Birth Weight and Eating Behaviors of Young Children

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Objective To evaluate the relationships prospectively between birth weight (standardized for gestational age) and problematic eating behaviors, as reported by the parents, at different ages in 3 birth cohorts: Generation XXI (Portugal), Avon Longitudinal Study of Parents and Children (United Kingdom), and Etude des Déterminants pre et postnatals précoces du développement et de la santé de l'ENfant study (France) – HabEat project. We also aimed to explore the effect of child's current body mass index (BMI) in these relationships.

Study design Problematic eating behaviors were assessed at 4-6, 12-15, 24, and 48-54 months, based on caregiver's perception. Children born small, appropriate, and large for gestational age were defined based on sex-specific Kramer growth references. Associations were tested by logistic regression (OR, 95% CI) adjusted for maternal age, education, BMI, smoking, breastfeeding duration, older siblings, birth type and, in a second step, for child's current BMI World Health Organization z-score.

Results Parents of children born small for gestational age (compared with appropriate gestational age) reported more often feeding difficulties and poor eating patterns (eating small quantities or needing stimulation to eat) at 4-6 months (Generation XXI: OR 2.02, 95% CI 1.40-2.94; Avon Longitudinal Study of Parents and Children: OR 1.36, 95% CI 1.14-1.62; Etude des Déterminants pre et postnatals précoces du développement et de la santé de l'ENfant OR 3.24, 95% CI 1.50-6.96), but this effect was weaker at older ages. Overall, the effects decreased, after adjustment for child's BMI, but remained significant.

Conclusions Low birth weight for gestational age was related to later difficulty in eating behaviors, primarily in the first 4-6 months. *(J Pediatr 2015;166:59-65)*.

Low weight and small size at birth have been associated with several health outcomes, particularly with a long-term increased obesity and cardiovascular risk.[1-3] In children, weight at birth has been inversely associated with insulin levels and blood pressure, suggesting a risk profile established early in life.[4,5] These associations have been explained by underlying biological pathways (eg, children born with low birth weight have a compensatory accelerated growth, during which they gain fat rather than muscle, leading to high fat mass later in life) which might lead to insulin resistance and other adverse metabolic consequences.[6-9] Moreover, it may be that in response to different physiological or morphologic states during development, low or high birth weight (as surrogates of the intrauterine environment; the low birth weight condition as a proxy measure of in utero growth restriction) programs or influences central nervous system appetite control and the desire for specific foods.[10]

At the same time, parents may use different feeding practices[11]; those with lower birth weight neonates may be more likely to try to feed them greater amounts of foods to encourage their child to grow larger, and this may cause disproportionate postnatal weight gain. Rapid early weight gain has been identified as a risk factor for overweight.[1,12] It is possible that parental use of more controlling feeding practices will cause problems with childhood eating behaviors and weight gain. Moreover, it may be that parents initiate 'controlling' feeding strategies in response to perceived child overweight or underweight in turn leading to the development of difficult eating behaviors.[13]

Our hypothesis in this study is that birth weight is related with problematic eating behaviors at different stages of life, which in turn could be mediators of a worse health profile in the future. Moreover, cross-cultural comparisons in the association between birth outcomes and eating behaviors may help to consolidate findings.

This study aims to prospectively relate birth weight (standardize for gestational age) with problematic eating behaviors, as reported by the parents, at different ages during childhood in 3 European birth cohorts. We also aim to explore the effect of child's current body mass index (BMI) in these relationships.

AGA	Appropriate for gestational age
ALSPAC	Avon Longitudinal Study of Parents and Children
BMI	Body mass index
EDEN	Etude des Déterminants pre et postnatals précoces du développement et de la santé de l'ENfant
LGA	Large for gestational age
SGA	Small for gestational age

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Funding information is available at www.jpeds.com (**Appendix**). The authors declare no conflicts of interest.

http://dx.doi.org/10.1016/j.jpeds.2014.09.031

Methods

Analyses were based on 3 European population-based birth cohorts: the Portuguese Generation XXI birth cohort, the British Avon Longitudinal Study of Parents and Children (ALSPAC) birth cohort, and the French Etude des Déterminants pre et postnatals précoces du développement et de la santé de l'ENfant (EDEN) mother-child cohort. In each cohort, the procedures were in accordance with the local and national ethical standards.

Generation XXI is a birth cohort that recruited women in all public maternity units from Porto, Portugal between April 2005 and August 2006. A total of 8647 children and 8495 mothers were enrolled at baseline. Just before recruitment, these hospitals were responsible for 91.6% of all deliveries in the catchment area. Of the invited mothers, 91.4% agreed to participate.[14,15]

Birth data were retrieved from medical records by trained researchers. Intermediate follow-up assessments were conducted in subsamples at 6 and 15 months, and weight and height measured during medical appointments were retrieved from the child's health records. At 4 years of age, 86% of all children were re-evaluated (70% by face-to-face interviews), including measured weight and height. At different ages, the child's eating behaviors were assessed based on a set of closed questions, answered by the main caregiver (usually the mother).

Subsamples were recruited at 6 and 15 months; for these analyses 980 children had complete data at 6 months and 577 at 15 months. At 48 months, 3802 had complete data for analysis.

The ALSPAC is a longitudinal birth cohort study, which recruited pregnant women residents in a geographically defined area in the South West of England with an expected delivery date between April 1991 and December 1992. A cohort of 14 541 pregnant women was established resulting in 13 988 children alive at 12 months of age. More details can be found on the ALSPAC website http://www.bristol.ac.uk/alspac/.

Birth data were abstracted from the medical records by trained midwives. Growth during infancy was monitored; weight and length were available from routinely collected measurements performed by health visitors as part of the infant health surveillance program and were extracted from the local child health database. Eating behaviors and feeding practices were assessed by questionnaires sent to the main caregiver (usually the mother) at 6, 15, and 54 months.

For these analyses, 6279 children with complete data were included at 6 months, 5277 at 15 months, 6044 at 24 months, and 5168 at 54 months.

The EDEN mother-child cohort is a longitudinal study, which recruited 2002 pregnant women in 2 French university hospitals, in Nancy and Poitiers.

Birth data were collected from medical records. As measurements were not collected in the children at the same time point, we predicted individual infant weight and length at 4, 12, 24, and 36 months using nonlinear mixed effects models, from clinical data measured by health care providers and weight and length measured during clinical examinations from birth to 5 years of age. The model used in the EDEN study to assess child's growth was detailed in a previous paper[16] but applied to data collected from birth to age 5 years. Maternal perception of child's appetite was assessed at 4, 12, and 24 months, the child's difficulty to feed was assessed at 24 and 48 months, and the child's food neophobia was assessed at 24 and 48 months.

For these analyses, 1280 children with complete data were included at 4 months, 1183 at 12 months, 1077 at 24 months, and 935 at 48 months.

Table I (available at www.jpeds.com) provide the description of the sample selection at different ages in each cohort.

Specific age frames were selected, in which comparable data among cohorts were available: 4-6 months, 12-15 months, and 48-54 months (with data available for Generation XXI, EDEN, and ALSPAC), and 24 months (with data available for EDEN and ALSPAC). Similar aspects of eating behaviors in at least 2 cohorts and food neophobia (in EDEN only), were aggregated into four main domains (feeding difficulties, poor eating, food refusal/food neophobia and irregular eating) (**Table II**). Eating behaviors were dichotomized into "yes" (eating behavior reported) vs "no" (reference category). In Generation XXI, to define food refusal at 48 months, a combined variable was created to summarize refusal to take milk, fruit and vegetables, soup, or fish ("yes" was considered if at least one was reported). In EDEN, to define food neophobia, an index was created based on the mean of 3 questions and then dichotomized into "≥ median (more neophobic)" vs "< median" (considered as reference category).

In the 3 cohorts, weight for gestational age was defined based on the same criteria—sex-specific population-based Kramer growth references.[17] Small for gestational age (SGA) and large for gestational age (LGA) were defined as below the 10th and above the 90th percentile, respectively; appropriate for gestational age (AGA) were deemed to be within these thresholds. Because these standards are for single births, only singletons were included in the analyses.

BMI was calculated as weight (kg) over the height squared (m). Each child was then classified according to the age- and sex-specific BMI standard z-scores developed by the World Health Organization.[18] For preterm babies, a corrected birth date was considered (birth date + [40-gestational age]) in sensitivity analyses but as associations were not modified, these results were not presented.

Statistical Analyses

Associations were estimated by OR and 95% CI obtained from unconditional logistic regression models. Three-step statistical models were considered: (1) (common to all