RANDOMISED CONTROLLED TRIALS

Effects of promoting longer-term and exclusive breastfeeding on childhood eating attitudes: a cluster-randomized trial

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Abstract

Background: Observational studies suggest that breastfeeding benefits later maternal child-feeding practices, which in turn may contribute to positive eating attitudes. We investigated the effect of a randomized intervention to increase duration and exclusivity of breastfeeding on pre-adolescent eating attitudes.

Methods: Long-term follow-up of the Promotion of Breastfeeding Intervention Trial (PROBIT), a cluster-randomized trial in 31 maternity hospitals and affiliated polyclinics in Belarus. Sites were randomly assigned an experimental intervention to promote longer duration and exclusivity of breastfeeding in mothers who initiated breastfeeding (n = 16 sites), or a control intervention of continuing usual care (n = 15 sites); 17 046 healthy infants were enrolled in 1996–7, of whom 13 751 (80.7%) completed the Children’s Eating Attitude Test (ChEAT) at 11.5 years of age. A ChEAT score ≥22.5 (85th percentile) was used as an indicator of problematic eating attitudes. Analysis was based on intention-to-treat, accounting for clustering within hospitals/clinics.

Results: Compared with the control arm, the experimental intervention substantially increased breastfeeding exclusivity (43.3% vs 6.4% exclusively breastfed at 3 months of age) and duration of any breastfeeding throughout infancy. The proportion of children
with ChEAT scores $\geq 22.5$ was lower in the experimental than control arm (boys 11.4% vs 17.2%; girls 18.5% vs 23.4%) [cluster-adjusted odds ratio (OR), boys: 0.44; 95% confidence interval (CI): 0.21,0.93; girls: 0.51; 95% CI: 0.27,0.99). Results were robust to adjustment for potential confounders and using a ChEAT score $\geq 25.5$ (91st percentile) as the outcome (OR: 0.53; 95% CI: 0.28,1.03).

**Conclusions:** An intervention to improve the duration and exclusivity of breastfeeding among term infants in Belarus was associated with a reduction in problematic eating attitudes at 11.5 years of age.

**Key words:** Breastfeeding, problematic eating attitudes, cluster-randomized trial

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**Key Messages**

- We investigated the effect of a randomized intervention conducted in Belarus to increase duration and exclusivity of breastfeeding (Promotion of Breastfeeding Intervention Trial) on pre-adolescent eating attitudes, measured by the Children’s Eating Attitude Test (ChEAT).
- The intervention was associated with a reduction in the odds of developing problematic eating attitudes at 11.5 years.
- Our results support the hypothesis that early-life feeding exposures may modify the risk of abnormal eating attitudes and behaviours in later life.

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**Introduction**

The promotion of longer duration of exclusive breastfeeding confers long-term health and neurocognitive benefits for the offspring. Biological explanations focus on the nutritional composition of human milk and the physiological responses it elicits. However, behavioural factors may also be important, if breastfeeding influences the feeding practice of mothers and eating patterns of children. Mothers who breastfeed appear less controlling, allowing their children to make more independent eating decisions, perhaps engendered by initially learning to trust the infant to signal when he or she has had enough breastmilk. Children who were breastfed have been reported to be less likely to continue eating when full or to be picky eaters.

These potential influences of breastfeeding on later eating behaviours may have implications for a child’s health and well-being. Children (particularly girls) of more controlling mothers appear more prone to overeat in the absence of hunger or to snack when restricted foods are available. They report a restrained eating style that suppresses feelings of hunger, a characteristic associated with overeating, excess weight gain and unhealthy eating behaviours, and having negative emotions (sadness, guilt or shame) about eating. These features (overeating, restraint and negative self-evaluation) are apparent in childhood but are also features of disinhibited and binge eating seen in adolescence and young adulthood. However, both breastfeeding and maternal feeding restriction are strongly socioeconomically patterned in many settings, potentially biasing results from observational studies. The causal effects of breastfeeding, therefore, can best be investigated in a large randomized controlled trial. We examined the relationship of breastfeeding with eating attitudes in the Promotion of Breastfeeding Intervention Trial (PROBIT), a cluster-randomized controlled trial among 17 046 children in the Republic of Belarus. The randomized intervention produced two groups with a similar distribution of potential confounding factors at baseline but substantially increased the duration and exclusivity of breastfeeding, providing a unique opportunity to test (in an experimental setting) whether breastfeeding causally influences long-term eating attitudes. We hypothesized that children with more prolonged and exclusive breastfeeding would be less likely to exhibit problematic eating attitudes, such as weight or food preoccupation, food restraint, attempts at dieting or purging, or feelings of pressure from others about eating.
Methods

Subjects

A detailed description of PROBIT has been published.\(^2\) Briefly, the clusters were maternity hospitals and one affiliated polyclinic per hospital. These units were randomized to a usual care control group (continuation of breastfeeding practices in effect at the time of randomization) or the experimental intervention, based on the Baby-Friendly Hospital Initiative developed by the World Health Organization (WHO) and United Nations Children’s Fund (UNICEF), to promote and support breastfeeding.\(^3\) The trial enrolled 17,046 infants born in 1996–7 from 31 maternity hospitals/polyclinics (16 intervention and 15 control sites). Trial inclusion criteria required infants to be healthy singletons born at ≥37 weeks, with birthweight ≥2500 g and Apgar score ≥5 at 5 min, whose mothers initiated breastfeeding and had no illness that would interfere with breastfeeding. Over 95% of mothers in the maternity hospitals chose to initiate breastfeeding, most of whom consented to participate in the trial. At 1, 2, 3, 6, 9 and 12 months, polyclinic paediatricians completed a form containing detailed information about infant feeding; an audit of the validity of the infant feeding data showed that chance-corrected agreement was high (Kappa >0.9) and that there was no difference in degree of over-reporting or under-reporting according to intervention vs control status.

As previously reported, the randomization produced two groups with similar distributions of baseline sociodemographic and clinical factors, and the intervention substantially increased breastfeeding duration and exclusivity. Infants were seven times more likely to be exclusively breastfed at 3 months vs the control group (43.3% vs 6.4%) and were breastfed to any degree at a higher rate throughout infancy, although at 6 months, exclusive (7.9% vs 0.6%) and predominant breastfeeding (10.6% vs 1.6%) were low in both groups.\(^2\) During follow-up in the first 12 months of life (PROBIT I), the differences in duration and exclusivity of breastfeeding produced appreciable reductions in risk of one or more gastrointestinal tract infections [9.1% vs 13.2%, odds ratio (OR): 0.60; 95% confidence interval (CI): 0.40,0.91] and atopic eczema (3.3% vs 6.3%; OR: 0.60; 95% CI: 0.39,0.95), the primary outcomes and atopic eczema (3.3% vs 6.3%; OR: 0.60; 95% CI: 0.39,0.95).\(^2\) The study protocol stipulated that children should be asked to complete the questionnaire without interference from either parents or the paediatricians and these instructions were reinforced to paediatricians at 6-monthly training workshops. The ChEAT assesses problematic eating attitudes, including food preoccupation, pressure from others about eating, weight and body image, dieting, purging and restriction of food intake. The ChEAT score is strongly correlated with other validated measures of disturbed eating and psychopathology, including the Eating Disorder Examination Adapted for Children, the Body Esteem Scale, the Revised Eating Disorder Inventory-Body Dissatisfaction Subscale, the Rosenberg Self Esteem Scale and Child Depression Inventory.\(^3\) We translated the ChEAT questionnaire into Russian and then back-translated it to English to verify meaning; we are not aware of any validation studies in Belarus or other Russian-speaking populations.

Based on the observation of Maloney et al.\(^3\) that one question (‘I can show self-control around food’) was inversely correlated with the other questionnaire items, we administered 25 questions only. To simplify the response categories for the Belarusian children who were not familiar with questionnaires, we adapted the original 6-item Likert scale to a 3-item scale: ‘often’, ‘sometimes’ and ‘never’. In preliminary factor analyses, another question (‘I enjoy trying new rich foods’) was inversely correlated with the total ChEAT score, and was thus removed from our analysis, which was therefore based on the 24-item form of ChEAT-26. We scored the responses as 3 (‘often’), 1.5 (‘sometimes’) and 0 (‘never’) to give a range of 0–72, similar to the range (0–78) from ChEAT-26.\(^4\)

Previous studies have used ChEAT scores ranging between the 75th and 91st percentiles as thresholds suggestive of problematic eating attitudes in children aged between 6 and 14 years.\(^2\)–\(^4\),\(^6\)–\(^8\) We defined our primary outcome as a ChEAT-24 score ≥85th percentile in our data (≥22.5), because lower thresholds generate more false positives, especially in younger children.\(^9\) In a sensitivity analysis, we investigated associations using a

11.5-year follow-up

Between January 2008 and December 2010, when children were a median age of 11.5 years, they were again followed up at dedicated research visits by 39 specially trained paediatricians at the 31 polyclinics (PROBIT III). Training and quality assurance procedures have been previously described,\(^2\) and null effects of the intervention on adiposity at 11.5 years have been published.\(^3\)

Eating attitudes

At the PROBIT III visit, children self-completed a modified version of the Children’s Eating Attitudes Test (ChEAT), a 26-item questionnaire that assesses a variety of eating attitudes and behaviours on a Likert scale, ranging from 1 (always) to 6 (never).\(^4\) The study protocol stipulated that children should be asked to complete the questionnaire without interference from either parents or the paediatricians and these instructions were reinforced to paediatricians at 6-monthly training workshops. The ChEAT assesses problematic eating attitudes, including food preoccupation, pressure from others about eating, weight and body image, dieting, purging and restriction of food intake. The ChEAT score is strongly correlated with other validated measures of disturbed eating and psychopathology, including the Eating Disorder Examination Adapted for Children, the Body Esteem Scale, the Revised Eating Disorder Inventory-Body Dissatisfaction Subscale, the Rosenberg Self Esteem Scale and Child Depression Inventory.\(^3\) We translated the ChEAT questionnaire into Russian and then back-translated it to English to verify meaning; we are not aware of any validation studies in Belarus or other Russian-speaking populations.

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ChEAT-24 score ≥91st percentile (≥25.5). The ChEAT-24 scores were positively skewed and had a bimodal distribution, because 10% of children had a total score of 0 (i.e. answered ‘never’ to all 24 questions) (Supplementary Figure 1, available as Supplementary data at IJE online). In line with all other identified studies using ChEAT, therefore, we modelled ChEAT as a dichotomous outcome.

Audit
As blinding of paediatricians to the intervention/control group assignment was not feasible, Minsk-based collaborators conducted a blinded re-measurement audit to assess the validity and reproducibility of the polyclinic data on 141 randomly selected children representing all 39 paediatricians. We assessed reproducibility as the percent agreement beyond chance (Cohen’s kappa) for ChEAT score ≥85th percentile at the original vs audit visit.

Ethics
PROBIT III was approved by the Belarusian Ministry of Health and received ethics approval from the McGill University Health Centre Research Ethics Board; the Institutional Review Board at Harvard Pilgrim Health Care; and the Avon Longitudinal Study of Parents and Children Law and Ethics Committee. A parent or legal guardian provided written consent in Russian at enrolment and at the 11.5-year follow-up visit, and children provided written assent.

PROBIT is registered with Current Controlled Trials (http://www.controlled-trials.com/) as ISRCTN-37687716 and with http://www.clinicaltrials.gov/ as NCT01561612, and conforms to CONSORT recommendations for the design, analysis and reporting of cluster-randomized trials.

Statistical analysis
To assess how each question contributed to the ChEAT score variance, we conducted a principal components analysis to verify the factor structure of ChEAT-24 compared with a previous study using a 25-item, 6-point Likert scale. We computed intra-class correlation coefficients (ICC) and graphed box-and-whisker plots by polyclinic to detect potential non-independence of clusters (Supplementary Figure 2, available as Supplementary data at IJE online). Polyclinic site ‘L’, an intervention site, was a clear outlier where 76% of the 928 respondents answered ‘never’ to all 24 items of the ChEAT questionnaire and just 2.3% of individuals scored ≥22.5. In a sensitivity analysis, we excluded site ‘L’ to determine its influence on the results.

We analysed the effect of the breastfeeding intervention on ChEAT scores ≥22.5 (≥25.5 in a sensitivity analysis) using an intention-to-treat (ITT) approach. We accounted for possible clustering within policlinics by employing mixed logistic regression models using the ‘xtmelogit’ command in STATA, which permits inference at the individual level within clusters. We also investigated the impact of adjustment for potential confounders: location of the hospital/polyclinic (urban vs rural and West vs East Belarus); child variables (age at administration of ChEAT, sex and birthweight); and family variables (mother’s age at child’s birth, maternal and paternal education, number of older siblings and maternal smoking during pregnancy). Body mass index (BMI) at 11.5 years was positively associated with having a ChEAT score ≥85th percentile in this cohort, but we did not adjust for BMI, which should not be considered a confounding variable as it was measured after randomization; in any case, BMI at ages 6.5 and 11.5 years was not associated with the intervention. In a sub-analysis, we computed the odds of having a ChEAT score ≥85th percentile within each of the individual ChEAT sub-factors obtained in the factor analysis, comparing intervention vs control arms.

We also conducted observational analyses (disregarding randomization status), in which we estimated the effects of the duration of any breastfeeding and exclusive breastfeeding on the same outcomes, employing mixed logistic regression models and adjusting for the same potential confounders described above. Duration of any breastfeeding was classified as <3 months (reference), 3–<6 months, 6–<9 months, 9–<12 months and ≥12 months. Duration of exclusive breastfeeding was defined as <3 months, 3–<6 months and ≥6 months.

All analyses used STATA version 11 (Stata Corp, TX).

Results
Of the 17 046 infants originally enrolled in the trial, 13 879 children (81.4%) were seen at a median age of 11.5 years (interquartile range: 11.3–11.8 years) (Supplementary Figure 3, available as Supplementary data at IJE online). Of these, 13 751 (99.1%) had complete and usable ChEAT-24 data. Those without ChEAT data involved 3167 who did not attend the follow-up, of whom 97 had died and 128 attended but did not answer the ChEAT questionnaire. Follow-up rates were similar in the experimental (82.9%) and control (78.2%) groups but varied by polyclinic (47.5% to 97.6%). Included children in the experimental and control groups had similar baseline characteristics, with small differences paralleling those seen (and previously reported) at randomization (Table 1). For 141 children, initial ChEAT scores were compared with a repeated audit at an average of 1.3 years (range 0.2 to 2.4) after the first clinic visit: percentage agreement for the
Table 1. Baseline characteristics of 13751 children at age 11.5 years, PROBIT (% unless stated)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Experimental arm (N=7352, 16 clusters)</th>
<th>Control arm (N=6399, 15 clusters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean birthweight, g (SD)</td>
<td>3443 (418)</td>
<td>3443 (423)</td>
</tr>
<tr>
<td>Age of mother at birth, years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;20</td>
<td>13.9</td>
<td>13.0</td>
</tr>
<tr>
<td>20-34</td>
<td>81.8</td>
<td>82.9</td>
</tr>
<tr>
<td>≥35</td>
<td>4.3</td>
<td>4.1</td>
</tr>
<tr>
<td>Other children living in household</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>59.0</td>
<td>54.5</td>
</tr>
<tr>
<td>1</td>
<td>33.3</td>
<td>36.4</td>
</tr>
<tr>
<td>≥2</td>
<td>7.7</td>
<td>9.1</td>
</tr>
<tr>
<td>Smoking during pregnancy</td>
<td>2.5</td>
<td>1.6</td>
</tr>
<tr>
<td>Male child</td>
<td>50.9</td>
<td>51.9</td>
</tr>
<tr>
<td>Urban (vs rural)*</td>
<td>65.1</td>
<td>49.4</td>
</tr>
<tr>
<td>West Belarus (vs East)*</td>
<td>51.3</td>
<td>53.9</td>
</tr>
<tr>
<td>Maternal education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incomplete secondary</td>
<td>4.2</td>
<td>2.8</td>
</tr>
<tr>
<td>Complete secondary</td>
<td>33.6</td>
<td>29.1</td>
</tr>
<tr>
<td>Advanced secondary or partial university</td>
<td>48.1</td>
<td>55.1</td>
</tr>
<tr>
<td>Complete university</td>
<td>14.1</td>
<td>12.9</td>
</tr>
<tr>
<td>Paternal education*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incomplete secondary</td>
<td>2.5</td>
<td>1.9</td>
</tr>
<tr>
<td>Complete secondary</td>
<td>40.9</td>
<td>32.7</td>
</tr>
<tr>
<td>Advanced secondary or partial university</td>
<td>42.8</td>
<td>53.0</td>
</tr>
<tr>
<td>Complete university</td>
<td>13.8</td>
<td>12.5</td>
</tr>
</tbody>
</table>

SD, standard deviation,
*312 experimental and 6399 control arm.
*7319 experimental and 6177 control arm.

The proportion ≥85th percentile was 85.1%, and Cohen’s kappa for chance-corrected agreement was 0.46 (95% CI: 0.30,0.63), indicating moderate test-retest reproducibility.

Factor analysis yielded six ChEAT-24 factors that accounted for 51.4% of the variance (Supplementary Table 1, available as Supplementary data at IJE online). These factors are similar to those previously reported for the ChEAT-26.34 Cronbach’s alpha for internal consistency was +0.81 for girls and +0.79 for boys.

The proportions of children in the intervention vs control sites with a ChEAT score ≥85th percentile were 14.9% and 20.2%, respectively (Table 2) [note that as the ChEAT score takes integers and values can cluster, the threshold for the 85th percentile actually contains 17.3% (2382/13 751) of individuals with scores ≥22.5]. The ICC was 0.22 overall, indicating a high degree of within-polyclinic clustering of responses. The cluster-adjusted OR indicated a decrease in the odds of problematic eating attitudes, comparing intervention vs control arms (OR: 0.47; 95% CI: 0.24,0.95). There was some statistical evidence that the effect of the breastfeeding intervention on ChEAT scores differed in boys compared with girls (P for interaction = 0.03), although the direction of effect was the same (OR in boys: 0.44; 95% CI: 0.21, 0.93; and OR in girls: 0.51; 95% CI: 0.27, 0.99).

Results did not differ after adjusting for potential confounders. Using a ChEAT score ≥91st percentile, to provide a more specific outcome measure, the cluster-adjusted OR was similar to that found using the 85th percentile threshold (OR in boys: 0.50; 95% CI: 0.27, 0.96; OR in girls: 0.58; 95% CI: 0.31, 1.02)(Supplementary Table 2, available as Supplementary data at IJE online). Exclusion of the outlier polyclinic ‘L’ minimally changed the ICC (0.21) and only slightly attenuated the effect of the breastfeeding promotion intervention on ChEAT scores ≥85th percentile (OR in boys: 0.49; 95% CI: 0.24, 1.02; OR in girls: 0.58; 95% CI: 0.31, 1.09) (Supplementary Table 3, available as Supplementary data at IJE online).

The effect of the intervention on individual ChEAT subfactors is shown in Table 3. Compared with the control group, the intervention was inversely associated with weight preoccupation in boys, purging and vomiting after eating among girls and pressure from others and a tendency towards dieting behaviours in both boys and girls. The intervention had no notable effect on the percentage of individuals who reported having food preoccupation or restriction and control of food intake.

Table 4 shows associations of breastfeeding duration and exclusivity with the ChEAT score, irrespective of randomized treatment allocation. There was no statistical evidence that associations of breastfeeding duration (P for interaction = 0.8) and exclusivity (P for interaction = 0.6) with ChEAT scores differed in boys compared with girls, so the overall effect estimates are shown. The proportion of children with ChEAT scores ≥22.5 decreased as the duration of any breastfeeding increased, from 19.0% in children breastfed for less than 3 months, to 14.9% in children breastfed for at least 12 months. Similar decreases were...
observed as the duration of exclusive breastfeeding increased. However, statistical evidence of a dose-response relationship was weak (\( P \) for trend = 0.12 for any breastfeeding and 0.54 for exclusive breastfeeding).

### Discussion

Based on the largest randomized trial ever conducted in the area of human lactation, our results suggest that an intervention to promote breastfeeding reduced the prevalence of problematic eating attitudes among the children at age 11.5 years, as measured by the ChEAT questionnaire. The effect estimates were imprecise, however, and the findings require replication in well-designed prospective studies before firm conclusions about the magnitude of the effect can be drawn. If our results are confirmed, the observed effect could be of public health importance, given the widespread implementation of similar breastfeeding promotion interventions and the prevalence of problematic/disordered eating attitudes in children and adolescents (as high as 20% in school-based samples).\(^\text{14–26}\)

Several mechanisms may explain how the breastfeeding intervention may have reduced later problematic eating attitudes in the children. Mothers’ breast milk, which carries the changing flavours of the maternal diet, may facilitate early flavour learning and positive weaning experiences,\(^\text{41}\) potentially contributing to increased willingness to try new foods in infancy\(^\text{42}\) and healthier diets\(^\text{12}\) and lower food aversion in later life.\(^\text{43}\) Also important may be enhanced mother-child bonding, maternal feeding styles shaped by the breastfeeding intervention, and feeding interactions that are sensitive to hunger and satiety cues that allow infants to learn to self-regulate intake.\(^\text{8–10}\) Given the high levels of comorbidity of eating disorders with other psychopathology,\(^\text{44}\) it is possible that breastfeeding’s beneficial effect is on factors (for example, cognitive

### Table 3. Difference in individual ChEAT sub-factors between experimental vs control groups

<table>
<thead>
<tr>
<th>Factor</th>
<th>N (%) of individuals with ChEAT scores ≥ 22.5</th>
<th>OR boys (95% CI)</th>
<th>OR girls (95% CI)</th>
<th>OR overall (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Experimental</td>
<td>Control</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Weight preoccupation</td>
<td>326 (8.7)</td>
<td>624 (17.3)</td>
<td>434 (13.0)</td>
<td>678 (22.1)</td>
</tr>
<tr>
<td>Pressure from others</td>
<td>428 (11.4)</td>
<td>494 (13.7)</td>
<td>541 (16.2)</td>
<td>599 (19.5)</td>
</tr>
<tr>
<td>Restriction and control</td>
<td>541 (14.5)</td>
<td>545 (15.1)</td>
<td>506 (15.2)</td>
<td>470 (15.3)</td>
</tr>
<tr>
<td>Food preoccupation</td>
<td>507 (13.5)</td>
<td>485 (13.5)</td>
<td>563 (16.9)</td>
<td>507 (16.5)</td>
</tr>
<tr>
<td>Dieting</td>
<td>405 (10.8)</td>
<td>494 (13.7)</td>
<td>581 (17.4)</td>
<td>582 (19.0)</td>
</tr>
<tr>
<td>Purging and vomiting</td>
<td>519 (13.9)</td>
<td>499 (13.8)</td>
<td>530 (15.9)</td>
<td>514 (16.8)</td>
</tr>
</tbody>
</table>

CI, confidence interval; OR, cluster-adjusted odds ratios.

### Table 4. Observational associations of duration and exclusivity of breastfeeding with ChEAT ≥ 22.5

<table>
<thead>
<tr>
<th>Exposure</th>
<th>N (%) with ChEAT score ≥ 22.5</th>
<th>Cluster-adjusted odds ratio (95% CI)</th>
<th>Fully adjusted odds ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration of any breastfeeding</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;3 months (( n = 4512 ))</td>
<td>856 (19.0)</td>
<td>1.00 (referent)</td>
<td>1.00 (referent)</td>
</tr>
<tr>
<td>3–&lt;6 months (( n = 3077 ))</td>
<td>547 (17.8)</td>
<td>1.00 (0.88, 1.13)</td>
<td>1.00 (0.88, 1.13)</td>
</tr>
<tr>
<td>6–&lt;9 months (( n = 1751 ))</td>
<td>289 (16.5)</td>
<td>0.93 (0.80, 1.09)</td>
<td>0.93 (0.79, 1.08)</td>
</tr>
<tr>
<td>9–&lt;12 months (( n = 1020 ))</td>
<td>171 (16.8)</td>
<td>1.00 (0.83, 1.21)</td>
<td>1.00 (0.83, 1.21)</td>
</tr>
<tr>
<td>≥12 months (( n = 2849 ))</td>
<td>423 (14.9)</td>
<td>0.88 (0.77, 1.01)</td>
<td>0.89 (0.78, 1.02)</td>
</tr>
<tr>
<td>( P ) for trend</td>
<td>0.10</td>
<td></td>
<td>0.12</td>
</tr>
<tr>
<td>Duration of exclusive breastfeeding</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;3 months (( n = 9552 ))</td>
<td>1750 (18.3)</td>
<td>1.00 (referent)</td>
<td>1.00 (referent)</td>
</tr>
<tr>
<td>3–&lt;6 months (( n = 3128 ))</td>
<td>457 (14.6)</td>
<td>0.96 (0.84, 1.10)</td>
<td>0.96 (0.84, 1.10)</td>
</tr>
<tr>
<td>≥6 months (( n = 516 ))</td>
<td>77 (14.9)</td>
<td>0.96 (0.73, 1.27)</td>
<td>0.95 (0.72, 1.26)</td>
</tr>
<tr>
<td>( P ) for trend</td>
<td>0.56</td>
<td></td>
<td>0.54</td>
</tr>
</tbody>
</table>

CI, confidence interval.

\(^{\text{a}}\)Adjusted for: hospital/polyclinic location (urban or rural, and West or East Belarus); child’s age at the measurement of ChEAT, sex, birthweight; and mother’s age at the child’s birth, maternal and paternal education, number of older children in household and maternal smoking during pregnancy (yes or no).
development) that may underlie a range of different forms of psychopathology. It is unlikely that the effect of breastfeeding on eating attitudes was related to weight regulation, as no effect of the intervention was observed on risk of childhood adiposity at age 6.5 or 11.5 years.

Analysis of the effects of the intervention on ChEAT sub-scales provides suggestive evidence that the protective effect of breastfeeding on problematic eating attitudes may be driven by reductions in dieting and feeding pressure from others in both boys and girls, and in weight preoccupation in boys and purging and vomiting after eating among girls, rather than restriction and control behaviours. However, these are sub-analyses which require independent confirmation.

A ChEAT score ≥85th percentile is an indicator of problematic eating, rather than being diagnostic of eating disorders. The prognostic value of the ChEAT questionnaire is uncertain, although alternative measures of problematic eating attitudes in early life are associated with an increased risk of the future development of eating disorders. For example, children aged 1–10 years with eating conflicts and struggles with food, as assessed by maternal interview, had a 6-to 7-fold increased risk of being diagnosed with anorexia nervosa in adolescence and young adulthood.

The children in our study responded to each ChEAT question on a 3-point, rather than the original 6-point, Likert scale, which could lead to less precise measurement of eating attitudes. However, factor analysis for our ChEAT results yielded factors comparable to those obtained in previous studies. In addition, as one question was negatively correlated with the ChEAT questionnaire and therefore removed from the analyses, the current distribution of ChEAT data is not fully comparable to previous studies that have used the ChEAT with a varying number of questions. A potential advantage of the age range we studied is that children may be less likely to conceal their eating attitudes than later in adolescence. Sensitivity analysis, using a higher threshold for problematic eating which may be more specific (the 91st percentile), produced similar results to those observed at the 85th percentile.

There was substantial clustering of ChEAT scores within polyclinics (ICC = 0.22). The ChEAT outcome was based on individually completed questionnaires, and training was provided to minimize differences in test administration; it is therefore unlikely that clustering is related to differences in measurement technique of the paediatricians. The high ICC could be due to the sharing of eating attitudes among similar-aged children living in the same community, many of whom attend the same schools. Whereas bias due to non-blinding of the children from the intervention vs control sites is possible, the likelihood seems low, as eating attitudes were not a primary hypothesis of the study. In addition, although the paediatricians were not blinded, it is unlikely that the paediatrician influenced the ChEAT completion. If the paediatricians’ knowledge of the intervention arm did affect how they assessed the children, then we would expect to see associations with other outcomes under their influence, such as measures of adiposity and blood pressure at 6.5 and 11.5 years and asthma, eczema or other atopy measures at 6.5 years; however, no such associations were apparent.

The estimated magnitude of the observational effect was smaller than the difference between the experimental groups. Thus, even though the treatment difference appears causal, the inconsistency between the observational and experimental (ITT) point estimates suggests possible overestimation of the treatment effect. It is also possible that the experimental intervention had other effects influencing the risk of problematic eating attitudes, in addition to increasing exposure to longer duration of exclusive breastfeeding. For example, the Baby-Friendly Hospital Initiative also encourages enhanced mother-child bonding and increased maternal awareness of child feeding behaviours, and provides postnatal support beyond breastfeeding initiation. Therefore, differences between the intervention and control groups may be due to a range of more general effects of the intervention on parental feeding practices and the parent-child relationship. Although different in many socioeconomic, cultural and economic respects from North America and Western Europe, Belarus is a relatively developed country with strict hygienic standards, high immunization rates, low incidence of infection, low rates of infant and child mortality, similar types of formula feeds and accessible healthcare services. Our results, however, may not generalize to settings with cultural attitudes to eating that differ from those in Belarus.

The major strengths of our trial are the randomized treatment allocation resulting in equal distribution of measured and unmeasured confounders, large sample size and high follow-up rate at 11.5 years, thus increasing the likelihood that differences in outcome between experimental and control groups are causally related to the intervention. It should be emphasized that the breastfeeding promotion intervention was designed to increase the duration and exclusivity of breastfeeding, not to increase its initiation (initiation was an inclusion criterion). Our findings may not, therefore, apply to comparisons of initiating breastfeeding vs exclusive formula feeding.

**Conclusion**

Our intervention to promote longer duration of exclusive breastfeeding reduced the odds of developing problematic eating...
eating attitudes in early adolescence, supporting our hypothesis that early-life feeding exposures may modify the risk of abnormal eating attitudes and behaviours later in life. PROBIT has shown beneficial effects of promoting increased duration and exclusivity of breastfeeding on gastrointestinal infections and atopy in infancy, child cognitive development, and now problematic eating attitudes. Our findings should further encourage public health efforts to promote, protect and support increased breastfeeding duration and exclusivity.

**Supplementary Data**

Supplementary data are available at IJE online.

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R.M.M., M.S.K., E.O., O.S., M.W.G. and G.D.S. designed the research. R.P., N.B. and B.S. coordinated the fieldwork under the supervision of O.S., R.M.M., E.O., M.S.K. and K.V. K.H.W. and R.C.R. performed the statistical analysis. K.H.W., R.C.R. and R.M.M. wrote the first draft of the paper, had full access to all the data in the study and take primary responsibility for the integrity of the data, accuracy of the analysis and final content. K.H.W., R.C.R. and R.M.M. act as the guarantors of the paper and vouch for its validity. R.M.M. confirmed references for completeness and accuracy. All authors critically commented on and approved the final submitted version of the paper.

**Conflict of interest:** R.M.M., E.O. and M.S.K. have given invited talks for Nestle Nutrition Institute. No other authors declare a conflict of interest.

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