# Impact of dietary habits on health outcomes in children and adolescents with poor oral hygiene

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## Abstract

Aim and Objectives. This study aimed to investigate the relationship between nutrition and the health status of children with poor oral hygiene. Specifically, it sought to identify factors influencing their health and to explore strategies for improving their nutrition and overall well-being. Material and Methods. Conducted at the Pediatric Department of the Emergency County Clinical Hospital in Oradea, the study reviewed medical records of patients aged 0 to 18 years hospitalized from May 13, 2023, to June 13, 2023. Inclusion criteria encompassed patients with poor oral hygiene, excluding those with chronic general diseases or syndromes. Demographic and dietary data were analyzed alongside laboratory parameters and systemic pathologies. Results. Among the 100 participants, the majority were male, with normal weight status, and followed artificial or mixed diets. Pathological alterations were predominant in the respiratory system, while no significant association was found between dietary patterns and pathological changes in other systems. However, significant correlations were observed between specific dietary habits and paraclinical parameters, such as Total-IgE and CPE levels. Conclusions. This study emphasizes the critical role of nutrition in children's health, particularly in the context of poor oral hygiene. Findings suggest that a natural or mixed diet may mitigate risks associated with allergies and immune disorders compared to an artificial diet. Advocating for balanced nutrition strategies could offer substantial benefits in mitigating chronic ailments and enhancing long-term health outcomes in children. Further research is warranted to validate and expand upon these findings.

**Keywords:** pediatric nutrition, oral hygiene, dietary impact

## INTRODUCTION

The growth and development of children is a complex and prolonged physiological process influenced by various factors [1]. Among these, nutrition plays a pivotal role in children's health and development, directly impacting the functioning of biological systems and the immune system [2]. A balanced and adequate diet supports healthy growth and development, while also reducing the risk of diseases and illnesses [3].

Nutrition is crucial both during the intrauterine development period [4] and immediately after birth [5]. The foundations of a healthy diet, which will sustain an individual throughout life, are established during early childhood. Therefore, it is important that the diet during this stage is balanced and adheres to recommendations from specialized associations [5]. As children grow older and enter adolescence—a period characterized by transformative growth and development—their nutritional needs continue to have significant long-term health implications [6]. During these periods, the risk of obesity can increase, affecting children across all age groups. The prevalence of obesity continues to rise, with approximately one-third of children and adolescents in the United States being classified as obese [7]. Multiple factors contribute to the rise in obesity, including biological, developmental, behavioral, genetic, environmental influences, and the composition of the intestinal microbiome [8,9]. If left untreated, obesity can lead to chronic conditions such as cardiovascular diseases, type 2 diabetes, and hypertension [10].

Thus, it is essential to provide children with a diet that supplies all necessary nutrients and substances to support their physical growth and cognitive development from the earliest years of life [11]. A diet rich in proteins, vitamins, minerals, and healthy fats contributes to the development of a robust immune system and helps prevent conditions such as obesity, diabetes, and cardiovascular diseases later in life [12]. Studies have also demonstrated that children's dietary choices can influence other aspects of their health, including energy levels, concentration, emotional state, and academic performance [13]. Consequently, promoting healthy eating habits among children and educating parents about the importance of nutrition can have a significant positive impact on long-term health and well-being [14].

Oral health is closely linked to the quality of nutrition [15]. Some studies have identified associations between obesity and increased caries prevalence [16], as well as between malnutrition and higher caries rates [17]. Excessive accumulation of dental plaque leads to the overgrowth of pathogenic microorganisms, contributing to dental caries and periodontal disease, and significantly altering the oral microbiome [18,19]. These changes may even impact the intestinal microbiome [20].

### Aim and objectives

Considering these aspects, the aim of this study was to explore the relationship between nutrition and the health status of children with poor oral hygiene. The focus is on identifying factors that influence their health and strategies to improve their nutrition and overall health.

## MATERIAL AND METHODS

The study was conducted in the Pediatric Department of the Emergency County Clinical Hospital in Oradea from May 13, 2023, to June 13, 2023. Medical records of patients hospitalized during this period were reviewed.

The following inclusion criteria were applied: patients aged 0 to 18 years who presented to the Emergency Department of the Oradea County Emergency Clinical Hospital

with urogenital, neurological, digestive, respiratory, or other emergencies. Additionally, patients with poor oral hygiene (characterized by plaque deposits, dental caries, or periodontal disease) were included. Information regarding birth type, breastfeeding duration, and predominant diet during the first two years of life was required for inclusion.

Patients were excluded if relevant information was unavailable, if they had been diagnosed with chronic general diseases, or if they were syndromic.

The variables analyzed included: patient age groups (0-6 years, 6-12 years, 12-18 years), gender (male, female), body mass index (BMI) categories (underweight, normal weight, obesity degree I, obesity degree II), predominant diet during the first two years of life (natural, mixed, artificial), and duration of breastfeeding (1 month, 3 months, 6 months, 12 months, 18 months). BMI was calculated using the formula: BMI = weight (kg) / height² (m²).

Laboratory examination values for the following parameters were investigated: Total Immunoglobulin E (Total-IgE), cationic protein of eosinophils (CPE), eosinophils, diamine oxidase, Respiratory Immunoglobulin E (Respiratory-IgE), Total Calcium (Total Ca), Ionic Calcium (Ionic Ca), Iron (Fe), Magnesium (Mg), Phosphorus, and Vitamin D. The digestive, urogenital, nervous systems, and sensory organs were also examined.

Statistical analysis was performed using IBM SPSS Statistics 26 and Microsoft Office Excel/Word 2013. Categorical variables were expressed in absolute numbers or percentages and were tested using Fisher's Exact Test. Z-tests with Bonferroni correction were conducted to detail the results from the contingency tables.

The research adhered to the principles specified in the Declaration of Helsinki, following its 2008 guidelines and the latest amendment in 2013. Approval was obtained from the Research Ethics Committee of the Faculty of Medicine and Pharmacy at the University of Oradea (IRB No. CEFMF/10, dated May 30, 2022).

**RESULTS**

The study comprised a final sample size of 100 patients. Table I presents the demographic characteristics of the patients under investigation. The majority of participants fell within the age brackets of 2-5 years (44%) or 6-12 years (31%), with a predominance of male subjects (57%) and a prevalence of normal weight status (80%). Regarding dietary habits, a substantial portion of the sample followed either an artificial (46%) or mixed (42%) diet regimen. Analysis of breastfeeding patterns revealed that the most prevalent durations were 3 months (52%), followed by one month (25%), and 6 months (17%).

Table I. Patients' characteristic

| Variable | Value |
|---|---|
| Age | 44 (44%) 2-5 years, 31 (31%) 6-12 years, 25 (25%) 12-18 years |
| Gender | 43 (43%) Female, 57 (57%) Male |
| BMI | 10 (10%) Underweight, 80 (80%) Normal, 7 (7%) Grade I Obesity, 3 (3%) Grade II Obesity |
| Diet | 12 (12%) Natural, 42 (42%) Mixed, 46 (46%) Artificial |
| Duration of breastfeeding | 25 (25%) 1 month, 52 (52%) 3 months, 17 (17%) 6 months,5 (5%) 12 months, 1 (1%) 18 months |

In terms of pathological changes identified across various bodily systems, a significant majority of patients exhibited anomalies within the respiratory system (99%), while only a minority presented abnormalities in the digestive system (10%). Pathological alterations were observed in a smaller proportion at the genitourinary level (6%), followed by the nervous system (3%) and sensory organs (3%). Notably, no patients exhibited pathological changes in either the cardiovascular (0%) or endocrine (0%) systems, as illustrated in Figure 1.
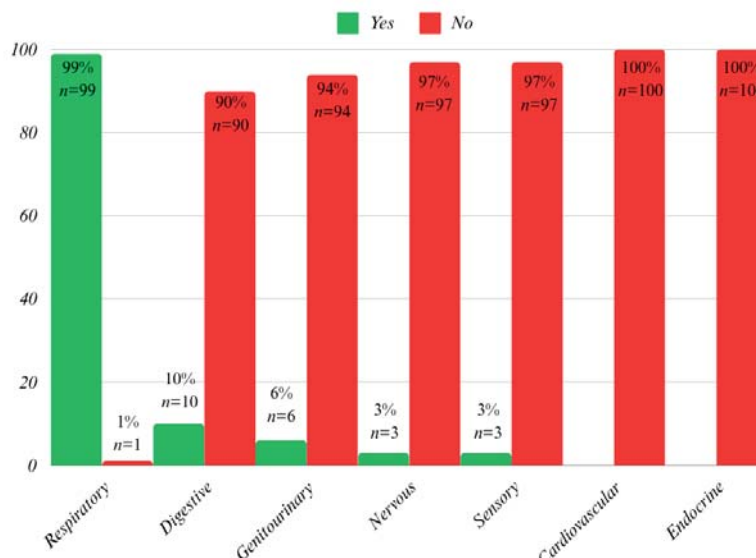
Figure 1. Systemic pathologies

The impact of nutrition on paraclinical examinations and the various systems under investigation was explored. Within this sample, no significant correlation was discerned between the presence of pathological alterations in the studied systems and specific dietary patterns. Analysis utilizing Fisher tests indicated nonsignificant differences between groups (p>0.05), as summarized in Table II.

Table II. Distribution of patients related to type of diet and the existence of pathological changes

| Diet/Alterations – Digestive System | Natural | | Mixed | | Artificial | | p* |
|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | |
| Absent | 10 | 83.3% | 38 | 90.5% | 42 | 91.3% | 0.723 |
| Present | 2 | 16.7% | 4 | 9.5% | 4 | 8.7% | |
| Diet/Alterations – Genitourinary System | Natural | | Mixed | | Artificial | | p* |
| | No. | % | No. | % | No. | % | |
| Absent | 10 | 83.3% | 39 | 92.9% | 45 | 97.8% | 0.101 |
| Present | 2 | 16.7% | 3 | 7.1% | 1 | 2.2% | |
| Diet/Alterations – Nervous System | Natural | | Mixed | | Artificial | | p* |
| | No. | % | No. | % | No. | % | |
| Absent | 11 | 91.7% | 11 | 97.6% | 45 | 97.8% | 0.486 |
| Present | 1 | 8.3% | 1 | 2.4% | 1 | 2.2% | |
| Diet /Alterations – Sensory Organs | Natural | | Mixed | | Artificial | | p* |
| | No. | % | No. | % | No. | % | |
| Absent | 12 | 100% | 41 | 97.6% | 44 | 95.7% | 1.000 |
| Present | 0 | 0% | 1 | 2.4% | 2 | 4.3% | |

*Fisher's Exact Test

However, significant findings emerged from certain paraclinical examinations conducted. Notably, for Total IgE levels, statistical significance was observed between the groups as per the Fisher test (p<0.001). Further analyses using Z-tests with Bonferroni correction revealed that patients exhibiting normal Total IgE values were significantly more prevalent among those adhering to a natural or mixed diet compared to those on an artificial diet (91.7%/76.2% vs. 37%). Conversely, patients with elevated Total IgE levels were

significantly more associated with an artificial diet compared to a natural or mixed diet (63% vs. 8.3%/23.8%), as illustrated in Figure 2.
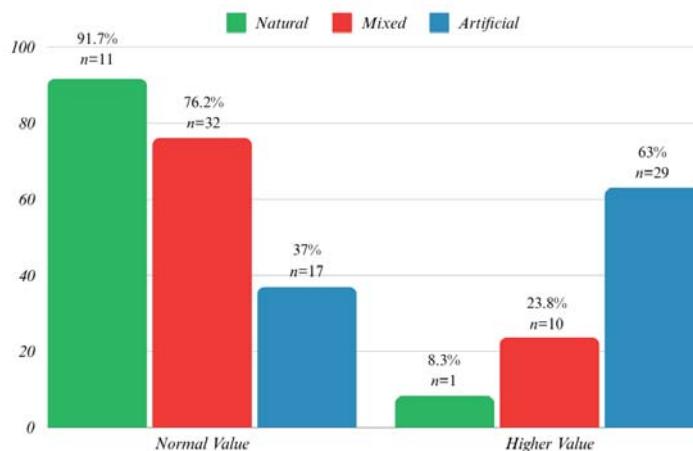


Figure 2. Distribution of patients related to type of diet and Total-IgE values

Figure 3 depicts the distribution of patients categorized by their dietary habits and CPE values. Statistical analysis, conducted using the Fisher test, revealed significant differences between the groups (p<0.001). Subsequent Z-tests, incorporating Bonferroni correction, demonstrated that patients with normal CPE values exhibited a significantly higher prevalence of association with natural or mixed diets compared to those with artificial diets (100%/76.2% vs. 8.7%). Conversely, patients with elevated CPE values were notably more associated with artificial nutrition compared to natural or mixed diets (91.3% vs. 0%/23.8%).
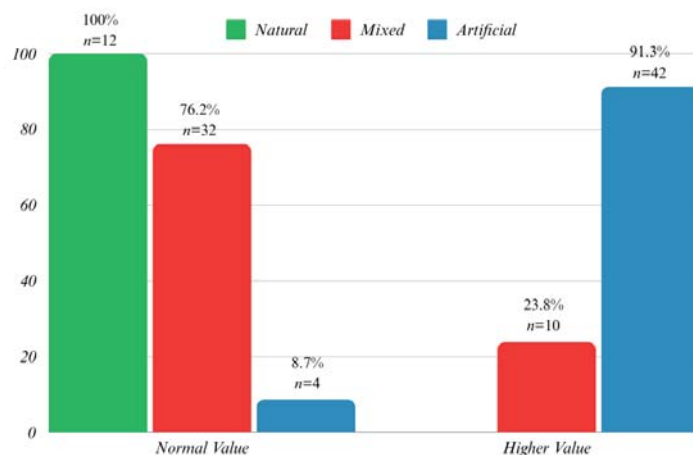


Figure 3. Distribution of patients related to type of diet and CPE values

The data presented in Table III illustrate the distribution of patients categorized by their dietary habits and the values of eosinophils, diamine oxidase, and total Ca. The following observations were made:

- Patients with normal eosinophil levels were notably more associated with a natural or mixed diet than with an artificial diet (100%/78.6% vs. 43.5%), while those with elevated eosinophil values exhibited a significant preference for artificial nutrition over natural or mixed diets (56.5% vs. 0%/21.4%).

- Patients with normal diamine oxidase levels were significantly more prevalent among those following a natural or mixed diet compared to an artificial diet (100%/92.9% vs. 37%), whereas individuals with elevated diamine oxidase values were notably more associated with artificial nutrition than with natural or mixed diets (63% vs. 0%/7.1%).

    Patients with low total Ca values exhibited a significantly higher frequency of association with natural nutrition than with artificial nutrition (16.7% vs. 0%).

Table III. Distribution of patients related to type of diet and eosinophils, diamine oxidase and Total Ca values

| Diet/Eosinophils | Natural | | Mixed | | Artificial | | p* |
|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | |
| Normal Value | 12 | 100% | 33 | 78.6% | 20 | 43.5% | <0.001 |
| Higher Value | 0 | 0% | 9 | 21.4% | 26 | 56.5% | |
| Diet/Diamine oxidase | Natural | | Mixed | | Artificial | | p* |
| | No. | % | No. | % | No. | % | |
| Normal Value | 12 | 100% | 39 | 92.9% | 17 | 37% | <0.001 |
| Higher Value | 0 | 0% | 3 | 7.1% | 29 | 63% | |
| Diet/Total Ca | Natural | | Mixed | | Artificial | | p* |
| | No. | % | No. | % | No. | % | |
| Normal Value | 10 | 83.3% | 40 | 95.2% | 45 | 97.8% | 0.043 |
| Higher Value | 0 | 0% | 0 | 0% | 1 | 2.2% | |
| Lower Value | 2 | 16.7% | 2 | 4.8% | 0 | 0% | |

*Fisher's Exact Test

The data depicted in Figure 4 illustrate the distribution of patients categorized by their dietary patterns and Respiratory-IgE values. Statistical analysis, conducted using the Fisher test, revealed significant differences between the groups ($p<0.001$). Further examination through Z-tests with Bonferroni correction revealed that patients with normal Respiratory-IgE values exhibited a significantly higher prevalence of association with natural or mixed diets compared to artificial diets (100%/78.6% vs. 15.2%). Conversely, patients with elevated Respiratory-IgE values were notably more associated with artificial nutrition than natural or mixed diets (84.8% vs. 0%/21.4%).
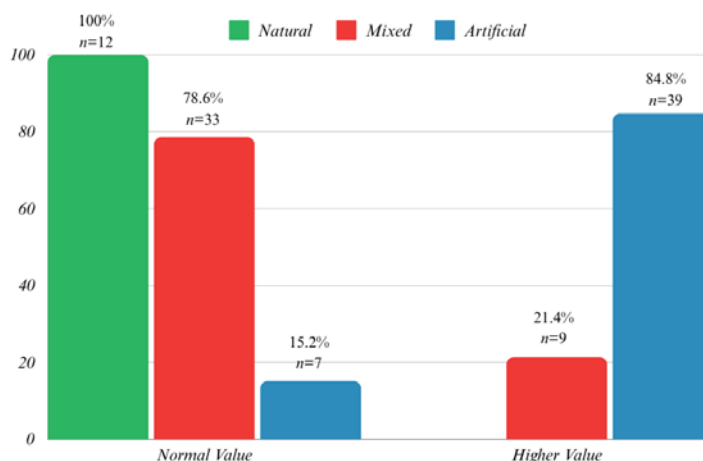


Figure 4. Distribution of patients related to type of diet and Respiratory-IgE values

The data illustrated in Figure 5 portray the distribution of patients categorized by their dietary habits and vitamin D levels. Statistical analysis, conducted using the Fisher test, revealed significant differences between the groups ($p=0.011$). Subsequent Z-tests with

Bonferroni correction demonstrated that patients with normal vitamin D values were significantly more frequently associated with mixed nutrition compared to artificial nutrition (69% vs. 39.1%). Conversely, individuals with low vitamin D values exhibited a notable preference for artificial nutrition over mixed nutrition (60.9% vs. 31%).
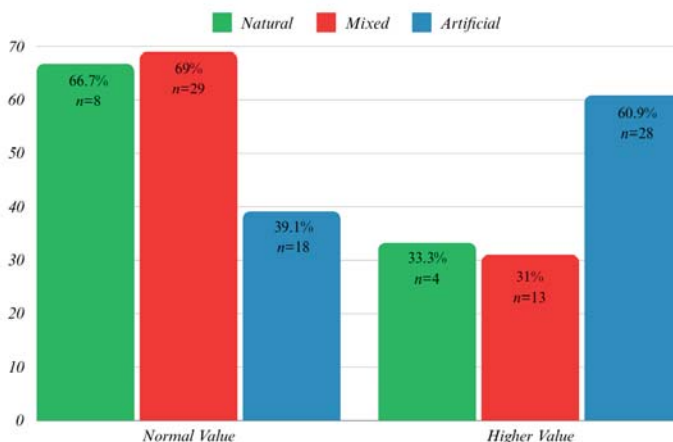


Figure 5. Distribution of patients related to type of diet and Vitamin D values

Conversely, for Iron (Fe), Ionic Calcium (Ca), Phosphorus, and Magnesium (Mg), no significant differences between groups were observed according to the Fisher test.


## DISCUSSIONS

The analysis of the results garnered in this study offers a comprehensive perspective on the link between nutrition and children's health. These findings underscore several correlations between patient characteristics and pathological changes identified across various bodily systems.

Although the majority of patients were under artificial or mixed nutrition regimens, no significant association was identified between these diets and the presence of pathological alterations. Notably, body mass index (BMI) assumes critical importance as it exerts multifaceted impacts on a child's well-being. Furthermore, elevated maternal BMI heightens the likelihood of complications during natural childbirth and correlates more frequently with cesarean deliveries [21].

An important discovery of this investigation was the notable correlation between diet type and specific paraclinical parameters. Notably, patients exhibiting normal total IgE, ECP, eosinophils, diamine oxidase, and respiratory IgE values were significantly more associated with a natural or mixed diet than with an artificial one. These findings suggest that a natural or mixed diet may entail a diminished risk of allergies and immune system disorders compared to an artificial diet. Notably, all major international medical associations advocate exclusive breastfeeding for the initial six months, followed by the commencement of complementary feeding and the introduction of mixed feeding thereafter. Among the manifold benefits of a natural diet are a reduced risk of atopic dermatitis, gastrointestinal disorders, childhood leukemia, obesity, and diabetes. Moreover, infants exclusively breastfed for the first six months tend to exhibit higher IQs in adulthood [22]. The correlation between natural feeding and a diminished allergy risk has also been underscored by other researchers [23], while some authors have posited a decreased risk of immune-related ailments [24,25].

The insights gleaned from these results present substantial opportunities for enhancing clinical practice and public health policies pertaining to child nutrition.

Advocating for a balanced diet could serve as an efficacious strategy for mitigating the risk of chronic ailments and augmenting the long-term health of children. Nonetheless, it is imperative to acknowledge certain limitations inherent in this study, such as the relatively modest sample size and the observational nature of the study design. Consequently, further research is warranted to validate and expand upon these findings.

## CONCLUSIONS

In conclusion, the findings of this study underscore the pivotal role of nutrition in shaping the health trajectory of children. A deeper comprehension of this interplay holds promise for crafting more efficacious strategies aimed at bolstering children's well-being during the formative stages of their lives.

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