COMMENTARY

Breastfeeding and IQ: Evaluation of the socio-environmental confounders

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Numerous papers (1–6), including a recent meta-analysis (7), have contributed to the growing literature investigating whether breastfeeding can enhance child cognitive development, as assessed by IQ. Virtually all the findings to date concur in showing an association between better performance on IQ tests in children who were breastfed over those who were bottlefed. This intellectual advantage has been demonstrated in several cultures for full terms and more strongly for preterm and low birthweight infants. The IQ advantage for full terms is small, roughly about 3–4 points, but it is consistent across studies. The controversy in this literature is not about whether there is an enhanced IQ score among the breastfed children, but whether this difference reflects a direct nutritional advantage or a difference in socio-environmental factors that are generally more optimal among women who breastfeed for an extended period of time. It is well established that women who breastfeed also often provide a more enriched and cognitively stimulating environment for the child, which could be responsible for the enhanced IQ scores. Most studies, including that of Rao et al. and our own (8), have shown that breastfeeding is associated with higher socioeconomic status and education. Thus, it is critical to determine whether the observed IQ advantage persists after control for the socio-environmental factors that may be the true cause of enhanced intellectual ability among breastfed children.

The new study by Rao et al. (9) contributes to the literature by comparing the effects of exclusive breastfeeding on cognitive and motor performance in full-term, small-for-gestational-age (SGA) and appropriate-for-gestational-age (AGA) children and by examining whether there is a minimum duration of breastfeeding (threshold) necessary for the breastfeeding advantage to become apparent. The authors distinguish between the impact of short (≤12 wk) and longer exclusive breastfeeding (>12 wk). This is an important distinction, because many mothers of SGA infants provide supplemental foods significantly earlier in the first year than mothers of AGA infants if their infants are still small after several weeks of breastfeeding.

Rao et al. detected no statistically significant differences between breastfed and bottlefed infants on the Bayley Scales of Infant Development (10) administered at 13 mo. However, at 5 y, SGA children who had been breastfed for >12 wk had a 4–5 point higher total IQ score on the Norwegian version of the Wechsler Preschool and Primary Scales of Intelligence (WPPSI) (11), after adjusting for confounders. This difference appears to reflect an advantage on Performance IQ, since there was no significant difference in relation to Verbal IQ. No apparent benefit on IQ was detected for the SGA children who were breastfed for only 12 wk. Duration of breastfeeding did not impact on growth, suggesting that the Performance IQ advantage was not mediated by size. The question, therefore, is to what extent and how definitively the Performance IQ advantage can be attributed to nutrition.

The nutritional benefits of breastfeeding have been demonstrated for preterm infants in a clinical trial (2). Rao et al. extend this finding by showing that there is also a benefit for full-term SGA infants if they are breastfed >12 wk. As they and others have suggested, certain nutrients in breast milk may enhance intellectual development or may be especially influential, given metabolic differences between AGA and very low birthweight SGA infants (12, 13). Evidence from clinical trials with formula-fed preterm infants has demonstrated beneficial effects on visual recognition memory and visual acuity from dietary supplementation with docosahexaenoic acid (DHA), a long-chain polyunsaturated fatty acid that is an important nutrient in breast milk (14).

As in most studies, the Rao et al. data show a significant positive association of breastfeeding with social class and education. Most studies have therefore included these variables as potential confounders and have reported a statistical advantage for breastfeeding after control for these two distal socio-environmental factors. In our research, the association between breastfeeding and IQ (β = 0.21, p < 0.001) also persisted after inclusion of social class and maternal education (3, 4). We found, however, that this association was substantially weakened (from β = 0.12, p < 0.025, to β = 0.06, n.s.) when we included maternal verbal IQ, assessed on the Peabody Picture Vocabulary Test-Revised (PPVT-R) (15), and quality of parenting, assessed on the Home Observation for Measurement of the Environment (HOME) (16). We therefore concluded that these socio-environmental influences were largely responsible for the enhanced IQ scores seen in
the two different cohorts and at the two different ages that we had studied.

The Rao et al. study further contributes to the research on this topic with the finding that maternal depression, anxiety and stressful life events are unrelated to duration of exclusive breastfeeding, confirming a finding we had previously noted (4, 8). This finding suggests that maternal intellectual enrichment and genetic endowment, as indexed by the HOME and maternal IQ, are the critical potential confounders of the breastfeeding effect. Rao et al. included a non-verbal measure, the Ravens Progressive Matrices (17), to assess maternal IQ. In our research, we found that maternal verbal IQ is a substantially stronger predictor of the child’s IQ than the two strongest non-verbal measures from the Wechsler Adult Intelligence Test-Revised (WAIS-R) (18). The correlation of the maternal Block Design and Picture Completion subtests with the child’s 7.5-year Full Scale IQ was only 0.18, compared with 0.35 for the maternal Vocabulary subtest, suggesting that a verbal IQ measure is likely to provide more complete control for the genetic and socio-environmental input of the mother.

Of the 11 studies included in the Anderson et al. meta-analysis (7), 5 controlled for maternal IQ and/or quality of parenting (referred to as “maternal training” in their table). Not surprisingly, the average effect of breastfeeding on IQ in these studies was smaller ($M = 3.4$ points; range $1–5$) compared with the six studies that controlled for socio-economic status and maternal education but not IQ or parenting ($M = 4.9$ points; range $3–8$), a difference of 30.6%. It is possible that the remaining variance attributed to breastfeeding in these studies is also due to socio-environmental influence. These data are consistent with the assumption that maternal breastfeeding reflects, to some degree, the mother’s concern with her infant’s welfare and her motivation and ability to stimulate and enrich her child’s subsequent development, which are partly correlated with, but to some extent independent of, social class and education. Because direct measures of parental input, such as, the HOME, explain significant variance in child outcome over and above socio-economic status and parental education (3, 19, 20), these measures control more completely for socio-environmental influences. The Rao et al. cohort was comprised of a relatively advantaged and homogeneous population, 50–65% of whom breastfed for at least 6 mo. Given this relatively limited range in social class and education, measures of quality of parenting may be especially important in controlling for differences in motivation and child-rearing attitudes and practices.

In summary, it is of particular interest that a more substantial breastfeeding effect in this careful study is found for the SGA children who were breastfed for a longer period of time—a finding that is consistent with other breastfeeding data and which suggests that breast milk may be particularly important for preterm and low birthweight infants and, in this case, for SGA infants.

By contrast, the effect of breastfeeding on IQ among the AGA infants averaged 3 points, well within the modest range found in the full-term samples in Anderson et al.’s meta-analysis (7), after adjusting for covariates. The degree to which this 3-point difference is attributable to nutrition or the social environment cannot be definitively determined until more precise measurements of nutrients in the breast milk and quality of parental input are examined in this context. Although the impact of breastfeeding on intellectual development in full-term children is still not clear, these comments should not be interpreted as detracting from other medical and psychological benefits linked to breastfeeding.

References

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Increased inspiratory effort in infants with a history of apparent life-threatening events

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Studies of the physiology of infants who have suffered an apparent life-threatening event (ALTE) compared with that of healthy control infants are of interest for two reasons: first, even for paediatric units with an interest in investigating such infants, only 40–50% of cases are given a diagnosis (1, 2). This often makes management decisions inexact and variable, and also causes increased anxiety for parents. If we can increase our understanding of the mechanisms for life-threatening episodes, we may be better equipped to manage such cases. Secondly, the mechanisms that cause ALTEs may be similar to those that cause sudden and unexpected infant death. This is supported by the fact that whereas most studies report survival in infants who have had an ALTE, a small proportion of infants who suffer recurrent ALTEs progress to sudden and unexpected death (3). Conversely, a small proportion of infants who have died of sudden infant death syndrome (SIDS) have a history of ALTE or apnoea (4). Thus infants who suffer ALTE have been considered an “at-risk” group for sudden death.

This study compares the physiological measurements in a group of cases with those of controls. Like many other studies that examine cohorts of ALTE infants, such studies may help identify group differences after the event, but have not yet reached the point of identifying an individual infant’s susceptibility to primary or subsequent events.

Horemuzova and colleagues studied 22 infants who had suffered ALTEs and found no differences compared with 22 controls in baseline SaO2 levels, transcutaneous pO2 and pCO2 levels, the proportion of quiet and active sleep and the proportion of periodic breathing (5). However, the authors did find differences in thoraco-abdominal asynchrony (TAA), with ALTE infants showing increases in TAA in both active and quiet sleep. Thoraco-abdominal asynchrony is considered to be an index of inspiratory effort, resulting from increased inspiratory airflow resistance. Other authors have termed this asynchrony as “paradoxical inward rib cage movement (PIRCM)” measured by a similar, but quantitatively different measure known as the laboured-breathing index (6). Despite the different terms and methods of measurement, TAA and PIRCM are considered to indicate sleep disordered breathing, such as occurs in obstructive sleep apnoea (7). It is correct that, in children, a relationship between TAA and PIRCM and other measures of obstructive breathing has been found (6), but only in children above 3 y of age. Below this age, PIRCM or TAA may be physiological (6, 8)—whether high levels of PIRCM, as found in this group of ALTE infants, are pathological is as yet unclear.

One factor that leads to inward rib cage motion on inspiration is intercostal hypotonia, as evidenced by the fact that the chest and abdominal wall asynchrony usually occurs during active sleep. However, this lack of rib cage muscle tone and the accompanying increase in chest wall compliance is not the only factor, as shown by the fact that TAA may occur during quiet sleep. Nevertheless, the reduction in chest wall compliance that occurs with age is likely to be one factor that results in the disappearance of TAA later during childhood (6).

The authors’ findings raise the question as to whether the increased asynchrony in ALTE infants indicates a physiological susceptibility, or pathological entity. It is also important to question whether the asynchrony necessarily arises in association with, or as a result of