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Maternal eating disorder and infant diet. A latent class analysis based on the Norwegian Mother and Child Cohort Study (MoBa)

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Abstract

Knowledge of infant diet and feeding practices among children of mothers with eating disorders is essential to promote healthy eating in these children. This study compared the dietary patterns of 6-month-old children of mothers with anorexia nervosa, bulimia nervosa, binge eating disorder, and eating disorder not otherwise specified - purging subtype, to the diet of children of mothers with no eating disorders. The study was based on 53,879 mothers in the Norwegian Mother and Child Cohort Study (MoBa). Latent class analysis (LCA) was used to identify discrete latent classes of infant diet based on the mothers' responses to questions about 16 food items. LCA identified five classes, characterized by primarily homemade vegetarian food (4% of the infants in the sample), homemade traditional food (8%), commercial infant cereals (35%), commercial jarred baby food (39%), and a mix of all food groups (11%). We then estimated the association between the different latent dietary classes and maternal eating disorders using a multinomial logistic regression model. Infants of mothers with bulimia nervosa had a lower probability of being in the homemade traditional food class compared to the commercial jarred baby food class, than the referent without an eating disorder (O.R. 0.59; 95% CI 0.36–0.99). Infants of mothers with binge eating disorder had a lower probability of being in the homemade vegetarian class compared to the commercial jarred baby food class, than the referent (O.R. 0.77; 95% CI 0.60–0.99), but only before controlling for relevant confounders. Anorexia nervosa and eating disorder not otherwise specified-purging subtype were not statistically significant associated with any of the dietary classes. These results suggest that in the general population, maternal eating disorders

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may to some extent influence the child's diet as early as 6 months after birth; however, the extent to which these differences influence child health and development remain an area for further inquiry.

Keywords

Eating disorder; Child feeding; Dietary patterns; Latent class analysis; MoBa; Norwegian Mother and Child Cohort Study

Introduction

Knowledge of factors associated with infant diet and feeding practices is essential in counseling and for the development of strategies to promote healthy eating in children (Lederman, Akabas, & Moore, 2004). There is, however, sparse knowledge concerning how maternal eating disorders may influence infant feeding practices. Parental feeding practices and styles, and the attitudes and behaviors that characterize parental approaches to maintaining or modifying children's eating behavior, shape the early feeding environment (Golan & Crow, 2004). Approaches to feeding may be an important environmental factor for the intergenerational transmission of eating disorders. Two recent studies based on the Avon Longitudinal Study of Parents and Children (ALSPAC) reported a higher rate of feeding difficulties among infants of mothers with a history of eating disorders, including slow feeding and refusal of solid foods (Micali, Simonoff, Stahl, & Treasure, 2011; Micali, Simonoff, & Treasure, 2009). Feeding difficulties were not only directly affected by the mothers' eating disorder, but also indirectly through maternal anxiety and depression (Micali, Simonoff, Stahl, et al., 2011).

Less is known about how maternal eating disorders may influence the types of foods that mothers provide for their children. Studies on the frequency of breastfeeding in mothers with eating disorders yield contrasting findings, including higher rates (Micali et al., 2009), lower rates (Golding, Pembrey, & Jones, 2001; Larsson & Andersson-Ellstrom, 2003; Torgersen et al., 2010; Waugh & Bulik, 1999), and comparable rates (Brinch, Isager, & Tolstrup, 1988; Evans & le Grange, 1995; Lacey & Smith, 1987) than mothers with no eating disorders. We know less about aspects of i nfant diet other than breastfeeding, for example introduction of different food groups.

Studies of older children (2 years or older) have shown that mothers with bulimia nervosa (BN) may avoid cooking (Woodside & Shekter-Wolfson, 1990), which may affect what children are fed. Limited in-home food availability has been observed in the homes of women with anorexia nervosa (AN) and BN (Fahy & Treasure, 1989; Russell, Treasure, & Eisler, 1998; Stein & Fairburn, 1989), which could lead to decreased variety in their children's diet. Case reports and case series also indicated that young children of women with eating disorders may be underfed (Russell et al., 1998). Mothers with AN have reported trying to avoid giving their children items such as candy and "junk food" (Russell et al., 1998). Mothers with histories of eating disorders may also be more likely to take "special approaches" to feeding their children, such as limiting the amount of processed foods or eliminating other types or classes of foods (Hoffmann et al., 2014). One recent study based

on the ALSPAC study investigated longitudinally the dietary pattern in older children (3 to 9 years of age) of mothers with a history of eating disorders (Easter et al., 2013). They conducted a principal components analysis on the Food Frequency Questionnaire (Easter et al., 2013), reporting that children in the maternal AN and BN group had higher scores on a "health conscious/vegetarian" dietary pattern and less adherence to a "traditional" dietary pattern, compared with unexposed children (i.e., children of mothers without histories of eating disorders). This finding was more pronounced among the youngest children. Based on this observation, it is possible that feeding differences in the infant period would be most affected, as this represents a time when the mother has even more influence over the infants' diet.

Moreover, we identified no studies reporting dietary patterns of children of mothers with binge eating disorder (BED). Food and nutrient consumption patterns differ across eating disorder subtypes, which may also be reflected in different infant diets. Pregnant women with BED consume diets that are higher in fat than women without eating disorders (Siega-Riz et al., 2008). Women with AN have been shown consistently to consume diets lower in fat (Affenito, Dohm, Crawford, Daniels, & Striegel-Moore, 2002; Hadigan et al., 2000; Misra et al., 2006), and they are more likely to be vegetarians (Hadigan et al., 2000) than a referent group. How these eating behaviors influence their infants diet remains unknown.

The present study

Therefore, the aim of this study was to investigate the association between maternal eating disorders (AN, BN and BED) and infant diet patterns at 6 months in a large Norwegian cohort, the Norwegian Mother and Child Cohort study (MoBa). We chose to examine this infants' diet during this time period for two reasons. First, 6 months of age, represents an important transition point in infant's nutrition. At 6 months, some infants are being introduced to solids and others are shifting from cereals to more solid baby food. In Norway, the Norwegian Directorate of Health follows the WHO recommendations that infants should be exclusively breast-fed for the first 6 months, and breast-feeding should continue until the child is 12 months old. The Directorate also recommends that infants be introduced to solid foods slowly, namely cereal made of rice or cornmeal, preferably at six months and that homemade or jarred baby foods are introduced after 6 months. As the introduction of cereals and solid foods represents an important developmental transition period, maternal eating disorder status may contribute to systematic differences in food choice during this time point. In Norway, twelve months of paid maternal leave is standard, and few children attend daycare or preschool. Thus, diet in this time period may be highly influenced by maternal choices with few external influences.

Second, previous research has demonstrated that the quality of infant diets at 6 months of age may have both short-term and long-term health implications. In the short-term, inappropriate food choices during this time could lead a failure to meet infants' changing nutrient needs (Fein, Labiner-Wolfe, Scanlon, & Grummer-Strawn, 2008). In the long-term, dietary patterns in infancy may set the foundation for lifelong eating patterns and possible eating problems. Therefore, it is especially important to investigate infant feeding practices

among mothers with eating disorders since their children are at risk for the development of eating disorder symptomatology (Patel, Wheatcroft, Park, & Stein, 2002; Stein et al., 2006).

Latent Class Analysis

We chose to conduct a latent class analysis to examine infant dietary patterns. In contrast to dominant epidemiological approaches which examine the impact of single nutrients or consumption of a single foods on health, examining dietary patterns permits the robust evaluation of dietary habits as a whole, accommodates the complexity of food consumption practices, and accounts for the high degree of intercorrelation and interactions between foods (Hu, 2002; Sotres-Alvarez, Herring, & Siega-Riz, 2010; Sotres-Alvarez et al., 2013).

Moreover, using latent class analysis (LCA) to quantify dietary patterns has distinct advantages. LCA is a comparatively newer method to detect patterns of unobserved (i.e., hidden or latent) subgroups or classes within a population. Unlike a-priori qualitative examinations of dietary patterns, LCA allows for the assessment of goodness of fit in detecting the number of classes of dietary patterns, adjustment for potential covariates, and quantification of the level of uncertainty in each individual's probability of belonging to each class. To our knowledge this technique has not yet been used to explore the diets of infants.

In sum, the primary goal of this study was to investigate the association between maternal eating disorders and infant diets in the Norwegian Mother and Child Cohort study (MoBa). As a first step, we used latent class analysis (LCA) to identify discrete classes of dietary patterns, based on the mothers' answers to a detailed questionnaire about what foods the child was eating at 6-months. The second step was to examine the relationship between maternal eating disorders and the infant dietary classes.

Method

Participants

The Norwegian Mother and Child Cohort Study (MoBa) is a prospective population-based pregnancy cohort study conducted by the Norwegian Institute of Public Health (Magnus et al., 2006). In brief, participants were recruited from all over Norway from 1999–2008 and 38.5% of invited women consented to participate. The cohort includes 108,000 children, 90,700 mothers, and 71,500 f athers. Follow-up is conducted by MoBa questionnaires at regular intervals and by linkage to national health registries. This study is based on version 4 of the quality-assured MoBa data files released for research in 2009. Informed consent was obtained from each MoBa participant upon recruitment. The study was approved by The Regional Committee for Medical Research Ethics in South-Eastern Norway and the Institutional Board of the University of North Carolina at Chapel Hill.

This study is based on MoBa Questionnaire 1 (gestational week 17) and MoBa Questionnaire 4 (6 months after birth). We excluded MoBa participants who: (a) completed an early pilot version of Questionnaire 1 (n = 2,599), (b) had invalid values for self-reported age, weight, and height (n = 306), (c) returned Questionnaire 1 after delivery (n = 293), (d) had a multiple birth (n = 2585), (e) had been enrolled in MoBa more than once, due to

additional pregnancies (only the first pregnancy was included, excluding n = 12097 pregnancies), and (f) did not complete both MoBa Questionnaire 1 and MoBa Questionnaire 4 (n = 20272). Many of the children for whom Questionnaire 1 was available had not yet reached the age at which Questionnaire 4 was administered. Of the initial 91,489 pregnancies enrolled in MoBa, 53,879 met the criteria above and were included in this report.

Measures

Eating disorder—Questionnaire 1 included items on eating disorders and disordered eating behaviors (see: http://www.fhi.no/dokumenter/1f32a49514.pdf). It was designed in accordance with the DSM-IV criteria (American Psychiatric Association, 1994) and the items have previously been used for studies on eating disorders in the Norwegian Institute of Public Health Twin Panel (Harris, Ma gnus, & Tambs, 2006; Reichborn-Kjennerud et al., 2003; Reichborn-Kjennerud, Bulik, Tambs, & Harris, 2004). Diagnostic algorithms and hierarchies were constructed to define the presence of eating disorders in the six months prior to pregnancy (retrospective assessment) and during pregnancy. Broadly defined AN was defined as meeting DSM IV criteria for AN with the exception of amenorrhea. Our definition of AN is more in accordance with DSM-5 since the amenorrhea criterion has been eliminated. It was not possible to categorize AN during pregnancy because of the missing BMI criterion due to pregnancy weight gain. The other eating disorder categories included: broadly defined BN, endorsing at least a weekly frequency of binge eating and either purging (vomiting, laxatives) or non-purging (exercise, fasting) compensatory behaviors; broadly defined BED, at least a weekly frequency of binge eating in the absence of compensatory behaviors; and eating disorder not otherwise specified-purging subtype (EDNOS-P), purging at least weekly in the absence of binge eating. Questions for binge eating included both eating an unusually large amount of food and the feeling of loss of control. The frequency criteria for binge eating and purging in BN, BED, and EDNOS-P differed from the DSM-IV criteria but reflect the new DSM-5 criteria (once a week instead of twice a week). As the symptom profile for many women changed in the interval before pregnancy and during pregnancy, the order for our diagnostic hierarchy was: AN, BN, EDNOS-P, BED, and no-ED. All individuals who met AN criteria before pregnancy were categorized as AN regardless of presentation during pregnancy. Those who met BN criteria either before or during pregnancy and who did not meet AN criteria prior to pregnancy were categorized as BN. If not classified as AN or BN, those who met criteria for EDNOS-P before or during pregnancy *and* did not endorse binge eating at either time were categorized as EDNOS-P. Similarly, individuals who endorsed BED and did not endorse purging during or before pregnancy were included in the BED group. Group assignment was made only when all responses were available to ensure accurate classification.

Infant diet—The mothers reported current infant diet (Questionnaire 4) 6 months after birth. Breastfeeding reflected whether the child “currently received breast milk,” and was coded as stopped breastfeeding (0) or still breastfeeding (1). The questions on food eaten by the child included 16 different food items, with the response categories never/seldom, 1–3 times a week, 4–6 times a week, and at least once a day. This was coded as never/seldom (0) or 1 time per week or more (1) (see Appendix for complete frequencies). Given that the

distribution of many food items were skewed due to non-consumers, the indicators was categorized as never/seldom (0) or 1 time per week or more (1). The 16 child items included three types of commercial infant cereals made of precooked rice/cornmeal, oatmeal, or wheat. Most of these cereals are not sweetened with sugar but some contain maltodextrins (a polysaccharide used as a food additive: easily digestible carbohydrates made from natural corn starch), and they are fortified with iron. The Norwegian authorities recommended these cereals as the first solid foods for infants at the age of 4–6 months, in addition to mashed fruit or vegetables. The child eating instrument also included four different homemade porridge groups: (1) cooked iron251 enriched wheat, (2) cooked wheat, semolina, or oats with no added vitamins or minerals, (3) cooked organically grown wheat, semolina, or oats with no added vitamins or minerals, and (4) cooked millet. Three types of commercial jarred baby foods in portion-size jars were also included on the list, categorized as containing vegetables, meat, or fruits/berries. None of these commercial jarred baby foods are fortified and they only contain the ingredients stated on the label, and do not contain preservatives or artificial colorings. The fruits/berries and the vegetable jarred foods are recommended starting at age 4 months, the jarred meats from 6 months on. The list also included five items of homemade baby food: fruit purees, vegetables, meat, fish, and an “other” category. The last food item was rusks/bread/biscuits. The questionnaires also included information about mothers’ age and education at pregnancy, and colic and milk allergies when the child was 6 months old.

Statistical Methods

Based on each participant’s responses on the 16 different food items, Latent Class Analysis (LCA)(Muthen, 2002) was used to model patterns of unobserved (i.e., hidden or latent) subpopulations or classes within the population. LCA is a form of mixture modeling, where the multivariate interdependency of a set of observed variables is explained by an a priori defined number of unobserved discrete classes. Membership in a specific class determines the probability of endorsing a specific item. The strength of this relationship is expressed by the probability of endorsing this specific item.

We entered the indicators of infant food items into the LCA, running the models sequentially, and increased the number of classes by one for each run. Statistical criteria (i.e., the lowest Bayesian Information Criterion, and the highest entropy (Nylund, Asparouhov, & Muthen, 2008)) and model interpretability (i.e., class size >2% and interpretable pattern separating the classes) were used to determine the optimal number of classes. We included none of the covariates in the LCA since maternal age, education, and breast-feeding were all strongly related both to the probability of having introduced the different food items, as well as having an eating disorder (Miller & Chapman, 2001). Introducing breast-feeding in the classes would therefore have masked the association between the dietary classes and the different eating disorders.

Relating the classes to eating disorder and the covariates—There are two different ways to estimate the women’s class membership: either assigning absolute class membership based on the mothers’ most likely latent class membership, or using the persons estimated probability for each of the different latent classes in the analysis. Whereas the first

method includes misspecification (i.e., all individuals are classified with total certainty, not considering the likelihood of them also being member of another group), the second method takes into account the uncertainty of class membership (measurement error). We therefore used the persons estimated probability for each of the different latent classes in the analyses, since including the chance of misspecification leads to more accurate population estimates of associations.

The probability of class membership was treated as a dependent latent multinominal measure and regressed on the covariates. We used a multinomial logistic regression analysis to relate the latent classes to mothers' eating disorders, controlling for maternal education, age, breastfeeding status, colic, and milk allergy. Mplus 7.1 was used in all analysis(Muthen & Muthen, 1998–2012).

Results

The mean age of the sample was 29.6 years (S.D. = 4.6). The highest level of education completed by the mothers was as: middle school (8%), high school (30%), 1–4 years university or technical college (41%), and more than 4 years university or technical college (21%). Nine percent of t he women (n = 4834) had missing information on the eating disorder variables such that they could not be classified. Of the remaining women, 44 (0.1%) met criteria for AN, 436 (0.9%) met criteria for BN, 2475 (5.0%) met criteria for BED, 58 (0.1%) met criteria for EDNOS-purging type, and 46,032 (93.9%) reported no eating disorder. The percentages of women breastfeeding at six months were as follows: AN (58%), BN (79%), EDNOS-P (59%), BED (76%), and no-ED (82%) (Overall group differences including mothers with and without an eating disorder: $\chi^2 = 71.07$; df = 4; p<. 001). Almost all mothers (97%) reported having introduced solid foods by 6 months, with no statistically significant differences between the groups ($\chi^2 = 4.1$; df = 4; p = .39).

Latent Class Analysis: Infant Dietary Classes

Analysis indicated that the five-class model was the best solution, based on both statistical and theoretical considerations. The statistical criteria used to guide this process were the highest entropy and the lowest BIC (Nylund et al., 2008). The 5-class solution had the highest entropy (results for the two, three, four, five, six and seven class solutions were .72, . 75, .73, .77, .73 and .74, respectively). The 5-class solution did not have the lowest BIC, but decreases became smaller with increasing numbers of classes. We started with a BIC on 675654 for the two class solution. The BIC change was thereafter 23525, 6362, 3940, 2771, 1959, 1447, 1310 for the three, four, five, six, seven and eight class solutions. However, the models with more than 5 classes contained groups with very small sample sizes, and represents splits of c lasses obtained in the other models rather than new interpretable classes. We therefore stopped at the 5-class solution, which also had the clearest and most meaningful interpretability.

Table 1 presents the conditional item endorsement probabilities for all 16 food items based on a five-class model. The classes were *Homemade vegetarian food* (high probabilities of homemade porridges made of millet and homemade purees of fruits and vegetables), *Homemade traditional food* (high probabilities of homemade fruits, vegetables, and meat in

combination with commercial infant cereal), *High variety food* (high probabilities of commercial baby foods, homemade foods, and rusks/bread/biscuits), *Commercial infant cereal* (high probabilities of commercial infant cereals based on rice or cornmeal, with almost no probability of commercial jarred baby foods, and a very small probability of fresh fruits and vegetables), and *Commercial jarred baby food* (high probabilities of commercial infant cereal and commercial jarred baby food, and low probabilities of homemade food.

Characteristics of the Mothers in the Different Classes

Table 2 presents the characteristics of the mothers in the five dietary classes.. In general, there were small differences in the proportion of mothers with eating disorders in the different classes. The *High variety food* class and the *Commercial jarred baby food* class had the highest proportion of mothers with any eating disorders, (6.64 and 6.48 %, respectively) compared with the *Commercial infant cereal* (5.80 %), *Homemade traditional food* (5.76 %) and the *Homemade vegetarian food* class (5.21 %). This pattern held for all eating disorder groups, except for a higher proportion of mothers with AN in the *Homemade vegetarian food* class. Around 90% of the mothers in the *Homemade vegetarian food* and the *Commercial infant cereal* class were still breastfeeding their infants at 6 months, compared with between 73% and 79% in the other classes.

Forty-one percent of the mothers in the *Homemade vegetarian* class had graduated from university, twice as many as in the other classes. Mothers in the *Mixed* class and the *Commercial jarred baby food* class had the lowest level of education, with mothers in the *Homemade traditional* and the *Commercial baby cereal* class were in between were located in the middle in terms of educational attainment.

Predicting Latent Class Membership by Eating Disorder

We used multinomial logistic regression analyses to determine whether having an eating disorder was associated with the infant dietary classes (Table 3). In the LCA, the mother got a separate score for her probability of belonging to each of the five classes, which was used in these analyses. The commercial jarred baby food class differed from the other dinner classes in that it was based solely on commercially made baby food, while the other classes included different types of homemade baby food. For this reason, and because it was the largest, the commercial jarred baby food class was used as the referent class. Infants of mothers with BN had significantly lower odds of being in the *Homemade traditional food* class than the *Commercial jarred baby food* class, compared with infants of mothers without any eating disorder. These findings remained statistically significant after controlling for the covariates (maternal age, education and breast feeding at 6 months). Infants of mothers with BED were significantly less likely to be in the *Homemade vegetarian food* class than the *Commercial jarred baby food* class compared with infants of mothers without any eating disorder, but this result was not significant after controlling for the covariates. AN and EDNOS-P were not statistically significantly associated with any of the dietary classes.

Discussion

To our knowledge, there has been no prior prospective, large-scale, population based cohort study that examined the relationship between maternal eating disorders and infant diet. We identified five different dietary classes characterized by homemade vegetarian baby food, homemade traditional baby food, commercial infant cereal, commercial jarred baby food and a class with a mix of all the different food groups. Infants of mothers with BN had a lower probability of being in the homemade traditional baby food class than the commercial jarred baby food class, compared to infants of mothers without eating disorders. Infants of mothers with BED had a lower probability of being in the homemade vegetarian class, but only before controlling for covariates. Maternal AN and EDNOS-P were not statistically significantly associated with any of the infant dietary classes.

Infant Diet Patterns

Overall, approximately one-third of the infants in the study that approximated the WHO recommendations for slow cereal introduction at 6 months, had the highest probability of being placed in the commercial infant cereal class. Another third of the infants had the highest probability of being in the commercial jarred baby food class where mothers with BN were more likely to be placed. Infants in this class had already been introduced to jarred baby foods at 6 months, which does not follow public guidelines from the Norwegian Directorate of Health that infants should only be introduced to homemade or jarred baby food after 6 months. As this study did not include information about the timing of food introductions, we do not know whether the introduction to jarred baby food occurred around the six month period, or much earlier, which would be of even greater concern.

One-fifth of the infants were in either the homemade traditional or the high variety food classes and ate combination of homemade and commercial infant baby food. Although the quality of the home-made diets may be as healthy as the commercially produced baby food, this is dependent on caregivers' ability to combine foods that satisfy infants' nutritional needs, which may depend on the caregivers' age, education level, and available time (Fein et al., 2008; Lande et al., 2003).

A diet based on only homemade porridge and fruit/vegetable puree as in the homemade vegetarian food class (approximately 5 percent of the infants) is not recommended. As 6-month-old infants need cereal or baby food fortified with iron and zinc, a diet based solely on homemade porridge and fruit/vegetable puree may pose a risk of zinc or iron deficiency, (Krebs & Hambidge, 2007; Schwartz, Scholtens, Lalanne, Weenen, & Nicklaus, 2011).

Maternal Eating Disorders and Infant Diet Patterns

Our study provided evidence that infants of mothers with BN had a lower probability of being in the homemade traditional baby food class than the commercial jarred baby food class, compared to infants of mothers without eating disorders. Although some studies have demonstrated higher rates of feeding difficulties among infants of mothers with eating disorders (Micali, Simonoff, Elberling, et al., 2011; Micali et al., 2009), we were unable to identify other cohort studies that reported on the actual diet of infants of mothers with eating

disorders. One clinical study reported no gross deficiencies in the diets of infants and young children (age 1–4 years) of mothers with current and past AN or BN (Waugh & Bulik, 1999). Another study of 25 mothers with a history of eating disorders compared with 25 matched mothers (children age 6–36 months) reported no differences in terms of child diet composition, but the mothers with a history of eating disorders were more likely to report taking special restrictive approaches to feeding such as limiting processed foods or feeding organic foods only (Hoffmann et al., 2014). One recent study based on the ALSPAC study investigated dietary pattern in older children (3 to 9 years of age) (Easter et al., 2013). They reported that children of mothers with a history of AN or BN had less adherence to a "traditional" dietary pattern, consisting of meat, poultry, potato, and vegetable, compared with other children. Infants of mothers with BN in our study had a lower probability of being in the "homemade traditional" baby food class, which included homemade baby food based on meat and vegetables. It is possible that the results in both studies reflects that these mothers are making less traditional food, described by Easter and her colleagues (Easter et al., 2013) as the British "meat and two veg diet", which is not dissimilar to the standard diet in Norway. They also found a higher score on a "health conscious/vegetarian" dietary pattern (vegetarian food, nuts, salad, rice, pasta, and fruit) among children with mothers with a history of AN or BN. We saw the same tendency in our study for the AN mothers, but the result was not statistically significant, due to small cell size which yielded very wide confidence intervals.

There are several possible explanations for why infants of mothers with BN had a lower risk of being in the homemade traditional baby food class compared to being in the commercial jarred baby food class, than the mothers without any eating disorder. The mothers' own difficulties relating to eating and cooking, as reported by Woodside and Shekter-Wolfson (Woodside & Shekter-Wolfson, 1990), may influence their willingness to make their own baby food. Furthermore, Fahy and Treasure (Fahy & Treasure, 1989) reported that some mothers with BN not only had considerable difficulty feeding their children, also because they were afraid they might "binge" on their child's food, but they often did not keep food in the house to reduce temptation to binge eat. It is therefore possibly easier, and less anxiety provoking, to give pre-portioned jarred baby food than to make homemade baby food using ordinary ingredients found in the home pantry.

Another possible explanation is that mothers with BN prefer commercial instead of homemade baby food because they are unsure about what kind of food and what portion sizes to give their infant. Koubaa and colleagues (Koubaa, Hallstrom, & Hirschberg, 2008) found that 92% of the mothers in their study with BN or AN reported problems regarding their maternal adjustment and uncertainty regarding their ability to take care of their infant compared to only 13% in the control group. In line with this, Brown and Lee (Brown & Lee, 2011) reported that a problematic maternal e ating style (mothers high in restraint, external, and emotional eating) was associated with higher levels of concern for the infant's weight, monitoring, and restriction compared to other mothers (at child age 6–12 months). This uncertainty may also affect infant feeding and diet. These mothers may feel safer giving their infant commercial jarred baby food that is especially manufactured and portioned to meet the infants' nutritional needs. It is important to note that there was not a strong association between the classes and BN, even if it was statistically significant.

The different classes may represent different timing of introduction of solids. It is therefore possible that the preference for commercial jarred baby food class in mothers with BN may be explained by an earlier introduction of solids their infants. However, timing of the first introduction to solids is highly associated with breastfeeding, and the risk of early cessation before 6 months post-partum is not higher for women with BN in this sample compared with mother with no eating disorder (Torgersen et al., 2010). In addition, prior studies on infant diet at 6 months have reported that age of introduction to solids had no additional effect on infant diet at 6 months, after including maternal characteristics like education, age, BMI, and maternal diet (Robinson et al., 2007).

AN, EDNOS-P and BED were not associated with dietary patterns of infants. Although, relatively smaller sample sizes may have precluded the detection of significant associations between maternal AN or EDNOS-P and infant diet, the maternal BED sample was relatively large and failure to detect significant associations was likely not due to low statistical power. However, previous studies in MoBa had reported that the children of mothers with BED displayed more fussiness at 6 months (Zerwas et al., 2012), and more eating problems at 36 months (Reba-Harrelson et al., 2010) and thus, we had expected to find that maternal BED was also a ssociated with infants' diet patterns. It may be that by examining infant dietary patterns, instead of caloric or fat intake, we did not capture elements of diet associated with maternal BED, as for example, maternal BED is associated with greater fat intake during pregnancy in comparison to healthy controls (Siega-Riz et al., 2008).

In addition, because this study assessed eating disorders immediately before and during pregnancy, we were not able to report whether maternal symptoms persisted until 6 months postpartum. It is possible that we would have detected more significant results if we had excluded all the mothers who had remitted from their eating disorder at 6 months. We were also unable to control for possible feeding problems in the infant. There have been some reports of greater infant feeding problems such as slow feeding and refusal of solid foods, in infants of mothers with a lifetime history of an eating disorder (Micali et al., 2009). It is possible that the differences in dietary patterns found in our study also tend to reflect a response to infants' feeding problems and do not only directly reflect the mothers' preferences for different food groups or preparation style. In some countries, it would be important to ascertain whether mothers were working at six months and how that influences food choice. This was not measured in this study as 12 months of paid maternal leave is standard and childcare is not available for children younger than nine months. As such children are almost always at home with their parents or other caregivers at 6 months.

The strength of our study is the large prospective and longitudinal design, and the sufficiently large sample size to study uncommon conditions such as eating disorders. However, the findings of this study should be interpreted in the context of the following limitations. First, all information about the mother and child is based on self-report. The questions about eating disorders used to develop diagnostic algorithms reflected DSM-IV criteria, but direct interviews could have yielded richer diagnostic information. Our algorithms for BED included binge eating (unusually large amount of food and out of control) and the absence of inappropriate compensatory behaviors. Although we did not include the items that describe the binge experience that exist in DSM-IV, we are heartened

by the fact that the prevalence of BED in our sample mirrors that of other population-based studies. Second, although self-reported dietary patterns have been shown to be valid measures of the child's diet in the general population, there is a possibility that this result does not include mothers with eating disorders. These mothers may be particularly prone to errors or bias in reporting of dietary intake, which may have inflected our findings. Third, only 38% of invited women agreed to participate in MoBa. This response rate is, however, typical for large epidemiologic studies (Hartge, 2006), and recent analysis has shown that while prevalence estimates of exposures and outcomes in MoBa may be biased, estimates of exposure-outcome associations are not (Nilsen et al., 2009). The rates of breastfeeding in this study are also consistent with earlier, more representative Norwegian studies (Lande et al., 2003). However, MoBa participants are somewhat more educated than the general Norwegian population (61% attending some form of college compared to 50% in the general population between the ages of 25 and 29 and 46% between the ages 30 and 39). Moreover, given multiple filters for entering this study (i.e., an individual had to be sufficiently healthy to get pregnant, agree to participate, and put forth the energy to respond to the various waves of the MoBa protocol), those women with eating disorders who do participate may represent the healthier end of the eating disorder severity spectrum. Our results therefore might not reflect what is seen in clinically ascertained samples. Fourth, the prevalence of AN and EDNOS- P in the study was low. Analyses exploring associations with dietary patterns could therefore be underpowered to detect significant differences. However, the multinomial logistic regression analysis was based on the LCA-model, where all infants have a probability for being a member of each class. This improves the statistical power compared to analyses based on the most likely latent class membership, which have been done in most previous studies using LCA. There is also a need for confirmatory analyses based on other samples to replicate the LCA groups before this can be generalized to other populations.

In general, our study suggests some differences in the early diets in infants of women with BN. Our results do not allow us to determine whether these different patterns will have long-term effects on the heath or development of the children at this point. It is however important to follow these infants as they grow older and are introduced to a wider variety of foods. As infants transition from a milk-based diet to one that includes different food groups, how infants are fed and the quality of their diet can have important health implications. There are also possible long-term implications, since dietary patterns in infancy may set the foundation for future eating patterns and weight regulation. Detection and intervention is therefore recommended to facilitate and guide the mothers feeding habits.

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Appendix

Appendix

Intakes of foods (d/week) by maternal eating disorder

	Anorexia nervosa				Bulimia nervosa				EDNOS-P				Binge eating disorder				No eating disorder			
	Days a week																			
Commercial infant cereal: (days/week)	**0**	**1–3**	**4–6**	**7**	**0**	**1–3**	**4–6**	**7**	**0**	**1–3**	**4–6**	**7**	**0**	**1–3**	**4–6**	**7**	**0**	**1–3**	**4–6**	**7**
-rice or commeal (%)	34	21	11	34	37	16	10	37	28	20	11	41	38	15	11	36	38	15	11	36
-oats (%)	27	9	11	52	32	12	13	43	29	8	15	48	34	13	12	41	35	11	13	41
-wheat (%)	50	14	10	26	50	12	10	28	48	10	8	35	49	11	11	29	51	10	10	29
Homemade porridge:																				
-iron-enriched (%)	98	0	0	2	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0
-organic (%)	98	0	0	2	98	1	0	1	100	0	0	0	98	1	0	1	98	0	0	1
-millet (%)	93	5	0	2	95	2	1	2	98	2	0	0	96	2	1	1	95	2	1	2
-wheat, other (%)	95	5	0	0	97	2	0	1	100	0	0	0	98	1	0	1	98	1	0	0
Jars of baby food:																				
-fruit (%)	32	21	18	30	37	21	17	25	32	19	25	25	39	25	16	20	42	23	16	19
-vegetables (%)	49	16	16	19	53	24	10	13	48	21	10	21	58	20	10	12	59	21	9	11
-meat/vegetables (%)	43	11	14	32	50	15	13	22	38	19	23	21	55	16	12	18	56	16	11	17
Homemade baby food:																				
-fruit puree (%)	63	23	5	9	61	18	12	10	64	12	10	14	61	20	10	9	59	20	11	10
-vegetables (%)	57	29	5	10	62	22	7	9	67	19	10	4	61	23	9	8	59	24	8	9
-meat/vegetables	88	7	5	0	88	8	2	3	82	10	2	6	86	8	3	3	87	8	3	2
-fish/vegetables	88	10	2	0	94	6	1	0	87	9	2	2	93	5	1	1	93	5	1	1
-other	88	7	5	0	89	8	1	2	90	8	2	0	91	7	1	1	91	7	1	1
Rusks/bread/biscuits	79	7	10	5	78	12	4	6	73	17	8	2	80	11	5	4	82	10	4	4

Note: EDNOS-P = Eating disorders not otherwise specified - Purging subtype

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Highlights

- Latent class analysis identified five classes of infant diet in a population study of 53,879 mothers
- We compared the dietary patterns of infants of mothers with and without an eating disorder
- Fewer infants of mothers with bulimia nervosa were in the homemade traditional baby food class
- More infants of mothers with bulimia nervosa were in the commercial jarred baby food class
- Maternal eating disorders may influence the child's diet as early as 6 months

Table 1

Class-Specific Response Probabilities for each food group by infant diet classes identified in the final LCA model

	Homemade vegetarian	Homemade traditional	High variety food	Commercial infant cereal	Commercial jarred baby food	All
Commercial infant cereal: rice or cornmeal	0.48	0.59	0.73	0.63	0.63	0.63
Commercial infant cereal: oats	0.25	0.80	0.88	0.47	0.79	0.66
Commercial infant cereal: wheat	0.08	0.65	0.73	0.32	0.61	0.49
Homemade porridge: iron-enriched	0.02	0.01	0.02	<0.01	<0.01	0.004
Homemade porridge: organic, no added vitamins or minerals	0.31	0.01	0.04	0.01	<0.01	0.03
Homemade porridge: millet	0.58	0.02	0.08	0.02	0.01	0.05
Homemade porridge: wheat, semolina, or oats	0.12	0.07	0.06	<0.01	<0.01	0.02
Jars of baby food: Fruit	0.36	0.52	0.88	0.29	0.81	0.58
Jars of baby food: Vegetables	0.19	0.05	0.90	0.07	0.74	0.41
Jars of baby food: Meat and vegetables	0.09	0.16	0.98	0.02	0.81	0.44
Homemade: fruit puree	0.75	0.73	0.71	0.23	0.36	0.41
Homemade: vegetables	0.77	0.86	0.93	0.21	0.31	0.41
Homemade: meat and vegetables	0.09	0.52	0.77	>0.01	0.03	0.14
Homemade: fish and vegetables	0.03	0.31	0.43	>0.01	0.01	0.07
Homemade: other	0.08	0.38	0.54	>0.01	0.02	0.09
Rusks/bread/biscuits	0.13	0.42	0.50	0.04	0.19	0.18

Final class counts and proportions for the latent-class patterns based on estimated posterior probabilities, classes based on the estimated model. Probabilities >.50 are shown shaded in grey.

Table 2

Maternal characteristics by infant diet classes in the Norwegian Mother and Child Cohort Study

	Homemade vegetarian	**Homemade traditional**	**High variety food**	**Commercial infant cereal**	**Commercial jarred baby food**	**Total**	**χ^2 (df)**
% (n)	**5.31 (2849)**	**9.27 (4970)**	**11.85 (6350)**	**35.00(18765)**	**38.57 (20677)**	**100 (53611)**	
Eating disorders, % (n)							
Anorexia nervosa	0.15 (4)	0 (0)	0.13 (7)	0.06 (11)	0.12 (22)	0.09 (44)	
Bulimia nervosa	0.71 (19)	0.62 (28)	1.03 (56)	0.77 (133)	1.05 (198)	0.89 (435)	
EDNOS-P	0	0.08 (4)	0.21 (12)	0.08 (14)	0.14 (26)	0.11 (56)	
Binge eating disorder	4.12 (110)	5.00 (228194)	5.29 (289)	4.84 (836)	5.28 (994)	5.09 (2459)	
No eating disorder	95.01(2536)	94.30 (4305)	93.35 (5113)	94.24 (16290)	93.41 (175818011)	93.87 (45826)	χ^2=36.90(16)**
Breastfeeding at 6 mos, %	95.58	80.02	74.50	91.92	70.85	80.93	χ^2=2154.92(4)***
Mother's age, mean (S.E.)	30.42 (.099)	29.63 (.078)	29.27 (.068)	29.98 (.034)	29.20 (.035)	29.6 (4.6)	χ^2= 302.36(4)***
Mother's education, %							
Middle school	10.00	8.38	13.28	4.84	10.22	8.04	
High school	11.05	29.77	34.63	25.38	24.60	29.64	
Undergraduate	40.19	41.56	35.66	46.96	38.78	41.62	
Graduate	47.36	20.29	16.43	22.82	16.40	20.71	χ^2=1650.33(12)***
Milk allergies, *%*	16.55	3.38	5.39	5.05	4.18	5.51	χ^2=436.31(4)***
Colic, %	14.00	12.07	13.62	10.79	12.59	12.09	χ^2=40.48(4)***

Note: EDNOS-P = Eating disorders not otherwise specified - Purging subtype;

** < 0.01;

*** < 0.001.

Table 3

Associations between maternal eating disorder and infant diet in the Norwegian Mother and Child Cohort Study

		Homemade vegetarian		Homemade traditional		High variety food		Commercial infant cereal	
		OR	**95% CI**	***OR***	**95% CI**	***OR***	**95% CI**	***OR***	**95% CI**
Ref. no-eating disorder		1.00		1.00		1.00		1.00	
Anorexia nervosa	Unadj.	1.31	0.43–3.97	*a)*		1.12	0.44–2.88	0.55	0.23–1.31
	Adj.	2.08	0.62–6.95	*a)*		1.230.83	0.49–3.112.62	0.79	0.32–1.97
Bulimia nervosa	Unadj.	0.67	0.36–1.24	**0.58**	**0.35–0.96**	0.98	0.68–1.40	0.73	0.57–9.41
	Adj.	0.82	0.45–1.50	**0.60**	**0.36–0.99**	0.95	0.66–1.384	0.78	0.60–1.02
EDNOS-P	Unadj.	*a)*		0.56	0.14–2.31	1.50	0.68–3.32	0.59	0.29–1.21
	Adj.	*a)*		0.63	0.15–2.773.35	1.43	0.63–3.244.11	0.95	0.44–2.05
Binge eating disorder	Unadj.	**0.77**	**0.60–0.99**	0.94	0.78–1.13	1.00	0.85–1.18	0.91	0.81–1.01
	Adj.	0.88	0.68–1.14	0.96	0.80–1.16	1.000.97	0.85–1.18	1.010.99	0.90–1.13

Note. Unadjusted and adjusted for mother's age, education, breastfeeding at 6 months, colic, and milk allergies. Commercial jarred baby food is the reference group; *a)* = unable to estimate because of too few subjects. EDNOS-P= eating disorders not otherwise specified - purging subtype.