ORIGINAL ARTICLE

Effects of breast milk nutrition on chronic adenoiditis, chronic tonsillitis and allergy

Efectos de la nutrición con leche materna sobre la adenoiditis crónica, la amigdalitis crónica y la alergia

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Abstract

Objective: *It is aimed to reveal whether breast milk has an effect against recurrent upper respiratory tract infections and allergies.* **Methods:** *The study group consisted of 300 children aged 0-15 years who applied to the Ear, Nose, and Throat Outpatient Clinic with complaints of frequent throat infections, snoring, sleeping with an open mouth, and decreased hearing. The control group consisted of 300 randomly selected healthy children between the ages of 0-15 whose routine controls were terminated. Both groups were compared in terms of age, gender, birth weight, duration of breast milk and formula use, eosinophil count in complete blood count, and time of transition to solid food.* **Results:** *It was observed that more operation (adenotonsillectomy) were performed in children with lower than normal birth weight (< 2500 g), children who had breastfed for < 6 months, and children who received formula for more than 6 months ($p < 0.001$). Eosinophil count was found to be higher in the complete blood count of the children in the study group compared to the children in the control group ($p < 0.001$).* **Conclusions:** *Children are protected from recurrent adenotonsillar infections and allergies with breast milk.*

Keywords: *Breastmilk. Tonsillitis. Allergy.*

Resumen

Objetivo: *Investigar si la leche materna tiene efecto sobre las infecciones recurrentes del tracto respiratorio superior y las alergias.* **Métodos:** *Se incluyeron en el estudio 300 niños de 0 a 15 años que presentaban quejas de frecuentes infecciones de garganta, ronquidos, dormir con la boca abierta y pérdida de audición. El grupo control estuvo constituido por 300 niños sanos de edades comprendidas entre 0 y 15 años. Se compararon ambos grupos en términos de edad, sexo, peso al nacer, duración del uso de leche materna y fórmula, y recuento de eosinófilos en el hemograma completo.* **Resultados:** *Se observó que se realizaron más intervenciones quirúrgicas (adenoamigdalectomía) en niños con bajo peso al nacer (< 2500 g), en niños que fueron amamantados por menos de 6 meses y en niños que fueron alimentados con fórmula por más de 6 meses ($p < 0.001$). El recuento de eosinófilos en el hemograma completo de los niños del grupo de estudio fue mayor que en el de los niños del grupo control ($p < 0.001$).* **Conclusiones:** *La leche materna protege a los niños frente a infecciones adenoamigdalares recurrentes y alergias.*

Palabras clave: *Leche materna. Amigdalitis. Alergia.*

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Introduction

Waldeyer lymphatic ring consists of palatine tonsils, pharyngeal tonsil (adenoid), lingual tonsils, lateral pharyngeal bands, and tubal tonsils. Adenotonsillar lymphoid tissues, a component of Waldeyer, are the structures that form the body's first defense mechanism against gastrointestinal and respiratory antigens. Immunological activity in these tissues starts after birth, reaches its maximum level between 3 and 10 years of age, and adenotonsillar tissues are at their greatest size at this age.[1] Local or systemic attacks of infection affect the growth of adenotonsillar lymphoid tissues.

The fact that adenotonsillectomy is one of the most frequently performed surgical procedures in childhood is important in terms of determining adenotonsillectomy indications. Among the indications for adenoidectomy, the most common chronic mouth breathing, adenoid hypertrophy causing snoring and obstructive sleep apnea (OSA), recurrent purulent adenoiditis, and tonsillectomy indications, which are frequently recurrent acute tonsillitis and tonsillar hypertrophy causing OSA.

Methods

The study was planned a cross-sectional cohort study in the Ear, Nose, Throat, and Pediatrics between August 1, 2020, and February 1, 2022, after the approval of the ethics committee of Karadeniz Technical University Faculty of Medicine (2020/91).

Otomicroscopic examination, audiometry, tympanometry, anterior rhinoscopy, and flexible nasal endoscopy, oropharynx and oral cavity examinations were performed when necessary, in all patients who applied to the Ear, Nose, and Throat clinic with the complaints of frequent throat infections, snoring, sleeping with an open mouth, and decreased hearing. In some cases, a direct lateral cervical radiograph was taken. The study group included 300 children aged 0-15 years, who were indicated for adenoidectomy, tonsillectomy, adenotonsillectomy, and ventilation tube application as a result of anamnesis, physical examination, audiological tests, and direct lateral cervical radiography. The control group consisted of 300 randomly selected healthy children between the ages of 0-15 whose routine controls were terminated. Five children with cleft palate, two with velopharyngeal insufficiency, three with systemic diseases, two with bleeding diatheses, and 20 with previous adenotonsillectomy were excluded from the study group. Five children with bleeding diatheses and 20 with systemic diseases were excluded from the control group.

Patient selection flow diagram

Total children evaluated at ENT and Pediatrics clinics (n = 657)

A. Excluded from study group (n = 32):
   - Submucosal cleft palate (n = 5)
   - Velopharyngeal insufficiency (n = 2)
   - Uncontrolled systemic disease (n = 3)
   - Bleeding diathesis (n = 2)
   - Previous adenotonsillectomy (n = 20).

B. Excluded from control group (n = 25):
   - Bleeding diathesis (n = 5)
   - Uncontrolled systemic disease (n = 20).

In addition to demographic information such as age and gender, the families of the children included in the study were asked questions about birth weight, duration of breast milk use, use and duration of formula, and transition to complementary foods. Parents of the patients were informed about the study, and written informed consent forms were obtained. Palatine tonsil sizes were noted in both groups, and adenoid size was noted in the study group. Serological tests performed on the patients were evaluated; the presence of eosinophilia and abnormal values was noted.

In the patients who accepted to participate in the study and had the necessary indications, operations were planned. During the operation, the neck was extended in the supine position under general anesthesia, and the tongue was pressed with a Crowe-Davis mouth opener, and the inside of the mouth was exposed. Adenoidectomy with the help of a curette, tonsillectomy with cold dissection, adenotonsillectomy, and ventilation tube application were performed when necessary. Demographic data such as age, birth weight, gender, breastfeeding status and duration, status and duration of formula feeding, eosinophil counts in serological tests, and transition time to solid food were compared between the children in the study group and the control group.

Statistical analysis

While evaluating the findings obtained in the study, IBM Statistical Package for the Social Sciences for Windows 23.0 program was used for statistical

analysis. Categorical data are number (n) and percentage (%); metric data were presented with mean, standard deviation, median, minimum, and maximum values. Chi-square test was used to compare categorical data. Cases with a $p < 0.05$ were considered significant. The power of the research was calculated as 91.5% using Open Epi version 3.0 software with a 95% confidence interval.

Multivariate logistic regression analysis was used to determine the factors affecting the presence of disease. The dependent variable was the presence of adenotonsillectomy, and the independent variables were gender, birth weight, duration of breastfeeding, and formula feeding. The reference categories were "girl" for gender, "normal" for birth weight, and "> 12 months" for duration of breastfeeding and formula feeding. The model was constructed using the enter method, and the results were evaluated at a 95% confidence interval.

Results

Gender

The study included 296 (49.3%) girls and 304 (50.7%) boys aged between 1 and 15 (mean 5,193). The control group included 166 (55.3%) girls and 134 (44.7%) boys, while the study group included 130 (43.3%) girls and 170 (56.7%) boys. When the applications to the outpatient clinics were evaluated in both groups, it was seen that adenoidectomy, tonsillectomy, adenotonsillectomy, and ventilation tube application when necessary were performed at a higher rate in boys ($p = 0.003$) (Table 1).

Table 1. Comparison of control and study groups by gender

Gender	Control	Study	Total	p
Girl				0.003
Number (n)	166	130	296	
Ratio (%)	56.1	43.9	49.3	
Boy				
Number (n)	134	170	304	
Ratio (%)	44.1	55.9	50.7	
Total				
Number (n)	300	300	600	

Birth weight

Of the 600 children participating in the study, 36 (6%) had a low birth weight, 536 (89.3%) had a normal birth weight, and 28 (4.6%) had a high birth weight. Of the 36 children with low birth weight, 7 (19.4%) were in the control group, and 29 (80.6%) were in the study group. Of the 536 children with normal birth weight, 283 (52.8%) were in the control group, and 253 (47.2%) were in the study group. Of the 28 children with high birth weight, 10 (35.7%) were in the control group, and 18 (64.3%) were in the study group. It was observed that more adenoidectomy, tonsillectomy, adenotonsillectomy and ventilation tube application when necessary were performed in children with lower than normal birth weight (< 2500 g) ($p < 0.001$) (Table 2).

Breast milk

Of the 600 children in our study, 16 (2.7%) were not breastfed at all, while 584 (97.3%) were breastfed. Of the 584 children who were breastfed, 299 (51.2%) were in the control group, and 285 (48.8%) were in the study group; of the 16 children who were not breastfed, 1 (6.2%) was in the control group, and 15 (93.8%) were in the study group. Of the children who were breastfed, 100 (16.7%) were breastfed for 0-6 months, 148 (24.7%) for 7-12 months, and 352 (58.6%) for more than 12 months. Of the 100 children who were breastfed for 0-6 months, 8 (8%) were in the control group, and 92 (92%) were in the study group. Of the 148 children who were breastfed for 7-12 months, 89 (60.1%) were in the control group, and 59 (39.9%) were in the study group. Of the 352 children who were breastfed for more than 12 months, 203 (57.7%) were in the control group, and 149 (42.3%) were in the study group.

It was observed that adenoidectomy, tonsillectomy, adenotonsillectomy, and ventilation tube application when necessary were performed more frequently in children who were breastfed for < 6 months compared to children who were breastfed for more than 6 months ($p < 0.001$) (Table 3).

Formula feeding

It was observed that more adenoidectomy, tonsillectomy, adenotonsillectomy, and ventilation tube applications when necessary were performed in children who received formula for more than 6 months

Table 2. Comparison of control and study groups by birth weight

Birth weight (g)	Control	Study	Total	p
Lower than normal (< 2500 g)				< 0.001
Number (n)	7	29	36	
Ratio (%)	19.4	80.6	6	
Normal (2500-4000 g)				
Number (n)	283	253	536	
Ratio (%)	52.8	47.2	89.3	
Higher than normal (> 4000 g)				
Number (n)	10	18	28	
Ratio (%)	35.7	64.3	4.7	
Total				
Number (n)	300	300	600	
Ratio (%)	50	50	100	

Table 3. Comparison of control and study groups by time of breastfeeding

Time of breastfeeding	Control	Study	Total	p
0-6 month				< 0.001
Number (n)	8	92	100	
Ratio (%)	8	92	16.7	
7-12 month				
Number (n)	89	59	148	
Ratio (%)	60.1	39.9	24.7	
> 12 month				
Number (n)	203	149	352	
Ratio (%)	57.7	42.3	58.6	
Total				
Number (n)	300	300	600	
Ratio (%)	50	50	100	

Table 4. Comparison of control and study groups by time period of formula feeding

Time period of formula feeding	Control	Study	Total	p
0-6 months				< 0.001
Number (n)	8	47	55	
Ratio (%)	14.5	85.5	30.2	
7-12 months				
Number (n)	7	64	71	
Ratio (%)	9.9	90.1	11.8	
> 12 months				
Number (n)	0	56	56	
Ratio (%)	0	56	9.4	
Total				
Number (n)	300	300	600	
Ratio (%)	50	50	100	

Table 5. Comparison of transition time to complementary food in control and study groups

Transition time to complementary food	Control	Study	Total	p
0-6 months				0.178
Number (n)	259	247	506	
Ratio (%)	51.2	48.8	84.3	
> 6 months				
Number (n)	41	53	94	
Ratio (%)	43.6	56.4	15.7	
Total				
Number (n)	300	300	600	
Ratio (%)	50	50	100	

compared to children who received formula for 6 months or less ($p < 0.001$) (Table 4).

Eosinophilia

The eosinophil count was found to be higher in the complete blood count of the children who underwent adenoidectomy, tonsillectomy, adenotonsillectomy, and when necessary, ventilation tube application compared to the children in the control group ($p < 0.001$).

The switching time to additional food in the control and study groups is shown in table 5, and there was no statistically significant difference between the groups ($p = 0.178$). There was no significant relationship between the control and study groups in terms of switching to solid food earlier than 6 months or after 6 months.

When the adenoid sizes of the children in the study group were examined, 7 (1.2%) children had grade 1, 9 (1.5%) children had grade 2, 240 (40%) children had grade 3, and 44 (7.3%) children had Grade 4 adenoids. When the palatine tonsil sizes of the children in our study were examined, 383 (63.8%) children had Grade 1, 83 (13.8%) children had Grade 2, 97 (16.2%) children had Grade 3, and 37 (6.2%) children had Grade 4 tonsils. It was seen that 223 (58.2%) of 383 children with Grade 1 tonsils were in the control group, and 160 (41.8%) were in the study group. 71 (85.5%) of 83 children with Grade 2 tonsils were in the control group, 12 (14.5%) were in the study group. 6 (6.2%) of 97 children with Grade 3 tonsils were in the control group, 91 (93.8%) were in the study group, and 37 (100%) of 37 children with Grade 4 tonsils were in the study group.

Of the children in the study group, 87 (29%) had adenoidectomy, 84 (28%) had adenotonsillectomy, 42 (14%) had adenotonsillectomy with simultaneous

bilateral ventilation tube application, 81 (27%) had adenoidectomy with simultaneous bilateral ventilation tube application, 4 (1.3%) had tonsillectomy, 2 (0.7%) had tonsillectomy and simultaneous bilateral ventilation tube application.

According to regression analysis, the risk of disease was statistically significantly increased in boys compared to girls (p = 0.006; odds ratio = 1.69). Low birth weight increased the probability of disease by 3.55 times compared to normal birth weight (p = 0.010), and the association between high birth weight and disease risk was not statistically significant (p = 0.085). When examined in terms of duration of breastfeeding, a 3.91-fold increase in disease risk was observed in those breastfed for the first 6 months compared to those breastfed for more than 12 months (p = 0.002), while no statistically significant association was found for those breastfed for 7-12 months (p = 0.060). No significant association was found between duration of formula feeding and disease risk (p = 1.000) (Table 6).

Table 6. Logistic regression analysis results

Variable	p	OR [Exp (B)]	95% CI (OR)
Boy (Reference: girl)	0.006	1.69	1.16-2.46
Low birth weight (Reference: normal birth weight)	0.010	3.55	1.36-9.29
High birth weight (Reference: normal birth weight)	0,085	2,16	0,90-5.21
Time of breastfeeding (0-6 months) (Reference: >12 months)	0.002	3.91	1.65-9.26
Time of breastfeeding (7-12 months) (Reference: >12 months)	0.060	0.66	0.42-1.02
Time of formula feeding (0-6 months) (Reference: >12 months)	1.000	0.000	0.000
Time of formula feeding (7-12 months) (Reference: >12 months)	1.000	0.000	0.000

OR: odds ratio; CI: confidence interval

Discussion

Waldeyer lymphatic ring consists of palatine tonsils, pharyngeal tonsil (adenoid), lingual tonsils, lateral pharyngeal bands, and tubal tonsils. Adenotonsillar lymphoid tissues, a component of Waldeyer, are the structures that form the body's first defense mechanism against gastrointestinal and respiratory antigens. With the independent immune system that develops in the mucous membranes, antigens are quickly eliminated, and permanent immunity is provided. This independent immune system is called mucosa-associated lymphoid tissue (MALT).

In adenotonsillar lymphoid tissues, plasma cells are transformed into lymphocytes with weak antigenic stimuli, while high stimuli lead to proliferation of B cells. Immunoglobulin G (Ig)G and IgA are produced by the resulting B cell response. Produced IgG is distributed to the nasopharynx, and IgA to MALT.[2] Ogra et al. found that nasopharyngeal IgA levels decreased 3-4 times in children who had undergone adenotonsillectomy.[3] Jeschke and Ströder found that there was a decrease in serum and secretory IgA levels after adenotonsillectomy.[4] D'Amelio et al. They observed a decrease in serum IgA levels in individuals aged 16-24 who had undergone tonsillectomy.[5]

In the intrauterine life, the transmission of immunoactive components that protect against infections to the baby is provided by the placenta, and these functions of the placenta can be fulfilled through nutrition after birth. Breast milk is a biologically active food with more than 200 compounds in it. Most of the breast milk is water (88%), and other elements are dispersed.[6] Breast milk can protect babies against infections and allergies, with compounds with antimicrobial activity such as immunoglobulins, T and B lymphocytes, macrophages, granulocytes, lysozyme, C3, and C4. Protection against infections with breast milk; it is the classical protection mediated by IgA, IgG, and IgM, or by the direct binding of microorganisms and viruses by some bioactive substances in breast milk, or by accelerating the maturation of the infant's immune system.[7-9] There are immunoglobulins such as IgG, IgM, IgD, and IgE, especially secretory IgA in breast milk. Plasma cells that produce IgA in the mother's intestinal and bronchial system produce antibodies against the microorganisms they encounter, and these antibodies pass to the baby through breast milk.[7-9] The major antibody in breast milk is secretory IgA, preventing viruses and bacteria from adhering to the mucosa. By binding the lactoferrin-free iron in breast milk, lysozyme also protects the baby against infections by acting on the bacterial cell wall. Cytokines, prolactin, ascorbic acid, alpha-tocopherol, β-carotene, antioxidants, and epithelial growth factor in breast milk provide the development of the infant's immune system and protect it from atopic diseases.

Adenoidectomy is one of the most commonly performed surgical procedures in childhood and is important in determining the indications for adenotonsillectomy. Indications for adenoidectomy include one or more of the following: history of nasal airway

obstruction with sleep disturbance for at least 3 months; four or more recurrent episodes of purulent rhinorrhea in the past 12 months in a child < 12 years of age (one episode must be documented by intranasal examination or diagnostic imaging); hyponasal speech; otitis media with effusion for > 3 months; dental malocclusion or orofacial growth disorder; cor pulmonale; pulmonary hypertension; cardiopulmonary complications such as right ventricular hypertrophy associated with upper airway obstruction; otitis media with effusion (age 4 years and older).

The two most common indications for tonsillectomy are sleep-disordered breathing and recurrent throat infection. Recurrent throat infection with a frequency of at least seven episodes in the past year, at least five episodes per year for 2 years, or at least three episodes per year for 3 years with documentation in the medical record for each episode of sore throat and one or more of the following: temperature > 38.3°C or 101°F, cervical adenopathy, tonsillar exudate, or positive test for group A beta hemolytic streptococcus. Additional indications for tonsillectomy include multiple antibiotic allergies/intolerance, periodic fever, aphthous stomatitis, pharyngitis, and adenitis, history of more than one peritonsillar abscess and suspected malignancy.

OSA syndrome is a common disease affecting 2-3% of the pediatric population. OSA is a common condition in which there are recurrent episodes of airflow interruption despite constant effort due to a mechanical obstruction anywhere from the nasopharynx to the larynx during sleep. According to the study by Lim and McKean, if OSA is not treated, it causes neurobehavioral and cardiovascular complications.[10] Apnea episodes lead to hypoxia and hypercapnia, stimulating an increase in sympathetic output that causes an increase in heart rate and blood pressure. This causes subcortical stimulation, which allows the individual to clear the airway obstruction by changing their body position. OSA is seen in adults and children, but the two groups usually have different etiologies.[10] Known risk factors for OSA in children are adenotonsillar hypertrophy, male gender, obesity, allergic rhinitis, premature birth, inadequate breastfeeding, rhinosinusitis, passive smoking, low socioeconomic status, African origin, family history of OSA, and craniofacial anomalies.[10] Considering that the most common cause of OSA in children is adenoid and tonsil hypertrophy; highlighted the importance of adenotonsillar hypertrophy formation mechanisms and risk factors. Factors such as passive smoking exposure, allergies, and intervening respiratory infections have all been recognized by several epidemiological studies to be associated with temporary or permanent hypertrophy of lymphoid tissues in the upper respiratory tract of snoring children. The main problem in all these risk factors is inflammation in lymphoid tissues.

According to the study of Goldbart et al.[11], in children exposed to respiratory syncytial virus (RSV) infection in the early period, lymphoid tissue proliferation occurs as a result of neuroimmune changes in the airway, and increased levels of nerve growth factor (NGF), neurokinin (NK1), and substance P (SP) are observed in adenotonsillar tissues. Together with mediators such as P, it causes the continuation of inflammation and hypertrophy as a result of hypoxia and reoxygenation.[11] It has been observed that NGF, NK1, and SP increase in the lymphoid tissues of the upper airways of children with sleep apnea.[11] However, adenotonsillar hypertrophy does not develop in every child with RSV infection.[11]

The pathophysiology of pediatric OSA is a complex interaction between neuromuscular compensation that can lead to airway collapse. Anatomical measurements of the airway lumen, soft tissue, and skeleton are important in the treatment of this disease. OSA is most common in children between the ages of 3 and 10 years because of significant lymphoid tissue enlargement around the airway during this time period. According to the study of Kang et al., OSA was found more in boys than girls. Although the exact mechanism of this has not been found, obesity, upper airway anatomy, breath control, and hormones can be counted among the causes.[12] In addition, an increase in soft palate cross-sectional area and an increase in airway volume were found in men compared to women. This study suggests that men's susceptibility to pharyngeal collapse is anatomically based, mainly as a result of increased soft palate size as well as increased sensitive airway length.[13] In our study, there were 166 (55.3%) girls and 134 (44.7%) boys in the control group, whereas 130 (43.3%) girls and 170 (56.7%) boys were found in the study group. Consistent to the previous studies, it was observed in our study that adenoidectomy, tonsillectomy, adenotonsillectomy, and ventilation tube application were performed more frequently in boys than in girls ($p = 0.003$).

According to the study conducted by Joosten et al., the probability of developing OSA in children born prematurely and with low birth weight is 3-5 times higher than in normal children.[14] Facial asymmetry and elongated head shape are common features in preterm infants and may impair the size and growth of the upper airway, resulting in increased upper airway resistance.[14]

Premature or low birth weight children are more likely to be hospitalized for additional problems. Thus, their breast milk intake rates are lower compared to normal children, whereas infection rates are higher due to the immaturity of immunity. Compared to normal children, the effects of enlargement in lymphoid tissue in terms of OSA are more in premature or low birth weight children due to their anatomical structures. Excessive infections lead to enlargement of adenotonsillar tissues, which leads to sleep apnea, and thus, the rate of undergoing adenotonsillectomy is higher in premature or low birth weight children than in children born at normal term or with normal birth weight. In our study, out of 36 children with lower than normal birth weight, 7 (19.4%) were in the control group, and 29 (80.6%) were in the study group. Consistent with the results of previous related studies, children with low birth weight had more indications for surgery ($p < 0.001$).

According to the study of Ponce-Garcia et al., breastfeeding has been suggested as a potential protective factor against childhood sleep apnea and snoring.[15] achieved by immunological mechanisms. The oropharyngeal muscle and palate development of the child may be altered by sucking. Mechanically, bottle feeding causes less oral motor stimulation because it delivers milk through simple tongue depression, eliminating the need for the active, complex sucking and jaw movements required during breastfeeding. Therefore, proper development and coordination of the oropharyngeal musculature, which is necessary for effective swallowing, is provided more effectively with breast sucking. Thus, oral and oronasal respiration is gained effectively. Immunologically, the immunoglobulins (especially IgA) provided by breast milk protect the baby from infection by respiratory viruses and bacteria, prevent potential inflammation, thereby reducing adenotonsillar hypertrophy.[15] Adenotonsillar lymphoid tissues are the primary proliferation point for respiratory viruses. In the long term, neuro-immune modulatory pathways are activated in adenotonsillar tissues and lead to proliferation in tissues.[15] According to the study of Ponce-Garcia et al., more adenotonsillar hypertrophy was observed in children who were breastfed for < 6 months and children who were fed with formula.[15] In our study, 8 (8%) of 100 children who were breastfed for 0-6 months were in the control group, and 92 (92%) were in the study group. 89 (60.1%) of 148 children who were breastfed for 7-12 months were in the control group, and 59 (39.9%) were in the study group. It was seen that 203 (57.7%) of 352 children who were breastfed for more than 12 months were in the control group, and 149 (42.3%) were in the study group. Consistent with this study,[15] in our study, it was observed that adenoidectomy, tonsillectomy, adenotonsillectomy, and ventilation tube applications were performed more in children who were breastfed for < 6 months compared to children who were breastfed for more than 6 months ($p < 0.001$). In our study, 8 (14.5%) of 55 (30.2%) children who received formula for 6 months or less were in the control group, 47 (85.5%) were in the study group, and 7 out of 71 (39%) children who received formula for 7-12 months. (9.9%) were in the control group, 64 (90.1%) in the study group, and 56 (100%) of the 56 (30.8%) children who received formula for more than 12 months were in the study group. Consistent with this study,[15] in our study, it was observed that more adenoidectomy, tonsillectomy, adenotonsillectomy and ventilation tube applications were performed in children who received formula for more than 6 months compared to children who received formula for < 6 months ($p < 0.001$). We can say that we can contribute to the literature by increasing the duration of breastfeeding, reducing the feeding of formula foods, and reducing the rates of adenotonsillectomy.

Breastfeeding for 4-6 months increases the colonization of bifidobacteria and lactic acid bacteria and creates a strong intestinal microbiota with galactooligosaccharides in breast milk. A wide variety of galactooligosaccharides is found in breast milk and show bifidogenic effects in the infant gut.[16] There are differences in the microbial content of the intestinal flora between breast-fed and formula-fed infants. Bifidobacteria and lactobacillus are found in both breast-fed and formula-fed infants, but *Clostridium difficile,* Bacteroides, Enterococci, and Enterobacteriaceae are more abundant in formula-fed infants, while Staphylococci are more abundant in breast-fed infants. Breastfed children have more diverse bacteria in their gut microbiome, and this diversity provides protection from allergic diseases.[17]

Adenotonsillar lymphoid tissues are located at the entrance of the airways and are the first contact points for inhalant allergens. Chronic and recurrent inflammatory events around the adenotonsillar tissues cause adenotonsillar hypertrophy. Allergy is among the most common inflammatory causes for the upper respiratory tract. Allergic diseases can initiate inflammatory processes affecting adenotonsillar tissues, and large numbers of IgE-positive plasma cells/mast cells can cause an increase in allergen-specific IgE and eosinophilic infiltration. As eosinophils are the primary effector cells in allergic diseases, they have often been

found to be increased in serum and related tissues. In the study of Yücel Ekici et al., it was found that children with allergic complaints who underwent adenotonsillectomy due to hypertrophy and/or recurrent infection had a significantly higher eosinophil count both in their tissues and in the serum.[18] Specific IgE produced in tissues may contribute to serum eosinophilia. Thus, it can be said that the allergic response is not limited to local inflammation, and it causes an increase in systemic inflammation too. In the study conducted by Nave et al., it was found that there are more IgE plasma cells in the adenotonsillar tissues and regional lymph nodes of atopic patients compared to non-atopic individuals.[19] In the study by Fokkens et al., when adenoidectomy tissues of allergic and non-allergic children were compared, eosinophils were found to be significantly higher in the allergic group than in the non-allergic group. In other words, this study revealed that eosinophils, which are involved at last in an allergic inflammation, increase in the adenotonsillar tissues of allergic children.[20] As it could be a local response in tissues, it can be detected in the skin test or serological tests as well. However, it is still unknown whether there is an increase in the frequency of tonsillopharyngeal infections in children with allergic diseases. In the study conducted by Griffin et al., no relationship was found between allergy and adenotonsillar disease.[21] In our study, 61 (30.3%) of 201 children with eosinophilia were in the control group, and 140 (69.7%) were in the study group. Compared to the children in the control group, the children in the study group had higher eosinophil counts in the complete blood count ($p < 0.001$). This may support the view that children with allergic diseases may have more tonsillopharyngitis attacks or that inflammation in allergies may cause adenotonsillar hypertrophy. Adenotonsillar lymphoid tissues have immunological properties that may contribute to the inflammation seen in allergy, but more comprehensive studies are needed to explain their role in allergic inflammation. Transforming growth factor β, which is high in breast milk, reduces the possibility of developing allergic diseases in children.[22,23] Children who are breastfed are less likely to have allergic diseases than children fed with formula or cow's milk.[22,23]

Feeding the baby only with breast milk for the first 6 months is called natural feeding. In cases where it is not possible to give breast milk, the use of formula milk, which is produced from cow's milk and compared to breast milk, is called artificial nutrition. If the baby receives other milk besides breast milk, it is defined as mixed feeding. In line with the recommendations of the World Health Organization, babies should be fed only with breast milk for the first 6 months. The most common type of nutrition in the first 6 months in our country is mixed nutrition. There is growing concern that the current practice of delaying the introduction of solid food until the baby is 6 months old may increase the risk of immune disorders such as eczema and allergic disease. Evidence suggests that proper intestinal colonization through continued breastfeeding can increase tolerance to foods as well as protection when complementary feeding is initiated.[24] New recommendations say that allergenic foods should be given between 4 and 6 months.[25] Prescott et al.'s study suggested that early administration of certain allergenic foods is safe and may create tolerance.[26] In our study, 259 (51.2%) of 506 children aged 0-6 months in the control group, 247 (48.8%) in the study group. It was observed that 41 (43.6%) of 94 children who switched to solid food for more than 6 months were in the control group, and 53 (56.4%) were in the study group. There was no significant relationship between the control and study groups in terms of switching to solid food earlier than 6 months or after 6 months ($p = 0.178$). Further research is required to identify the microbial stimulus for normal development, to investigate the relevant mechanisms, and to confirm the role of microbiota in the prevention of allergic disease, chronic adenotonsillar infection, and adenotonsillar hypertrophy.

Limitations in our study

Since our study was carried out during the Coronavirus Pandemic period, the small number of people participating in the study, not recording the allergic symptoms of the children participating in the study, paying attention only to eosinophilia in the evaluation of allergic parameters in the complete blood count (not checking Ig E), and not noting the birth weeks of the children participating in the study are among the limitations of the study.

Conclusions

Adenotonsillectomy is one of the most common surgical operations in childhood. For this reason, operation indications, risk factors, and attempts to prevent surgery are important for public health.

Breast milk is a very important physiological nutrient source because it contains the nutrients necessary from the birth of the baby, various bioactive substances that provide protection against infections, and is protective

against chronic diseases in the long term. Breast milk ensures the formation of a strong microbiota in the child's intestines, ensures the development of the immune system, and protects it from allergic diseases.

When our cases were evaluated with a literature review in line with our plan, it was found that the patients who underwent adenoidectomy, tonsillectomy, and bilateral ventilation tube operations were mostly male, had a lower birth weight, had higher eosinophilia rates in complete blood counts, breastfed for less time, and formula-fed for longer. There are many variables that can play a role in recurrent upper respiratory tract infections and allergies. In our study, we found that breastfeeding is one of these variables. Based on our findings, breast milk protects the child from infections and allergies. Hence, we contribute to the literature in the favor of breastfeeding, stating that breastfeeding can reduce the number of surgical procedures due to allergies and recurrent adenotonsillar infection.

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Conflicts of interest

The authors declare no conflicts of interest.

Ethical considerations

Protection of humans and animals. The authors declare that the procedures followed complied with the ethical standards of the responsible human experimentation committee and adhered to the World Medical Association and the Declaration of Helsinki. The procedures were approved by the institutional Ethics Committee.

Confidentiality, informed consent, and ethical approval. The authors have followed their institution's confidentiality protocols, obtained informed consent from patients, and received approval from the Ethics Committee. The SAGER guidelines were followed according to the nature of the study.

Declaration on the use of artificial intelligence. The authors declare that no generative artificial intelligence was used in the writing of this manuscript.

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