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Pediatrics 2008;121;e435-e440
DOI: 10.1542/peds.2007-1248

ARTICLE

Effects of Prolonged and Exclusive Breastfeeding on Child Behavior and Maternal Adjustment: Evidence From a Large, Randomized Trial

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The authors have indicated they have no financial relationships relevant to this article to disclose.

ABSTRACT

OBJECTIVE. The objective of this study was to assess the long-term effects of breastfeeding on child behavior and maternal adjustment.

METHODS. We followed up children who were in the Promotion of Breastfeeding Intervention Trial, a cluster-randomized trial of a breastfeeding promotion intervention based on the World Health Organization/United Nations Children's Fund Baby-Friendly Hospital Initiative. A total of 17 046 healthy, breastfeeding mother–infant pairs were enrolled from 31 Belarussian maternity hospitals and affiliated polyclinics; 13 889 (81.5%) were followed up at 6.5 years. Mothers and teachers completed the Strengths and Difficulties Questionnaire and supplemental questions bearing on internalizing and externalizing behavioral problems. Mothers also responded to questions concerning their relationships to their partner and child and their breastfeeding of subsequently born children.

RESULTS. The experimental intervention led to a large increase in exclusive breastfeeding at 3 months (43.3% vs 6.4%) and a significantly higher prevalence of any breastfeeding at all ages up to and including 12 months. No significant treatment effects were observed on either the mother or the teacher Strengths and Difficulties Questionnaire ratings of total difficulties, emotional symptoms, conduct problems, hyperactivity, peer problems, or prosocial behavior or on the supplemental behavioral questions. We found no evidence of treatment effects on the parent's marriage or on the mother's satisfaction with her relationships with her partner or child, but the experimental intervention significantly increased the duration of any breastfeeding, and mothers in the experimental group were nearly twice as likely to breastfeed exclusively the next-born child for at least 3 months.

CONCLUSIONS. On the basis of the largest randomized trial ever conducted in the area of human lactation, we found no evidence of risks or benefits of prolonged and exclusive breastfeeding for child and maternal behavior. Breastfeeding promotion does, however, favorably affect breastfeeding of the subsequent child.

www.pediatrics.org/cgi/doi/10.1542/peds.2007-1248

doi:10.1542/peds.2007-1248

This trial has been registered at www.controlled-trials.com/isrctn (ISRCTN37687716).

Key Words
breastfeeding, child behavior, conduct disorder, ADHD, peer relations, randomized trial

Abbreviations
PROBIT—Promotion of Breastfeeding Intervention Trial
SDQ—Strengths and Difficulties Questionnaire
CI—confidence interval
OR—odds ratio
ICC—intraclass correlation coefficient

Accepted for publication Jul 20, 2007

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GIVEN THE FREQUENTLY studied and reported associations between breastfeeding and cognitive development and the intimate mother–infant physical and emotional contact during the act of breastfeeding, surprisingly few studies have reported on the long-term effects of infant feeding on child behavior and maternal adjustment.[1] Short-term studies during infancy reported effects on infant crying and fussing[2,3] and sleep patterns[4] but no effect on mother–infant attachment behavior.[5] A recent US study reported a strong protective effect of breastfeeding (especially if prolonged) against nocturnal enuresis, which the authors attributed to accelerated neurodevelopmental maturation.[6] A New Zealand study reported that first-year undergraduate psychology students who had been

breastfed for >3 months had lower anxiety scores but showed no differences in neurotic or extroverted personality characteristics, compared with those who were never breastfed or were breastfed for a shorter duration.[7] In long-term follow-up of a birth cohort study from New Zealand, adolescents who had been breastfed for ≥4 months reported their mothers as having been more caring and less overprotective but had no reduction in risk for juvenile offending, substance use, or mental illness.[8] One Danish study reported a strong association between early weaning (within the first 2 weeks of birth) and early alcoholism among adult men.[9] Finally, 2 long-term studies relating infant feeding to schizophrenia or affective disorder in adulthood reported conflicting results.[10,11]

All of this evidence is based on observational (nonexperimental) studies. Although many of these studies controlled statistically for demographic factors and socioeconomic differences among mothers with different feeding practices, all of their reported associations are likely to be confounded by more subtle differences in the mother's behavior or her interaction with the infant. These differences are extremely difficult to measure and virtually impossible to control for in observational studies. In the mid-1990s, we designed and implemented the Promotion of Breastfeeding Intervention Trial (PROBIT), a large, cluster-randomized trial in the Republic of Belarus.[12] In this article, we report on measures of parent- and teacher-reported child behavior, maternal self-reported adjustment, and breastfeeding of the subsequent sibling on the basis of follow-up of the cohort when the children were 6.5 years of age. We hypothesized that the enhanced exclusivity and duration of breastfeeding previously reported to result from the intervention[12] would increase maternal–infant physical contact and consumption of bioactive components of breast milk and thereby lead to long-term improvements in conduct and behavior.

METHODS

The detailed methods of PROBIT and the results during the first year of follow-up have been previously reported.[12] The experimental intervention was based on the Baby-Friendly Hospital Initiative, which was developed by the World Health Organization and the United Nations Children's Fund to promote and support breastfeeding, particularly among mothers who have chosen to initiate breastfeeding,[13] whereas control sites continued the practices and policies in effect at the time of randomization. The units (clusters) of randomization were maternity hospitals and 1 affiliated polyclinic (pediatric outpatient clinic for routine well-child and illness care) per hospital, with double randomization based on both a random-numbers table and a coin flip.[12] The trial results are based on a total of 17 046 healthy breastfed infants from 31 maternity hospitals/polyclinics; all were born at term in 1996–1997, weighed at least 2500 g, and were enrolled during their postpartum stay.[12] Mothers consented in writing to participate in PROBIT interviews and examinations, but no details were provided about the experimental and control interventions. To our knowledge, PROBIT is the largest randomized trial ever undertaken in the area of human lactation. It conforms to the CONSORT recommendations for the design, analysis, and reporting of cluster-randomized trials.[14]

As previously reported,[12] the 2 randomized groups were similar in baseline sociodemographic and clinical variables, including maternal age, education, number of other children at home, the proportion who had breastfed a previous child for at least 3 months, cesarean delivery, maternal smoking during pregnancy, birth weight, gestational age, and 5-minute Apgar score. The experimental intervention led to a substantial difference in the duration of any breastfeeding that was maintained throughout the first year of follow-up: 72.7% vs 60.0% were still breastfeeding at 3 months, 49.8% vs 36.1% were still breastfeeding at 6 months, 36.1% vs 24.4% were still breastfeeding at 9 months, and 19.7% vs 11.4% were still breastfeeding at 12 months in the experimental versus control groups, respectively. In addition, the prevalence of exclusive breastfeeding was sevenfold higher in the experimental group at 3 months (43.3% vs 6.4%), although low in both groups at 6 months (7.9% vs 0.6%).[12]

At the age of 6.5 years, children (accompanied by a parent, usually [92%] the mother) attended a special study interview and examination held at the polyclinic between December 2002 and April 2005. The parent (usually the mother) who accompanied the child to the polyclinic for the 6.5-year follow-up visit consented in writing to the examination and testing procedures at that visit. While awaiting the examination and interview in the polyclinic waiting room, the parent completed the Strengths and Difficulties Questionnaire (SDQ), parent version. The SDQ is a brief scale devised for behavioral screening of children aged 3 to 16 years.[15] The scale contains 25 items, some positive and others negative. The 25 items are divided into 5 scales of 5 items each, which generate scores for conduct problems, hyperactivity/inattention, emotional symptoms, peer problems, and prosocial behavior. In addition, as part of the SDQ impact supplement, both the parent and the teacher were asked a global question about whether the child has difficulties in any of the following areas: emotion, concentration, behavior, or being able to get along with other people.

The SDQ has been used widely in Europe and more recently in North America, and various comparative studies have shown that its reliability and validity are equal or superior to other competing scales, in particular the Achenbach Child Behavior Checklist.[16] There is abundant evidence of the cross-cultural validity of the SDQ in several European and developing countries.[17–20] It has been translated, validated, and standardized in Russian. Once or twice a month, the polyclinic pediatricians distributed the teacher's version of the SDQ to teachers of children who had started formal schooling by the time of their follow-up visit. Teachers' names were reported by the parents at the polyclinic visit. The teacher version of the SDQ is identical to that of the parent version. Teachers were blind to the experimental versus control treatment allocation of the children. In-

ternal consistency of the parents' and teachers' responses was assessed using Cronbach's α.

Test–retest reproducibility of the parents' SDQ was assessed by requesting completion of a repeat SDQ at the time of an audit visit for 5 randomly selected children for each of the 38 participating polyclinic pediatricians, for a total of 190 audited children. To ensure that all children were eligible to be audited, the audits were conducted an average of 17.7 months (range: 5.3–32.6 months) after the initial polyclinic visits. Reproducibility was assessed using the intraclass correlation coefficient (and its 95% confidence interval [CI]).

In addition to the SDQ, parents and teachers responded to supplemental behavioral questions taken from the Canadian National Longitudinal Survey of Children and Youth.[21] To provide a format comparable to that of the SDQ, each supplemental item was stated as a descriptor of the child's behavior, and the parent was asked whether the item was not true, somewhat true, or certainly true for that child. These questions were then grouped as relating to externalizing (5 items for parents, 8 for teachers) or internalizing (9 items for parents, 6 for teachers) behaviors. The score for each category was obtained by summing the scores on the component questions (0 for not true, 1 for somewhat true, and 2 for certainly true). For both the SDQ and supplemental behavioral questions, we also analyzed the scores dichotomously by defining "abnormal" as a score ≥85th percentile (or ≤15th percentile for prosocial behavior).

We also assessed several aspects of the mother's adjustment and behavior, including any change in her marital status since the index child's birth and her satisfaction with her relationship with her partner, with her relationship with her child, and with her experience as a mother in general. Responses to the 3 last questions used a 7-point Likert format ranging from "very dissatisfied" to "perfectly satisfied." Finally, we also inquired about the duration of any breastfeeding and of exclusive breastfeeding of siblings who were born subsequent to the index child. Because few mothers had >1 subsequent child, the analysis was limited to the next-born sibling.

All statistical analyses were based on intention to treat. Differences in outcome between the experimental and control groups were analyzed using the MIXED procedure in SAS 8.2 (SAS Institute, Cary, NC). This is a multilevel statistical model that accounts for the clustered randomization and for clustering of children who shared the same teacher, thereby permitting inferences at level of the individual child and mother, rather than at the cluster (maternity hospital/polyclinic or teacher) level. The analogous GLIMMIX penalized quasi-likelihood procedure for generalized linear mixed models[22] in SAS was used to estimate adjusted odds ratios (ORs) and 95% CIs for dichotomous outcomes. The cluster-adjusted differences and ORs presented in the tables are virtually identical to those obtained from a multivariate mixed model that also adjusts for stratum-level variables, including geographic region (West versus East) and urban versus rural location, as well as the following individual-level covariates: age at follow-up, gender, birth weight, and both maternal and paternal education (results available on request). We also examined whether intervention effects differed in boys and girls by including treatment-by-gender multiplicative interaction terms in the MIXED models.

TABLE 1 **Baseline Comparison of Children Who Were Followed up at Age 6.5 Years in Experimental Versus Control Groups**

Variable	Experimental (n = 7108)	Control (n = 6781)
Maternal age, %, y		
<20	14.3	13.2
20–34	81.4	82.6
≥35	4.3	4.2
Maternal education, %		
Incomplete secondary	4.4	3.0
Complete secondary	34.3	29.7
Advanced secondary or partial university	47.8	54.5
Complete university	13.5	12.9
Older children living in household, %		
0	58.8	54.5
1	33.3	36.1
≥2	7.9	9.4
Maternal smoking during pregnancy, %	2.6	1.6
Child gender (% male)	51.4	52.0
Birth weight, mean ± SD, g	3440 ± 418	3441 ± 423

RESULTS

A total of 13 889 children were seen in follow-up for PROBIT II, representing 81.5% of the 17 046 originally randomly assigned children. Of the 3157 (17 046–13 889) children who were enrolled but not followed up, 88 had died, 2938 were lost to follow-up, and 131 were unable/unwilling to come for their PROBIT II visit. Follow-up rates were similar in the experimental (80.2%) and control (82.9%) polyclinics but varied considerably by polyclinic: from 56.1% at 1 of the Minsk polyclinics to 94.6% at Klimovichi, a small rural-based polyclinic. As shown in Table 1, the children who were followed up in the experimental and control groups were similar on baseline characteristics, with small differences paralleling those seen (and previously reported[12]) at randomization. The mean ± SD age at follow-up was 6.6 ± 0.3 years.

Internal consistency was higher for the teacher SDQ than for the parent SDQ: 0.82 vs 0.73 for total difficulties, 0.81 vs 0.67 for hyperactivity, 0.81 vs 0.62 for prosocial behavior, 0.69 vs 0.60 for emotional symptoms, 0.69 vs 0.51 for conduct problems, and 0.49 vs 0.34 for peer problems. Test–retest reproducibility for the parent SDQ (comparing results from the initial polyclinic visit and the audit visit) were high, especially considering the 18-month average time elapsed between the 2 visits. Intraclass correlation coefficients (ICCs) were 0.80 (95% CI: 0.74–0.85) for total difficulties, 0.77 (95% CI: 0.69–0.83) for emotional symptoms, 0.72 (95% CI: 0.64–0.79) for conduct problems, 0.77 (95% CI: 0.70–0.83) for hyperactivity, 0.64 (95% CI: 0.53–0.72) for peer problems, and 0.63 (95% CI: 0.51–0.71) for prosocial behavior.

Table 2 summarizes the results for the parent SDQ

TABLE 2 **Results for the Parent SDQ**

SDQ Subscale	Experimental, Mean ± SD	Control, Mean ± SD	ICC	Cluster-Adjusted Difference in Means (95% CI)
Total difficulties (n = 13 807)	11.5 ± 5.0	11.6 ± 5.0	0.02	−0.1 (−0.7 to 0.5)
Emotional symptoms (n = 13 811)	2.5 ± 2.0	2.7 ± 2.0	0.01	−0.1 (−0.3 to 0.1)
Conduct problems (n = 13 811)	1.6 ± 1.5	1.6 ± 1.5	0.01	0.0 (−0.1 to 0.1)
Hyperactivity (n = 13 814)	4.8 ± 2.3	4.7 ± 2.2	0.01	0.1 (−0.2 to 0.3)
Peer problems (n = 13 813)	2.5 ± 1.6	2.6 ± 1.6	0.03	0.0 (−0.2 to 0.2)
Prosocial behavior (13 814)	8.3 ± 1.7	8.3 ± 1.6	0.01	0.1 (−0.2 to 0.3)

according to treatment group; it shows the number of children whose parents completed the questions relating to each subscale, the crude individual-based mean ± SD in the experimental and control groups, the ICCs reflecting the degree of within-polyclinic clustering, and the cluster-adjusted differences in means and their 95% CIs. ICCs were very low (≤0.03), reflecting that the responses were provided independently by nearly 14 000 parents. Except for slightly lower scores on the emotional symptom scale among children in the experimental group, the means were extremely similar in the 2 randomly assigned groups, including scores on conduct problems, hyperactivity, peer problems, and prosocial behavior, as well as the total difficulties score. Analysis of dichotomized scores (≥85th percentile or, for prosocial behavior, ≤15th percentile) yielded adjusted ORs near 1, ranging from 0.9 (95% CI: 0.7–1.1) for emotional symptoms to 1.1 (95% CI: 0.9–1.2) for conduct problems. Similar proportions of parents in the experimental and control groups reported at least some difficulties on the global SDQ question (46.1% vs 45.4%; clustered-adjusted OR: 1.0; 95% CI: 0.7–1.5).

Table 3 shows the corresponding results for the teacher SDQ. Teacher SDQs were completed for ~87% of the children who were followed up; most of the remainder had not yet begun formal schooling at the time of the follow-up visit. The teachers' ratings were lower (less extreme) than the parents' ratings for all scales, including both problem and prosocial behaviors. None of the differences between the experimental and control groups was statistically significant, a result confirmed by analysis of dichotomized scores based on the 85th or 15th (for prosocial behavior) percentiles (adjusted ORs ranging from 0.9 [95% CI: 0.7–1.1] for emotional symptoms to 1.0 [95% CI: 0.8–1.4] for hyperactivity). Similar proportions of teachers reported at least some difficulties on the global SDQ question (43.1% vs 43.5% in the experimental versus control groups; cluster-adjusted OR: 0.9; 95% CI: 0.7–1.3).

We also combined the parents' and teachers' SDQ ratings to compare the proportion of children whose behavior was rated as "abnormal" (≥85th percentile, or ≤15th percentile for prosocial behavior) by both respondents. The proportion of children who fell into this category ranged from 4% for total difficulties to 8% for peer problems but were similar in the experimental and control groups. Cluster-adjusted ORs ranged from 0.8 (95% CI: 0.6–1.2) for prosocial behavior to 1.1 (95% CI: 0.8–1.6) for peer problems.

We found no consistent evidence that intervention effects differed by child gender, although a borderline significant reduction in emotional difficulties was observed among girls in the experimental group (cluster-adjusted difference: −0.2 [95% CI: −0.4 to −0.03] for both parent and teacher versions of the SDQ). Spearman (rank) correlations between the parent and teacher versions of the SDQ were modest, albeit highly statistically significant ($P < .0001$ for all): 0.19 for emotional symptoms, 0.29 for conduct problems, 0.36 for hyperactivity, 0.19 for peer problems, 0.28 for total difficulties, and 0.19 for prosocial behavior.

Results for the supplemental behavior questions were similar to those for the SDQ. The mean ± SD externalizing behavior scores based on the parents' ratings were 1.9 ± 1.7 vs 1.8 ± 1.6 in the experimental and control groups, respectively, with a clustered-adjusted difference of 0.1 (95% CI: −0.05 to 0.3). The corresponding results for the teachers' ratings were 3.5 ± 3.3 and 3.3 ± 3.3, respectively, in the experimental and control groups, with a clustered-adjusted difference of 0.2 (95% CI: −0.2 to 0.5). The internalizing behavior scores were 4.1 ± 2.7 vs 4.2 ± 2.7 (cluster-adjusted difference: 0.0 [95% CI: −0.3 to 0.2]) based on the parents' ratings and 2.0 ± 2.0 vs 2.0 ± 2.0 (cluster-adjusted difference: −0.1 [95%

TABLE 3 **Results for the Teacher SDQ**

SDQ Subscale	Experimental, Mean ± SD	Control, Mean ± SD	ICC	Cluster-Adjusted Difference in Means (95% CI)
Total difficulties (n = 12 028)	9.5 ± 5.8	9.7 ± 5.8	0.02	−0.5 (−1.1 to 0.1)
Emotional symptoms (n = 12 031)	1.9 ± 2.0	2.0 ± 1.9	0.01	−0.2 (−0.3 to 0.04)
Conduct problems (n = 12 032)	1.4 ± 1.7	1.4 ± 1.7	0.01	0.0 (−0.2 to 0.1)
Hyperactivity (n = 12 031)	3.9 ± 2.7	3.9 ± 2.6	0.01	−0.1 (−0.4 to 0.1)
Peer problems (n = 12 030)	2.3 ± 1.7	2.4 ± 1.7	0.03	−0.1 (−0.4 to 0.1)
Prosocial behavior (12 031)	7.5 ± 2.2	7.4 ± 2.2	0.02	0.1 (−0.2 to 0.5)

CI: −0.4 to 0.1]) based on the teachers' ratings. The parent and teacher ratings were modestly correlated (Spearman $\rho = 0.23$ [$P < .0001$] for externalizing behaviors and 0.20 [$P < .0001$] for internalizing behaviors).

A slightly higher proportion of the mothers in the experimental group were no longer married and living with the same partner that they had at the time of the birth of the index child (18.6% vs 16.1%), but the cluster-adjusted OR was not significantly elevated (1.2; 95% CI: 0.95–1.5). Neither were significant differences noted in the mother's satisfaction in her relationship with her current partner (mean ± SD: 4.8 ± 1.3 in both groups on 7-point scale; cluster-adjusted difference: 0.0; 95% CI: −0.3 to 0.3), with the index child (mean ± SD: 5.7 ± 1.2 vs 5.8 ± 1.3; cluster-adjusted difference: −0.3; 95% CI: −0.6 to 0.1), or with her general experience of motherhood (mean ± SD: 6.2 ± 1.2 vs 6.3 ± 1.2; cluster-adjusted difference: −0.2; 95% CI: −0.5 to 0.2).

Mothers in the experimental group breastfed their subsequent child ($n = 3323$) significantly longer than those in the control group. The means ± SD for any breastfeeding were 7.6 ± 6.4 vs 6.1 ± 5.9 months, respectively, with a cluster-adjusted difference of 1.5 (95% CI: 0.7–2.3). For exclusive breastfeeding, the corresponding results were 4.2 ± 3.3 vs 3.5 ± 3.2 months (cluster-adjusted difference: 0.7; 95% CI: 0.1–1.2). The proportions who exclusively breastfed their subsequent child for at least 3 months were 69.9% and 55.3%, respectively (cluster-adjusted OR: 1.9; 95% CI: 1.4–2.8).

DISCUSSION

Our results show no consistent and significant differences in behavioral strengths or difficulties in children who were cluster-randomized to a breastfeeding promotion intervention. Despite the substantial increase observed in both the duration and the exclusivity of breastfeeding in the experimental group,[12] that increase did not lead to any detectable reductions in emotional difficulties, hyperactivity, or conduct or peer problems or to improvement in prosocial behavior. Because breast milk in Belarus is provided almost exclusively via breastfeeding (<0.5% of PROBIT infants were receiving expressed breast milk at any of the follow-up visits during the first 12 months of life), the absence of any behavioral benefits does not support our hypothesized advantage of increased maternal–infant physical contact.

Although it would have been infeasible and unethical to randomly assign healthy mothers and infants to breastfeeding versus formula-feeding or to different degrees and durations of breastfeeding, it was both feasible and ethical to randomly assign them to receive or not to receive a breastfeeding promotion intervention. Because that intervention resulted in substantial increases in both the exclusivity (sevenfold higher at 3 months) and duration of breastfeeding,[12] our large sample size should have enabled us to detect modest differences in the child's behavior. Indeed, as previously reported, the intervention resulted in significant detectable reductions in gastrointestinal infection and atopic eczema,[12] as well as significant differences in growth trajectories,[23] during the first year of follow-up; however, because all PROBIT children were initially breastfed, our results cannot be generalized to long-term behavioral outcomes in infants who are breastfed versus those who are formula-fed; neither can they be extrapolated to behavioral outcomes later in childhood or adulthood.

In the consent that mothers gave to participate in this study, they were informed that the maternity hospital at which they had given birth and the affiliated polyclinic at which their child would be subsequently followed were participating in a study to compare 2 approaches to assist mothers in breastfeeding. Although mothers who received the additional support for breastfeeding offered at experimental maternity hospitals and polyclinics undoubtedly appreciated that support, most mothers were probably unaware whether their hospital and polyclinic had been randomly assigned to the experimental or control intervention; therefore, we have no reason to believe that study mothers would report biased assessments of their children's behavior. That we observed similar results for the teachers' blinded assessments reinforces the validity of those provided by the mothers, because the 4098 participating teachers were unaware of the children's participation in the study and had an average of only 3 or 4 PROBIT children in their class.

Correlations between the parents' and teachers' assessments of the children's behavior were only modest. This is consistent with previous reports on consistency of child behavior ratings across raters[24] and likely reflects a combination of factors, including the parents' greater familiarity with the child's behavior, the fact that the child's behavior may differ substantially at home and in school, and the larger size of the teachers' comparison group (accumulated experience with children of that age).

Our aim was to assess effects of prolonged and exclusive breastfeeding not on severe psychopathology but rather on behavioral functioning and adjustment as evaluated by parents and teachers. We reasoned that any behavioral advantages conferred by more exclusive or prolonged breastfeeding should have been evident by early school age, given the frequent contact with other children at school and play and the academic and behavioral demands of the school setting. We therefore did not carry out formal clinical evaluations of psychopathology in study children. In any case, it would have been infeasible to ensure the presence of a child psychiatrist or psychologist for nearly 14 000 child visits that occurred across the entire country, including many small towns and villages.

We found no evidence that the breastfeeding promotion intervention affected the mother's relationship with her partner or with her child nor her satisfaction with motherhood in general. We did, however, note a significant carryover effect on mothers' breastfeeding of the next-born child among those who gave birth to subsequent children, with longer duration of any breastfeeding and of exclusive breastfeeding. This significant carryover effect was observed despite our having provided a similar breastfeeding promotion training workshop at control maternity hospitals and polyclinics after the first

12 months of follow-up of all children who were enrolled in PROBIT. We have no information, however, on where these subsequent children were born or followed up or on change in maternity hospital or polyclinic practices after the training workshop at control sites. Nonetheless, this encouraging long-term result suggests that a successful breastfeeding experience with the previous child may encourage prolonged and exclusive breastfeeding of subsequent children.

ACKNOWLEDGMENTS

This research is funded by a grant from the Canadian Institutes of Health Research. Dr Fombonne holds a Canada Research Chair in Child Psychiatry. Dr Platt is a Monat-McPherson Career Investigator of McGill University and a career investigator (chercheur-boursier) of the Fonds de la recherche en santé du Québec.

REFERENCES

1. Golding J, Rogers IS, Emmett PM. Association between breast feeding, child development and behaviour. *Early Hum Dev.* 1997;49(suppl):S175–S184
2. Lucas A, James-Roberts I. Crying, fussing and colic behaviour in breast- and bottle-fed infants. *Early Hum Dev.* 1998;53(1):9–18
3. Lee K. Crying and behavior pattern in breast- and formula-fed infants. *Early Hum Dev.* 2000;58(2):133–140
4. Wolke D, Sobne B, Riegel K, Obrt B, Osterlund K. An epidemiologic longitudinal study of sleeping problems and feeding experience of preterm and term children in southern Finland: comparison with a southern German population sample. *J Pediatr.* 1998;133(2):224–231
5. Britton JR, Britton HL, Gronwaldt V. Breastfeeding, sensitivity, and attachment. *Pediatrics.* 2006;118(5). Available at: www.pediatrics.org/cgi/content/full/118/5/e1436
6. Barone JG, Ramasamy R, Farkas A, et al. Breastfeeding during infancy may protect against bed-wetting during childhood. *Pediatrics.* 2006;118(1):254–259
7. Hughes RN, Bushnell JA. Further relationships between IPAT Anxiety Scale performance and infantile feeding experiences. *J Clin Psychol.* 1977;33(3):698–700
8. Fergusson DM, Woodward LJ. Breast feeding and later psychosocial adjustment. *Paediatr Perinat Epidemiol.* 1999;13(2):144–157
9. Goodwin DW, Gabrielli WF, Penick EC, et al. Breast-feeding and alcoholism: the Trotter hypothesis. *Am J Psychiatry.* 1999;156(4):650–652
10. Leask SJ, Done DJ, Crow TJ, Richards M, Jones PB. No association between breast-feeding and adult psychosis in two national birth cohorts. *Br J Psychiatry.* 2000;177:218–221
11. Sørensen HJ, Mortensen EL, Reinisch JM, Mednick SA. Breastfeeding and risk of schizophrenia in the Copenhagen Perinatal Cohort. *Acta Psychiatr Scand.* 2005;112(1):26–29
12. Kramer MS, Chalmers B, Hodnett ED, et al. Promotion of breastfeeding intervention trial (PROBIT): a randomized trial in the Republic of Belarus. *JAMA.* 2001;285(4):413–420
13. WHO/UNICEF. *Protecting, Promoting and Supporting Breastfeeding: The Special Role of Maternity Services*. Geneva, Switzerland: World Health Organization; 1989
14. Campbell MK, Elbourne DR, Altman DG, CONSORT Group. CONSORT statement: extension to cluster randomised trials. *BMJ.* 2004;328(7441):702–708
15. Goodman R. The Strengths and Difficulties Questionnaire: a research note. *J Child Psychol Psychiatry.* 1997;38(5):581–586
16. Goodman R, Scott S. Comparing the Strengths and Difficulties Questionnaire and the Child Behavior Checklist: is small beautiful? *J Abnorm Child Psychol.* 1999;27(1):17–24
17. Goodman R, Renfrew D, Mullick M. Predicting type of psychiatric disorder from Strengths and Difficulties Questionnaire (SDQ) scores in child mental health clinics in London and Dhaka. *Eur Child Adolesc Psychiatry.* 2000;9(2):129–134
18. Smedje H, Broman JE, Hetta J, von Knorring AL. Psychometric properties of a Swedish version of the "Strengths and Difficulties Questionnaire." *Eur Child Adolesc Psychiatry.* 1999;8(2):63–70
19. Klasen H, Woerner W, Wolke D, et al. Comparing the German versions of the Strengths and Difficulties Questionnaire (SDQ-Deu) and the Child Behavior Checklist. *Eur Child Adolesc Psychiatry.* 2000;9(4):271–276
20. Koskelainen M, Sourander A, Kaljonen A. The Strengths and Difficulties Questionnaire among Finnish school-aged children and adolescents. *Eur Child Adolesc Psychiatry.* 2000;9(4):277–284
21. Statistics Canada. National Longitudinal Survey of Children & Youth. Available at: www.statcan.ca/english/survey/household/child/child.htm. Accessed January 21, 2008
22. Breslow NE, Clayton DG. Approximate inference in generalized linear mixed models. *J Am Stat Assoc.* 1993;88(421):9–25
23. Kramer MS, Guo T, Platt RW, et al. Breastfeeding and infant growth: biology or bias? *Pediatrics.* 2002;110(2 pt 1):343–347
24. Achenbach TM, McConaughy SH, Howell CT. Child/adolescent behavioral and emotional problems: implications of cross-informant correlations for situational specificity. *Psychol Bull.* 1987;101(2):213–232

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Pediatrics 2008;121;e435-e440
DOI: 10.1542/peds.2007-1248