

Breastfeeding and Stress in Children

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Abstract

Objective

Repeated serious stress e.g. repeated serious life events or chronic stress may contribute to increased morbidity. One of the most important protective health factors for children is breast-feeding, but the mechanisms for this effect are not fully elucidated. Our objective was to assess if the duration of breastfeeding actually could influence degree of stress of children still at school-age.

Methods

A random sample of 126 children from the ABIS-study, a prospective population-based child cohort study in southeast of Sweden was included. We had registered duration of breastfeeding and a number of psycho-social factors related to breast-feeding and/or stress. As a biomarker of stress we measured the child's cortisol in hair at 8 years of age.

Results

We found a negative correlation ($r = -0.23$, $p = 0.009$) between total duration of breastfeeding and hair cortisol levels. In a multivariate analysis this association persisted ($p = 0.006$) even when adjusted for other potential intervening factors like age of mother at delivery and early psychosocial vulnerability in the family, an index based on 12 factors.

Conclusion

A long breastfeeding seems to decrease stress many years later in children. This is a reason to facilitate for mothers to breast-feed their children, also in the modern society where women are expected to have a professional life.

Background

Stress is part of the homeostasis associated with health (1). Transient increased stress either caused by trauma, psychosocial factors, infections etc. can usually be managed by the body (2), while repeated serious stress e.g. repeated serious life events (3) or chronic stress may contribute to increased morbidity. There is no simple way to determine stress over longer time but in recent years cortisol in hair, reflecting the cortisol concentrations of the body for some months since hair grows ca 1 cm/month (4), has been used as biomarker for long-term stress both in animals (5,6) and in humans (4,7,8,9).

A number of factors in early childhood play an important role for health later in life. Early psychosocial stress acts as a health trajectory in to adulthood (10,11). One of the most important health factors is breast-feeding (12,13). The mechanisms are supposed to be related to prevention of infections, influence on the gut flora, effects on the immune system related to maturation of the immune system and development of tolerance against antigens etc. Breast-feeding with its close contact between mother and

child has also profound psychological effects on the child. Duration of breastfeeding is related to several factors such as age and social circumstances of the mother, smoking behavior. It is therefore difficult to know what role breast-feeding plays per se. As we in a prospective birth cohort study of a general child population, ABIS (All Babies in Southeast Sweden) have detailed information on breastfeeding and possibility to determine cortisol in hair of the children during childhood, we have studied whether breast-feeding may influence stress levels during childhood.

Materials And Methods

The ABIS-study

All parents with children born between October 1st in 1997 and October 1st in 1999 in Southeast Sweden (N = 21.700) were asked to participate in the ABIS study (All Babies in Southeast Sweden), a prospective cohort study. Out of the 21.700 invited families 17.055 (78.6%) gave their informed consent to participate. Questionnaires were answered at birth and then at the age of 1, 3, 5, 8, 12-13 years of age, and different biological samples were collected at the follow-ups. During the first year of life a diary was used for daily registration of certain nutritional data, infections etc. In the questionnaires, parents were asked for duration of breastfeeding. Exclusive breastfeeding means no other food than breast-milk. Partial breastfeeding is defined as breastfeeding in addition to formula or other food. In this analyses we focus on total breastfeeding, defined as the duration of any breastfeeding (exclusive and partial breastfeeding). The registration by the mothers has been validated by comparison with breast-feeding data registered at the well-baby clinics showing very high agreement.

In earlier follow-up of questionnaire data (from the whole ABIS cohort) one year after birth showed that 78.4% of infants were exclusively breast-fed at 3 months, 10.1% at 6 months and 3.9% up to 9 months. Partially breast-fed children were 68.9% at 6 months, while 43.6% were partially breast-fed to at least 9 months of age (14). The median exclusive breastfeeding duration was four months and the median duration for total breastfeeding eight months. Maternal smoking, high maternal BMI, and being a single mother were associated with short-term exclusive breastfeeding. Both maternal and paternal age was positively associated with the duration of both exclusive and partial breastfeeding (Huus 2008).

In this study we analyzed a subpopulation of ABIS-children and parents since we were interested in studying different psychosocial factors impact on long-term HPA-axis activity i.e prolonged stress measured by cortisol in hair (8). For 126 ABIS children at 8 years of age we had sufficient hair samples to be analysed and also reliable information about breastfeeding, as well as other relevant data of the child, mother and family. Duration of breastfeeding was measured through a questionnaire to the mothers one year after the childbirth, when she answered about the duration in months of exclusive and partial breastfeeding. Possible confounding factors include child's gender, child's birth weight (low, normal and high), gestational age (early, normal or over time), type of delivery (vaginal, Cesarean section or other problems), mother parity (first born or earlier parity), age of mother at delivery (range 18-40 years), if mother smoked during pregnancy, and a composite index of early psychosocial vulnerability in the family

including different indicators: single mothers, unemployment, low family income, low parental education, parents born abroad, mother experience of serious life events, not feeling safe or lack of social support during pregnancy (4).

Measures of cortisol in hair

Trained staff cut strands of hair from the posterior vertex area of the participants' heads in accordance with guidelines published by the Society of Hair Testing (15). The hair was then enclosed in sealed plastic tubes marked with identification numbers and stored in room temperature until analysis. All analyses were performed at the laboratory of Clinical Chemistry at the University of Linköping. The first 3 cm of outgrowth were analyzed for cortisol concentrations using a competitive radioimmunoassay in methanol extract (Morelius 2004). At least 3 mg of hair was required for reliable measurements. The samples were dissolved in radioimmunoassay buffer and analyzed. Hair samples between 3-10 mg were required to maintain a total inter-assay coefficient of variation below 8% for hair extraction and measurement of cortisol by the radioimmunoassay. The method is fully described elsewhere (8,16)).

Statistical analysis

Statistical analyses was made by using the Statistical Package for the Social Sciences software, version 23 (IBM SPSS Statistics, IBM Corporation). The measured cortisol values were logarithmised before the statistical analysis due to possible skewness in the distribution. In the univariate tests analysis of variance (ANOVA) was used for comparisons of mean. For the association between continued variables, Pearson's correlation coefficient was applied. Variables statistically significant in the univariate analysis were included in a multivariate linear regression model. A p-value <0.05 was considered statistically significant.

Results

We found an association ($p=0.009$; $r= -0.23$) between total length of breastfeeding and hair cortisol levels when the child was 8 year old. The longer the child was breastfed the lower the cortisol in hair, (**Figure 1**).

In addition we noticed that the duration of total breastfeeding was longer for elderly mothers ($p=0.013$). The children's cortisol levels at eight years were higher for those with younger mothers ($p=0.016$), those delivered by cesarean section or with other problems at delivery ($p=0.003$), and if mothers were smoking during pregnancy ($p=0.004$), (**Table 1**).

In a multivariate analysis the association between long duration of breastfeeding and lower cortisol levels persisted ($p=0.006$) even when adjusted for other potential intervening factors like the index of early psychosocial vulnerability in the family and age of mother at delivery. The children had also higher cortisol levels at eight years if the child was not delivered vaginally ($p=0.006$) or if the mother smoked during pregnancy ($p=0.030$).

Discussion

Few would question the value of breastfeeding for children, and its close contact between mother and child. In our study we show how long duration of breastfeeding is associated with lower cortisol in hair, a biomarker of stress, of the children at the age of 8 years, which may reflect one important mechanism behind the protective effect of breastfeeding from several diseases. We have previously shown that serious life events early in life are related to the development of diabetes-related autoantibodies (17,18) and that serious life events during childhood increases the risk of developing Type 1 diabetes three-fold (3). Early stress is also related to development of several other common health problems e.g. obesity (19,20). Breast-feeding has been found to protect against Type 1 diabetes and obesity, with different possible explanations. One mechanism may be our finding that long breastfeeding is related to lower cortisol in children still at the age of 8, as cortisol both influences the immune system and increases insulin resistance.

Our results are robust as the registration of duration of breastfeeding is done close to the breastfeeding period, and we have validated the data by comparison with registration at well-baby clinics. The stress is measured using a biomarker determined with a reliable and accurate method.

Conclusion

In conclusion our results show that long breastfeeding is associated with lower cortisol levels in the child many years later. These findings give implications for public health. Mothers should be encouraged to breast-feed their children also in the modern society, since stress reduction promotes health.

Declarations

Ethics approval and consent to participate

The ethics committee of Linköping and Lund universities approved the ABIS project. All participants/caregivers provided informed consent.

Consent for publication

Not applicable.

Availability of data and materials

The dataset is available from the corresponding author upon reasonable request

Competing interests

The authors declare no competing interests.

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Authors contributions

JL designed and created ABIS, delivered all data, worked with the manuscript. ÅOF and TF made statistical calculations and worked with the manuscript. All authors approved the final version.

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Tables

Table 1. Hair Cortisol Concentration at Age 8 (n = 126), Univariate and Multivariate Analyses of Some Perinatal and Sociodemographic Factors and Length of Breastfeeding.

	Total length of breast feeding		Cortisol concentration at 8 years			
	Univariate		Univariate		Multivariate*)	
	F-value	p-value	F-value	p-value	Beta	p-value
Gender (boys/girls)	0.75	0.389	0.32	0.571		
Birth weight (low, normal, high)	0.84	0.436	1.86	0.160		
Gestational age (early, normal, over time)	1.82	0.166	0.81	0.447		
Type of delivery (vaginal/section/other problems)	0.28	0.599	9.31	0.003	0.25	0.006
Mother parity (firstborn, earlier parity)	2.51	0.116	1.74	0.190		
Age of mother at delivery (from 18 to 40 years of age)	2.00	0.013	1.95	0.016	-1.08	0.282
Early psychosocial vulnerability in the family (index of 12 variables)	2.40	0.072	0.25	0.859	-0.47	0.637
Mother smoking during pregnancy (not smoked, smoked)	0.62	0.434	8.62	0.004	0.19	0.030
Duration of of breast feeding (<1 month - 10 months)	-	-	-0.23 #)	0.009	-2.82	0.006

All univariate associations measured by Anova except #) measured by Pearson correlation.

*) Multivariate model: df=5, adj R²= 0.15, F=5.38, p<0.0001

Figures

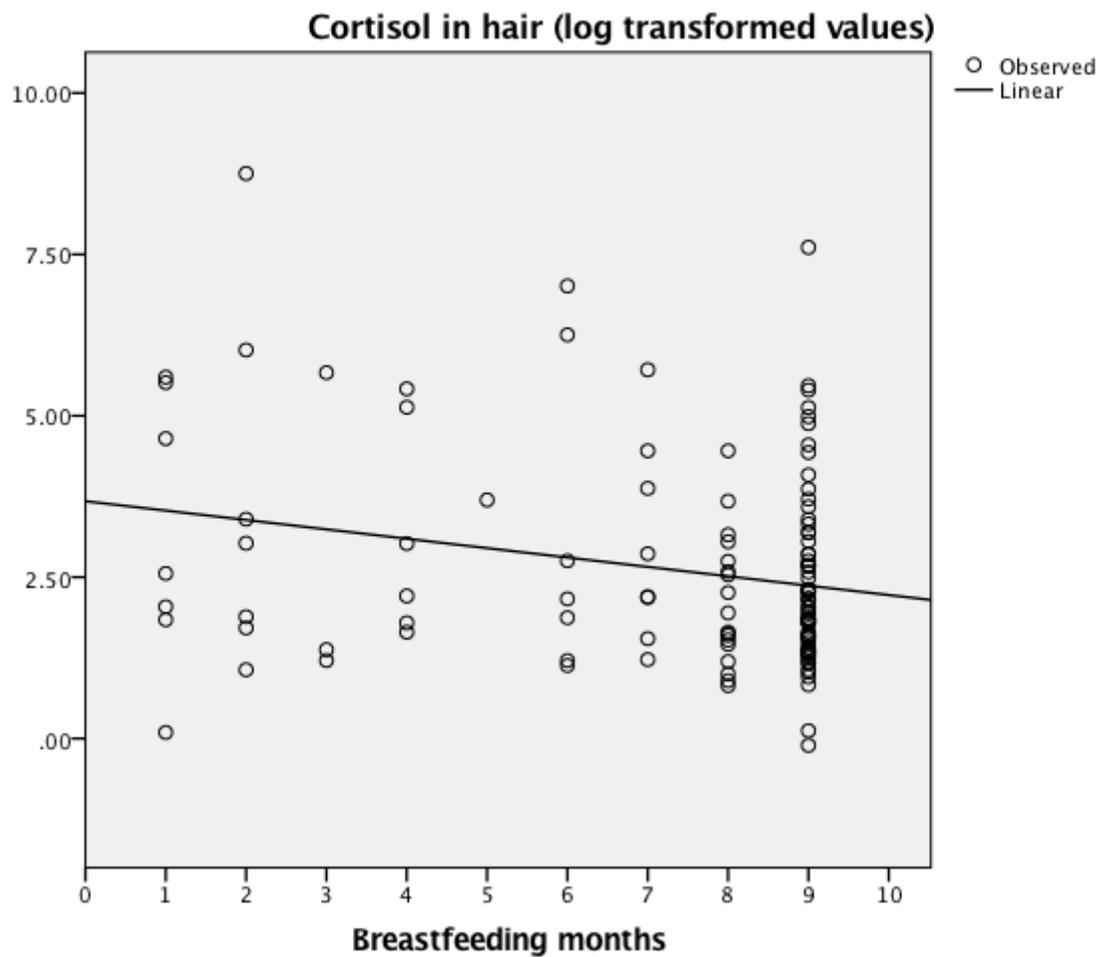


Figure 1

Breastfeeding length and cortisol concentration. Correlation between total duration of exclusive and partial breastfeeding and cortisol concentration (log-transformed) in hair for (N=126) 8 year old children ($r = -0.23, p = 0.009$).