SHORT REPORT

Can breast feeding modify the adverse effects of smoking during pregnancy on the child's cognitive development?

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Harmful effects of maternal smoking during pregnancy on cognitive development of the child have been shown,[1] as have beneficial effects of breast feeding.[2] We examined whether adverse effects of maternal smoking can be modified by breast feeding.

PARTICIPANTS, METHODS, AND RESULTS

The Perinatal Project Groningen (PPG) is a cohort of 3162 singleton infants born in the University Hospital Groningen in 1975–1978. Perinatally, detailed sociodemographic, obstetric, and neonatal data were collected, including the average number of cigarettes smoked daily by the mother during pregnancy. For this study we focused on those children (n=570) whose reading, spelling, and arithmetic performance was tested around their 9th birthday using short standardised Dutch tests. For sample and test characteristics see Hadders-Algra *et al* 1988.[3] The mothers of the 570 children examined at 9 years breast fed their children less often than the mothers whose children were not followed up (28.7% *v* 33%; χ^2 (2) =10.56, p=0.005) and they smoked more (4.9 *v* 4.4 cigarettes a day; t=−1.73, p=0.094). However, our comparisons are valid within the study sample, and unless the links between feeding method, maternal smoking, and performance of the child differ between this sample and others—which is unlikely—also have wider implications.

Type of feeding was assessed on discharge from hospital after delivery (1975–78), and, retrospectively, as reported by the mothers, when their children were 9 (1993[2]) and 25 (2000) years old. The three assessments corresponded highly (Cohen's κ respectively 0.95, 0.88, and 0.86), which concurs with previous findings that long term recall of breast feeding practices is reliable.[2] We used the 1993 data because these were most complete (0% missing and 1% (7) excluded because mothers had difficulty recalling the information). Children that were breast fed for one or two weeks only (n=16) or received both breast and formula milk (n=10) were excluded to maximise differences between the breast fed and bottle fed groups.

Likelihood ratio (LR) tests indicated highly significant interactions between the effects of maternal smoking and breast feeding on reading (χ^2=24.1; df=3; p<0.001), spelling (χ^2=35.6; df=3; p<0.001), and arithmetic performance (χ^2=32.0; df=3; p<0.001), as analysed in least squares regression models.

Significant negative links between maternal smoking and scholastic performance existed only in children that had been bottle fed (n=388). LR tests against linearity were non-significant so that a dose-response effect can be assumed. It persisted after adjustment for other risk factors that were linked to the separate cognitive performance outcomes (see table 1) including the child's gender (55% male), parental marital state during pregnancy (7% unmarried), and socioeconomic status. Socioeconomic status was operationalised as the principal component (Eigenvalue 3.03, Cronbach's α=0.86) summarising mother's and father's vocational and educational levels. Also examined but unrelated to the dependent variables and therefore not adjusted for were: paternal smoking, maternal age, parental psychiatric history, length of gestation, obstetric complications (for example, instrumental delivery, rotation disturbances), birth weight, birth order, family size, and family circumstances (traditional two parent family compared with others).

Table 1 Adjusted regression coefficients for the relations between maternal smoking during pregnancy and school performance in respectively breast fed and bottle fed children, 95% confidence intervals (in parentheses) and p values

Number of cigarettes smoked daily		Reading	Spelling	Arithmetic
		More than 3 weeks breast feeding (n=156)		
0	60.0%	*crude link*	*crude link*	*crude link*
1–5	13.3%	–0.16 (–0.55 to 0.22)	–0.16 (–0.50 to 0.19)	–0.14 (–0.57 to 0.29)
6–10	21.3%	p=0.164	p=0.626	p=0.516
>10	5.3%	*adjusted*	*adjusted*	*adjusted*
		0.09† (–0.27 to 0.45)	0.04† (–0.29 to 0.37)	0.03‡ (–0.37 to 0.43)
		0.268	0.607	0.696
		Bottle feeding (n=388)		
0	46.8%	*crude link*	*crude link*	*crude link*
1–5	15.0%	–0.51 (–0.74 to –0.28)	–0.50 (–0.69 to –0.32)	–0.52 (–0.75 to –0.30)
6–10	20.2%	p<0.001*	p<0.001*	p<0.001*
>10	18.0%	*adjusted*	*adjusted*	*adjusted*
		–0.22† (–0.43 to –0.02)	–0.26† (–0.42 to –0.09)	–0.26‡ (–0.46 to –0.06)
		0.032*	0.002*	0.012*

*Significant at 0.05 level. †Adjusted for significant confounders: social economic state and sex of the child. ‡Adjusted for significant confounders: social economic state and civil state of the parents.

COMMENT

Our results indicate that negative effects of maternal smoking on children's cognitive performance were limited to those who had not been breast fed. Roughly, there are three explanations for these findings.

Firstly, women who breast feed their child may differ from women who do not on factors related to the child's school performance. Although we controlled for important socio-demographic variables, it remains possible that some other factors not included in our study, like maternal IQ or parenting skills,[4] are related to maternal smoking and feeding practices as well as to the child's school performance.

Secondly, psychological aspects of breast feeding may play a part, but their relative importance remains unclear. Biological rather than psychosocial aspects of breast feeding may affect cognitive development: it has been reported that 8 year old children, who were born pre-term and were fed breast milk by nasogastric tube, had an eight point advantage in IQ over those fed on formula milk.[5]

So thirdly, features of breast milk itself, like high concentrations of long chain polyunsaturated fatty acids or maternal hormones,[2 4 5] may have positive effects on early brain development, and counteract the harmful effect of maternal smoking during pregnancy on the fetus. This notion has important practical implications, especially for nicotine addicted future mothers. Apart from helping these mothers to stop or diminish their tobacco consumption, they should be encouraged to breast feed.

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Contributors

Laura Batstra interpreted the data and wrote the report. Jan Neeleman and Mijna Hadders-Algra coordinated the study and provided overall supervision of the analyses. Mijna Hadders-Algra collected the school achievement data and assisted in writing the report.

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