The duration of breastfeeding and attention deficit hyperactivity disorder

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Abstract

Purpose: To examine whether duration of the breastfeeding is associated with the symptoms of attention deficit hyperactivity disorder in children.

Material and methods: A total of 100 children aged 4-11 years were divided into two groups: 60 children with ADHD symptoms (based on ICD-10) and 40 subjects of normal control grup. The structured interview and the retrospective questionnaire (including the items: number of pregnancy, pregnancy course, gestational age, status of newborn, birth weight, duration of breastfeeding: <3 months; 3-6 months; 6-12 months; >12 months) were used during the study of the both examined groups to indicate the risk factors of development.

Results: No significant differences in the percentages of duration of pregnancy, pregnancy complications, delivery complications, condition of the newborn, and birth weight were found between the two groups. The mean of the duration of breastfeeding for group with ADHD was 0.45 year: 5 months and 9 days (median 0.25 year: 3 months). The mean of the duration of breastfeeding of control group was 0.55 year: 6 months and 18 days (median 0.46 year: 5 months) and was significantly greater than that of group with ADHD ($p<0.04$). The 36 (60%) children with ADHD were breast fed less than 3 months. For comparison 13 (32.5%) controls were breast fed less than 3 months. Significant differences were found among the two children groups ($p<0.05$).

Conclusions: The short duration of breastfeeding as environmental factor may be considered a risk factor of ADHD symptoms. However, the further studies are nedeed.

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Introduction

Attention deficit hyperactivity disorder (ADHD) is the most commonly diagnosed neurobehavioral disorder in childhood. Children with ADHD also had problems with sustained attention, impulse control and their motor hyperactivity. Different symptoms may appear in different settings, depending on the demands the situation may pose for the child's self-control. Children with ADHD show difficulties with social contacts. Its onset is in early childhood: by definition before the age of 6, nearly always before the age 5 and frequently before the age of 2 years [1-3]. Clinical studies indicate that the inattentive and restless behavior is a developmental risk. Of children referred to clinics for ADHD, 30-60 percent will continue to have symptoms of the disorder into their adolescence and adulthood. Patients diagnosed with ADHD are at higher risk for learning, behavioral and emotional problems [3,4]. Scientific data suggested that ADHD is due to neuroanatomical or neurochemical abnormalities that result in the inconsistent meta-regulations of brain chemicals [1,3]. The exact aetiological pathways of ADHD are unknown. This is disorder with an aetiology in a combination of genetic and environmental factors. Molecular genetic studies have found associations with variations in genes for the dopamine receptors: DRD4, DRD5, and the dopamine transporter: DAT1[5-9]. The central dopamine receptors participate in the control of locomotor, cognitive and emotional funcions in the brain. Studies using structural and functional brain imaging and transcranial magnetic stimulation have shown various abnormalities in prefrontal, temporal, parietal cortical regions and striatum [1,3]. Nonetheless, researches have not discovered a unique brain pattern with ADHD.

There is also association with a variety of environmental factors, including prenatal and perinatal obstetric complications, low birth weight, prenatal exposure to alcohol or nicotine, viral

infections, and brain diseases and injuries [10-12]. Idiosyncratic reactions to food and exposure to toxic levels of lead are also considered to have aetiological importance[1]. There may be multiple developmental pathways from aetiological factors to behavioral symptoms.

ADHD impairs specific aspects of cognition, including the ability to sustain attention in early childhood [2,13]. On the other hand several studies have shown a positive correlation between breastfeeding and cognitive development. Breastfeeding is the optimal mode of feeding for the infant. Human milk composition knowledge has been basis for recommended dietary allowances for infants, contains just the right amount of long-chain polyunsaturated fatty acids (LC-PUFA), such as docosahexaenoic acid (DHA, C22:6n3) and arachidonic acid (AA, C20:4n6), lactose, different oligosaccharides, water, and amino acids for human brain development [14-17]. Docosahexaenoic acid (DHA) is a major component of neuronal membranes. In rats, low brain levels of DHA during development produce alterations in the mesocortical and mesolimbic dopamine systems [18]. It is also well known that sensory stimulation is like a nutrient which is essential for the normal growth, development and functioning of the brain and that sensory deprivation during the formative periods of brain development induces developmental brain abnormalities of both structure and function including the neurochemical activity. Clinical literature provide support for the hypothesis that breast feeding benefits mental development. On the hand, biochemical components of human milk affect particular elements of the neural circuitry that contribute to information processing. On the other hand, in addition to the emotional ties that arise between mother and infant from suckling, it is plausible that breastfeeding helps the development of interpersonal communication between infant and caretaker [14,17,19-22].

The aim of the study was to investigate whether is a link between duration of breastfeeding and ADHD symptoms in children.

Material and methods

The specific method of laboratory, psychological or biological research enough to make an accurate diagnosis of the ADHD is unknown. Observation of the subject's behavior and the disease is still the basic procedure for determining the presence of this mental disorder. The DSM-IV or ICD-10 criteria are the fundamental elements of diagnosis of ADHD [23,24].

The ICD-10 and DSM-IV diagnostic criteria for ADHD require symptoms or impairment in two or more settings. Thus, information on children's behaviors at school or kindergarten is usually required.

Sifting examination was conducted in 6 randomly chosen kindergartens and elementary schools of Białystok. The object of the research was a group of 1180 children aged 4-11 years (591 boys and 589 girls). The initial selection of children was conducted using the ICD-10 criteria (*Tab. 1*). The study was preceded by meetings with parents and teachers that detailed directions to the investigation to inquire into the qustionnaire were imparted. The consent was obtained from parents or legal guardians. It contains statements regarding the observed behavior of a child in 3 categories: motor restlessness, impulsiveness, and concentration problems. Children were divided into two groups.

Table 1. **The Behavioral Scale of ICD-10 criteria**

	Hyperactivity	yes	no
1.	Often fidges with hands or feet		
2.	Often leaves seat in classroom or in other situation in which remaining seated is required		
3.	Often runs about or climbs		
4.	Often has difficulty engaging in leisure activities quietly		
5.	Is often "on the go" or often acts as if "driven by a motor"		
	Innatention		
1.	Is often forgetful in daily activities		
2.	Often fails to give close attention to details or makes careless mistake in schoolwork or other activities		
3.	Often has difficulty sustaining attention to tasks or play activities		
4.	Often does not seem to listen when spoken to directly		
5.	Often has difficulty organizing tasks and activities		
6.	Often loses things necessary for tasks or activities		
7.	Often does not follow through on instructions and fails to finish schoolwork (not due to oppositional behavior or failure to undersand instructions)		
8.	Is often easily distracted by external stimuli		
9.	Often avoids or is reluctant to engage in tasks that require sustained mental effort		
	Impulsivity		
1.	Often talks excessively		
2.	Often blurts out answers before questions have been completed		
3.	Often has difficulty one's waiting turn		
4.	Often interrupts or intrudes on others		

Subjects

Group I with ADHD (N=60) selected a group of 60 children (51=85% boys and 9=15% girls), aged mean age 7 years and 3 months, who had been referred to them by parents and teachers of difficulties learning in an ordinary classroom setting. All children were of 10-18 points according to ICD-10 classification (at least 3 symptoms of hyperactivity, at least 1 symptom of impulsivity and at least 6 symptoms of concentration problems). Stated disorders disturbed the functioning of children, out of proportion to their development. All the children of this group were subjected to psychiatric examination. Any neurological disease, mental handicap, head injury, anxiety, or general developmental disorder (according to ICD-10) were exclusion criteria.

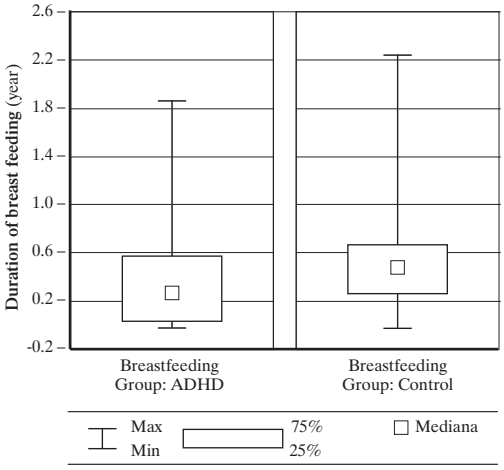
Group II, normal control children (N=40): 34=85% boys and 6=15% girls, mean age 7 years and 8 months were selected as normal controls, who in the parent's and teacher's opinion, had no significant learning difficulty, no know hearing loss and no significant behavioral nor emotional problems.

Table 2. **The perinatal state of study groups**

Examined group	with ADHD		control group		
	N= 60		N=40		p
	N	%	N	%	
Number of pregnancies					
I	24	40.00	15	37.50	ns
II	21	35.00	14	35.00	ns
III	10	16.67	5	12.50	ns
≥IV	5	8.33	6	15.00	ns
Pregnancy complications	12	20.00	3	7.50	ns
Gestational age (wk)					
<37	7	11.67	3	7.50	ns
37-40	52	86.67	37	92.50	ns
>40	1	1.67	-	-	
Delivery complications	7	11.67	2	5.00	ns
Status of newborn					
(Apgar test point)					
10-7	53	88.33	38	95.00	ns
6-4	6	10.00	2	5.00	ns
3-1	1	1.67	-	-	
Birth weight (g)					
<2500	6	10.00	1	2.50	ns
2500-3500	34	56.67	25	62.50	ns
>3500	20	33.33	14	35.00	ns

p – ns – not significant difference between the children with ADHD and the control group

Figure 1. **The assesment of the duration of breastfeeding in examined groups**



Group with ADHD: median – 0.2500; mean – 0.4462 SD – 0.50355; Control group: median – 0.4583; mean – 0.5498; SD – 0.50067 p<0.04 Significant difference between the children with ADHD and the control group

Procedure

The structured interview and the retrospective questionnaire (including the items: number of pregnancy, pregnancy course, gestational age, status of newborn, birth weight, kind of nutrition, duration of breastfeeding: <3 months; 3-6 months; 6-12 months; >12 months) were used during the study of the both examined groups to indicate the risk factors of development.

Data of the quantity variables as birth weight and duration of breastfeeding were expressed as mean, median and standard deviation (SD). The U Mann-Whitney test was used to examine the differences between children with ADHD and control group. Results were expressed using the percentages for discrete variables (number of pregnancy, pregnancy complications, getational age, status of newborn, delivery complications). Groups were compared the Chi-square test or Fisher precision test for discrete variables. P value was considere statistically significant at the level <0.05. The data was analysed using Statistica 5.0 Stat-Soft program.

Results

The retrospective study of perinatal and postnatal period of a child from both examined groups was evaluated. Six (10%) children with ADHD had low birth weight: <2500g. Pregnancy complications were refered to 12 (20%) children with ADHD, and to 3 (7.5%) controls, but no significant differences were observed in the number and duration of pregnancy, pregnancy complications, delivery complications, condition of the newborn (Apgar test), and birth weight between the two groups (*Tab. 2*).

The mean of the duration of breastfeeding for group with ADHD was 0.45 year: 5 months and 9 days (median 0.25 year: 3 months). The mean of the duration of breastfeeding of control group was 0.55 year: 6 months and 18 days (median 0.46 year: 5 months) and was significantly greater than that of group with ADHD (*Fig. 1*). The 36 (60%) children with ADHD were breast fed less than 3 months. For comparison 13 (32.5%) controls were breast fed less than 3 months. There was significant difference between two groups (*Tab. 3*).

Discussion

The results of the children with ADHD in the present study differed from those of the control children in duration of breastfeeding and number of pregnancy complications and in birth weight, but duration of breastfeeding was evident in significant diference. The children of control group have been breast fed longer than children with ADHD. WHO and Work Group on Breastfeeding of American Academy of Pediatrics conclude exclusive breastfeeding is ideal nutrition and sufficient to support growth and development for approximately the first 6 months after birth. It is recommended that breastfeeding continue for at least 12 months [17,21,22].

Children who were breast fed for less than three months had a higer risk, compared to children who were breast fed at least six months, of a lower mental developmental index [19,21]. Human milk contain many biological factors that may be beneficial for mental development, including biologically active peptides and the long chain polyunsaturated fatty acids [25-29]. Dietary fats may affect the brain composition and func-

Table 3. **Duration of breastfeeding (BF) of examined group with ADHD and control group**

Duration of BF	<3		3 – 6		6 – 12		>12		Total	
(months)	n	%	n	%	n	%	n	%	n	%
With ADHD	36	60.00	9	15.00	7	11.67	8	13.33	60	100
Control group	13	32.50	15	37.50	8	20.00	4	10.00	40	100
p value		0.05*		ns		ns		ns		

* p – significant difference between the children with ADHD and the control group; ns – not significant difference

tion in early life. Breast fed infants receive docosahexaenoic acid (DHA) and arachidonic acid (ARA) in their diet, which are highly concentrated in the central nervous system and they are important components of it's [26,29]. Upon weaning, infants lose this dietary source of long-chain polyunsaturates because many commercial formulas do not contain these important fatty acids [29]. The amount of these fatty acids in the central nervous system increases dramatically during the last intrauterine trimester and the first of life. DHA and ARA are transferre across the placenta, are present in human milk, and are accumulated in the brain and retina during fetal and infant development [25,29]. The high of DHA and ARA concentrations in brain gray matter suggest that these fatty acids have important roles in neural functions. Lipids are essential for brain development and function thoughout the life course. Over the first 6 months of life, DHA accumulates at about 10 mg/d in the whole body of breast fed infants with 48% of that amount appearing in the brain [29]. The latter effects may be explained by changes in the membrane bilayer that alter membrane – associated receptors and signal transduction systems, ion channel activity, or direct effects on gene expression [25]. May by possbility that deficiency of docosahexaenoic acid and arachidonic acid in diet of children have been breast fed short may be played any role in ADHD pathogenesis. Maher et al. [9] indicate that the dopamine system play a major role in the development of attention deficit hyperactivity disorder. Farooqu and Horrocks suggest that deficiencies of DHA and plasmalogenes in ADHD may be responsible for abnormal signal transduction associated with learning disability and cognitive deficit. These abnormalities in the signal – transduction process can be partially corrected by supplementation with a diet enriched with DHA [31]. Several studies have identified abnormalities in membrane fatty acids in some subjects with ADHD, and some success has been reported using dietary treatment with supplementation DHA of children with ADHD [30,32].

The brain develops intensively in the first two years. Infant interacts with environment every time and its brain makes a new connection. At the first months of age there is intensive activity in the cortical and subcortical regions that control sensory-motor functions. The sensory stimulation is like the biochemical components of human milk which is essential for the normal growth, development and functioning of the brain [33]. Breastfeeding has lots of skin to skin contact and interaction between child and with his mother. Breastfeeding itself with its the emotional senses of body touch, and the closeness between mother and baby is usually a more interesting, more interactive experience than bottle-feeding this is nature's way of insuring that babies get the stimulation they need for optimal brain development. The closeness of breastfeeding is an important bridge between baby's intrauterine life and his new experience of being out in the world. Studies have shown that babies who receive lots of closeness with their breastfeeding mothers and lots of stimulating eye contact and conversation are getting important brain stimulation that gadgets and and toys cannot produce [22,33,34]. The contact between mothers and their infants who are formula-fed is short. These sensory deprivation process that involve the emotional senses of body touch, movement and smell have been well described in failed affectional bonding in the mother-infant/child relationship [35].

Conclusions

The results of this study suggest that the short duration of breastfeeding beside others may be considered a risk factor of ADHD development. However, the further studies are needed to understanding of this problem better.

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