

## ORIGINAL ARTICLE

# Premature birth did not have a pronounced impact on eating behaviour of four-year-old children, but some effects were observed in girls

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## Abstract

**Aim:** Feeding of preterm-born children has been extensively studied during infancy. Few studies have focused on later life but the available data indicate that feeding problems may persist after infancy. We studied this topic using two cohorts of full-term and preterm-born children.

**Methods:** The Children's Eating Difficulties Questionnaire was used to assess the appetite, food enjoyment, pickiness and neophobia, the fear of new foods, of 347 four-year-old children born in 2009–2011. Of these, 179 (52% boys) were born preterm at 24 to 36 weeks and recruited from paediatric clinics in southeast Sweden. The 168 children (54% boys) born full-term were recruited from a maternity health clinic in the same region. The parents graded 12 statements about their child's eating behaviour from very false to very true.

**Results:** A low gestational age at birth was associated with less reported appetite in girls. Estimates describing appetite and food enjoyment correlated with gestational age at birth in girls but not in boys. This difference between boys and girls was significant ( $p < 0.05$ ).

**Conclusion:** Prematurity had no major effects on food-related behaviour in four-year-old children. However, some estimates of reduced appetite and food enjoyment were associated with lower gestational age at birth in girls but not in boys.

## KEYWORDS

Appetite, eating behaviour, food enjoyment, preterm birth, sex differences

## 1 | INTRODUCTION

Issues related to feeding preterm-born infants during the first few months of life have attracted interest for a long time.<sup>1</sup> This topic has not been studied as much in older children but relevant studies have produced conflicting findings. Johnson et al.<sup>2</sup> found that children born from 32 to 36 weeks of gestation had an increased risk of eating problems at 2 years of age but these problems tended to

be mediated by various neurobehavioral conditions. Nieuwenhuis et al.<sup>3</sup> reported that children born preterm and at full-term had a similar prevalence of feeding problems at 3 years of age. However, the parents of preterm-born children sometimes encounter various problems related to feeding of their offspring. For example, Cerro et al.<sup>4</sup> found that the parents of toddlers born preterm reported that their children were poor feeders more often than the parents of toddlers born at term. Sanchez et al.<sup>5</sup> studied three-year-old boys and

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girls, born before 30 completed weeks of gestation and found no difference between preterm and term-born children with respect to behavioural feeding outcomes. However, the parents of preterm children did express more concern about feeding their children than the parents of children born at term. Therefore, the authors suggested that either the parents of preterm children had persistent concerns that were unfounded, or these children's early feeding issues had not been entirely resolved.<sup>5</sup> Lapillonne et al.<sup>6</sup> reviewed the appropriate literature and we agree with their conclusion that the risk for long-term feeding problems in children born moderately preterm required further study.

Migraine et al.<sup>7</sup> studied the effect of preterm birth on eating behaviour at 2 years of age using The Children's Eating Difficulties Questionnaire, a tool that was developed and validated by Rigal et al.<sup>8</sup> After adjustment for maternal and neonatal characteristics their results did not indicate that prematurity was associated with impaired eating behaviour but female sex was associated with eating difficulties.<sup>7</sup> We have previously reported the size and body composition of four-year-old preterm-born children and compared them to term-born controls.<sup>9</sup> Those who were born prematurely were lighter and shorter and had less fat and fat-free mass than those born full-term. Furthermore, the gestational age at birth in the preterm group was correlated with height, weight, body mass index, fat mass in kilogram and in percent, fat mass index and with fat-free mass in kilogram in girls but not in boys.<sup>9</sup>

The aim of this study was to gather additional knowledge about the feeding problems of four-year-old boys and girls born preterm. The Children's Eating Difficulties Questionnaire was applied to children who had participated in two of our previously reported studies.<sup>9,10</sup>

## 2 | MATERIALS AND METHODS

### 2.1 | Design

We studied one group of term-born children, and one group of preterm-born children, who were all born 2009 to 2011. When the children were 4 years old their parents took them to a session where body composition and eating behaviour were studied. The body composition data have already been published<sup>9,10</sup> and this paper reports the eating behaviour results that were obtained at the same time. The parents received written and oral information about the study two to 3 months before the planned measurements session. All the children who were recruited were reasonably healthy, without malformations or serious handicaps. At the measurement session, the parents confirmed that their children were healthy without malformation that influenced their ability to eat and digest food.

### 2.2 | Subjects

The full-term group comprised 177 children who were the offspring of pregnant women who were recruited when they visited

### Key notes

- This Swedish study examined whether feeding problems persisted after infancy in children born preterm, by comparing them with a full-term cohort.
- Appetite, food enjoyment, pickiness and neophobia, fear of new foods, were assessed when the children were 4 years of age.
- Prematurity had no major effects on eating behaviour, but some estimates of reduced appetite and food enjoyment were associated with lower gestational age at birth in girls.

a maternity health clinic in Östergötland, Sweden from 2008 to 2010.<sup>11</sup> The body composition of these children was studied when they were 1, 12 weeks and 4 years of age.<sup>10</sup> The parents of nine children failed to fill in the questionnaire satisfactorily and 168 full-term children (54% boys) were included in the present study.

The 188 preterm-born four-year-old children were recruited using hospital records during 2013 to 2015 from paediatric clinics in southeast Sweden. These served the populations in Östergötland and Småland.<sup>9</sup> The parents of nine singletons failed to fill in the questionnaire satisfactorily and thus 179 children (52% boys), born at 24 to 36 weeks of gestation, were included in the present study. These children were divided into early preterm if they were born before 32 weeks of gestation and late preterm if they were born between 32 and 37 weeks.

### 2.3 | The children's eating difficulties questionnaire<sup>7</sup>

The questionnaire assessed four basic dimensions of eating behaviour: appetite, food enjoyment, pickiness and neophobia, which is the fear of new foods. Each dimension included three statements (Table 1). Parents provided a response to each of the 12 statements using a five-point scale ranging from one point for very false to five points for very true. This questionnaire was developed and validated with the French mothers of children aged 20–36 months.<sup>8</sup> It was translated into Swedish and some of the statements were rephrased to make sure that a high score always indicated a more pronounced eating problem than a low score. These modified statements were: appetite statement one, food enjoyment statements one to three, pickiness statement three and neophobia statement one. The questionnaire was completed by the parents who brought the children to the measurement sessions.

### 2.4 | Statistics

The values provided are means and standard deviations. The effect of length of gestation at birth, namely early preterm, late preterm

TABLE 1 The children's eating difficulties questionnaire<sup>a</sup>

Appetite	
Statement 1	My child eats small quantities (even if the food is liked).
Statement 2	My child has a poor appetite.
Statement 3	My child is a small eater (whatever is served).
Food enjoyment	
Statement 1	My child lacks interest in food.
Statement 2	My child does not enjoy eating.
Statement 3	My child does not look forward to mealtimes.
Pickiness	
Statement 1	My child eats only a small variety of foods.
Statement 2	My child loves some foods but vigorously refuses others.
Statement 3	My child accepts only a small variety of vegetables.
Neophobia	
Statement 1	My child's spontaneous reaction is to refuse when a novel food is offered.
Statement 2	My child pulls a face when offered a novel food.
Statement 3	My child refuses new foods on merely seeing them.

<sup>a</sup>For each statement, parents assigned a score from very false (one) to very true (five), which corresponded best to the behaviour of their child.

or full-term, was studied in relation to the response to each of the 12 statements. This was carried out using analysis of covariance followed by Tukey's test, and the covariates were the age at measurement and the z-score for birthweight. Scores representing the parents' response to each of the 12 statements were regressed on their offspring's gestational age at birth. This was carried out using multiple regression analysis to identify partial correlations adjusted for age at measurement and z-score for birthweight. Significant differences between the correlation coefficients for the boys and girls were identified using the Student's *t*-test. All hypothesis tests were two-sided and  $p < 0.05$  was considered significant. Statistica software (StatSoft Inc.) was used for the statistical analysis.

## 2.5 | Ethics

The study was approved by the ethics review authority in Linköping (2013/298–32). Informed consent was always obtained from at least one parent and, in most cases, from both parents.

## 3 | RESULTS

The mothers filled out the questionnaire in about 80% of the cases, the fathers in about 14% and they filled them out together in about 7%.

Table 2 provides information about the study participants at birth and at the time of the investigation. The scores reflecting the

effect of gestational age at birth, namely early preterm, late preterm or full-term, on the responses to the 12 statements are shown in Table 3 for both sexes. Note that high scores were associated with more pronounced eating problems. When the scores for each statement were compared within each sex, a number of significant differences were identified in relation to the children's appetites. The statement that the child ate small quantities received significantly higher scores for early preterm girls ( $2.87 \pm 1.48$ ) than for late preterm girls ( $2.21 \pm 1.07$ ) while the statement that the child was a small eater received a significantly higher score for early preterm girls ( $2.92 \pm 1.54$ ) than for full-term girls ( $2.19 \pm 1.25$ ). No other significant effects, related to length of gestation, were identified in boys or girls for any of the 12 statements.

Table 4 shows the partial correlation coefficients that were obtained when the parents' responses to the 12 statements were regressed on gestational age at birth for four-year-old preterm-born boys and girls. In the girls, all the estimates describing appetite and food enjoyment were significantly, and negatively, correlated with gestational age at birth. None of the correlations for estimates describing pickiness or neophobia were significant. None of the correlations in Table 4 were significant in boys. Correlations for four statements were significantly different between the sexes (Table 4). These were that children ate small quantities, had poor appetites, were small eaters and lacked interest in food.

## 4 | DISCUSSION

Our results suggest that premature birth was not an important factor when it came to eating problems in four-year-old children. However, our findings do indicate that preterm-born girls tend to eat small amounts of food, have poor appetite and lack interest in food. This information may well be of practical and clinical relevance in situations when preterm-born girls display eating problems. However, it should also be noted that these effects were small and they were not identified in boys.

It is important to point out that it was not possible for us to design a recruitment procedure that could be expected to produce cohorts that were truly representative of all the relevant children in the area. Furthermore, it was not possible to match preterm-born children with full-term controls at an individual level. The main reasons for these limitations were that very little is known about the eating behaviour of young Swedish children and that participation in the study was voluntary. However, we tried to make the two groups as comparable as possible. Both groups were born during a similar time period and they were of very similar age at the time of investigation. Nevertheless, we want to emphasise that the two cohorts of children represented convenience samples. The preterm-born children were recruited from southeast Sweden and represented about 15% of all such children born in the area during the recruitment period. It is possible that the preterm group may have differed from the full-term group because it was recruited from a slightly different population with a somewhat lower level

**TABLE 2** Age, height and weight of early preterm, late preterm and full-term boys and girls in the study at birth and at the time of investigation

Weeks of gestation	Early preterm <32		Late preterm 32–36		Full-term 37 or more	
	Boys <i>n</i> = 30	Girls <i>n</i> = 39	Boys <i>n</i> = 63	Girls <i>n</i> = 47	Boys <i>n</i> = 88	Girls <i>n</i> = 80
At birth						
Weight (kg)	1.32 ± 0.38	1.20 ± 0.44	2.88 ± 0.41	2.12 ± 0.45	3.70 ± 0.47	3.56 ± 0.44
Length (cm)	38 ± 4	38 ± 5	46 ± 2	44 ± 3	52 ± 2	51 ± 2
Gestational week	29.1 ± 2.2	28.6 ± 2.5	34.8 ± 1.2	34.3 ± 1.1	40.2 ± 1.2	40.0 ± 1.3
At investigation						
Age (years)	4.43 ± 0.06	4.45 ± 0.06	4.44 ± 0.05	4.43 ± 0.06	4.42 ± 0.05	4.42 ± 0.05
Height (cm)	106 ± 3	104 ± 4	107 ± 4	105 ± 6	109 ± 4	107 ± 4
Weight (kg)	17.5 ± 1.8	16.0 ± 2.3	17.9 ± 2.2	17.1 ± 2.6	18.7 ± 2.3	17.9 ± 2.0

Note: Values are means ± standard deviations.

**TABLE 3** Response to the three statements in each of the four dimensions, appetite, food enjoyment, pickiness and neophobia, by parents of four-year-old boys and girls born at full term, late preterm<sup>a</sup> or early preterm<sup>b,c</sup>

Statement	Girls			Boys		
	Full-term ( <i>n</i> = 80)	Late preterm ( <i>n</i> = 47)	Early preterm ( <i>n</i> = 39)	Full-term ( <i>n</i> = 88)	Late preterm ( <i>n</i> = 63)	Early preterm ( <i>n</i> = 30)
Appetite <sup>d</sup>						
Statement 1 <sup>d</sup>	2.51 ± 1.11	2.21 ± 1.07	2.87 ± 1.48 <sup>e</sup>	2.20 ± 1.11	2.51 ± 1.22	2.49 ± 1.48
Statement 2	1.95 ± 0.94	1.93 ± 1.00	2.16 ± 1.25	1.88 ± 0.87	2.05 ± 1.04	1.92 ± 1.10
Statement 3	2.19 ± 1.25	2.25 ± 1.37	2.92 ± 1.54 <sup>f</sup>	1.91 ± 1.17	2.38 ± 1.10	2.06 ± 1.63
Food enjoyment <sup>d</sup>						
Statement 1	1.67 ± 0.91	1.53 ± 0.82	1.86 ± 1.14	1.63 ± 0.84	1.79 ± 0.90	1.79 ± 1.10
Statement 2	1.56 ± 0.84	1.62 ± 0.95	1.84 ± 1.12	1.58 ± 0.86	1.89 ± 0.95	1.99 ± 1.16
Statement 3	1.81 ± 1.00	1.70 ± 1.07	2.00 ± 1.11	1.78 ± 0.94	2.08 ± 1.03	1.94 ± 1.0
Pickiness <sup>d</sup>						
Statement 1	2.02 ± 1.03	1.89 ± 1.09	2.04 ± 1.26	1.93 ± 1.03	2.20 ± 1.16	1.94 ± 1.34
Statement 2	3.01 ± 1.35	2.67 ± 1.33	2.82 ± 1.35	3.05 ± 1.32	3.10 ± 1.32	2.63 ± 1.55
Statement 3	2.82 ± 1.47	2.70 ± 1.50	3.08 ± 1.48	2.76 ± 1.40	2.95 ± 1.41	2.93 ± 1.67
Neophobia <sup>d</sup>						
Statement 1	2.64 ± 1.27	2.26 ± 1.27	2.64 ± 1.39	2.66 ± 1.24	2.89 ± 1.30	2.42 ± 1.51
Statement 2	2.29 ± 1.14	2.11 ± 1.22	2.34 ± 1.47	2.24 ± 1.13	2.67 ± 1.19	2.16 ± 1.30
Statement 3	2.05 ± 1.16	1.81 ± 0.90	2.07 ± 1.33	2.04 ± 1.15	2.26 ± 1.21	1.94 ± 1.37

Note: Values are means ± standard deviations.

<sup>a</sup>Gestational age at birth 32–36 weeks.

<sup>b</sup>Gestational age at birth <32 weeks.

<sup>c</sup>Compared using analysis of covariance followed by Tukey's test with age at measurement and z-score for birthweight<sup>12</sup> as covariates.

<sup>d</sup>All statements in the four dimensions are described in Table 1. A high score indicates a more pronounced eating problem than a low score

<sup>e</sup>Significantly higher ( $p < 0.05$ ) than the corresponding value for late preterm girls.

<sup>f</sup>Significantly higher ( $p < 0.05$ ) than the corresponding value for full-term girls.

of education. This may have influenced food habits and attitudes towards eating. However, this is pure speculation and we do not have any data to support any such differences between our two groups. Furthermore, it is conceivable that the recruitment procedure itself may have given rise to some bias because parents worried about feeding their children adequately may be more likely to

accept participation. However, this kind of bias would have been equally likely in both groups.

It is relevant to consider a few methodological issues in relation to our study. Our results were based on the parents' reports of their children's food-associated behaviour, which was not the same as carrying out a true assessment of the children's food intake. However,

**TABLE 4** Partial correlation coefficients obtained using a multiple regression analysis where the scores describing children's eating behaviour were regressed on gestational age at birth (days) in four-year-old girls and boys born premature<sup>a</sup>

Eating behaviour Statement <sup>b</sup>	Appetite			Food enjoyment			Pickiness			Neophobia		
	1	2	3	1	2	3	1	2	3	1	2	3
Girls (n = 86)												
Partial correlation	-0.399	-0.268	-0.434	-0.326	-0.301	-0.238	-0.179	-0.086	-0.171	-0.117	-0.052	-0.145
p value	0.00017	0.014	0.000037	0.0025	0.0055	0.029	0.103	0.44	0.12	0.29	0.64	0.19
Boys (n = 93)												
Partial correlation	0.067	0.041	0.074	-0.011	-0.025	-0.015	0.184	0.204	0.115	0.176	0.205	0.153
p value	0.53	0.70	0.49	0.92	0.81	0.89	0.08	0.052	0.28	0.095	0.052	0.147
p for difference between correlations for boys and girls <sup>c</sup>	0.0015	0.0395	0.0005	0.0328	0.062	0.1365	0.017	0.0557	0.0600	0.0539	0.0893	0.0501

<sup>a</sup>Adjusted for age at measurement and z-score for birthweight.<sup>12</sup>

<sup>b</sup>Statements described in Table 1.

<sup>c</sup>Identified using Student's t-test.

valid estimates of such intake are almost impossible,—or at least very difficult,—to obtain. Furthermore, our results were obtained using a questionnaire that was developed and validated in a cohort of French mothers with children who were younger than ours.<sup>8</sup> We also translated this questionnaire into Swedish and slightly rephrased some of the statements. Unfortunately, we did not validate this modified questionnaire with Swedish parents. In addition, the questionnaire was developed based on the assumption that it should be filled in by mothers.<sup>8</sup> However, the fathers in our study also filled in the questionnaires. We have no reason to believe that our modifications influenced the validity of our results, but we have no data to clearly demonstrate that they did not. These factors were limitations of our study. However, the questionnaire was quite simple and straightforward. Therefore, it seems motivated to consider the scores provided by the parents as a relevant reflection of their children's eating behaviour.

The difference between boys and girls that we observed was noteworthy. We have previously reported that many variables describing their body size and composition of four-year-old preterm-born children were positively correlated with gestational age at birth in girls but not in boys.<sup>9</sup> It is possible that premature birth counteracts the bodily development of female children, which may result in a lower requirement for dietary energy, resulting in a lack of appetite and less interest in food. Migraine et al.<sup>7</sup> also observed that female sex was associated with eating problems in preterm-born children.

## 5 | CONCLUSION

Our study did not identify any pronounced effects of premature birth on the food-related behaviour of four-year-old children. However, parental assessments of appetite and food enjoyment were associated with gestational age at birth in girls but not in boys. Our results suggest that prematurity may influence eating behaviour in girls and that the magnitude of the response tends to increase with decreasing gestational age at birth. Having said that, it should be noted that studies in this area are difficult and our study had limitations. Therefore, our results need to be confirmed.

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## CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

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