanation may be that the studies examining early infant nutrition and later obesity are observational and therefore subject to several caveats.

For obvious reasons it is unethical to conduct a randomised controlled trial in which individuals are randomised either to breast feeding or to formula. Robust evidence is therefore difficult to come by. Thus we are dependent on observational studies with differing methodologies of varying rigour. These differences may explain some of the contradictory findings that have been reported.

One such difference relates to the methods used for ascertaining individuals' exposure to breast milk. For example, more than half of the studies examining the connection between early infant nutrition and later obesity rely on retrospective assessments of breast feeding.^{4,6-8,10,11} Such assessments are subject to greater bias than studies that collect this information prospectively. Moreover, the definition of breast feeding is also an issue—only five studies differentiated between exclusive and non-exclusive breast feeding, and even among these it is not always clear whether standard definitions of the World Health Organization were used.^{3,7,8,11,12}

Also contributing to the contradictory findings in the literature on breast feeding and obesity is the large sample sizes that prospective observational studies need to adjust for confounders. Large sample sizes mean large budgets, particularly when the outcome of interest (obesity) is measured years or decades later. Sample size also goes hand in hand with the issue of statistical power and its corollary, type 2 error, and this could explain the negative findings in these studies.^{3,4,11,12} However, it is difficult to draw such a conclu-

sion because none of these studies stated explicitly and a priori the hypothesis that was to be tested. As a result each study's statistical power remains a mystery. Admittedly it is not always possible to state a specific, testable hypothesis or to perform a formal sample size calculation. This is particularly true when there is a paucity of evidence to guide this process. None the less on the basis of current evidence future research should be able to address this limitation with relative ease.

Another explanation for the discordant findings noted in the literature is that the studies measured confounders by using different criteria and adjusted for these confounders to varying degrees. In any observational study, adjusting for such variables is essential to arrive at an estimate of the independent effect of the exposure (breast feeding) on the outcome (obesity). For example, socioeconomic status was measured by using father's occupation,^{4,10} maternal education,^{3,12} highest level of education attained by either parent,^{6,7} or household income by census tract.⁸ Differing methods for measuring and adjusting for confounders could contribute to the conflicting findings. Again efforts to ensure complete and accurate reporting of definitions and measurements of all variables of interest will improve our understanding of the complexities of childhood obesity.

Finally, these discordant findings may stem from the selection of disparate end points for measurement of the obesity. Variation in the age at which obesity was measured was wide both between and within these studies. For example, one work¹¹ assessed obesity when children were aged 3-5 years, whereas another¹² when members of their cohort were aged 50. Other studies include children of various ages.^{4,6-8} Admittedly obesity at any age is a concern, and forcing the selection of a single, arbitrary end point for assessing obesity would not be in anyone's best interests. However, when trying to reconcile seemingly incongruent findings from several studies we need to take a closer look at the studies' methods to ensure that apples are not compared with oranges.

Where does this leave us? Obviously, breast is still best—even if the benefits of breast feeding do not extend to preventing obesity. But the possibility remains that even if the effect of breast feeding on future obesity is small the public health impact can be tremendous. Future research needs to build on existing works, particularly involving birth cohorts, by addressing the caveats inherent in observational studies noted above. Designing such studies will be relatively easy. I doubt

whether the same can be said of the efforts required to convince bureaucrats and agencies to fund longitudinal, observational research of the scope that will be needed to show the long term benefits of breast feeding—but I would welcome the opportunity to stand corrected.

Tammy J Clifford *director of epidemiology*

Chalmers Research Group, Children's Hospital of Eastern Ontario Research Institute, Ottawa, K1H 8L1 Canada (tclifford@cheo.on.ca)

Competing interests: None declared.

- 1 de Onis M, Blossner M. Prevalence and trends of overweight among pre-school children in developing countries. *Am J Clin Nutr* 2002;72:1032-9.
- 2 Freedman DS, Dietz WH, Srinivasan SR, Berenson GS. The relation of overweight to cardiovascular risk factors among children and adolescents: the Bogalusa heart study. *Pediatrics* 1999;103:1175-82.
- 3 World Health Organization/UNICEF. *Protecting, promoting and supporting breastfeeding: the special role of maternity services*. Geneva: WHO, 1989.
- 4 Toschke AM, Vignerova J, Lhotska L, Osancova K, Koletzko B, von Kries

- R. Overweight and obesity in 6- to 14-year-old Czech children in 1991: protective effect of breast-feeding. *J Pediatr* 2002;141:764-9.
- 5 von Kries R, Koletzko B, Sauerwald T, von Mutius E, Barnert D, Grunert V, et al. Breast feeding and obesity: cross sectional study. *BMJ* 1999;319:147-50.
- 6 Gillman MW, Rifas-Shiman SL, Camargo CA, Berkey CS, Frazier AL, Rockett HRH, et al. Risk of overweight among adolescents who were breastfed as infants. *JAMA* 2001;285:2461-7.
- 7 Bergmann KE, Bergmann RL, von Kries R, Bohm O, Richter R, Dudenhausen JW, Wahn U. Early determinants of childhood overweight and adiposity in a birth cohort study: role of breast feeding. *Int J Obes Relat Metab Disord* 2003;2:162-72.
- 8 Parsons TJ, Power C, Manor O. Infant feeding and obesity through the lifecourse. *Arch Dis Child* 2003;88:793-4.
- 9 Hediger ML, Overpeck MD, Kuczmarski RJ, Ruan WJ. Association between infant breastfeeding and overweight in young children. *JAMA* 2001;285:2453-60.
- 10 Ravelli ACJ, van der Meulen JHP, Osmond C, Barker DJP, Bleker OP. Infant feeding and adult glucose tolerance, lipid profile, blood pressure and obesity. *Arch Dis Child* 2000;82:248-52.
- 11 Victora CG, Barros FC, Lima RC, Horta BL, Wells J. Anthropometry and body composition of 18 year old men according to duration of breastfeeding: a birth cohort study from Brazil. *BMJ* 2003;327:901-4.
- 12 Li L, Parsons TJ, Power C. Breast feeding and obesity in childhood: cross-sectional study. *BMJ* 2003;327:904-5.

Intrauterine factors, adiposity, and hyperinsulinaemia

Thin babies with excess body fat may explain later adiposity in Indians

The first world congress on fetal origins of adult disease was held in Mumbai, India, in 2001. The second congress was recently held in Brighton, United Kingdom. In spite of their diverse locations both these meetings were dominated by data from developed countries. This is largely a consequence of the extreme rarity of good historical records of birth size from developing countries. The recent insights emerging from prospective studies by Yajnik et al in Pune in India are therefore notable and deserve attention.^{1 2}

The core of the theory of fetal origins of disease is that nutritional deprivation of the fetus during critical periods of development forces the baby to resort to adaptive survival strategies, which entail a resetting of the normal course of metabolic, physiological, and anatomical development. These adaptations become maladaptive if the organism encounters contrasting nutritional circumstances in later life. In relation to insulin action and diabetes Hales and Barker have described this phenomenon as the “thrifty phenotype.”³ In the words of J V Neel, the initial proponent of the thrifty genotype hypothesis,⁴ the thrifty phenotype is “rendered detrimental by progress” and leads to high rates of metabolic syndrome and type 2 diabetes.⁵ Recently it has become apparent that it is the disharmony between fetal growth and later growth rates that seems to be the best predictor of the later pathology.^{6 7}

A wide range of pathological and non-pathological factors influence fetal growth. Some of these are modifiable during pregnancy (smoking, alcohol, intake of nutrients), and others are essentially fixed at the moment of conception. One of these fixed influences is a mother's body size and composition. In the Indian studies pregnant women are very small.¹ In rural villages they average about 44 kg in mid-gestation, with a height of 1.52 metres and body mass index of 18 kg/m². Under such circumstances maternal uterine constraint becomes a dominant regulator of fetal growth in order to protect the mother from having to deliver an inappropriately large baby. The importance of uterine

constraint has been known for many decades and was graphically shown by Walton and Hammond in their experiments crossing shire horse sires with Shetland pony mares that were much smaller. The uterine environment in the mare suppressed the inherited growth potential of the paternal chromosomes and produced appropriately small foals to allow natural delivery.⁸ More recently the molecular biology of this process is emerging as a fascinating conflict between maternal and paternal influences that involves a range of imprinted genes, especially insulin-like growth factor-2 and its receptors.⁹ The details aside it has become clear that maternal constraint must have a central role in fetal programming.

Together with Caroline Fall from David Barker's Medical Research Council group in Southampton, Yajnik and his team have used anthropometric measurements of babies to describe their morphology at birth. The picture that emerges is of Indian babies that are much smaller than those in Southampton in all respects except measures of body fat—especially central fat as judged by the subscapular skinfold thickness.^{1 2} They describe this as the “thin-fat” baby syndrome and believe that it shows that the excess visceral adiposity of most Asian adults can be traced back to the neonate.

In collaboration with Yudkin at University College London Yajnik has shown that in the babies of urban mothers in Pune, insulin concentrations in the blood of the cord seem raised compared with the British babies and are correlated with subscapular skinfold thickness.² Later in childhood these thin-fat Indian babies can be shown to have profoundly impaired indices of insulin sensitivity, which are inversely correlated with birth weight.^{10 11} These correlations with birth weight are importantly modified by both their postnatal growth rate and their achieved size in relation to their predicted size based on mid-parental height; with greater growth equating to worse insulin resistance (data presented by Yajnik at the recent Brighton congress). These findings emphasise the issues about disharmonious growth being a major contributor to later pathology.

BMJ 2003;327:880-1