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Review Article

Breastfeeding: A Fundamental Pillar in the Development of the Immune System in Infants

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Abstract

Breast milk is an essential pillar in the development of the infant's immune system, providing protection against infections and diseases during the first months of life. At birth, the infant's immune system is immature, making it vulnerable to serious infections. Maternal immunity is transferred to the fetus through the placenta and continued through breastfeeding, which provides antibodies (mainly IgA), growth factors and immunomodulatory elements.

The neonatal immune system has limitations in pathogen identification, T cell response and antibody production, which reduces the effectiveness of vaccines and increases the predisposition to allergies and asthma. Breast milk helps mitigate these effects by transferring immunoglobulins, transfer factors and complement system molecules, which reinforce passive immunity and modulate the immune response.

The benefits of breastfeeding transcend childhood, reducing the risk of obesity, type 2 diabetes and cardiovascular disease, as well as improving the child's cognitive and emotional development. It also protects the mother against breast and ovarian cancer, reduces hypertension and promotes mother-child bonding.

From an economic and environmental perspective, breastfeeding reduces health costs, resource use and environmental impact. Promoting breastfeeding should be a public health priority to ensure optimal child development and long-term well-being.

Keywords: Breast Milk; Breastfeeding

Introduction

The immune system is the body's intrinsic defence mechanism against external pathogens, such as viruses, bacteria and other microorganisms capable of inducing disease.

It is made up of a network of cells, tissues, and organs, such as leukocytes, spleen, bone marrow, and lymph nodes, that work together to identify and eradicate threats before they inflict harm.

The correct operation of this mechanism is crucial for health, since it not only fights infections, but also contributes to the healing of injuries, the elimination of compromised cells and the regulation of inflammatory responses.

In many respects, the immune system we are born with is the result of immune dynamics during pregnancy. To preserve the fetus, the mother must ignore fetal alloantigens, in which half of the antigens are of paternal origin, and therefore, of indeterminate origin. This circumstance leads to a scenario of immunosuppression/ regulation during pregnancy, which persists in the initial phases of life.

Development of the immune system and its evolution

The immune system does not reach full functionality at birth, which increases our susceptibility to serious infections, with a high mortality rate. As we move from the sterile environment of the uterus to the external environment, we are faced with a variety of pathogens with which we had not previously interacted and against which we have no protection.

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Safeguarding transfer from mother to infant

The main component of immune protection that is transmitted from mother to child is antibodies that are transmitted through the placenta to the fetus, using the neonatal Fc receptor (FcRn), or through breast milk. The predominant transferred immunoglobulin is IgA, which plays its role on mucosal surfaces, where it can inhibit pathogen penetration. However, other crucial factors are also transferred, such as complement molecules and commensal bacteria, which may offer protection against asthma and allergy at later stages (see complement system).

Characteristics of the immune system in the neonatal stage characteristics of the immune system in the neonatal stage

Pattern identification: Neonatal responses to pathogen-linked molecular patterns are restricted compared to adult individuals. However, the degrees of manifestation of receptors that identify patterns are analogous. This seems to be attributable to the fact that signaling molecules play a limited role. As a result, a reduction in the production of inflammatory mediators, such as interleukin-12 (IL-12) and interferonα (IFN-α), is observed. The function of PRRs increases proportionally with time since birth compared to "gestational" age, indicating that it is regulated by environmental exposure and the eradication of maternal influence.

T-cell response: The bias present in the response of neonatal T cells towards Thelper 2 (Th2) has been corroborated and seems to be linked to a decrease in IL-12 and IFN-α production by neonatal antigen-presenting cells (APCs). This can influence the immune response to antigens during the early stages of life, potentially triggering an allergic response.

B-cell response: A decrease in antibody generation is observed during the early phases of life. Specifically, it refers to the reaction of antibodies in response to the polysaccharide antigen. This is a significant problem in relation to bacterial infections, to which neonates are highly susceptible. This failure in antibody production correlates with a number of factors, including decreased T-cell assistance, fewer follicular and germ dendritic cells, and decreased signaling across members of the CD40 ligand family.

Consequences of the immune response in the neonatal stage

The immaturity of the immune response in the neonatal stage has repercussions in three fundamental domains:

- Increased vulnerability to infection. The identification of pathogens is decreased during the initial phases of life, which facilitates the invasion of the pathogen to the host. Neonates have a reduced experience, resulting in an insufficiency of immunological memory against infection.
- Reduced effectiveness of immunizations. As with infections, the identification of vaccinated antigens as foreign is decreased, implying that the induction of protective memory responses against vaccines is also decreased. Similarly, there is an influence of maternal-derived antibodies, which can mask essential vaccine epitopes.
- Evolution of asthma and allergies. It has been hypothesized that the predisposition to Th2 in the T cell response could lead to the development of allergic responses to antigens during the early stages of life.

To enrich this phase of immune immaturity and minimize the likelihood of infection, mothers provide passive protection to the child, mainly in the form of antibodies and transfer factors.

A set of biological elements contained in breast milk play a fundamental role in the development of the newborn's immune system. These elements include:

- **Antibodies:** Antibodies, also called immunoglobulins, are proteins generated by the immune system in response to the presence of antigens, foreign compounds capable of triggering an immune response. Antibodies are critical to the immune system, playing a crucial role in the detection and eradication of invading pathogens. Their ability to adapt and offer specific immunity is essential for the protection of the body against infectious diseases. Its attributes and functions will be detailed.

Attributes of antibodies

Structure: Antibodies are proteins of "Y" morphology, made up of chains of heavy and light amino acids. This structure facilitates recognition and is binding to particular antigens.

Classification

There are five primary categories of antibodies in humans, each with functions and attributes:

- **IgG:** The most prevalent immunoglobulin in the bloodstream, it constitutes the largest proportion of immunological protection against bacterial and viral infections. In addition, it has the ability to cross the placenta and, in lower amounts in breast milk, provide protection to the fetus.
- **IgA:** It is found in mucous secretions, such as saliva, tears and breast milk. It safeguards the mucous membranes and tissues of the respiratory and gastrointestinal system. The primordial antibody present in breast milk, providing protection to the mucous membranes of the gastrointestinal and respiratory tract of the infant.
- **IgM:** The initial immunoglobulin that is generated in response to an infection. It is characterized by its effectiveness in neutralizing pathogens and activating the complementary system. It is found in lower proportions in breast milk.
- **IgE:** Linked to allergic responses and defense against parasites. It is associated with allergens and triggers the release of histamine.
- **IgD:** Although its function has not yet been fully understood, it is located on the surface of B lymphocytes and could be involved in the activation of these cells.

Functions of molecular antibodies

- **Neutralization:** Antibodies have the ability to neutralize viruses and toxins by interacting with them, preventing them from inflicting damage on the body's cells.
- **Opsonization:** It is the process by which pathogens are most easily identified and eliminated by immune cells, such as macrophages.
- **Complement System Activation:** Antibodies have the ability to activate a set of proteins present in blood plasma, which contribute to the elimination of pathogens.
- **Passive Immunity:** Through maternal transfer, such as in breast milk, antibodies can offer temporary protection to the newborn, contributing to the prevention of infections during the early stages of their development.
- **Transfer Factors:** Transfer factors (FTs) are low molecular weight proteins, derived from leukocytes, which play a role as modulators and chemical messengers of the immune system. Due to their low molecular weight, they are not immunogenic and, in addition, they do not have a species barrier. They are abundant in the colostrum of all mammals during the lactating period, in the eggs of naturally fertilized birds and in certain types of fungi, with the ability to transfer immunity.

Operation mechanism

Transcription factors function as modulators of the immune system through the following mechanisms: 2. Immune memory mediation: They interact with antigen-presenting cells (APCs) and T lymphocytes, transmitting information about particular pathogens.

- Promotion of the proliferation and activity of helper (CD4+) and cytotoxic (CD8+) T cells.
- **Immune regulation:** They balance the responses of Th1 and Th2 cells, promoting an appropriate response depending on the immunological context.
- **Pleiotropic effect:** They modulate essential cytokines such as IFN-γ, IL-2 and TNFα, intensifying or inhibiting the immune response as required.
- **Growth Factors:** They promote the development and maturation of the immune system, as well as other body tissues of the newborn. It comprises three segments:
- **Inducing Fraction:** Promotes the immune response by activating immune cells to identify and counteract pathogens more effectively, thereby strengthening the body's defenses.
- **Suppressive Immune Fraction:** Regulates and regulates the immune response with the aim of preventing exaggerated responses, such as autoimmune diseases, mitigating inflammation and protecting tissues.
- **Specific Antigen Fraction**: Houses data on previously identified pathogens, facilitating a faster and more effective response in the event of additional exposure, acting as an "immunological memory".

The benefits derived from transfer factors:

- **Optimization of the immune response:** Transfer factors enhance the body's ability to identify and counteract infections or pathologies, providing an additional stimulus to the immune defenses.
- **Immune System Regulation:** By transferring immune "memory," transfer factors contribute to immune system regulation by balancing exaggerated or under responses, a crucial aspect for autoimmune or immunodeficiency conditions.

- **Infection prevention:** Transmission factors increase susceptibility to certain infections.
- The decrease in the immune response leads to an increase in susceptibility to pathogens and limited responses to vaccines that are effective in adults, which makes it essential to investigate specific formulations for the child population. Alterations in neonatal immune function may also affect the later development of asthma and allergies.

Significance and relevance of the same

In the first year of life, five million children die, of which 1.5 million are attributable to an infection. The most prevalent etiologic factors include respiratory infection and diarrhea. Breastfeeding has the potential to prevent a considerable number of these mortalities, strengthening the immune system of infants.

Breastfeeding is an innate process that offers multiple advantages for both the infant and the mother. Breast milk is a unique, whole, and balanced food that meets the nutritional requirements of the infant and plays a fundamental role in its growth and development.

Research has shown that breastfed infants have lower rates of pathologies such as diarrhea, respiratory infections and otitis media compared to those who feed on infant formulas. This safeguard is especially essential during the first months of life, when the newborn's immune system has not yet reached maturity and susceptibility.

Breast milk provides protection against various diseases.

Breast milk contains a high content of immunoglobulins that safeguard infants against pathologies such as pneumonia, diarrhea, ear infections and asthma, among other conditions. The importance of breastfeeding immediately after birth is that the immune system of newborns has not yet reached full maturity. Breastfeeding is therefore often characterized as "the first vaccine".

Breastfeeding in the first hour of life decreases the probability of death in the first month of life by approximately 20%. Neonates have a highly immature immune system and are highly susceptible. Breast milk provides immediate protection, as well as boosting the immune system. In the first month of life, non-breastfed infants are six times more likely to die compared to those who are; Between 9 and 11 months, non-breastfed infants are 30% more likely to die. Suboptimal breastfeeding is estimated to have accounted for 11.6% (804,000) of neonatal deaths in 2011.

Long-term advantages

The advantages of breastfeeding transcend the infant stage. It has been shown that breastfed infants have a reduced risk of developing chronic pathologies, such as obesity, type 2 diabetes mellitus, and cardiovascular conditions later in life. Breastfeeding is also linked to increased cognitive performance and healthier emotional development, attributable to the intense interaction between mother and child during the feeding process. According to Sánchez., *et al*. (2021).

Breastfeeding contributes to the reduction of health care costs

Research found that for every 1,000 non-breastfed newborns, there were 2,033 additional doctor visits, 212 additional days of hospitalization, and 609 additional prescriptions for just three conditions — auditory, respiratory, and gastrointestinal infections. In the United States alone, if 90% of mothers breastfed exclusively for six months, it would save $13 billion annually in pediatric health care costs and prevent more than 900 deaths.

Breast feeding contributes to the prevention of being overweight in the child population.

Prolonged breastfeeding can reduce the risk of childhood obesity and obesity by 12%, thus contributing to the fight against severe chronic diseases linked to these conditions.

Breastfeeding contributes to the acquisition of greater intelligence in infants

Individuals in adolescence and adulthood who were breastfed as children show an increase of 2 to 5 points in indicators of intellectual development. Breastfeeding is also correlated with an increase in academic achievement. Additionally, the practice of breastfeeding for 6 months, in contrast to 4 months, promotes the motor development of infants.

Breastfeeding promotes mother-child bonding.

An extended duration of breastfeeding is also correlated with greater maternal responsiveness and with the emotional security provided by bonding.

Breastfeeding contributes to the protection of mothers against ovarian and breast cancer. Women who do not breastfeed have a 4% increased risk of developing breast cancer and a 27% increased risk of ovarian cancer. In addition, they have an increased risk of developing hypertension and cardiovascular pathologies.

Breastfeeding is beneficial for the environment and human health

Breast milk is characterized by being a natural and renewable food that does not require packaging, transport or fuel for its preparation. For every one million infants fed infant formula, 150 million packages are used, many of which end up in solid waste.

Breastfeeding represents a profitable business

Women are the fastest-growing segment of the workforce. Breastfeeding decreases absenteeism and costs associated with health care, boosts employee retention, productivity, and morale, and contributes positively to public relations. Daily interruptions to care for sick children are twice as common among mothers of formula-fed infants.

Breastfeeding contributes positively to the domestic economy

In the United States, if 90% of mothers were able to breastfeed for at least one year (currently only 23%), $17.4 billion in costs to society from premature deaths, $733.7 million and $126.1 million in direct and indirect morbidity costs from the increase in breast cancer cases could be avoided. Hypertension and myocardial infarction.

To conclude, the proposed conclusion will be extrapolated

Breast milk represents an invaluable resource that offers optimal nutrition and immune protection to the newborn during its first months of life. Its nutritional value, in conjunction with transfer factors and antibodies, provides a number of advantages that promote healthy development and solid growth. The guidelines regarding the beginning and duration of breastfeeding are explicit: exclusive breastfeeding should be encouraged during the first six months of life and persisted for at least one year, supplemented with foods of high nutritional quality.

Promoting breastfeeding not only offers immediate benefits to the infant, but it also lays the foundation for a future healthy existence. Consequently, it is imperative that health professionals and society as a whole support and promote breastfeeding as a public health priority [1-24].

Bibliography

1. World Health Organization (WHO). In 2022. "Nutrition during the first 1,000 days: A global perspective". It has been obtained from www.who.int.

2. C Victora., *et al*. "Breastfeeding in the 21st century: epidemiology, mechanisms and long-term impact". *The Lancet* 387.10017 (1966): 475490.

3. Ip S., *et al*. "Breastfeeding, maternal and child health outcomes in developed countries". *Evidence/Technology Assessment Report* 153 (1977): 1-186.

4. Reynolds M J., *et al*. "Preventing disease and optimising resources: The potential contribution of rising breastfeeding rates in the UK". London: UNICEF United Kingdom (1992).

5. Bingham C., *et al*. "Breastfeeding in Australia: A review of the existing literature". *Nutrients* 9.8 (2017): 814.

6. M Labbok., *et al*. "Breastfeeding and Health Impacts for the Maternal-Infant Period". *Breastfeeding Medicine* 4.1 (1993): 29-45.

7. Bartick María and Reinhold A. "The Impact of Suboptimal Breastfeeding in the United States: A Cost Study for the Pediatric Population". *Pediatrics* 125.5 (2015): 1048-1056.

8. TEDDER J. "The Breastfeeding Success Strategy: Child Development Instruction to Prolong the Duration of Breastfeeding". *Perinat Education* 24.4 (2015): 239-248.

9. Victora CG., *et al*. "The correlation between breastfeeding and intelligence, attainment of education, and admission at age 30: a prospective study of a birth cohort from Brazil". *The Journal of Global Health* 3.4 (2015): E199-E199.

10. Aguirre Cordero MJ., *et al*. "Breastfeeding as a preventive strategy against overweight and obesity in children and adolescents; a systematic analysis". *Home Nutrition* 31.2 (2015): 606-620.

11. Carlos Calvo Quirós. "Socioeconomic, cultural and health system elements influence breastfeeding". *Currently in Costa Rica* (2008): 15.

12. Association of Pediatrics Physicians. Manual on the Breastfeeding Process. Madrid: Ediciones Médicas Panamericanas (2015): 504.

13. Sustainable Development Goal. Global nutrition targets for 2025: regulatory document on breastfeeding. Sustainable Development Goal; 2017. Registration No.: WHO/NMH/NHD/14.7 (2017).

14. Brown Jesus. "Nutrition throughout the life cycle". 6 ed. Cengage Learning (2016).

15. Aguirre Cordero MJ., *et al*. "Breastfeeding as a preventive strategy for cardiovascular conditions in the mother and infant". *Home Nutrition* 31.5 (2015): 1936-1946.

16. F Serrao., *et al*. "The effect of early emission of Human Milk on Insulin-Like Growth Factor 1 and short-term outcomes in preterm neonates". *Proceedings of the PloS One* 11.12 (2016): E0168139.

17. Amitay EL and Keinan-Bokk L. "A meta-analysis and systematic review of breastfeeding and the incidence of childhood leukemia". *JAMA Pediatrics* 169.6 (2015): e151025.

18. Mosca F and Gianní M. "Human milk: composition and health benefits". *Pediatric Medicine* 39.2 (2017): 155.

19. Ballard Ohio and Morrow Alabama. "Composition of breast milk: nutrients and bioactive factors". *North American Clinical Journal* 60 (2013): 49-74.

20. S Unal., *et al*. "Evidence-Based Strategy during the First Week to Prevent Neonatal Hypernatremic Dehydration during Breastfeeding". *Plos One* 11.12 (2016): e0167313.

21. Reszel J., *et al*. "Breastfeeding in infants beyond the neonatal period". *Review of Cochrane Database Software* 10 (2020): CD011248.

22. Paixón de MJG. "Breastfeeding in infants beyond the neonatal period". *Specialized Clinical Nurse* 32 (2018): 116-117.

23. Suresh S., *et al*. "Determinants of feeding difficulties during the first postnatal week and their impact on the rate of exclusive feeding at six months: experience in a tertiary care center in Northern India". *Public Health of Indian Journal* 58.4 (2014): 270-273.

24. Díaz-Gómez NM., *et al*. "Reasons and obstacles that Spanish women perceive in relation to breastfeeding". *Res publica o Rēs pūblica* 90 (2016): e1-18.