

Breastfeeding as an important factor of reduced infants' infection diseases

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ABSTRACT

Purpose: Respiratory tract infections and severe allergy reactions are a leading cause of hospitalization and morbidity in infants and children. The protection of breastfeeding against infectious diseases as well as allergy development has often been suggested. The aim of the study was to assess the relationship between the various models of infant nutrition, its immunity influence and children response after 3-6 years of age.

Materials and methods: The research was based on a voluntarily questionnaire, filled in by parents of pre-school children. Information on breast and milk formula feeding duration (never; 1-6 months; 6-12 months; 12-24 months; 24>months) were collected. The frequency of infections, chronic diseases and allergies occurrence was analysed.

Results: A statistically significant differences between infants breastfeeding and milk formula feeding in case of reduced infection ($p=0.003$) and infection recurrences ($p=0.001$) were found. This relationship was not found among children at further stages of development. There was no correlation between the consumption of only mothers' milk, and the reduced occurrence of asthma, allergies and eczema.

Conclusions: Maternal milk has an influence on the reduced risk of infection in the first year of the child's life compared to children fed only with artificial mixtures.

Keywords: Breastfeeding, milk formula, infection, infants

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INTRODUCTION

Feminine breast milk is recognized as the international "golden standard" in infants' feeding [1]. The food of a healthy, well-nourished mother, produced in sufficient amount, should fully cover the child's need for all nutrients necessary for growth and normal development in the first 6 months of its life [2]. The female milk contains IgA, lactoferrin and lysozyme, which is thought to reduce the infection risk, by improving the immune system function, it is also hypothesised that these compounds decreases the risk of food allergy, especially provided with cow's milk [3].

The female food provide growth factors that influence the proliferation and maturation of immune cells - a humoral and cellular response, as well as hematopoietic cell lines. Female milk also has a high prebiotic activity, which is conditioned by the content of oligosaccharides. The growth factor of the placenta affects the appropriate blood supply to the infants' intestine [4].

Mother's milk was shown to be rich source of anti-inflammatory factors and stem cells. For example, cytokines which possess chemotactic activity are responsible for infants' small intestine maturation and inflammatory modulation of reactions, via activation of erythrocyte system. Cytokines activate B lymphocytes, macrophages, monocytes, mast cells, eosinophils and dendritic cells [5].

Transforming growth factor (TGF) regulates the milk production process and increases the population of progenitor cells that produce IgA antibodies. Thus, affects the maturation of the lymphoid tissue system occurring within the GALT (*gut-associated lymphoid tissue*) digestive tract, thereby actively stimulating the processes of formation, maturation and development of the infants' nervous system [6].

Recent research shows that lactose, a source of carbohydrates, is also an important factor in human immunity. Female milk contains higher amount of lactose compared to cow's milk, which is why it is a better substrate in microorganism energy processes. Lactose affects the development of infants' bacterial flora. In artificially fed infants, the digestive tract is colonized by *Escherichia*, *Bacterioides* and *Clostridium* and in case of breastfeeding the growth of *Lactobacillus bifidus* and *Bifidobacterium* is observed. What is more, this disaccharide is a component of galactose that builds the nervous system myelin's [7].

The aim of the study was to assess the relationship between the various models of infant nutrition and immunity in the further perspective of child development.

MATERIALS AND METHODS

The study was conducted among parents of pre-school children in two different educational institutions (private and public kindergarten) from October 1th, 2017 to January 1th, 2018. The Medical University protocols' study number is R-I-002/306/2017. The study was attended by 100 respondents (50 parents per institution) familiarized with the goal and methodology of research. People who expressed their willingness to participate were asked to fill in the questionnaire anonymously. Children from pre-school age (from 3 to 6 years old) were analysed, 24 boys and 26 girls from private and 24 boys and 26 girls from public kindergarten in the city of Bialystok. 76% of children had a birth weight in the range of 2500 – 4000g. Natural childbirth occurred much more frequent as in the caesarean section (72 vs 28). 83% of children scored 10 points on the Apgar scale, which proves good health after birth.

The basic research tool was a questionnaire, which was divided into three parts corresponding in turn to important issues concerning the basic data of the child, the way of feeding in infancy and questions related to the current state of health. Genetic predisposition to the occurrence of allergies was also analysed.

In order to perform statistical analysis of data obtained from questionnaires, the Statistica 13 program was used, StatSoft Poland z o.o. The T-student's, Mann-Whitney test and Spearman's rank correlations were used. Variables were considered statistically significant when $p \leq 0.05$.

RESULTS

Table 1 shows the duration of breast and milk formula feeding among studied population. Modified milk nutrition model was used for longer period of time (19 children over 24 months and 42 children above 12 months of age) when compared to mother's milk nutrition (only 7 were fed naturally above 24 months and 22 children over 12 months of age). Mixed nutrition was the most prevalence model of studied population.

In our study, a weak positive correlation was found between natural delivery and mother's milk feeding ($R=0.287$). In case of caesarean section, artificial nutrition was more often chosen. Table 2 shows a statistically significant relationship between the reduced occurrence of infection and decreased recurrences of infants' infection when mixed nutrition and breastfeeding where compared to milk formula only ($p=0.003$, $p=0.001$, respectively). There was no statistical significance in the frequency of infection and in recurrent infections at later stages of the child's life.

Table 1. Children breastfeeding and milk formula feeding

	Children breastfeeding	Milk formula feeding
Feeding time (mos.)	n=90 (%)	n=70 (%)
1-6	36 (40)	7 (10)
6-12	25 (28)	2 (3)
12-24	22 (23)	42 (60)
24 >	7 (7)	19 (27)

Table 2. Statistical comparison between different models of nutrition

Variable	p-value
The occurrence of infants' infection	0,003
Occurrence of infants' recurrent infections	0,001
Prevalence of infection in pre-school age	0,137
Occurrence of recurrent infections in pre-school age	0,149

The most frequent were upper respiratory tract infections (16), there were also urogenital infections (3) skin (3), less children were reported with gastrointestinal infections (2) and ear infections (2). As in case of recurrent infections during the first year of life, the most frequent infections in the preschool age were upper respiratory tract infections (29) ear inflammation (3), sinusitis (1), urogenital (1) and skin infections (1). Increased exposure to pathogens in kindergarten, lack of protective effects of immunoglobulins and other biologically active ingredients contained in mother's milk caused that infections were more often observed at pre-school age rather than infants' age (all children were vaccinated according to Polish standards).

Children fed with modified milk were shown to have chickenpox diseases more frequent compared to breastfeeding ones (39% vs 26%), this group had a greater percentage of infectious diseases overall (50% vs 62%).

The genetic factor was also analysed in the context of children allergies occurrence. Significantly more frequent was the occurrence of allergies in parents (51) compared to children (27). The main type of allergy was inhalation one - parent vs children (29% vs 11%). In addition, there were cases of food allergy (12% vs 11%), contact / skin allergy (11% vs 10%) and animal venom allergy (3% vs 1%). Parents more often indicated allergy to dairy products, i.e. milk, milk products (64%) in comparison to children (59%). The surveyed parents more often indicated allergy to citrus fruits (22%) compared to children (17%). Allergy to egg proteins was found in 7% of parents and 6% of children. Interestingly, parents who were diagnosed with allergy to egg proteins, where shown to have children with peanut allergy. There was no relationship between exclusive mother's

milk nutrition and a reduced risk of all kind of allergies.

DISCUSSION

According to the Pandolfi et al. [8] exclusive breastfeeding was not associated with reduced pertussis (*Bordetella pertussis*) compared with partial breastfeeding or artificial feeding mixtures (OR: 1, 2; 95% CI: 0.31-4.67). Children with siblings were more susceptible to disease development (OR: 2.5, 95% CI: 1.21-5.35). IgA against pertussis antigens were not higher in the experimental group (med A anti-PT IgA=0.24 optical density) compared to the control group (median IgA anti-PT=0.21 optical density). However, the binding of bacteria to *pertussis* rods, measured in breast milk, was higher in the experimental group (median=4.35%) compared to the control group (median=2.8%, p=0.004). The IgG titer, exceeded the norm in mothers, but no correlation was found between serum IgG and breast IgA. In our study no pertussis was recorded, nevertheless, more frequent occurrence of infectious diseases among children fed exclusively with artificial mixtures was observed.

According to the study conducted by Ventura et al. [9], breastfeeding influences dietary preferences and obesity occurrence in the future. The first 1000 days of a child's life is called a critical period for the obesity prevention. Children fed naturally experience the so-called the "jump start" effect. Supplementation of new biological compounds contained in breast milk reduces the likelihood of immune over-activity at later stages of child development. In the study carried out by Schiherer et al. [10] the allergy occurrences of alimentary and genetic factors were analysed. It was found, regardless of the genetic predisposition,

a positive relationship between the consumption of peanuts during pregnancy and elevated serum IgE concentration in breastfeeding children diagnosed with cow's milk and egg allergy. In our own research a similar relationship was also observed.

In the Wang et al. study [11], breastfeeding was not associated with allergic eczema at any age compared to children who never have been fed naturally. The adjusted odds ratios for eczema were 1.02 (95% CI 0.90-1.15) for 0-3 months breastfed children, 0.97 (0.97) 0.82-1.13) for 4-6 months, and 0.98 (0.85-1.14) for infants over 6 months. There was no strong evidence for the effect of parental atopy modification (p-value for response time was 0.061) and no association was found between eczema in breastfed children and the onset of eczema later in childhood.

In retrospective studies in which over 5000 children were involved, natural feeding for 6 months was associated with a reduced risk of developing lower respiratory tract infections up to the age of four (OR: 0.71, 95% CI: 0.51-0.98) [12]. Interestingly, in another large cohort study, breast milk feeding over 6 months had no effect on the incidence of lower respiratory tract infections, but authors did not evaluate cases which have ever been breastfed [13]. In other study, the effect of breast milk nutrition on the occurrence of total infection with respect to artificial mixtures was analysed. A study conducted by the Japanese team [14], showed that the frequency of hospitalization for respiratory infections among infants aged 18-30 months and 30-42 months fed 6-7 months with breast milk was lower compared to artificially fed children, 0.82 (0.66-1.01) and 0.76 (0.58-0.99), respectively. There were no statistically significant differences in diarrhea frequency. In population studies carried out in 31 Belarusian medical centres, no correlation was found between exclusive breastfeeding and reduced risk of asthma, eczema and allergy [15]. Similar results were obtained in our study.

CONCLUSIONS

Maternal milk has an influence on the reduced risk of infection in the first year of the child's life compared to children fed only with artificial mixtures. This relationship was not found among children at further stages of development. In pre-school children higher incidences of infectious diseases were observed. There was no correlation between the consumption of only mother's milk and the reduced occurrence of asthma, allergies and eczema.

Conflicts of interest

None declared.

REFERENCES

1. Jolly K, Ingram J, Clarke J, Johnson D, Trickey H, Thomson G, Dombrowski SU, Sitch A, Dykes F, Feltham MG, Darwent K, MacArthur C, Roberts T, Hoddinott P. Protocol for a feasibility trial for improving breast feeding initiation and continuation: assets-based infant feeding help before and after birth (ABA). *BMJ Open* 2018 Jan 23;8(1):e019142.
2. Horta BL, Victora CG. Long-term effects of breastfeeding-a systematic review. Geneva: World Health Organisation, 2013.
3. Wirt DP, Adkins LT, Palkowetz KH, Schmalstieg FC, Goldman AS. Activated and memory T lymphocytes in human milk. *Cytometry* 1992 13(3):282-90.
4. Reeves AA, Johnson MC, Vasquez MM, Maheshwari A, Blanco CL. TGF- β 2, a protective intestinal cytokine, is abundant in maternal human milk and human-derived fortifiers but not in donor human milk. *Breastfeed Med* 2013 Dec;8(6):496-502.
5. Hoddinott P, Craig L, Britten J, McInnes R. A prospective study exploring the early infant feeding experiences of parents and their significant others during the first 6 months of life: what would make a difference. Edinburgh: NHS Health Scotland, 2010.
6. Vandenplas Y, Veereman-Wauters G, DE Greef E, Mahler T, Devreker T, Hauser B. Intestinal microbiota and health in childhood. *Biosci Microflora* 2011 30(4):111-7.
7. Festi D, Schiumerini R, Birtolo C, Marzi L, Montrone L, Scaioli E, Di Biase AR, Colecchia A. Gut microbiota and its pathophysiology in disease paradigms. *Dig Dis* 2011 29(6):518-524.
8. Pandolfi E, Gesualdo F, Carloni E, Villani A, Midulla F, Carsetti R, Stefanelli P, Fedele G, Tozzi AE. Does Breastfeeding Protect Young Infants From Pertussis? Case-control Study and Immunologic Evaluation. *Pediatr Infect* 2017 36(3):e48-e53.
9. Ventura AK. A major developmental task during the first years of life is for the child to learn both how and what to eat, as well as to develop preferences for a wide array of healthy foods. Does breastfeeding shape food preferences links to obesity. *Ann Nutr Metab* 2017 70:8-15.
10. Sicherer SH, Wood RA, Stablein D, Lindblad R, Burks AW, Liu AH, Jones SM, Fleischer DM, Leung DY, Sampson HA. Maternal consumption of peanut during pregnancy is associated with peanut sensitization in atopic infants. *J Allergy Clin Immunol* 2010 Dec;126(6):1191-7.
11. Wang J, Ramette A, Jurca M, Goutaki M, Meardsmore CS, Kuehni CE. Association between breastfeeding and eczema during

- childhood and adolescence: A cohort study. PLoS One 2017;12(9):e0185066.
12. Tromp I, Kiefte-de Jong J, Raat H, Jaddoe V, Franco O, Hofman A, de Jongste J, Moll H. Breastfeeding and the risk of respiratory tract infections after infancy: The Generation R Study. PLoS One 2017 Feb 23;12(2):e0172763.
13. Li R, Dee D, Li CM, Hoffman HJ, Grummer-Strawn LM. Breastfeeding and risk of infections at 6 years. Pediatrics 2014 Sep;134 Suppl 1:S13-20.
14. Yamakawa M, Yorifuji T, Kato T, Inoue S, Tokinobu A, Tsuda T, Doi H. Long-Term Effects of Breastfeeding on Children's Hospitalization for Respiratory Tract Infections and Diarrhea in Early Childhood in Japan. Matern Child Health J 2015 Sept;19(9):1956-65.
15. Kramer MS, Matush L, Vanilovich I, Platt R, Bogdanovich N, Sevkovskaya Z, Dzikovich I, Shishko G, Mazer B. Effect of prolonged and exclusive breast feeding on risk of allergy and asthma: cluster randomised trial. BMJ. 2007 Oct 20; 335(7624): 815.