

Original article

Fatty acids in colostrum from mothers of children at high risk of atopy in relation to clinical and laboratory signs of allergy in the first year of life

Background: It remains controversial whether fatty acid (FA) composition of breast milk relates to development of atopy in the infant. This study evaluates FA in colostrum from mothers of children at high risk of atopy in association with atopy at the age of 1 year.

Methods: The FA of colostrum were analyzed for 218 children (60 with low birth weight between 1500 and 2500 g, 84 with a history of maternal atopy, and 74 with an elevated cord blood immunoglobulin (Ig)E of > 0.9 IU/ml). Total lipids were extracted, methylated and separated by gas–liquid chromatography.

Laboratory screening for allergic sensitization and clinical examination took place within the Leipzig Allergy Risk Children's Study (LARS).

Results: Low birth weight was correlated with low percentage levels of 20:2n-6, 22:2n-6, and 22:3n-3 ($r = 0.14$, $P < 0.05$; $r = 0.14$, $P < 0.05$ and $r = 0.20$, $P < 0.01$, respectively) and low gestational age at birth was correlated with low 22:3n-3 ($r = 0.15$, $P < 0.05$). There was no association between FA and atopic eczema at the age of 1 year. However, high linoleic acid (LA, 18:2n-6) was linked to high specific IgE against cow's milk protein ($P < 0.05$), and low docosapentaenoic acid (DPA, 22:5n-3) was associated with elevated total serum IgE ($P < 0.05$) at the age of 1 year, respectively.

Conclusions: The polyunsaturated fatty acid composition of colostrum in a high risk newborn population shows associations with atopic sensitization at the age of 1 year and may be predictive for later atopic disease.

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The relationship between fatty acids (FA), in particular long chain polyunsaturated fatty acids (long chain PUFA, LCP) and atopy has been heavily investigated since the first observation of increased levels of linoleic acid (LA, 18:2n-6) and lower levels of its long chain metabolites in the plasma of patients with eczema (1). A number of LCP are involved in inflammatory responses, where most member of the n-6 PUFA series such as AA (20:4n-6) and its metabolites leukotriene B₄ and prostaglandin E₂ show proinflammatory capacity (2). In contrast, the n-3 series, e.g. eicosapentaenoic acid (EPA, 20:5n-3) and docosahexaenoic acid (DHA, 22:6n-3), are mostly referred to as suppressing the inflammatory response (3). The parent PUFA, LA (18:2n-6) and alpha-linolenic acid (LNA, 18:3n-3), respectively, compete for the same enzyme systems, desaturases and elongases. Linoleic acid and LNA are essential and have to be provided with the diet. Thus, the nutritional intake influences PUFA composition of the body, where small

changes between the n-3 and n-6 series can have important effects on physiological processes and may influence the development of allergy (4).

The major nutritional source for newborns is breast milk. It is still controversial whether the FA composition of breast milk may relate to the development of atopy in the child. Breast milk that was given to atopic children has been reported to higher LA (5) or lower n-6 LCP (6) than milk given to healthy children, but other studies found instead decreased n-3 LCP (7, 8).

In our study, we investigated the FA composition of colostrum in a population of 218 newborns at high risk of atopy: (1) low birth weight (LBW) infants (< 2500 g), (2) newborns of atopic mothers, and (3) newborns with elevated cord blood immunoglobulin (Ig)E (> 0.9 IU/ml). The main aim of this study was to investigate links between the FA composition of colostrum and signs of atopy in the child. We analyzed our data in association with the development of clinical atopy and allergic

sensitization in the first year of life, as followed-up within the Leipzig Allergy Risk Children's Study (LARS). By choosing a high-risk population we aimed to increase sensitivity of analysis because of an expected higher percentage rate of atopic individuals. Additionally, we wanted to see whether these risk factors would be differentially reflected in the colostrals FA composition. Finally, by choosing colostrum for analysis we wanted to explore, whether possible alterations in breast milk composition might be visible at this early, well-defined timepoint of lactation.

Material and methods

Patients and general experimental design

Between March 1995 and March 1996, 429 LBW neonates (birth weight between 1500 and 2500 g and without neonatal intensive care) and neonates with elevated cord blood IgE >0.9 kU/l or double positive family atopy history were selected from a full 1 year birth cohort ($n = 3540$) within the LARS study. The response rate was 47.9% (429 of 895 with these criteria). Two hundred and eighteen of these 429 mothers additionally agreed on providing breast milk samples for FA analysis. They also answered a nutritional questionnaire to ensure comparable diet. Vegetarian mothers were allowed to enter the study. Only three mothers declared to have been on a vegetarian diet, and all of those reported to have consumed cow's milk products. No mother declared to be on a predominantly fish diet or on other 'exotic' diets, what would have led to her exclusion from the study.

The corresponding 218 children were grouped into one of three risk groups according to modified criteria from LARS, and as such included in the study described here. Group 1 consisted of 60 of these 218 children (27.5%) who had a LBW ($1500 < \text{b.w.} < 2500$ g). Forty-one of these 60 LBW newborns (68%) were also premature (<37 completed gestational weeks). Group 2 was formed of 84 newborns (38.5%) with a history of maternal atopy. Group 3 included 74 newborns (34%) showing an elevated total IgE in cord blood (>0.9 kU/l; Pharmacia CAP System, Pharmacia, Feucht, Germany). The mean birth weights ($\pm$ SD) for groups 1–3 were 2218 ± 247 g, 3483 ± 422 g, and 3452 ± 453 g, respectively. The mean gestational age at birth (mean $\pm$ SD) for groups 1–3 were 36.1 ± 2.3 , 39.3 ± 1.2 , and 39.5 ± 1.1 weeks, respectively.

The grouping was performed hierarchically in the sequence given, i.e. all LBW newborns were grouped into group 1 (irrespective of additional risks such as maternal atopy or high IgE), then all non-LBW with maternal atopy went into group 2 (irrespective of IgE-level), followed by non-LBW, nonmaternal atopy newborns with elevated IgE in group 3.

Clinical and laboratory evaluation of atopy

At the age of 6 weeks and at the age of 1 year, parents responded to questionnaires on signs of allergy in the children, and infants underwent a medical examination by an experienced pediatrician (U.D.). A clinical endpoint under the pediatrician's judgment was atopic dermatitis diagnosed according to Sampson's criteria (9). Blood samples were taken at the age of 1 year in an outpatient department of the children's hospital specifically designed for the follow-up of the study. Among other parameters tested, determin-

ation of total IgE, and specific IgE as well as radioallergosorbent test (RAST) against a battery of antigens (milk protein, egg white, egg yolk, grass, birch, aspergillus, candida, *Dermatophagoides pteronyssinus*, *D. farinae*, cat) were performed as described previously (10). Total and specific IgE were measured from the same blood sample and simultaneously, without prescreening for total IgE. All antibodies and kits were provided by Pharmacia, Feucht, Germany. Laboratory analyses were performed without knowledge of the clinical evaluation of the patient. Signs of atopy were compared with PUFA in colostrum of children with 5 months or more of exclusive breast-feeding in order to ensure a possible maximal effect of breast milk while still having enough children for statistical valid analysis (analyses for 4 months, 3 months and irrespective of duration of breast-feeding were also done, but did not reveal additional statistical associations with FA, data not shown). The 5 months children group had been of special interest, as in a previous study of LARS investigating other aspects of this cohort, a correlation between breast-feeding for at least 5 months and the frequency of eczema at the age of 1 year had been found for children with elevated cord blood IgE (11).

Breast milk sampling

Between day two and five after birth, 2–7 ml samples of midstream colostrum were collected in duplicates into sterile plastic collecting jars and stored at -20°C until analysis. The mothers were instructed to collect the milk in the early morning, at the first meal.

Preanalytical treatment of samples

The principles of analysis have been described previously (12) and received modifications in incubation temperature and period for best results with the given samples. Briefly, a 0.2 ml sample of milk was mixed with 5 ml of methanol : acetyl chloride (50 : 1, v/v) and incubated for 90 min at 70°C . The process of ester formation was stopped by adding sodium bicarbonate. After adding hexane and vortexing, the upper phase, containing the FA methyl esters was removed, purified by centrifugation and diluted with hexane before analysis.

Analysis by gas chromatography

Fatty acid methyl esters were separated and quantitated using a Hewlett Packard (HP) 5890 series II chromatograph (HP Co., Avondale, PA) with a HP INNO WAX (30 m $\times$ 0.32 mm $\times$ 25 μm) column coated with cross-linked polyethyleneglycole and quantitated by a 3396A HP integrator with a split ratio of 1 : 32. Helium gas was used as carrier gas (5.7 ml/min). Identification of FA of carbon chain length C10–24 occurred by comparison with commercially available standards (Supelco Inc. and Sigma Chemical Co., St Louis, MO). The level of each FA was expressed as weight percent of total lipid.

Statistical analysis

Data were analyzed with the statistical package SPSS 9.0 (Chicago, IL). Nonparametric analyses were performed as FA had been recorded as weight percentages of total weight. Nonparametric ANOVA (Kruskal–Wallis H -test) was performed in the three group comparison of the risk population (The Kruskal–Wallis ANOVA by Ranks test assumes that the variable under consideration is continuous and that it was measured on at least an ordinal (rank

order) scale. The test assesses the hypothesis that the different samples in the comparison were drawn from the same distribution of from distributions with the same median. Thus, the interpretation of the Kruskal–Wallis test is basically identical to that of the parametric one-way ANOVA, except that it is based on ranks rather than on means. Mann–Whitney's *U* test (a nonparametric rank sum test) was performed for pairwise comparisons between FA and with clinical and laboratory expression of allergy. Spearman's Rank correlation was employed for comparison of FA with birth weight and gestational age at births. Individual Spearman's correlation coefficients *r* are listed. Differences were considered statistically significant if $P < 0.05$.

Ethical considerations

Participation in the study was voluntary. Informed consent was obtained from the parents of all children. The study was approved by the Ethics Committee of the University of Leipzig.

Results

Table 1 compares the FA composition of colostrum in 218 mothers of children at high risk of atopic disease.

Table 1. Fatty acid composition (% wt/wt; median, interquartile range IR) of colostrum in mothers of children at high risk of atopic disease

Fatty acid	All risk groups (<i>n</i> = 218)		Low birth weight (1550–2500 g) (<i>n</i> = 60)		Atopic mother (<i>n</i> = 84)		Elevated cord blood immunoglobulin E (>0.9 IU/l) (<i>n</i> = 74)	
	Median	IR	Median	IR	Median	IR	Median	IR
10:0	0.17	0.15	0.18	0.28	0.18	0.15	0.16	0.14
12:0	1.55	1.01	1.70	1.54	1.51	1.01	1.49	0.89
14:0	4.14	1.76	4.22	2.12	4.13	1.94	3.99	1.46
14:1n-5	0.14	0.06	0.13	0.08	0.14	0.06	0.14	0.05
15:0	0.34	0.12	0.33	0.15	0.35	0.12	0.33	0.12
16:0	22.72	2.49	22.59	3.08	22.75	2.72	22.75	2.61
16:1n-7	2.30	0.67	2.29	0.69	2.24	0.64	2.34	0.75
18:0	8.34	1.59	8.20	1.70	8.37	1.94	8.29	1.41
18:1n-9c	38.38	3.78	38.62	4.52	38.39	3.93	37.97	3.38
18:1n-9t	1.70	0.44	1.68	0.54	1.70	0.41	1.71	0.40
18:2n-6	9.34	2.86	9.31	2.79	9.15	3.41	9.68	2.44
18:3n-9	0.11	0.06	0.10	0.06	0.10	0.06	0.12	0.08
18:3n-6	0.05	0.07	0.05	0.09	0.05	0.07	0.04	0.06
18:3n-3	0.80	0.25	0.78	0.29	0.79	0.21	0.81	0.23
18:4n-3	0.41	0.14	0.42	0.14	0.41	0.13	0.41	0.21
20:0	0.31	0.09	0.31	0.10	0.30	0.10	0.30	0.08
20:1n-9	1.16	0.29	1.12	0.38	1.18	0.29	1.15	0.28
20:2n-6	0.67	0.26	0.61	0.28	0.72	0.23	0.69	0.33
20:3n-6	0.63	0.24	0.65	0.26	0.61	0.22	0.62	0.26
20:4n-6	0.83	0.24	0.82	0.28	0.84	0.21	0.85	0.20
20:3n-3	0.12	0.04	0.12	0.03	0.12	0.04	0.13	0.04
20:5n-3	0.11	0.05	0.11	0.05	0.11	0.05	0.10	0.05
22:0	0.18	0.12	0.17	0.12	0.19	0.12	0.18	0.12
22:1n-9	0.24	0.07	0.24	0.08	0.25	0.08	0.24	0.09
22:2n-6	0.12	0.06	0.11	0.07	0.13	0.06	0.12	0.07
22:4n-6	0.36	0.19	0.34	0.19	0.36	0.18	0.36	0.21
22:3n-3	0.10	0.05	0.08	0.04	0.10	0.04	0.10	0.06
22:5n-3	0.34	0.14	0.31	0.14	0.33	0.14	0.34	0.15
22:6n-3	0.75	0.26	0.71	0.28	0.76	0.26	0.76	0.20
24:1n-9	0.26	0.17	0.24	0.15	0.28	0.16	0.26	0.18
Total n-6	12.05	3.00	11.87	2.78	11.87	3.25	12.24	3.03
LCP n-6	2.63	0.72	2.54	0.64	2.67	0.67	2.68	0.86
LA/n-6 LCP	3.53	1.40	3.45	1.37	3.49	1.62	3.65	1.23
Total n-3	2.69	0.49	2.70	0.51	2.70	0.52	2.66	0.59
LCP n-3	1.41	0.48	1.40	0.48	1.41	0.54	1.42	0.42
LNA/n-3LCP	0.57	0.25	0.56	0.29	0.57	0.30	0.60	0.22
SAFA	38.07	5.41	38.12	6.70	38.59	5.33	37.77	4.62
MUFA	44.28	4.00	44.43	5.30	44.11	4.02	44.14	3.50
PUFA	14.88	3.17	14.72	3.14	14.79	3.44	15.10	3.32
P/S-ratio	0.39	0.13	0.38	0.14	0.39	0.12	0.41	0.13
n-6/n-3	4.54	1.34	4.46	1.26	4.58	1.47	4.60	1.08
n-6 LCP/n-3 LCP	1.85	0.44	1.87	0.52	1.84	0.40	1.85	0.38

wt, weight; SAFA, saturated fatty acids; MUFA, monounsaturated fatty acids; PUFA, Polyunsaturated fatty acids; P/S, PUFA/SAFA; LCP, long chain PUFA. No statistical differences (nonparametric ANOVA or Kruskal–Wallis).

When the three risk groups, each defined by a single risk factor, were compared, no differences were seen. Neither the saturated FA, nor monounsaturates or n-6 series or n-3 series of polyunsaturates in each group showed statistically significant deviations. Furthermore, when a group was formed of all atopic mothers (group 2 + atopic mothers in group 1) and compared against the remaining (all nonatopic) mothers, also no associations with the FA status of colostrums were detected.

While the group comparisons did not reveal differences, correlation analyses with birth weight (irrespective of the arbitrary threshold of 2500 g defining LBW) and gestational age at birth did. Low birth weight was shown to be correlated with low 20:2n-6, 22:2n-6, and 22:3n-3 ($r = 0.142$, $P < 0.05$; $r = 0.136$, $P < 0.05$; and $r = 0.196$, $P < 0.01$, respectively). Low gestational age at birth (which as expected correlated by itself with LBW, $r = 0.558$, $P < 0.001$) correlated with low 22:3n-3 ($r = 0.147$, $P < 0.05$).

We also compared the breast milk of the three mothers who declared to have been on a vegetarian diet with that of their nonvegetarian counterparts. The breast milk did not differ significantly within the respective groups and in the total risk population, respectively.

Table 2 shows the results of the comparison of FA with clinical expression of allergy (atopic eczema) at the age of 1 year. Of the initial 218 children 164 were seen at the age of 1 year. Results are demonstrated for the 78 children exclusively breast-fed for at least the first 5 months. These 78 children consisted of 11 children (14%) of group 1, 36 children (46%) of group 2, and 31 children (40%) of group 3. The data demonstrate that there were no differences between the weight percentages of PUFA in colostrum of children expressing atopic eczema or obstructive bronchitis compared with clinically healthy infants at the age of 1 year.

Table 3 comparatively lists the colostrum PUFA for the children with and without allergic sensitization at the age of 1 year. Statistically significant differences between the groups are marked. Here, the parent FA of the n-6 series of polyunsaturates, LA, was higher among mothers with children bearing specific IgE against cow's milk ($P < 0.05$). This effect also leads to a higher amount of total n-6 series of PUFA ($P < 0.01$), an elevated ratio of LA to LNA ($P < 0.05$), and an elevated ratio of n-6/n-3 PUFA ($P < 0.05$). No changes were seen among the long chain derivatives of LA, AA and dihomogamma-linoleic acid (DHGLA, 20:3n-6) in relation to specific IgE. In contrast, DPA (22:5n-3) was found to be decreased ($P < 0.05$) in the breast milk of mothers of children with elevated total IgE in serum at the age of 1 year. Other members of the n-3 series including EPA and DHA were found unchanged. Data are presented for children with 5 months or more of exclusive breast-feeding for possible maximal effect of breast milk. Analyses of 4 months, 3 months, and irrespective of duration disclosed no additional statistical differences.

Table 2. Parent fatty acids and polyunsaturated fatty acids (% wt/wt; median, interquartile range IR) in colostrum of children at high risk of allergy and expression of atopic eczema at the age of 1 year. Results are shown for children exclusively breast-fed for at least the first 5 months

	Atopic eczema at the age of 1 year			
	Yes ($n = 17$)		No ($n = 60$)	
	Median	IR	Median	IR
Omega (n)-6				
18:2n-6	8.81	3.16	9.10	2.78
20:2n-6	0.63	0.29	0.63	0.24
20:3n-6	0.56	0.20	0.63	0.22
20:4n-6	0.81	0.21	0.84	0.19
22:2n-6	0.12	0.04	0.12	0.06
22:4n-6	0.38	0.18	0.36	0.19
Total n-6	11.26	4.18	12.02	2.93
n-6 LCP	2.69	0.62	2.61	0.78
18:2n-6/n-6 LCP	3.35	1.63	3.43	1.26
Omega (n)-3				
18:3n-3	0.74	0.35	0.80	0.22
20:3n-3	0.13	0.04	0.12	0.04
20:5n-3	0.11	0.06	0.10	0.04
22:3n-3	0.10	0.05	0.10	0.06
22:5n-3	0.34	0.16	0.34	0.16
22:6n-3	0.72	0.27	0.79	0.31
Total n-3	2.77	0.36	2.73	0.45
n-3 LCP	1.42	0.63	1.41	0.55
18:3n-3/n-3 LCP	0.45	0.40	0.57	0.24
18:2n-6/18:3n-3	11.02	5.19	11.46	2.46
Total n-6/total n-3	4.12	1.55	4.53	1.29

wt, weight; LCP, long chain polyunsaturated fatty acids.

No statistical differences (Mann-Whitney's *U*-test).

Analyses of other specific IgE tested showed no associations between FA and sensitization. Fourteen children (of the 78 children exclusively breast-fed for at least 5 months) were tested CAP positive against egg white, and seven against egg yolk. Sensitization against respiratory allergens was considerably lower as expected: grass (two children), birch (two), cat (one), aspergillus (one), candida (one), *D. pteronyssinus* (1), *D. farinae* (none). For all of these antigens, analyses of breast-feeding periods of 4 months, 3 months, and irrespective of duration showed no statistical association with the FA investigated (data not shown).

Discussion

Our data demonstrate an association between the PUFA composition of colostrum of mothers of children at high risk of atopy and an increased rate of atopic sensitization in the child. High percentage levels of LA (18:2n-6), and resulting higher LA/LNA ratio and higher total n-6/n-3 ratio were correlated with high specific IgE against cow's milk protein, and low levels of 22:5n-3 and low total n-3 were associated with elevated serum total IgE at the age of 1 year.

Table 3. Parent fatty acids and polyunsaturated fatty acids (% wt/wt; median, interquartile range IR) in colostrum of children at high risk of allergy and signs of allergic sensitization at the age of 1 year. Results are shown for children exclusively breast-fed for at least the first 5 months

	Elevated total IgE in serum (>34 IU/ml)				Specific IgE against cow's milk in serum (CAP > 0)			
	Yes (n = 31)		No (n = 32)		Yes (n = 8)		No (n = 54)	
	Median	IR	Median	IR	Median	IR	Median	IR
Omega (n)-6								
C 18:2n-6	9.12	3.49	9.28	2.79	11.11*	8.73	8.07*	2.64
C20:2n-6	0.62	0.24	0.66	0.26	0.73	0.37	0.62	0.21
C 20:3n-6	0.60	0.20	0.67	0.21	0.75	0.22	0.61	0.22
C 20:4n-6	0.82	0.18	0.86	0.18	0.84	0.26	0.83	0.16
C22:2n-6	0.12	0.06	0.13	0.05	0.14	0.08	0.12	0.06
C22:4n-6	0.35	0.16	0.36	0.19	0.36	0.12	0.35	0.18
Total n-6	11.64	2.41	12.21	2.89	13.57**	9.19	11.55**	2.56
n-6 LCP	2.51	0.78	2.65	0.73	2.93	0.90	2.60	0.60
C 18:2n-6/n-6 LCP	3.82	1.46	3.38	1.17	4.32	2.49	3.41	1.14
Omega (n)-3								
C 18:3n-3	0.75	0.28	0.81	0.26	0.91	0.49	0.78	0.27
C 20:3n-3	0.12	0.04	0.12	0.04	0.11	0.09	0.12	0.04
C 20:5n-3	0.10	0.04	0.11	0.04	0.10	0.04	0.11	0.05
C 22:3n-3	0.10	0.0	0.10	0.06	0.10	0.06	0.10	0.06
C 22:5n-3	0.31*	0.11	0.38*	0.18	0.32	0.11	0.35	0.14
C 22:6n-3	0.74	0.26	0.86	0.36	0.74	0.35	0.77	0.28
Total n-3	2.66*	0.42	2.88*	0.41	2.75	0.45	2.75	0.46
n-3 LCP	1.29	0.56	1.60	0.61	1.33	0.58	1.46	0.54
C 18:3n-3/n-3 LCP	0.62	0.30	0.48	0.22	0.61	0.29	0.56	0.26
C 18:2n-6/C 18:3n-3	11.77	4.62	11.27	2.46	14.54*	4.27	11.12*	2.48
Total n-6/total n-3	4.62	1.51	4.21	1.15	5.63*	2.06	4.16*	1.20

* $P < 0.05$; ** $P < 0.01$ (Mann–Whitney's U -test).
LCP, long chain polyunsaturated fatty acids; IgE, immunoglobulin E.

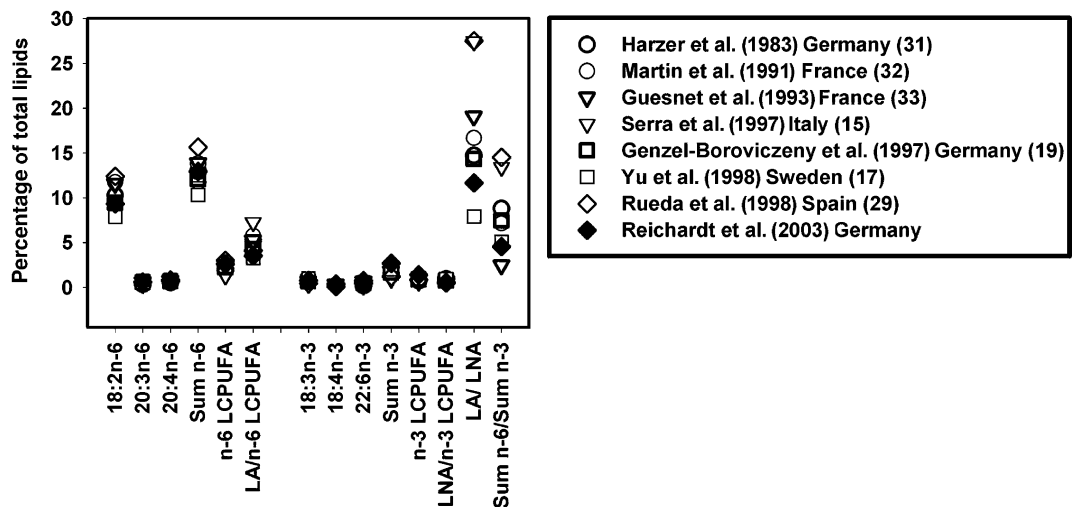


Figure 1. Percentages of characteristic polyunsaturated fatty acids (PUFA) and PUFA ratios as determined in our study compared to results from studies of colostrum of healthy Caucasian women in developed (Western) central European countries on a normal, nonmediterranean diet.

Our observation resembles data from previous studies of breast milk, where high LA and low n-3 LCP (6), low n-3 LCP plus low total n-3 (7), and low total n-3 and high n-6/n-3 ratio (because of both higher n-6 and lower n-3)

(8) were linked to atopic development in children. Studies in serum phospholipids also found higher LA (13–15), lower n-3 LCP (33) or both (8, 16) in atopic compared with healthy individuals. Many of these studies also

found decreased n-6 LCP. In fact, for many years research was more focused on disturbances in the n-6 series. The concomitant increase of LA and decrease of n-6 LCP gave rise to the idea of an abnormal metabolism in atopic individuals, namely of an impaired conversion of the C18 precursors into their LCP products because of enzymatic deficiencies (16, 17). However, this hypothesis is not unquestioned (14). Recently, the importance of disturbances in the n-3 series for the development of atopy has been stressed (7, 8). In one report, only the composition of n-3 LCP was related to atopic development in children (18). 22:5n-3, which we found connected to elevated serum IgE is the metabolic linker between 20:3n-5 (EPA) and 22:6n-3 (DHA) both of which have reportedly anti-inflammatory capacity (3).

The varying results in previous studies regarding PUFA in breast milk in relation to atopy may have one reason in the fact that the percentage of LCP in breast milk varies substantially throughout lactation. The PUFA metabolites were found to be highest in colostrum and to decrease later (12, 19). Thereby, the decline of n-3-PUFA during lactation occurs more rapidly than of n-6-PUFA (17), what has to be considered in analysis. In our study, we chose colostrum for several reasons. First, sampling breast milk at one convenient and well-defined timepoint minimizes errors because of varying composition of breast milk during the time course of lactation. Secondly, some studies investigating breast milk in the context of atopy were able to observe differences at earlier timepoints, which disappeared later through lactation (7, 17). Thirdly, because of the higher percentual contents of PUFA metabolites in colostrum, possible differences can be more apparent and increase the reliability of detection. This can be of importance, as many of the characteristic PUFA are available in only low quantities.

Our observation of associations between PUFA in colostrum and atopic sensitization but not clinical atopy at the age of 1 year can likely be explained by the early timepoint of clinical analysis. While clinical symptoms for atopy, e.g. atopic dermatitis, start often before the age of 1 year (9), many and more specific symptoms will become apparent only later. However, there is evidence that exposure to environmental antigens, modulated by genetic susceptibility, can result in allergic sensitization very early (22). As sensitization generally precedes manifestation of atopy, our finding of associations with atopic sensitization may point to a possible development of allergy later in life. It would therefore be of interest to follow-up the children included for a longer time. In this regard, is it somewhat disappointing that there was no association between FA and IgE specific to hen's egg protein, as the presence of such antibodies in the first year of life is reportedly predictive for allergic sensitization against other antigens later in life (23). However, we observed sensitization against cow's milk protein, which can also be associated with a higher incidence of asthma later in childhood (24).

A secondary result of our study was that the FA composition of colostrum did not differ between the three individual risk groups when compared with each other. In fact, the composition seemed to closely match values obtained in studies of colostrum of healthy Caucasian women in developed (Western) central European countries on a normal, nonmediterranean diet (see Fig. 1). Maternal nutrition is a key influence factor for the composition of breast milk (20). We had all women included in our study fill in a nutritional questionnaire to exclude 'exotic diets'. Breast milk of the three vegetarians in our study was not statistically different from nonvegetarians. It is known that vegetarian diet can lead to increased levels of LA, and LNA as well as to reduced levels of DHA (21). While we have no solid explanation for the lack of difference in our study, it is possible that the low number of participating vegetarians and the fact that all three reported to have consumed cow's milk products may have masked some differences.

Our data suggest that the risk factors 'elevated cord blood IgE' in the child and 'atopic mother' were not reflected in the colostrum FA composition. A number of studies observed lower LA in the milk of atopic mothers (7, 25), but others did not (8, 26). It is possible that some deviations will only reveal in mature milk, while being masked in colostrum or early transitional milk (7, 18).

Our data correlating birth weight and gestational age at birth with LCP levels in breast milk confirm previous reports (19, 27). However, other studies were unable to find differences when preterm and term breast milk was compared (28, 29). The selection of an appropriate time point of investigation may again be of importance for the results.

In conclusion, our data show that links between the FA status of breast milk and atopic sensitization in children can be observed as early as during the first few days of lactation, in colostrum. Apart from the advantage of using a well-defined and convenient timepoint, it seems worthwhile to speculate on the future importance of detecting FA deficiencies early after birth. Future studies will need to further our understanding of defects in metabolic pathways of FA related to atopic disease. They also might reveal specific deficiencies in subgroups of individuals/families at high risk of atopy. It is possible to envision that some of these patients might profit from an early individual supplementation of nutrition by specific LCP, an approach currently recommended only for nutritional purposes for very LBW infants (30).

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