ARTICLE

Effect of Supplementing Pregnant and Lactating Mothers With *n*-3 Very-Long-Chain Fatty Acids on Children's IQ and Body Mass Index at 7 Years of Age

Ingrid B. Helland, MD, PhD[a,b], Lars Smith, PhD[c], Birgitta Blomén, MSci[c], Kristin Saarem, PhD[d], Ola D. Saugstad, MD, PhD[b], Christian A. Drevon, MD, PhD[b]

[a]Department of Nutrition, Institute of Basic Medical Sciences, [b]Department of Paediatric Research, Faculty of Medicine, and [c]Institute of Psychology, University of Oslo, Oslo, Norway; [d]Peter Möller Department of Orkla ASA, Oslo, Norway

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What's Known on This Subject

We previously demonstrated that maternal intake of *n*-3 very-long-chain PUFAs as cod liver oil compared with *n*-6–rich corn oil, from week 18 of pregnancy to 3 months after delivery, promotes increased cognitive function among 4-year-old children.

What This Study Adds

Children were followed to 7 years of age to examine whether maternal supplementation of *n*-3 very-long-chain PUFAs during pregnancy and lactation would improve cognitive function. There was no significant effect of marine fatty acid supplementation at this age.

ABSTRACT

OBJECTIVES. Arachidonic acid (20:4n-6) and docosahexaenoic acid (22:6*n*-3) are essential for brain growth and cognitive development. We have reported that supplementing pregnant and lactating women with *n*-3 very-long-chain polyunsaturated fatty acids promotes higher IQ scores at 4 years of age as compared with maternal supplementation with *n*-6 polyunsaturated fatty acids. In our present study, the children were examined at 7 years of age with the same cognitive tests as at 4 years of age. We also examined the relation between plasma fatty acid pattern and BMI in children, because an association between arachidonic acid and adipose tissue size has been suggested.

METHODS. The study was randomized and double-blinded. The mothers took 10 mL of cod liver oil or corn oil from week 18 of pregnancy until 3 months after delivery. Their children were tested with the Kaufman Assessment Battery for Children at 7 years of age, and their height and weight were measured.

RESULTS. We did not find any significant differences in scores on the Kaufman Assessment Battery for Children test at 7 years of age between children whose mothers had taken cod liver oil ($n = 82$) or corn oil ($n = 61$). We observed, however, that maternal plasma phospholipid concentrations of α-linolenic acid (18:3*n*-3) and docosahexaenoic acid during pregnancy were correlated to sequential processing at 7 years of age. We observed no correlation between fatty acid status at birth or during the first 3 months of life and BMI at 7 years of age.

CONCLUSION. This study suggests that maternal concentration of n-3 very-long-chain polyunsaturated fatty acids during pregnancy might be of importance for later cognitive function, such as sequential processing, although we observed no significant effect of *n*-3 fatty acid intervention on global IQs. Neonatal fatty acid status had no influence on BMI at 7 years of age. *Pediatrics* 2008;122:e472–e479

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Key Words
dietary supplements, polyunsaturated fatty acids, breast milk, cognitive function, BMI

Abbreviations
AA—arachidonic acid
DHA—docosahexaenoic acid
LA—linoleic acid
ALA—α-linolenic acid
PUFA—polyunsaturated fatty acid
EPA—eicosapentaenoic acid
K-ABC—Kaufman Assessment Battery for Children

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Address correspondence to Ingrid B. Helland, MD, PhD, Division of Paediatrics, Rikshospitalet HF, N-0027 Oslo, Norway. E-mail: ingrid.helland@rikshospitalet.no

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Arachidonic acid (AA; 20:4*n*-6) and docosahexaenoic acid (DHA; 22:5*n*-3) are essential for brain growth and cognitive development. DHA and AA are important components of neuronal and retinal membranes and accumulate rapidly in the brain and retina during the later part of gestation and early postnatal life.[1–3] AA and DHA can be part of the diet or synthesized from shorter essential fatty acids of the respective families. AA is derived from linoleic acid (LA; 18:2*n*-6) and DHA from α-linolenic acid (ALA; 18:3*n*-3). Fetal and maternal synthetic capabilities are not known, and it seems as if the perinatal essential fatty acid status depends on maternal intake. During pregnancy, AA and DHA are preferentially transported across the placenta into fetal venous blood.[4,5] After birth, the neonate is supplied AA and DHA via breast milk but the content of essential polyunsaturated fatty acids (PUFAs) in breast milk is related to maternal intake of these fatty acids.[6,7]

The hypothesis that maternal *n*-3 very-long-chain PUFA intake is essential for optimal visual and neurologic development during early life has promoted several observational,[8–11] as well as interventional, studies[12–17] with different results. We have reported earlier that supplementing pregnant and lactating women with n-3 very-long-chain PUFAs promotes higher IQ scores at 4 years of age, as compared with maternal supplementation with n-6 long-chain PUFAs.[18] Pregnant women were supplemented with cod liver oil (n-3 very-long-chain PUFAs) or corn oil (n-6 PUFAs) from 18 weeks of pregnancy until 3 months after delivery. In our present study, the children were (re-)examined at 7 years of age with the same cognitive test as at 4 years of age.

It has been suggested that n-6 long-chain PUFAs are potent promoters of both adipogenesis in vitro and adipose tissue development in vivo. A high content of LA in mature breast milk and a high LA/ALA ratio might favor the development of adipose tissue during infancy.[19] We, thus, investigated the correlation between the concentration of these fatty acids in plasma phospholipids at birth and BMI at 7 years of age and the correlation between these fatty acids in breast milk during the first months of life and BMI at 7 years of age.

MATERIALS AND METHODS

Study Design

The participating infants in the present study were followed up after examining the effect of supplementing mothers with n-3 very-long-chain PUFAs on birth weight, gestational length, and infant development during the first year of life.[20] The mothers randomly received 10 mL per day of either cod liver oil or corn oil from 18 weeks of pregnancy until 3 months after delivery. The oils were supplied by Peter Möller (Department of Orkla ASA). The cod liver oil contained 1183 mg/10 mL of DHA, 803 mg/10 mL of eicosapentaenoic acid (EPA; 20:5n-3), and a total of 2494 mg/10 mL of $\sum n$-3 PUFAs (including 18–22 carbon atoms fatty acids). The corn oil contained 4747 mg/10 mL of LA and 92 mg/10 mL of ALA.[20] The amount of fat-soluble vitamins was identical in the 2 oils (117 μg/mL of vitamin A, 1 μg/mL of vitamin D3, and 1.4 mg/mL of DL-α-tocopherol). Norwegian guidelines for infant nutrition recommended that all infants have 5 mL of cod liver oil daily from 4 weeks of age.

Pregnant women were enrolled between December 1994 and October 1996 at Rikshospitalet University Hospital and Baerum Central Hospital in the Oslo area. The participating women were healthy and aged 19 to 35 years at inclusion. Only nulliparous or primiparous women with single pregnancies were included. Neonates requiring special attention were excluded.[20] The study was double-blinded and randomized, and the participating women received written information and consented to enroll in the study, which was approved by the regional ethics committee.

Information about the mothers and their diet was collected from pregnancy records and from food frequency questionnaires. Characteristics of the infants were obtained from birth records and information given by the mothers via questionnaires. When the children were tested for cognitive function at 7 years of age, the parents filled in a new questionnaire concerning cod liver oil intake, the child's general health, and the parents' educational level. The children were also weighed, and their height was measured.

Study Population

A total of 341 mothers took part in the study until giving birth. All of the infants of these women were scheduled for assessment of cognitive function at 6 and 9 months of age, and 245 complied with the request[20] (Fig 1). As part of the protocol, 84 subjects from this population were tested with the Kaufman Assessment Battery for Children (K-ABC)[21] at 4 years of age.[18]

All of the children who were tested with the Fagan Test of Infant Intelligence during their first year of life were invited for intelligence testing with the K-ABC at 7 years of age. A total of 143 children came for assessment, 82 from the cod liver oil group and 61 from the corn oil group (Fig 1). Birth data of the study population, growth data at 7 years of age, and sociodemographic characteristics of the parents are described in Table 1. The study population (n = 143) did not differ from the population that did not take part in the follow-up (n = 198) concerning gestational age, birth weight, birth length, head circumference at birth, placental weight, maternal parity, maternal BMI, or maternal smoking habits during pregnancy (data not shown). Maternal age was higher in this study population than in the population not taking part in the follow-up (28.9 vs 27.6 years; $P < .001$). Maternal education (at delivery) was also significantly longer among the mothers of the children who met for testing at 7 years of age than for the mothers of the children who did not show up (14.7 [SD: 2.1] vs 13.8 [SD: 2.4] years; $P = .001$).

We received information about cod liver oil intake during preschool age from all of the mothers. In the cod liver oil group, 44 (54%) of 82 children had taken cod liver oil on a regular basis, whereas 22 had taken it sporadically. The rest (16 children) had not taken supplements of cod liver oil. In the corn oil group, 28 (46%) of 61 children had taken cod liver oil regularly, 14 sporadically, and 19 had not taken cod liver oil. There was no statistical difference between the groups concerning intake of cod liver oil.

There also were not any statistical differences between the 2 groups concerning illness. In the cod liver oil group, 50 parents (61%) of 82 reported that their child had not suffered from any serious illness. In the corn oil group, the number was 36 (59%) of 61. In the cod liver oil group, 4 children had pneumonia, whereas 5 children in the corn oil group had pneumonia during their first 7 years of life. In the cod liver oil group, 3 parents reported that their child suffered from asthma and/or allergy, whereas 6 parents in the corn oil group reported the same.

Blood and Milk Samples

Blood samples were collected from the mothers during pregnancy, the umbilical cords, and from the infants by

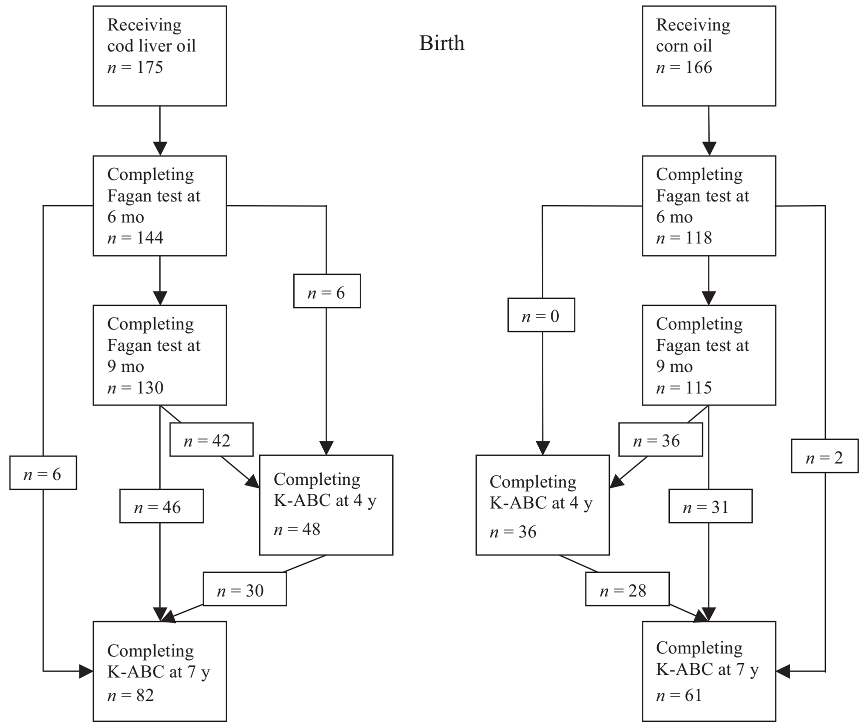

FIGURE 1
Flowchart for participants in the 7-year follow-up study providing background for correlation and regression analyses.

venipuncture at the ages of 4 weeks and 3 months. Breast milk samples were collected at 4 weeks and 3 months after delivery. The content of fatty acids in plasma phospholipids and breast milk was determined by gas liquid chromatography as earlier reported.[7,22]

Dietary Evaluation

All of the participating mothers filled in a self-administered food frequency questionnaire when they entered the study (week 18) and at week 35 of pregnancy. The questionnaire has been validated repeatedly, demonstrating that the questionnaire may be used for estimation of dietary intake of *n*-3 very-long-chain PUFAs, as well as most other nutrients.[23–25] The mothers were asked to continue their habitual diet during the study period.

TABLE 1 **Characteristics Related to Pregnancy, Birth, Growth, and Sociodemography of the Participants at the 7-Year Follow-up Among Infants of Mothers Receiving Cod Liver Oil or Corn Oil From Week 18 of Pregnancy Until 3 Months After Birth**

Variable	Cod Liver Oil ($n = 82$)	Corn Oil ($n = 61$)
Gestational length, mean (SD), d	280.5 (9.7)	277.5 (11.1)
Birth weight, mean (SD), g	3613 (458)	3518 (560)
Birth length, mean (SD), cm	50.8 (1.8)	50.5 (2.3)
Birth head circumference, mean (SD), cm	35.3 (1.3)	35.1 (1.5)
Maternal age at delivery, mean (SD), y	29.7 (3.3)	28.6 (2.6)[a]
Parity, 0/1	58/24	42/18
Maternal BMI, mean (SD), kg/cm^2	22.8 (2.6)	22.1 (2.9)
Weight at 7 y of age, mean (SD), kg	26.8 (4.1)	27.0 (4.1)
Height at 7 y of age, mean (SD), cm	127.5 (5.5)	128.6 (5.0)
BMI, mean (SD), kg/cm^2	16.4 (1.7)	16.3 (1.7)
Boys/girls	35/47	34/35
Cod liver oil intake, regular/sporadically/not	44/22/16	28/14/19
Mothers smoking, yes/no	15/66	16/44
Midparental education, mean (SD), y	14.9 (2.0)	14.8 (1.9)

[a] $P \leq .05$.

Assessment of Intelligence

The K-ABC is a method for evaluation of intelligence and achievement designed for children aged 2.5 to 12.5 years.[21] This multisubtest battery is composed of 4 scales: sequential processing, simultaneous processing, achievement (not used in the present study), and nonverbal abilities. The sequential and simultaneous processing scales are hypothesized to reflect the children's style of problem solving and information processing. Examples of sequential processing are memory of numbers and word order. The best measure of simultaneous processing is face recognition. Scores from these 2 scales are combined to form a mental processing composite, which serves as the measure of intelligence in the K-ABC. The nonverbal scale is not an independent scale. It is composed of subtests from the sequential and simultaneous processing scales that do not require words. The examiner may convey instructions through gestures, and the child may respond with movements. The sequential and simultaneous processing scales were designed to reduce the effects of verbal processing and gender and ethnic bias. The sequential processing scale was designed to measure children's ability to solve problems that require the arrangement of stimuli in sequential or serial order, whereas the simultaneous processing scale was designed to measure children's ability to solve spatial, analogical, or organizational problems that require processing of

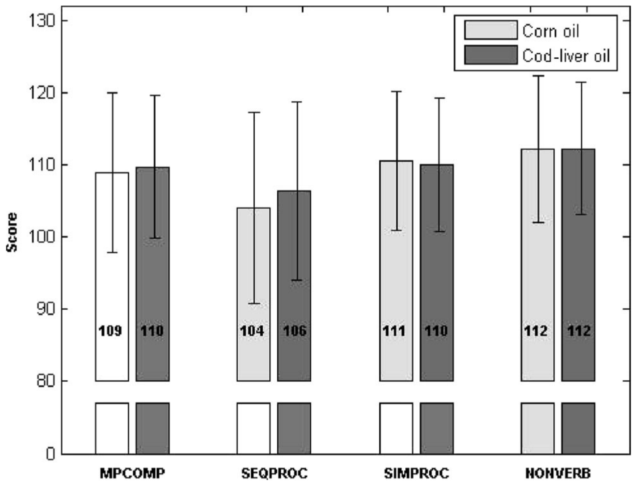

FIGURE 2
Scores on the K-ABC at 7 years of age for children whose mothers had taken cod liver oil ($n = 82$) or corn oil ($n = 61$) during pregnancy and lactation. Values for the different subtests are shown. MPCOMP indicates mental processing composite; SEQPROC, sequential processing; SIMPROC, simultaneous processing; NONVERB, nonverbal abilities.

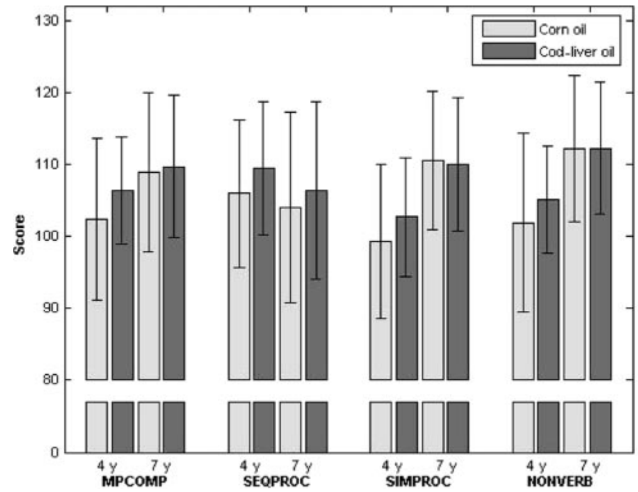

FIGURE 3
Scores on the K-ABC tests at both 4 and 7 years of age for children whose mothers had taken cod liver oil ($n = 30$) or corn oil ($n = 28$) during pregnancy and lactation. Values for the different subtests are shown. MPCOMP indicates mental processing composite; SEQPROC, sequential processing; SIMPROC, simultaneous processing; NONVERB, nonverbal abilities.

many stimuli simultaneously. Raw scores are transformed into standard scores with means of 100 and SDs of 15. Because the K-ABC does not have a Norwegian standardization, the raw scores were converted to standard scores according to the US norms.

Statistics

From previous data,[18] we calculated that we needed 83 persons in each group to obtain a difference in IQ scores of 4.1 (SD = 9.4; $\alpha = 5\%$; $\beta = 20\%$).

Data are presented as means (SDS). Student's *t* test and analysis of covariance were used to examine differences between groups for continuous variables. For categorical values, the χ^2 test was used. Correlation coefficients were calculated using the Pearson's test. Multiple regression analyses to study the effect of different PUFAs on cognitive function were also used. In addition to demographic variables (gestational length, head circumference, maternal age, parity, gender of the child, cod liver oil intake by the child, maternal smoking habits, and parental education), different PUFAs (maternal plasma phospholipid concentrations of ALA, EPA, DHA, Σn-3, and Σn-3/Σn-6 in week 37 of the pregnancy; umbilical plasma phospholipid concentrations of AA, EPA, and DHA; infant plasma phospholipid concentrations of ALA, EPA, and DHA at 4 weeks and at 3 months of age; and breast milk concentrations of EPA and DHA 4 weeks and 3 months after delivery) were entered in the equation. We also used regression analyses to study the effect of different PUFAs (breast milk concentrations of LA, ALA, AA, EPA, and DHA at 4 weeks and at 3 months of age) on BMI at 7 years of age. Moreover, we used other demographic variables (maternal BMI at the beginning of pregnancy, birth weight, gender of the child, cod liver oil intake by the child, maternal smoking habits reported when the child was 7 years of age, and parental education) in the regression analyses. Final models were obtained using both forward and backward variable selection strategies. *P* values of ≤.05 were considered significant. SPSS 13.0 for Windows (SPSS, Inc, Chicago, IL) was used for calculations.

RESULTS

Cognitive Function

We did not find any statistical differences in the K-ABC scores at 7 years of age between the 2 groups of children whose mothers had received different fatty acid supplementation from week 18 of pregnancy until 3 months after delivery (Fig 2). There was a tendency toward higher scores in the cod liver oil group concerning sequential processing, but this did not reach statistical significance.

The scores on the K-ABC test for the group being tested both at 4 and at 7 years of age are shown in Fig 3 and Table 2. We did not find any significant differences between the 2 groups at either 4 or at 7 years of age, but at 4 years there was a clear tendency toward higher scores in the cod liver oil group. In both groups we found a significant increase in IQ scores on the mental process-

TABLE 2 ***P* Values After Analyses of the Scores on the K-ABC Test for the Group Being Tested at Both 4 and 7 Years of Age**

Variable	1[a]	2[b]	3[c]	4[d]
Mental processing composite scale (total)	.01	.005	.064 (.031)	.96
Sequential processing scale	.307	.662	.104 (.091)	.83
Simultaneous processing scale	.001	.000	.124 (.055)	.97
Nonverbal scale	.000	.000	.169 (.443)	.91

The numbers in parentheses are results of nonparametric analyses. A total of 58 children were tested both at 4 and at 7 years of age: 28 in the corn oil group and 30 in the cod liver oil group.
[a] Data show 4 years of cod liver oil versus 7 years of cod liver oil (paired *t* test).
[b] Data show 4 years of corn oil versus 7 years of corn oil (paired *t* test).
[c] Data show 4 years of corn oil versus 4 years of cod liver oil (2-sample *t* test).
[d] Data show 7 years of corn oil versus 7 years of cod liver oil (analysis of covariance with results at 4 years as baseline).

TABLE 3 Correlations Between Scores on the Sequential Processing Scale and the Mental Processing Composite Scale and Different Fatty Acids in Plasma (Phospholipids) and Breast Milk (Total Lipids)

Fatty Acid	Scores on the Sequential Processing Scale, *R*, *P*	Scores on the Mental Processing Composite Scale, *R*, *P*
Maternal phospholipids, wk 35 of pregnancy		
ALA	0.200, .018[a]	0.137, .109
DHA	0.196, .021[a]	0.170, .046[a]
Σn-3	0.191, .024[a]	0.159, .062
Σn-3/Σn-6[b]	0.174, .040[a]	0.143, .094
Umbilical phospholipids		
EPA	0.192, .034[a]	0.185, .041[a]
Infant phospholipids at 4 wk of age		
ALA	0.193, .025[a]	0.098, .257
Infant phospholipids at 3 mo of age		
EPA	0.190, .026[a]	0.150, .079
Breast milk 3 mo after delivery		
EPA	0.178, .044[a]	0.143, .108

[a] $P \leq .05$.
[b] Data include 18 to 22 carbon atom fatty acids.

ing composite scale, the simultaneous processing scale, and on the nonverbal scale from 4 to 7 years of age (Fig 3).

Correlations between different long-chain PUFAs and scores on the sequential processing scale and the mental composite scale are shown in Table 3. It is striking that *n*-3 very-long-chain PUFAs in maternal, as well as in neonatal, samples positively correlate with scores on the sequential processing scale.

Regression analyses were performed with sequential processing scores or mental processing composite scores as dependent variables and demographic variables in addition to certain PUFAs in plasma phospholipids and breast milk as independent variables. We observed that maternal plasma phospholipid concentrations of ALA and DHA at 35 weeks of pregnancy were positively associated with scores on the sequential processing scale at 7 years of age (Table 4).

When we correlated the scores on the Fagan test at 6 months of age with the scores on K-ABC at 7 years of age, we found positive correlations for the simultaneous processing scale and the mental processing composite scale ($r = 0.17$, $P = .045$; $r = 0.19$, $P = .024$, respectively). Comparing the scores on the Fagan test at 9 months of age and the scores on K-ABC at 7 years of age, we found positive correlations for scores on the simultaneous processing scale ($r = 0.28$; $P = .001$), nonverbal scale ($r = 0.20$; $P = .020$), and mental processing composite scale ($r = 0.26$; $P = .003$). These results suggest some stability over time in cognitive development of the participants.

TABLE 4 Final Models After Regression Analyses With Scores on the Sequential Processing Scale as the Dependent Variable and ALA and DHA in Maternal Plasma Phospholipids in Week 35 of Pregnancy

Model	*B*	SD	*P*
ALA			
(Constant)	78.91	8.41	
Parental Education	1.31	0.54	.017
ALA	1.53	0.72	.035
DHA			
(Constant)	79.43	8.41	
Parental Education	1.25	0.55	.024
DHA	0.06	0.032	.049

Initial models contained gestational age, head circumference at birth, maternal age, parity, gender of the child, cod liver oil intake among children during childhood, maternal smoking reported when children were 7 years of age, and midparental education reported at 7 years of age, in addition to different fatty acids.

TABLE 5 Final Models After Regression Analyses With BMI at 7 Years of Age as a Dependent Variable and ALA in Breast Milk 4 Weeks and 3 Months After Delivery

Model	*B*	SD	*P*
4 wk after delivery			
(Constant)	15.45	0.50	
ALA in breast milk	1.01	0.51	.050
3 mo after delivery			
(Constant)	14.83	0.55	
ALA in breast milk	1.61	0.57	.006

Initial models contained birth weight, maternal BMI in the beginning of pregnancy, gender of the child, cod liver oil intake among children during childhood, maternal smoking reported when children were 7 years of age, and midparental education reported at 7 years of age, in addition to ALA in breast milk 4 weeks and 3 months after delivery.

BMI

We did not find any significant correlations between umbilical plasma phospholipid concentrations of LA, AA, ALA, DHA, or the ratio of Σn-3/Σn-6 fatty acids (includes 18–22 carbon atoms fatty acids) and the children's BMI at 7 years of age. We also did not observe any significant correlations between the same fatty acids in plasma phospholipids at 4 weeks or 3 months of age and BMI at 7 years of age. The content of AA or LA in breast milk did not correlate with BMI at 7 years, whereas the concentration of ALA in breast milk 3 months after delivery correlated positively with BMI at 7 years of age ($r = 0.30$; $P = .001$). In a regression model with BMI at 7 years of age as a dependent variable and demographic variables, in addition to certain fatty acids in breast milk as independent variables, we found that ALA in breast milk 4 weeks and 3 months after delivery came out as significant contributors (Table 5).

DISCUSSION

We did not find any significant difference in cognitive scores at 7 years of age between children whose mothers had taken *n*-3 or *n*-6 long-chain PUFA supplements during pregnancy and lactation. Neither did we find any relation between umbilical plasma phospholipid DHA or AA and scores on the K-ABC at 7 years of age. We are the first group of scientists aiming to follow the same term children from pregnancy all the way to the age of 7 years after intervening the mothers from week 18 of pregnancy until 3 months after delivery. In this experimental design we were not able to find differences in cognitive function at 6 and 9 months after birth.[20] However, we observed a significant and substantial difference in IQ at 4 years of age using K-ABC.[18] The fact that we do not find any differences in the major end points at the age of 7 may be interpreted in at least two different ways.

One explanation might be that the potentially positive effects of *n*-3 very-long-chain PUFAs are diluted by several other factors, like other nutrients, drugs, social stimulation, and diseases.[26] This is also in accordance with our results showing that parental educational level is a significant confounding factor (Table 4). It is also reasonably documented that deficiency of nutrients like iron,[27,28] iodine,[29] and severe malnutrition[30] influence cognitive function markedly. Little is known about the importance of dietary intake of *n*-3 very-long-chain PUFAs during later life and cognitive functioning. Perhaps the concentration of *n*-3 very-long-chain PUFAs in membrane phospholipids is related to present dietary intake of these PUFAs. In our population there was no difference between the 2 groups concerning cod liver oil intake at 7 years of age, but we have no data on intake of *n*-3 very-long-chain PUFAs from the diet.

Another explanation to our null finding at the age of 7 years might be that there is really no effect of *n*-3 very-long-chain PUFAs at this age. This interpretation is hard to test in particular, because we do not know if our methods of cognitive testing are sensitive enough to discriminate differences of practical importance.

From our previous data we calculated that 83 persons in each group were required to obtain significant differences of IQ scores. We invited 245 children (130 in the cod liver oil group and 115 in the corn oil group) to the study, and 143 participated at the 7-year follow-up. We do not think we would find significant differences if the study groups had been larger, because we see no trend from our present data.

It is possible that the phospholipid fatty acid pattern in plasma represents a better way of looking at the relation between fatty acids and central nervous function than just comparing the original intervention groups (Table 3). Our results show that *n*-3 long-chain PUFAs in maternal, as well as in neonatal, samples positively correlate with scores on the sequential processing scale, although the correlations are weak. Again, it might be that the potentially positive effects of *n*-3 very-long-chain PUFAs are diluted by several other factors, like other nutrients, drugs, social stimulation, and diseases.[26] Bakker et al[8] have reported from an observational study that there was no association between the concentration of DHA or AA in plasma phospholipids at 7 years of age and cognitive performance at this age.

When we performed statistical regression analyses, we observed that maternal plasma phospholipid concentrations of ALA and DHA during pregnancy came out as significant contributors for the children's sequential processing at 7 years of age. The K-ABC is based on Lurias neuropsychological theory of functional "blocks" in the brain, each subserving differential cognitive functions.[31] One block located in the visual, parietal, and temporal lobes is dedicated to the analysis, coding, and storage of information. The simultaneous code functioning is associated with 1 block. There is presumably also a general purpose sequencing block that is used in language performance, as well as action,[32] located in the frontal lobes around Broca's region. The effects of *n*-3 fatty acid supplementation were limited to sequential processing at the age of 7 years, most likely because of a preferential effect on the frontal areas of the brain. At age 7, the brain is more specialized than at age 4, making language functions more amenable than at an earlier age to protective factors such as supplementation of very-long-chain PUFAs.

Several studies have shown a positive correlation between breastfeeding and cognitive development in children.[33–35] All breast milk contains long-chain PUFAs, and it has been suggested that this may explain some of the beneficial effects of breastfeeding.[36] In our present study we found no correlations between DHA in breast milk at 4 weeks and 3 months after delivery and IQ scores at 7 years of age.

Some data suggest that formulas enriched with *n*-3 PUFAs have an adverse effect on neonatal growth.[37–39] We did not find any effect of *n*-3 very-long-chain PUFAs on growth, which is in accordance with the majority of the conducted studies.[40]

We found no correlation between the content of *n*-6 long-chain PUFAs in breast milk and later BMI. However, we observed that the content of ALA in breast milk 4 weeks and 3 months after birth correlated positively with BMI. This is in contrast to what has been reported earlier in mice, where a high dietary content of ALA promotes less increase in body weight as compared with LA.[41] Other animal studies do not suggest an adipogenic effect of LA in the offspring.[42] We are aware that there are large interspecies differences in the development of adipose tissue, and extrapolation from animal models to human infants is questionable and may not be relevant.[43]

Few studies on the effect of dietary *n*-3 or *n*-6 long-chain PUFAs on childhood obesity have been performed. Lauritzen et al[44] observed that maternal fish oil supplementation during lactation led to increased BMI and waist circumference at 2.5 years of age. In another study it was found that preterm infants supplemented with AA and DHA had less fat mass and greater lean body mass at 12 months of age than infants not being supplemented.[45] So far, any adipogenic effects of *n*-3 or *n*-6 long-chain PUFAs have not been established.

CONCLUSIONS

Our study did not reveal any difference in overall IQ scores at 7 years of age between children whose mothers had taken *n*-3 very-long-chain PUFAs or *n*-6 long-chain PUFAs during pregnancy and lactation. However, our data suggest that maternal concentration of *n*-3 very-long-chain PUFAs during pregnancy may be important for later cognitive function, like sequential processing. Neonatal fatty acid status does not seem to have any influence on BMI at 7 years of age.

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