Original Article

The impact of maternal negative affectivity on dietary patterns of 18-month-old children in the Norwegian Mother and Child Cohort Study

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Abstract

Early dietary habits are formative for dietary habits later in life. Maternal personality might be an important factor in unhealthy feeding of children. The current study aims to assess the degree to which the personality trait of negative affectivity in mothers predicts their child's diet at age 18 months. This study is a part of the Norwegian Mother and Child Cohort Study conducted at the Norwegian Institute of Public Health. A total of 27 763 mothers completed 3 repeated assessments of negative affectivity before and after childbirth and of the child's diet when the child was 18 months old. Exploratory factor analysis was used to identify the dietary patterns, and structural equation modeling was used to investigate the relationship with negative affectivity adjusted for socio-demographical variables. Exploratory factor analysis of a foods frequency questionnaire revealed two dietary patterns in the child, labeled unhealthy diet and wholesome diet. The unhealthy diet comprised foods rich in sugar and fat; the wholesome diet comprised foods rich in fibre, vitamins and minerals. Mothers high in negative affectivity were more inclined to feed their child an unhealthy diet. The results were adjusted for maternal age, years of education, relative income, marital status, number of children, having the child in daycare, maternal smoking, maternal body mass index, and child gender. This study shows that a maternal personality trait, negative affectivity, is related to feeding the child an unhealthy diet after controlling for key socio-demographic variables.

Keywords: cohort, diet, infant, mothers, parenting, personality.

Background

In recent years, several research groups have studied patterns of early childhood diet from infancy to pre-school age in the Western world using exploratory statistical techniques (North & Emmett 2000;

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Aranceta *et al.* 2003; Northstone & Emmett 2005; Robinson *et al.* 2007). The two main dietary patterns found for weaned infants and children of pre-school age were an unhealthy diet rich in sugar and fat and a wholesome diet rich in fibre, vitamins and minerals.

The most important person for the establishment of dietary habits in the child during toddlerhood is usually the mother. Maternal decisions concerning their child's diet are influenced by social and psychological factors. With respect to social factors, studies have shown that younger maternal age, shorter education, lower income, a higher number of children, daily smoking, working outside the home and male child gender are risk factors for a more unhealthy child diet and a less wholesome diet (North & Emmett 2000; Northstone & Emmett 2005).

Of psychological factors, the influence of anxiety and particularly post-partum depression on difficulties in maternal feeding behaviour has been investigated (Coulthard & Harris 2003; Henderson *et al.* 2003). However, post-partum depression is relatively rare and often remits during the first year after childbirth. Therefore, lasting effects on child diet ought not to be expected. Instead, it could be useful to focus on the normally distributed, enduring personality trait of negative affectivity (NA). This trait does not itself express psychopathology but rather represents a liability for repeated episodes of anxiety and depression (Clark & Watson 1999). Persons high in NA are emotionally unstable, experience anxiety, anger and sadness frequently and tend to see the world in a negative light (Watson & Clark 1984). They are highly vulnerable to stress and tend to prematurely give up their goals in the face of obstacles (Vollrath *et al.* 1998; Vollrath 2001).

Child feeding is not only a rationally guided behaviour. It also entails distressing conflicts where maternal goals to feed the child a wholesome diet and child preferences clash. By 18 months of age children have clear preferences for sweet and fatty foods (Hill 2002) and are inclined to reject novel foods, not least fruits and vegetables (Birch *et al.* 1987).

It is not known how NA affects maternal feeding behaviour when the child is a toddler. However, we showed recently that mothers with high levels of

NA were more likely to give up breastfeeding earlier than at the end of the recommended period of 6 months (Ystrom *et al.* 2008). Moreover, high NA is related to not expecting the child to be capable of self-regulation, and to not experience control over the child (Lovejoy *et al.* 1997), and poor parental control (Metsapelto & Pulkkinen 2003). Therefore, we hypothesize that mothers high in NA will be less efficient in feeding their child a wholesome diet and more prone to feed their child an unhealthy diet. The present study is the first to address this issue in a large prospective population study.

Materials and methods

The Norwegian Mother and Child Cohort Study

The data collection was conducted as a part of the Norwegian Mother and Child Cohort Study (MoBa) at the Norwegian Institute of Public Health. MoBa was launched in 1999 with the aim to study health development (Magnus *et al.* 2006). The target population consisted of all pregnant Norwegian women who could read and write. There were no exclusion criteria, and all maternity units in Norway with more than 100 births annually were included. The MoBa study will reach its goal of recruiting 100 000 pregnancies within the end of 2008. Mothers were recruited for the study when they underwent their first prenatal ultrasound examination at gestation week 17 to 18. The participation rate in MoBa was 42.7%. Except for a small overrepresentation of women aged 30 to 34, 37.5% in MoBa vs. 33.2% in the total population, the MoBa sample represented the total population. Mothers filled out questionnaires at the 17th and 30th week of gestation and when the child is 6 and 18 months of age. Response rates during pregnancy were 95% and 92% at gestation weeks 17 and 30, 87% at 6 months after childbirth, and 77% at 18 months after childbirth. For the present study, we used information from the MoBa questionnaires administered at the four assessment points. In addition, we used information from the Medical Birth Registry of Norway (MBRN), which contains information about all births in Norway (Irgens 2000).

Sample

At the time that we conducted the present study, questionnaires from 28 242 participating mothers with a child that had reached 18 months of age were available. Of those mothers who participated several times, we included only the first participation. We excluded 1.5% ($n = 479$) of the participants because of missing data. The final sample consisted of 27 763 mothers.

Measures

Demographic, medical and socio-economic risk factors

We retrieved information on maternal age, gender and number of children from the MBRN. We retrieved information on years of education and relative income from the MoBa questionnaires. To scale income, we defined relative income largely in line with the definition of relative poverty used by the Organization for Economic Cooperation and Development: median income earned by mother and father during pregnancy as 0 and intervals of $\pm 50\%$ of the median as ± 1 . From the MoBa questionnaires, we also retrieved information on child care (child currently cared for at home by parents or child in day care), maternal daily smoking (currently daily smoking or not smoking), single mother (currently single mother or cohabitating/married) and current maternal body mass index (BMI).

Negative affectivity

We constructed a latent factor measure of mothers' NA from short scales measuring the NA components of anxiety and depression, anger, and self-esteem, pooling information from three assessments: at gestation week 30 and at 6 and 18 months after childbirth. This allowed us to tap the time-invariant dispositional core of NA and to obtain a measure with strong psychometric properties (for details, see Statistical Analysis below). We assessed the anxiety/depression component using an 8-item short version of the Hopkins Symptom Checklist (Strand *et al.* 2003), the anger component using three items from the anger subscale of the differential emotions scale (Izard *et al.* 1993), and the self-esteem component using a 4-item

short version of the Rosenberg self-esteem scale (Rosenberg 1989).

The MoBa cohort study also includes an assessment of the child's father at the 17th week of gestation (Magnus *et al.* 2006). In this assessment, the items used for modelling NA among mothers were included together with a measure of *emotional stability/neuroticism* from the *International Personality Item Pool* (Gow *et al.* 2005). The construct of emotional stability/neuroticism is equivalent to NA (Clark & Watson 1999). When correlating a latent NA variable construed in the fathers' data with a latent variable of neuroticism/emotional stability from the same dataset, we found a correlation of $r = 0.92$, suggesting an excellent validity of the NA-measure used in our study.

Child diet

We collected information on the current diet of the 18-month-old children from their mothers, who filled out a foods frequency questionnaire that included 36 dietary items on types of foods and drinks such as dairy products, cereal based porridge and fruit juice. Response categories ranged from 'never' to 'five or more times a day' for drinks and from 'never' to 'three or more times a day' for foods.

Statistical analysis

To compare the characteristics of the mothers included in the analysis and mothers excluded because of missing data, we performed independent *t*-tests for the continuous variables and chi-square tests for the categorical variables.

We conducted exploratory factor analysis (EFA), confirmatory factor analyses (CFA) and structural equation modelling using Mplus 5.0 (Muthén & Muthén 2007). For these analyses, we estimated missing data for dependent variables as a function of the covariates in the model. To impute missing data prior to estimation of the model on continuous independent variables with information from continuous covariates, we used the expectation-maximization algorithm. We excluded cases with missing data on categorical independent variables from the analyses.

Negative affectivity

To construct the NA components of anxiety/depression, anger, and self-esteem, we used CFA for ordinal data with polychoric correlations using robust weighted least-squares (WLS) estimation (Flora & Curran 2004). To secure measurement invariance across time, we forced the thresholds of the response categories within each item and the factor structure of each component to be equal across time points. First, we combined the three NA components at each time point into three latent variables of time-specific NA with equal factor loadings across time. As a next step, we constructed a cross-time NA latent variable, with the three time-specific NA variables as indicators, with equal factor loadings. This latent variable represents the stable core of NA across time. The scaling of the NA variable was standardized with a standard deviation of 1 and a mean of 0.

Dietary patterns

We applied an EFA on a polychoric correlation coefficients matrix, a technique for assessing the factor structure of tests involving ordinally measured items, to identify the dietary pattern factors from the 36 dietary items. We then chose the number of dietary pattern factors according to the scree plot. To scale the dietary variables we standardized them with a standard deviation of 1 and a mean of 0.

Structural equation modelling

We defined NA and the socio-demographic variables as independent variables and the two dietary patterns as uncorrelated dependent variables in a multivariate linear regression. To identify the model, we used robust WLS (Flora & Curran 2004; Muthén & Muthén 2007).

To evaluate model fit to the data, we interpreted the root mean square error of approximation (RMSEA), where a value below 0.06 is considered necessary for a good fit (Hu & Bentler 1998). Because we used robust WLS, it was not possible to estimate a confidence interval of the RMSEA (Muthén & Muthén 2007).

Table 1. Characteristics of the mothers included and those excluded because of missing data*

	Included (n = 27 763)	Excluded (n = 479)
Maternal age (y)	29.6 ± 4.5 [†]	29.2 ± 4.5
Child gender boy (%)	51.0	53.5 [475]
Daily smoking (%)	11.0	12.0 [191]
Child in day care (%)	60.5	54.0 [285] [‡]
Education (y)	14.5 ± 2.4	13.9 ± 2.6 [§]
Maternal BMI [¶]	24.7 ± 4.4	24.6 ± 4.2
Number of children (n)	0.8 ± 0.9	0.8 ± 0.9
Relative income**	0.0 ± 0.9	-0.1 ± 0.9 [§]
Single marital status (%)	3.7	3.5 [452]

*Number of cases in brackets; [†]Mean (SD) standard deviation (all such values); [‡]Significantly different from the included cases (chi-square test): $P < 0.05$; [§]Significantly different from the included cases (t -test): $P < 0.01$; [¶]Body mass index; **Median household income set to zero and intervals of 50% below or above median set to ± 1 .

Results

Participants

The mothers excluded from the analyses because missing data had fewer years of education and lower income, and their children were less often in day care (Table 1).

Dietary patterns

The dietary data conformed to two uncorrelated main factors and therefore applied varimax orthogonal rotation to ease interpretation. We retained two dietary patterns from the EFA, which we labelled *unhealthy diet* and *wholesome diet* (Table 2). The food items loading with 0.20 or more on the unhealthy diet factor were chocolate, sweets, soda, soda with artificial sweeteners, desserts, ice cream, fruit juice drinks with sugar, cakes, cookies, waffles, fruit juice drinks with artificial sweeteners, bread with jam or honey, juice, pancakes and tap water (negatively). This dietary factor comprises foods rich in sugar and/or fat. The food items loading above 0.20 on the wholesome diet factor were raw vegetables, boiled vegetables, fish, fruit, plain yogurt, rice, peas, beans, bread with fish products, soured milk, bread with cheese, pasta, bread with meat, soured milk with *Lactobacillus rhamnosus*

Table 2. Dietary patterns of 27 763 18-month-old children. Orthogonal rotated factor loadings of various dietary items in the two dietary factors identified in 18-month-old children based on the food frequency questionnaire (loadings above 0.2 are shown in bold)

	'Unhealthy'	'Wholesome'
Chocolate	0.76	-0.13
Sweets	0.76	-0.14
Soda	0.72	-0.15
Soda with artificial sweeteners	0.54	-0.14
Dessert and ice cream	0.52	0.07
Fruit juice drinks with sugar	0.49	-0.04
Cakes, cookies and waffles	0.46	-0.03
Fruit juice drinks with artificial sweeteners	0.41	-0.14
Bread with jam or honey	0.34	0.02
Juice	0.28	0.15
Pancakes	0.28	0.11
Tap water	-0.25	0.25
Industrial baby porridge	-0.19	-0.07
Flavoured yogurt	0.17	0.04
Full-cream milk	0.11	0.03
Semi-skimmed milk	0.10	0.04
Raw vegetables	-0.11	0.50
Boiled vegetables	0.04	0.44
Fish and fish products	0.02	0.44
Fruit	-0.11	0.43
Plain yogurt	-0.14	0.41
Rice	0.07	0.36
Peas and beans	0.02	0.36
Bread with fish products	-0.02	0.36
Soured milk	0.08	0.35
Bread with cheese	0.04	0.35
Pasta	0.11	0.34
Bread with meat	0.15	0.30
Homemade baby porridge	0.02	0.30
Soured milk with LGG	-0.05	0.29
Meat, sausage and meatballs	0.17	0.23
Potatoes	0.08	0.19
Bread with liver paste	-0.06	0.19
Bottled water	0.08	0.18
Extra semi-skimmed milk	0.00	0.14
Skimmed milk	-0.02	0.12

GG and meat. This dietary factor comprises foods rich in fiber, vitamins and minerals.

CFA of maternal personality

The CFA for ordinal data of maternal personality across three time points displayed a structure that was more than above adequate. The median item factor loadings for the Hopkins Symptom Checklist (anxiety/

Table 3. Regression coefficients between uncorrelated dietary patterns in 27 763 18-month-old children and maternal negative affectivity adjusted for socio-demographic characteristics*

	'Wholesome' [†]	'Unhealthy' [†]
Negative affectivity [‡]	-0.00 (-0.02, 0.02)	0.09 (0.07, 0.10)
Child gender boy	-0.07 (-0.10, -0.04)	-0.04 (-0.07, -0.02)
Daily smoking	-0.19 (-0.24, -0.15)	0.19 (0.15, 0.23)
Child in day care	-0.05 (-0.08, -0.02)	0.02 (-0.01, 0.05)
Education (y)	0.08 (0.07, 0.08)	-0.02 (-0.02, -0.01)
Maternal age (y)	0.02 (0.02, 0.03)	-0.03 (-0.04, -0.03)
Maternal BMI	-0.01 (-0.01, -0.01)	0.02 (0.02, 0.02)
Number of children (n)	-0.10 (-0.12, -0.08)	0.37 (0.35, 0.39)
Relative income [‡]	0.02 (-0.01, 0.04)	-0.06 (-0.08, -0.04)
Single marital status	0.07 (-0.01, 0.15)	-0.04 (-0.11, 0.03)

BMI, body mass index; *Data are given as adjusted regression coefficients (95% CI); [†]Standardized score; [‡]Median household income set to zero and intervals of 50% below or above median set to ± 1 .

depression), differential emotions scale (anger) and Rosenberg self-esteem scale (self-esteem) were good at 0.79, 0.80, and 0.78, respectively. The median factor loading of the time specific NA variables was satisfactory at 0.73. The median factor loading of the cross time NA variable was very good at 0.87.

Association of maternal personality with child dietary patterns

As expected, mother's level of NA was clearly associated with a greater inclination to feed the child an unhealthy diet, which is a diet rich in sugar and fat (Table 3). This association was independent of socio-demographic factors. At the same time, there was no association between mother's level of NA and feeding the child a wholesome diet.

Association of socio-demographic characteristics with child dietary patterns

Maternal socio-demographic and behavioural characteristics were associated with children's diet in several ways (Table 3). Mothers who were daily smokers, had higher BMI, several children, had their child in day care, or whose child was a boy were less likely to feed their child a 'wholesome' diet. Mothers with more years of education or who were older tended to feed

their child a more 'wholesome' diet. Mothers who were older, had more years of education, were relatively poor, or had boys tended not to feed their child an 'unhealthy' diet. Mothers who were daily smokers, had higher BMI, or had several children were more likely to have children with an 'unhealthy' diet.

The structural equation model reached a good fit to the covariance matrix with an RMSEA of 0.03.

Discussion

The principal finding of this investigation was that mothers with high levels of NA were more likely to feed their children an unhealthy diet, which is a diet rich in sugar and fat. At the same time, mothers high in NA were neither more nor less likely to feed their child a wholesome diet, i.e. a diet rich in fiber, vitamins and minerals. This effect persisted over and beyond earlier found socio-demographic risk factors.

The maternal socio-demographic characteristics were important in several respects, and replicate to large extent earlier findings in pre-school aged children. In terms of effect size the number of children was by far the most important predictor, with more than one-third standard deviation increase of unhealthy diet per child. Maternal daily smoking was also a substantial risk factor for feeding the child a less wholesome as well as a more unhealthy diet. The effect of the continuous variables in Table 3 are given as incremental change per interval. For example, a 3-year increase in maternal education should be interpreted as three times the effect given in Table 3. This difference in relation to wholesome diet is quite substantial.

These findings are novel in several respects. No previous study has explored the potential relation between mothers' personality characteristics and infant dietary patterns. Beyond that, our findings fit nicely with previously reported findings from this sample showing that mothers high in NA were more likely to terminate breastfeeding before the end of the recommended period of 6 months (Ystrom *et al.* 2008). Taken together, this suggests that mothers high in NA show a tendency to feed their child in a less than optimal way.

Nothing in the psychological literature suggests that NA fosters careless attitudes with regard to

health. On the contrary, persons high in NA tend to be preoccupied with health-related issues and are anxious about their own health (Vollrath *et al.* 1999). At the same time, individuals high in NA are vulnerable to stress and ineffective in coping (Vollrath 2001). Therefore, we suppose that the effects of mothers' NA are mediated through poor coping with conflicts that may arise in feeding situations, when the child is angry and screaming. Since mothers characterized by high NA to a lesser extent believe their child is capable of self-regulation (Lovejoy *et al.* 1997), it does not make sense to not interfere where the child could self-regulate. Specifically, we assume that mothers with high NA will use inconsistent parenting practices with respect to feeding. In support of the latter assumption, studies have shown that parents high in NA and low control experience exert both excessive and insufficient parental control (Janssens 1994; Metsapelto & Pulkkinen 2003). Inconsistent parenting, in turn, increases the risk of an unhealthy diet in children of various ages (De Bourdeaudhuij 1997; Patrick *et al.* 2005; Golan 2006).

Readers should note several limitations to our findings. First, the range and number of indicators for the dietary patterns were limited. On the other hand, 18-month-old children have a diet with a limited range. Second, the effect size for the influence of NA on the child's diet was small. Further, we assessed dietary patterns but not maternal feeding practices. Moreover, a complete personality assessment comprising five factors, which is standard today (John & Srivastava 1999), would certainly have shown a greater overall effect of personality. Unfortunately, the space limitations of the questionnaires did not allow the inclusion of a complete personality test.

With respect to clinical implications, our study suggests that mothers high in NA may feed their children sub-optimal diets, mostly because they may be less apt at coping with the challenges of feeding a child. It is easy for health personnel to recognize NA, as mothers high in NA tend to express excessive concerns, and they may appear helpless and dependent and show signs of insecurity. Health professionals dealing with mothers of children showing these signs may prevent problems by asking mothers questions pertaining to problems with feeding their child.

Future studies on maternal psychological influences on child feeding and diet ought to include the entire spectrum of the five personality traits, as several of them may be important for feeding behaviour. Moreover, to investigate mediating processes between maternal personality and childhood diet, future studies should assess stress experiences, experienced parental control, and feeding practices jointly with maternal personality and child dietary patterns.

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Conflict of interests

The authors declare that there is no conflict of interests.

Key messages

- Diets high in sugar and fat have been made responsible for the increasing prevalence of obesity in children. Socio-demographic factors, particularly low levels of education and number of children predict that mothers tend to feed their child with this type of diet.
- However, maternal personality also plays a role. Negative affectivity (NA) is a personality trait manifesting itself by the tendency to frequently experience anxious, depressive, shameful, and angry states of mind. Little has been known up to now about to the extent to which high NA in mothers affects the diet with which they feed their child.
- We showed that at child age 18 months, two distinguished, independent dietary patterns could be identified. The 'unhealthy' dietary pattern was characterized by a frequent intake of sugar and fat (e.g. chocolate, cookies, sodas). The 'wholesome' dietary pattern is characterized by a frequent intake of vegetables, fish and fruit.
- Mothers characterized by high levels of NA were more inclined to feed their child an unhealthy diet.
- Health education may be targeted at mothers displayed high levels of NA expressing distress with the task of feeding their child a healthy diet.

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Appendix

Negative affectivity: subscales, items and factor loadings

		NA*
Hopkins Symptom Checklist		0.83
Feeling fearful	0.76	
Nervousness or shakiness inside	0.80	
Feeling hopeless about the future	0.79	
Feeling blue	0.78	
Worrying too much about things	0.79	
Feeling everything is an effort	0.67	
Feeling tense or keyed up	0.68	
Suddenly scared for no reason	0.71	
Rosenberg self-esteem scale		0.76
I take a positive attitude toward myself	-0.84	
I certainly feel useless at times	0.83	
I feel I do not have much to be proud of	0.69	
I feel that I'm person of worth, at least on an equal plane with others	-0.74	
Anger subscale of differential emotions scale		0.73
Feel like screaming at somebody or banging at something	0.79	
Feel angry, irritated, annoyed	0.81	
Feel mad at somebody	0.81	

NA, negative affectivity; Factor loadings are from taken from the assessment at 18 months post-partum; *NA, negative affectivity.