The effect of the diet of pregnant women on the development of allergy at their children

BARBARA WRÓBLEWSKA[1], GRAŻYNA DUDA[2], EWA WIECZOREK[3], WANDA KARWOWSKA[4]

[1]Department of Food Enzymes and Allergens, Institute of Animal Research of the Polish Academy of Sciences, Olsztyn, Poland; [2]Department of Bromatology , Faculty of Pharmacy, Poznań University of Medical Sciences, Poznań, Poland; [3]Clinic of Neonatology and Infant Intensive Care, National Research Institute of Mother and Child; [4]Department of Functional Foods, Warsaw Agricultural University, Warsaw, Poland

Abstract

The objective of this study was to investigate dietary habits and nutritional status of 67 pregnant women. The food intake was assessed by questionnaire studies. It was found out that dietary habits of pregnant women are partly adequate to the nutritional requirements and it connected both with the frequency and type of consumed products (vegetables, fruits whole-meal bread). The aim of this work was to estimation the activity of blood cells in umbilical cord of new-born children with the family atopic disease history. The analysis of umbilical cord blood showed that children from non-atopic families displayed lower IgE levels when compared with the newborns of atopic parents. The differences in serum IgE levels in umbilical blood were statistically significant. The newborns from atopic parents displayed higher IgE antibody level in umbilical blood, in comparison to the children with negative family history of atopy. Increased concentration of the immunoglobulin E in blood umbilical cord is affected by heredity or is acquired during the life-time of the fetus with tendency to the allergy. On the other hand, the differences between both groups in the migration index for β-lactoglobulin-inhibited leukocytes were highly statistically significant.

Key words: *pregnant women, cord blood, newborns, leukocytes*

(Centr Eur J Immunol 2006; 31 (1-2): 40-43)

Introduction

Nutrition is one of the basic physiological functions of every living organism. Pregnancy is a time when serial metabolic changes in the mother are carefully regulated to provide optimum substrate to both mother and fetus. Taking into consideration the fact that during the first three months of pregnancy the growth of fetus is determined by protein content in mother's diet, so the diet of mothers with food protein allergy history is of special concern. Many authors have shown that allergic reactions to food products ingested by the mother may take place as early as before the child's birth [1, 2]. However, food allergy is the major problem of childhood. The development and phenotypic expression of atopic diseases depends on a complex interaction between genetic factors, environmental exposure to allergens, and non-specific adjuvant factors. The causal relationship between the ingested food product and the anomalous reaction in a given organ or body system and coexistent immune disturbances are the criteria for the diagnosis of allergic hypersensitivity [3]. The antigen content in the mother's diet during pregnancy can increase the risk of developing allergy in the newborn. Nutrition standards for people in Poland recommend women in their second and third trimester should increase energy intake by 300 kcal/day, up to average daily intake 2500 kcal±700 kcal [4]. (It is estimated that in the second trimester more than 2/3 of energy from the diet is used by the mother and the rest by the child in the uterus). Approximately 60% of general amount of protein should be of animal origin e.g. meat, milk and diary products. Balanced animal protein is the source of valuable amino acids, however it can have allergen character. Maternal nutritional status affects maternal nutrition of the offspring and provides the signal in the capacity to reach the embryo, to be 'read' by it and to modify expression of the selected genes. Meat and milk protein allergens act on developing baby organism in uterus by dependent and

Correspondence: dr Barbara Wróblewska, Instytut Rozrodu Zwierząt i Badań Żywności Polskiej Akademii Nauk, Oddział Nauki o Żywności, Zakład Enzymów i Alergenów Żywności, ul. Tuwima 10, 10-747 Olsztyn, tel. +48 89 523 46 88, fax +48 89 524 01 24, e-mail: basia@pan.olsztyn.pl

independent mechanisms of IgE antibodies production [5]. The analysis of the role of various environmental factors triggering hypersensitivity reactions showed that the percentage of people allergic to food products was the greatest in the youngest age group [6]. Detailed enquiries concerning medical history of the mothers, including their diet during pregnancy were made to define the role of food factors in the development of allergy at the very earliest stage of human life. The aim of the study was to evaluate risk factors for the development of hypersensitivity to food products in the selected groups of infants from the families with and without atopy. In the research study conducted, the effect of family history of atopy and the selected environmental factors on the development of food allergy in infants were assessed.

Materials and methods

Nutrition questionnaire was filled in the presence of examined 67 women recruited at the Department of Obstetrics National Research Institute of Mother and Child in Warsaw. Questions had closed character and were concerned women's dietetic habits. During follow-up visits, women filled in a questionnaire, whereas the infants were clinically examined. Determination of 67 newborn umbilical cord cellular response was measured by *in vitro* migration of leukocytes in the presence of various antigens [7]. Six ml of umbilical cord blood samples were mixed with preservative-free heparin and 2 ml of Plasmagel was allowed to sedimentation at 37°C for one hour. The WBC-rich supernatant was centrifuged and the cell pellet washed three times in Hank's. The washed cells were resuspended in minimum essential medium (MEM) with 25 mM Hepes buffer. The leukocyte suspension was centrifuged at 350 x g for 10 minutes in microhaematocrit capillary tubes sealed at one end with non-toxic plasticine. The chamber was placed in an incubator at 37°C and the leukocytes were allowed to migrate for 20 hours. Total IgE in umbilical cord sera was estimated by enzyme linked immunosorbent assay ELISA [8].

The study was approved by Opinion of Bioethical Commission (No 41/2005) at National Research Institute of Mother and Child in Warsaw issued on 9th of August 2005.

Results

About 60% of the infants with allergies had a family history of allergies. Their risk for developing allergies is influenced by the antigens in the mother's diet during pregnancy. It results from analysis of three day questionnaire filled in by pregnant women that energy intake from their daily rations was 2416 + 639,05 kcal. The results of statistic analysis of energy and various nutrients intake are showed in the table 1.

Detailed enquiries concerning atopic history of the mothers, including their diet during pregnancy were made to define the role of food factors in the development of allergy at the very earliest stage of human life. It was concluded that the women who were conscious of allergy threat usually eliminated milk and dairy products from their diet. The percentage of women on the milk-free diet was higher in atopic as compared to non-atopic families, but this difference was not statistically significant. Neither was

Table 1. Nutritional composition of diets of breast feeding women

Factors	MIN	MAX	AVERAGE	MEDIANA	SD	p
energy (kcal)	1376.95	4441.76	2416.30	2355.97	639.05	3.97
water (g)	1135.77	4881.09	2286.49	2034.41	753.17	4.68
protein (total) (g)	32.01	139.27	78.92	72.67	22.92	0.14
animal protein (g)	10.73	98.11	49.96	45.64	17.76	0.11
vegetal protein (g)	11.36	58.61	28.89	28.26	8.33	0.05
saccharides (total) (g)	169.55	736.07	332.38	318.79	97.49	0.61
lipids (g)	31.43	209.80	89.25	88.35	30.70	0.19
saturated fatty acids (g)	8.39	78.66	33.78	32.52	13.15	0.08
monounsaturated fatty acids (g)	12.96	86.23	34.64	32.64	12.63	0.08
polyunsaturated fatty acids (g)	5.46	47.72	13.20	11.63	6.30	0.04
EFA (g)	5.45	47.73	13.18	11.61	6.28	0.04
saccharose (g)	6.69	387.72	80.72	68.51	51.36	0.32
lactose (g)	0.00	71.18	15.18	13.22	12.30	0.08
amylose (g)	77.14	408.48	181.79	171.94	59.96	0.37
fibre (g)	7.12	50.66	20.47	19.34	7.39	0.05

Table 2. Changes in the components of diet introduced during pregnancy in women from atopic and non-atopic families

Investigated group	No changes in the diet prior to the time of pregnancy [%]	Changes in the diet			
		additional food components		eliminated food components	
		milk and dairy products	beef	milk and dairy products	beef
mothers from atopic families n=29	26	17*	16	9*	3
mother from non-atopic families n=38	31	36*	21	5	2

p<0.05

Table 3. Cord blood leukocytes migration index

Group	Migration index		
	antigen		
	β-lactoglobulin 10 µg/ml x±SD	α-casein 10 µg/ml x±SD	BSA 10 µg/ml x±SD
new-borns from atopic families n=29	0.6±0.1*	0.7±0.1	0.7±0.1
new-born children from non-atopic families n=38	0.9±0.1*	0.8±0.1	0.8±0.2

**p<0.05*

Table 4. Relationship between new diet components and increased concentration of IgE umbilical cord blood of newborns

Group	Antigen		p
	milk and dairy products	beef	
	%	%	
newborn children from atopic families IgE>0.3 kU/l	38	15	0.03
newborn children from atopic families IgE<0.3 kU/l	62	85	
new-born children from non-atopic families IgE>0.3 kU/l	8	2	0.01
new-born children from non-atopic families IgE<0.3 kU/l	92	98	

there a significant difference concerning the time period when milk and dairy products were eliminated from the diet of pregnant women. Women tended to be on the elimination diet in the third trimester of pregnancy and in the majority of cases it proved ineffective in the prevention of hypersensitivity reactions in infants. Only few women during pregnancy, whose children were threatened by atopy disease, eliminated beef from their diets (3%) (table 2).

It was found that food antigens: α-casein and β-lactoglobulin added to leukocytes culture isolated from umbilical cord blood showed ability to stop their migration. Leukocytes from umbilical cord blood of infants threatened by atopy, migrated slower than leukocytes from umbilical cord blood of infants not threatened by atopy. After adding β-lactoglobulin to leukocytes culture isolated from umbilical cord blood of infants not threatened by atopy, significantly higher value of average index inhibition migration of leukocytes was observed (0.9±0.1). Supply of bovine serum albumin (BSA) in the culture, inhibited migration of leukocytes culture isolated from umbilical cord blood of infants not threatened by atopy and threatened by atopy with the same strength. Average index data of inhibiting migration of leukocytes from umbilical cord blood by animal food antigens are shown in table 3.

Variety of nutrients in mothers' diets during the pregnancy had an influence on emerging nutritional allergy by infants. This analysis proved strong relationship between the diet of mother from atopy families and IgE umbilical cord levels in newborn. The combination of atopic heredity and elevated cord blood IgE resulted in the best predictive discrimination as regards development of allergic disease. The optimal high-risk group was defined by either double parental atopic predisposition or single atopic predisposition, the latter combined with a cord blood IgE> or = 0.3 kU/1. Percentage of infants threatened by emerging the disease from families without atopy was smaller. Observed differences were statistically important (p>0.05). Among infants from atopy families, who had allergy, 85% was exposed to milk allergens of cow milk from their mother's diet (table 4).

Discussion

The role of primary prevention of allergic diseases has been a matter of debate for the last 40 years. The complex mechanism and etiology of hypersensitivity reactions to some food products encourage the investigators to search for pathogenetic factors of the disease. The causal relationship between the ingested food product and the anomalous reaction in a given organ or body system and coexistent immune disturbances are the criteria for the diagnosis of allergic hypersensitivity [8, 10]. The aim of the study was to evaluate risk factors for the development of hypersensitivity to food products in a selected group of infants from the families with and without atopy. Our results suggest that allergen-specific transplacental transfer is unlikely to be a major mechanism of allergen-specific immunity in infancy. The process of allergic sensitization needs an understanding of the role environmental factors play in its development. As it has been proven by Hermann [11], presence of antibodies for β-lactoglobulin in amniotic fluid contributes to the conclusion that immunologic answer to this allergen is already formed in fetus life. Detailed enquiries concerning medical history of the mothers, including their diet during pregnancy were made to define the role of food factors in the development of allergy at the very earliest stage of human life. It was concluded that the women who were conscious of allergy threaten usually eliminated milk and dairy products from their diet [12]. Elevated values of immunoglobulin E (IgE) concentrations in cord blood may indicate the hereditary or acquired susceptibility to allergy during prenatal period. The analysis of cord blood showed that newborns from atopic families displayed considerably higher IgE levels when compared with the newborns of non-atopic parents. The percentage of women on the milk-free diet was higher in atopic versus non-atopic families, but this difference was not statistically significant. Neither was there a significant difference concerning the period of time when milk and dairy products were eliminated from the diet of pregnant women. Women tended to be on the elimination diet in the third trimester of pregnancy and in the majority of cases it proved ineffective in the prevention of hypersensitivity reactions in infants.

References

1. Chandra RK (2000): Food allergy and nutrition in early life: implications for later health. Proc Nutr Soc 59: 273-277.
2. Warner JA, Warner JO (2000): Early life events in allergic sensitisation. Br Med Bull 56: 883-893.
3. Belles-Isles M, Ayotte P, Dewailly E, et al. (2002): Cord blood lymphocyte functions in newborns from a remote maritime population exposed to organochlorines and methylmercury. J Toxicol Environ Health A 65: 165-182.
4. Ziemlański S, Budzyńska-Topolowska J (1995): Normy żywieniowe dla ludności w Polsce (energia, białko, tłuszcz, witaminy i składniki mineralne). IŻŻ Nowa Medycyna 4: 5-18.
5. Buonocore G, Zani S, Tomasini B, et al. (1992): Serum IgE concentrations in the neonatal period. Biol Neonate 62: 10-14.
6. Shirakawa T, Morimoto K, Sasaki S, et al. (1997): Effect of maternal lifestyle on cord blood IgE factor. Eur J Epidemiol 13: 395-402.
7. Bowszyc J, Hryniewiecka J (1983): Modified leukocyte migration inhibition test with workers of the buildings and metals industries with chromium eczema. Med Pr 32: 423-437.
8. Paris-Kohler A, Megret-Gabeaud ML, Fabre C, et al. (2001): The allergic pregnant woman. Allerg Immunol (Paris) 33: 399-403.
9. Kobayashi Y, Kondo N, Shinoda S, et al. (1994): Predictive values of cord blood IgE and cord blood lymphocyte responses to food antigens in allergic disorders during infancy J Allergy Clin Immunol 94: 907-916.
10. Pranke P, Failace RR, Allebrandt WF, et al. (2001): Hematologic and immunophenotypic characterization of human umbilical cord blood. Acta Haematol 105: 71-76.
11. Herrmann ME, Dannemann A, Gruters A, et al. (1996): Prospective study of the atopy preventive effect of maternal avoidance of milk and eggs during pregnancy and lactation. Eur J Pediatr 155: 770-774.
12. Nedham I, Meydani SN (2002): Mother–infant interaction and food allergy development. Nutr Bullet 97: 27-29.