ORIGINAL ARTICLE

CONTENTS

# Explanaton symptoms into mechanisms: functional gastrointestinal disorders in the children

**Olesya M. Horlenko[1], Gabriella B. Kossey[1], Adrian I. Tomey[1], Kamila Yu. Voronych[2], Nataliia V. Sochka[1], Lybov Yu. Pushkash[1], Mariana Yu. Synenko[1]**

[1]UZHHOROD NATIONAL UNIVERSITY, UZHHOROD, UKRAINE

[2]GLOBAL MEDICAL KNOWLEDGE ALLIANCE LEHI, UTAH, USA

## ABSTRACT

**Aim**: To investigate and analyze clinical and laboratory data in children with functional gastrointestinal disorders and the role of phytotherapeutic correction in the treatment.

**Materials and Methods**: Clinical and follow-up observation was conducted on 131 children aged 4 to 22 months (72 boys and 59 girls) with manifestations of functional gastrointestinal disorders.

**Results:** 53 (40,5%) children received artificial milk formulas from birth, 20 children (15,3%) - from 2 months of age, 22 (16,8%) - from 4 months of age, 36 (27,4%) - from 6 months of age or older. Complementary feeding in most cases was introduced earlier than the WHO recommended terms - 85 children (64,8%) began to receive complementary feeding before 6 months of age. The most frequent clinical manifestations were: flatulence (97 children/74,2±3,8%), pain syndrome (92 patients/70,4±3,9%), decreased appetite (64 children/48,6±4,4%) and refusal to eat (47 children/36,0±4,2%), constipation (45 patients/34,8±4,2%). Children with functional gastrointestinal disorders were characterized by a decrease in the degree of physical development: physical development below average was observed in 23,6±3,7% of the examined children, low physical development - in 18,3±3,4%, very low - in 22,9±3,7%. Liver ultrasound revealed no abnormalities in children with FGID. Coprological findings reflected impaired gastric and intestinal digestion and impaired pancreatic secretion.

**Conclusions:** The most significant risk factors for the development of FGID in young children are certain inconsistencies of nutrition with the functional capabilities of the child's organism in the form of artificial feeding and early introduction of complementary feeding.

**KEYWORDS:** functional gastrointestinal disorders, functional dyspepsia, homeostasis disorders, children

Wiad Lek. 2026;79(7):1615-1624. doi: 10.36740/WLek/225984 DOI

## INTRODUCTION

Functional gastrointestinal disorders (FGIDs), also recently referred to as gut-brain interaction disorders, are common in children and vary according to age groups, i.e., FGIDs in neonates/toddlers and children/adolescents. Pediatric FGIDs typically develop and persist into adulthood, causing financial and psychological distress. Despite several decades of progress and advances in molecular biology and medical sciences, the exact pathophysiology remains unknown, although genetic, psychosocial, gut dysbiosis, visceral hypersensitivity, and neuroimmune causes have been considered [1]. The Rome IV criteria facilitate easier and earlier diagnosis of FGIDs by excluding organic causes and minimizing unnecessary investigations. There are dietary, psychosocial, neurostimulating and pharmacological treatment methods, although fewer studies have focused on drug treatment in children. Early diagnosis and appropriate treatment have the potential to improve recovery and quality of life. Functional gastrointestinal disorders (FGIDs) are a common pathology among children. According to statistics, they occupy the largest percentage in the structure of digestive pathology in young children and occur with a frequency of 85-90% [1,2]. Numerous studies conducted in Western Europe and North America allow us to consider this pathology the most frequent among gastroenterological diseases in children. During the first year of life, about half of children have at least one symptom of functional disorders of the gastrointestinal tract, and often a combination of several symptoms [3]. The treatment of children with functional dyspepsia syndrome is quite complex, since no clear schemes have been developed for this, and the literature on the treatment of children with digestive pathologies, in particular with functional dyspepsia, is scarce [4]. When choosing a treatment strategy for young children, preference should be given to drugs that have a mild effect and cause the least number of side effects [5].

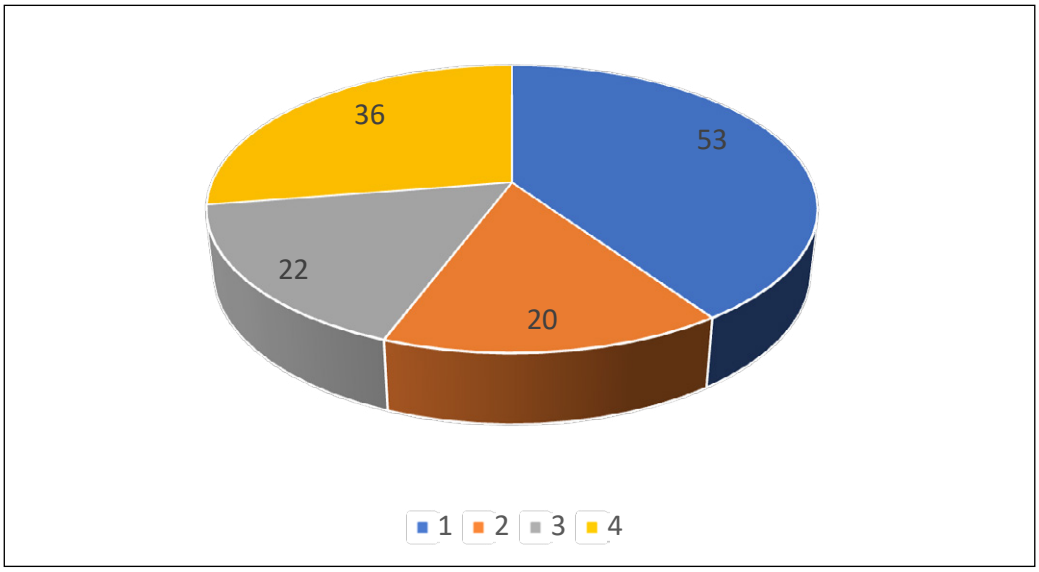


**Fig. 1.** Type of feeding of the surveyed contingent of children
1- artificial feeding from birth
2- artificial feeding from 2 months of age
3- artificial feeding from 4 months of age
4- artificial feeding from 6 months of age or older
*Picture taken by the authors*

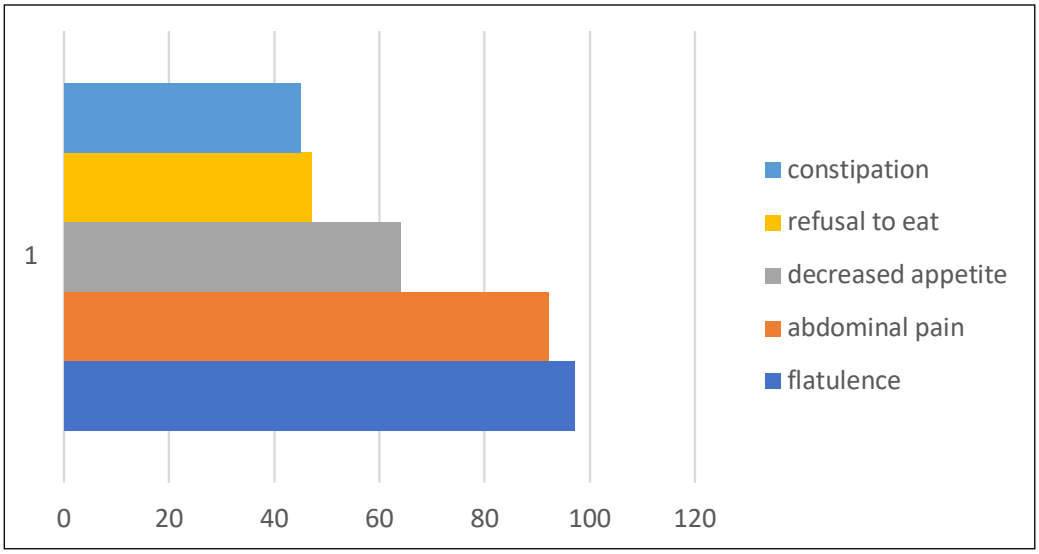


**Fig. 2.** Main clinical manifestations of functional gastrointestinal disorders in the examined children
*Picture taken by the authors*

## AIM

To investigate and analyze clinical and laboratory data in children with functional gastrointestinal disorders and the role of phytotherapeutic correction in the treatment.

## MATERIALS AND METHODS

Clinical and follow-up observation was conducted on 131 children aged 4 to 22 months (72 boys and 59 girls) with manifestations of functional gastrointestinal disorders who were inpatients in the early childhood department of the Uzhhorod Clenecal Children hospital. Diagnoses were verified according to the diagnostic criteria developed by the Ministry of Health of Ukraine. The studies were carried out in compliance with the basic provisions of GCP, the Council of Europe Convention on Human Rights and Biomedicine, and the World Medical Association Declaration of Helsinki on the ethical principles of conducting scientific medical research involving human subjects (2000).

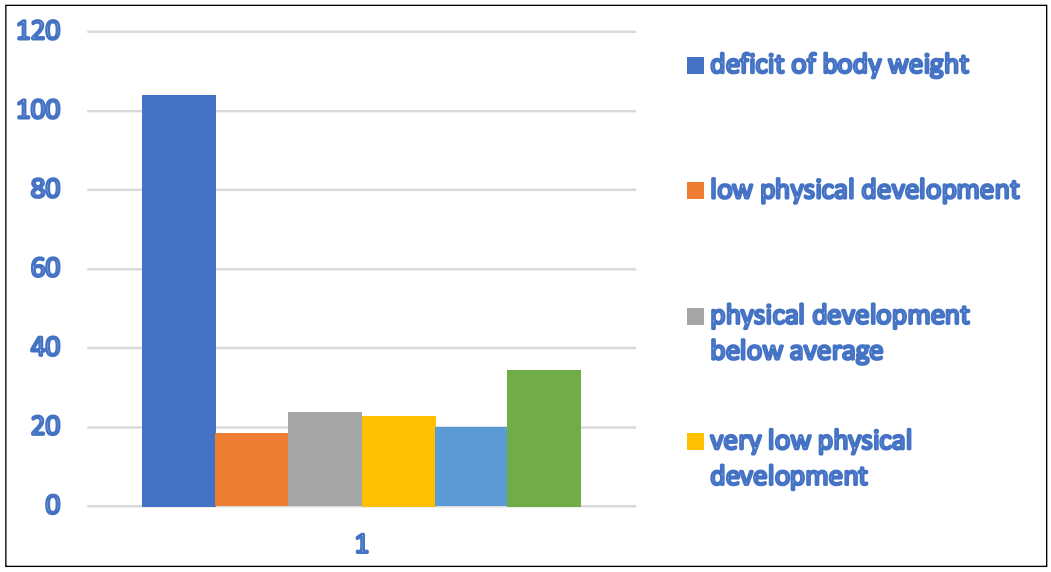


**Fig. 3.** Deviations in physical development indicators in children with functional gastrointestinal disorders
*Picture taken by the authors*

## RESULTS

The examined children with functional gastrointestinal disorders were on artificial feeding, which confirms the important role of breastfeeding in the prevention of the development of pathological processes in children. Children did not receive human milk at all or its amount was less than 1/5 of the daily food intake, and the main food product were artificial milk formulas. 53 (40,5%) children received artificial milk formulas from birth, 20 children (15,3%) - from 2 months of age, 22 (16,8%) - from 4 months of age, 36 (27,4%) - from 6 months of age or older (Fig. 1).

As a substitute for breast milk, the examined children received highly adapted milk formulas. In all cases, the formulas corresponded to the age of the examined children.

Complementary feeding in most cases was introduced earlier than the WHO recommended terms - 85 children (64,8%) began to receive complementary feeding before 6 months of age (55 children received porridge starting from 4 months of age, 10 from 5 months of age; 12 children were introduced to vegetable puree from the 4th month of life; 8 children received meat puree as complementary feeding from the 5th month). From the beginning of the examination, complementary feeding products were introduced to the studied contingent of children in accordance with age standards.

The obtained data make it possible to state that the nature of feeding, violation of the timing of the introduction of complementary feeding are significant risk factors for diseases of the digestive system, the development of clinical manifestations of functional gastrointestinal disorders.

The examined children received food 5 times a day both before, during and after the course of treatment. The diet was calculated so that the amount of proteins constituted on average 3,5 g/kg of body weight per day for children aged 4-6 months and 4,0 g/kg of body weight per day for older children (of which 65-70% were animal proteins); fats – 6,0 and 5,5 g/kg of body weight per day, respectively (of which 85-90% were of animal origin); carbohydrates – 12-14 g/kg of body weight per day for both age groups (special attention was paid to the presence in the diet of a sufficient amount of plant fibers that stimulate the motor activity of the digestive system and normalize peristalsis). The energy value of the daily diet for 4-6 months old infants was on average 120 kcal/kg of body weight per day, for older children – 115 kcal/cell per day.

Due to the presence of a fairly large difference in the age of the examined children (4-22 months), the study of clinical manifestations of functional gastrointestinal disorders was carried out in two age categories: children under 12 months and children aged 13-22 months.

It was established that regardless of the age of the examined contingent, the most frequent clinical manifestations of functional gastrointestinal disorders were flatulence, pain syndrome, decreased appetite and even refusal to eat, constipation (Fig. 2). Based on the conducted studies, it was found that age differences in the clinical picture of the disease are not observed, the prevalence of the dyskinetic form of functional dyspepsia was established.

Flatulence was diagnosed on the basis of superficial palpation of the anterior abdominal wall, during which 97 children (74,2±3,8%) had abdominal distension.

**Table 1.** The content of total protein and protein fractions in the blood serum of children with functional gastrointestinal disorders (n = 131)

| Indicator | Indicator level (M±m) | Reference values |
|---|---|---|
| Total protein, g/l | 57.8±0.7* | 57.0-73.0 |
| Albumines, % | 47.8±0.8** | 56.5-66.5 |
| Globulines, % | 52.2±0.6** | 33.5-43.5 |
| α1-globuline, % | 9.3±0.2** | 2.5-5.0 |
| α2-globuline, % | 12.0±0.5** | 5.1-9.2 |
| β-globuline,% | 12.5±0.7* | 8.1-12.2 |
| γ-globuline, % | 19.3±0.6* | 12.8-19.0 |

*Notes:* *– significance of differences between indicator values p>0,05; **– significance of differences between indicator values p<0,05
*Source: compiled by the authors of this study*

**Table 2.** Serum biochemical tests in children with functional gastrointestinal disorders (n = 131)

| Indicator | Indicator level (M±m) | Reference values |
|---|---|---|
| Creatinine, mmol/l | 71.2±1.8* | 50-115 |
| Urea, mmol/l | 4.4±0.2* | 4.2-8.3 |
| Thymol test, un. | 0.25±0.04* | до 4.0 |
| ALT, Mkat/l | 0.20±0.04* | 0.1-0.68 |

*Notes:* *– significance of differences between indicator values p>0,05; **– significance of differences between indicator values p<0,05
*Source: compiled by the authors of this study*

Due to the age characteristics of the examined contingent, the equivalent of pain syndrome, which is one of the main manifestations of functional gastrointestinal disorders in older children, was considered to be restlessness and crying of the child along with tension of the muscles of the anterior abdominal wall. Such phenomena were observed in 92 (70,4±3,9%) of the examined children.

Decreased appetite was manifested by reluctant eating or undereating of a portion of food appropriate for the child's age and was found in 64 of the examined children (48,6±4,4%).

Refusal to eat was recorded in 47 children (36,0±4,2%) with functional gastrointestinal disorders. In this case, the children refused not a specific type of food, but one or more meals.

Constipation was manifested by a prolonged (48 hours or more) delay in bowel movements, accompanied by difficulty in defecation, as well as a small amount or increased density of feces, and was diagnosed in 45 examined children (34,8±4,2%) (Fig. 2).

## ASSESSMENT OF PHYSICAL DEVELOPMENT OF CHILDREN WITH FUNCTIONAL GASTROINTESTINAL DISORDERS

Regarding physical development, as the main indicator of health in young children, certain deviations were found in the examined children with functional gastrointestinal disorders.

104 (79,4±3,5%) children had a deficit of body weight in relation to the normative indicators, which reflects the main clinical manifestations of functional gastrointestinal disorders in young children in the form of reduced appetite and refusal to eat. Low levels of other anthropometric indicators, such as height, chest circumference, etc. can be considered a consequence of the above manifestations of the disease. During the assessment of physical development using centile tables, changes in the degree and harmony of physical development were observed [6]. Children with functional gastrointestinal disorders were characterized by a decrease in the degree of physical development: physical development below average was observed in 23,6±3,7% of the examined children, low physical development - in 18,3±3,4%, very low - in 22,9±3,7%. Average physical development was observed in 26,7±3,8% of children, and physical development above average - in 9,2±2,5%.

Deviations were found in the harmony of physical development: extremely disharmonious physical development was diagnosed in 34,4±4,1% of children with functional dyspepsia, disharmonious - in 19,9±3,5%. Harmonious physical development was in 45,8±4,4% of the examined children. The most frequent deviations in physical development indicators are presented in Fig. 3.

Based on the analysis of anthropometric data, it was found that the main deviations in physical development in children with functional gastrointestinal disorders are: deficit of body weight in relation to the normative indicators for children of this age, low levels of physical development and its disharmony.

Before the initiation of treatment and after its completion, the examined contingent of children underwent a general blood test, the main average indicators of which were as follows: ESR – 12,6±1,2 mm/h, hemoglobin – 111,0±6,5 g/l, erythrocytes – 3,5±0,1×$10^{12}$/l, leukocytes – 10,2±0,2×$10^{9}$/l, with no significant deviation from the age norm.

However, there were isolated cases of decreased hemoglobin and erythrocyte levels - in 27 (20,6%) children, which, in our opinion, was associated with malnutrition in the form of reduced appetite and, as a consequence, insufficient intake of iron with food products. Being in close contact with proteins of various tissues, blood proteins react very subtly to changes in chemical and physicochemical processes occurring in the body, and disorders of protein metabolism in tissues have a significant impact on the composition of blood proteins [7]. Therefore, the determination of protein fractions is an important component of assessing the child's condition, in particular in functional gastrointestinal disorders. The total content of plasma proteins does not have significant age-related changes. In newborns, especially in premature infants, the protein content is somewhat lower, and increases during the first year of life. The albumin content in children approaches that of adults by the end of the first year of life, while globulins reach this level somewhat later. No significant difference in the content of blood plasma proteins in girls and boys was found [8].

Table 1 presents the main indicators of proteinogram in young children with functional gastrointestinal disorders.

It was found that children with functional gastrointestinal disorders have changes in the level of total protein and protein fractions of blood serum. In particular, there was a tendency to a low level of total protein – 57,8±0,7 g/l (at the lower limit of reference values) and albumin fractions – 47,8±0,6% ($p<0,05$), while globulin fractions exceeded the upper limit of the norm – 52,2±0,6% ($p<0,05$). Such indicators indicate the presence of dysproteinemia in young children with functional gastrointestinal disorders [9].

In addition to determining the content of total protein and its fractions, other biochemical indicators of blood serum were studied as well (table 2):

The serum creatinine level in the examined contingent corresponded to the reference values and was 74,5±1,8 μmol/l with a norm of 50-115 μmol/l. There were no cases with low or high creatinine levels among the examined children. As for urea, the average values were 4,4±0,2 mmol/l with a norm of 4,2-8,3 mmol/l, however, there were cases (12 children) when the urea level was lower than 4,2 mmol/l; since the urea content in the blood reflects the level of protein load of the body, in our opinion, this is associated with insufficient intake of proteins as a result of reduced appetite in the examined children [9].

The thymol test, a biochemical test that assesses the protein-synthetic function of the liver and reflects the nonspecific inflammatory reaction of the liver tissue, did not deviate from the reference values in any child and was at the level of 0,25±0,04 units. The content of alanine aminotransferase (ALT) - an enzyme that is present in many tissues of the body, in particular in the liver and the release of which occurs when the internal structure of hepatocytes is disrupted and the permeability of cell membranes increases - also was within the normative limits at the level of 0,20±0,04 μmol/l. Such data confirm the absence of organic changes, in particular of the liver in functional gastrointestinal disorders in young children.

In children who had clinical manifestations of functional gastrointestinal disorders, a study of pigment metabolism indicators was conducted. The state of pigment metabolism was studied by the content of total bilirubin and its fractions: indirect bilirubin (free, unconjugated) and direct bilirubin (conjugated, bound). Under physiological conditions, bilirubin is accumulated by the liver and excreted in the bile. No deviations in the indicators of pigment metabolism were detected, the levels of total bilirubin and its fractions were within the age norm. The level of total bilirubin was on average 7,5±0,7 μmol/l, direct bilirubin – 3,3±0,4 μmol/l, indirect bilirubin – 4,1±0,9 μmol/l.

No significant deviations were detected in the electrolyte metabolism of the examined children. The level of calcium ions was slightly reduced at the level of 2,02±0,21 mmol/l with reference values of 2,2-2,4 mmol/l. The content of potassium ions constituted 4,27±0,34 μmol/l (normal 4,1-5,7 μmol/l), sodium ions – 139,6±0,86 mmol/l with a norm of 133-142 mmol/l.

Children with functional gastrointestinal disorders had their pituitary and thyroid hormone levels determined by enzyme-linked immunosorbent assay.

The relevance of their determination is explained by the fact that the leading role in controlling the growth processes belongs to neuroendocrine regulation with the participation of the hypothalamic-pituitary system. In addition, determining the level of thyroid hormones is of interest in regions endemic for iodine deficiency, such as Transcarpathia [10].

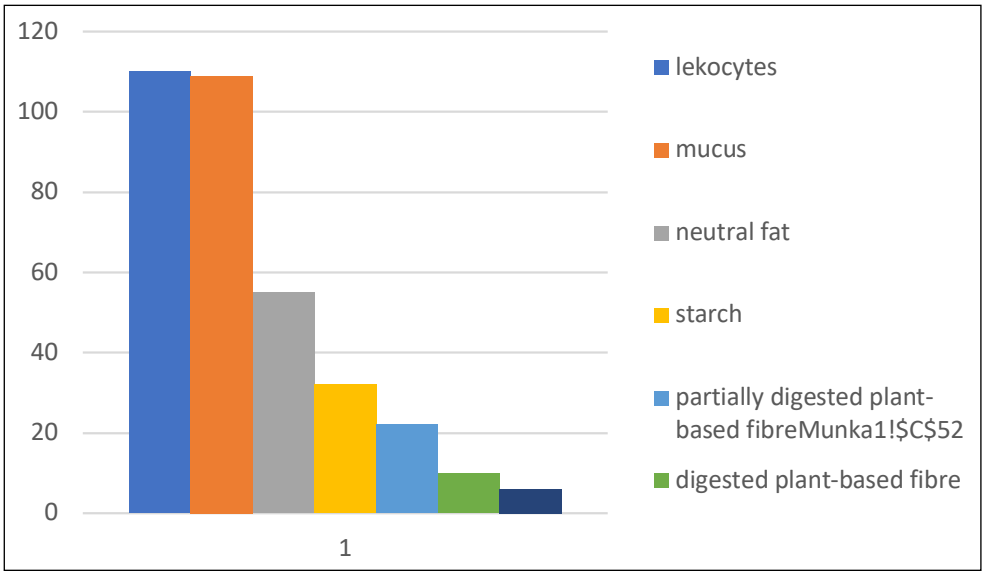


**Fig. 4.** Coprological findings in children with FGIR
*Picture taken by the authors*

It is known that in the first five years of life, the greatest growth effect of thyroid hormones is manifested (stimulation of osteogenesis and skeletal maturation). Later, the role of thyroxine is reduced to participation in the synthesis of somatomedins, which are mediators in the implementation of the action of somatotropic hormone. The activity of the anterior pituitary gland increases after two years, the secretion of somatotropic hormone increases, which from the age of five becomes decisive in the stimulation of chondrogenesis and linear bone growth. In addition, somatotropic hormone (STH) stimulates gluconeogenesis, protein synthesis, increases muscle mass and strength, absorption of calcium and phosphorus in the intestine and bone ossification, which is also of great importance during the period of intensive growth of the child [11].

Thyroid-stimulating hormone (TSH) is the main regulator of thyroid function, which, by the principle of feedback, ensures compliance between the activity of the thyroid gland and the needs of the body [10].

According to our data, the level of somatotropic hormone in children with functional gastrointestinal disorders was at the level of 7,41±0,40 mIU/l (normally its level fluctuates within 2-20 mIU/l), i.e. the average values of the indicators did not exceed the age norm. However, in 5 (3,8%) children, the level of STH was lower than the reference values and ranged from 0,31-0,9 mIU/l.

The level of thyroid-stimulating hormone in children with functional gastrointestinal disorders was on average 1,19±0,08 μIU/l with a norm of 0,23-3,4 μIU/l.

The thyroid hormone levels in the examined children were also within the normal limits: the level of triiodothyronine (T3) was 1,63±0,06 nmol/l, thyroxine (T4) – 146,9±0,9 nmol/l with a norm of 1,01-2,01 nmol/l and 53-158 nmol/l, respectively.

Based on the data obtained, it can be stated that in functional gastrointestinal disorders in the examined children there are no significant deviations in the level of pituitary and thyroid hormones.

During the work, a study of humoral immunity indicators was conducted. The main serum immunoglobulins - immunoglobulin E (Ig E), immunoglobulin A (Ig A), immunoglobulin G (Ig G) were determined using enzyme-linked immunosorbent assay.

The indicators of humoral immunity were as follows: the content of immunoglobulin E (Ig E) was on average 19,5±1,2 IU/ml, immunoglobulin A (Ig A) – 0,31±0,07 mg/ml, immunoglobulin G (Ig G) – 12,4±3,4 mg/ml. The reference values of immunoglobulins are up to 100 IU/ml, 0,3-1,2 mg/ml and 3,1-13,8 mg/ml, respectively. It was established that in children with functional dyspepsia there is a slight increase in the level of immunoglobulin G, and the level of immunoglobulin A is at the lower limit of the age norm.

The level of cytokines such as interleukin-2 and interleukin-4 was determined in the examined contingent of children.

The relevance of studying the level of cytokines in this contingent of patients is due to their participation in the formation and regulation of the body's protective reactions. At the body level, cytokines establish a connection between the immune, nervous, endocrine, hematopoietic and other systems and involve them in the organization and regulation of protective reactions [12].

It was found that the level of IL-2 in the examined children was 35,5±4,8 pg/ml, which is within the reference limits of indicators for children of this age.

As for the level of IL-4 in the examined contingent, the indicators also corresponded to the age reference values and were 13,1±1,0 pg/ml.

**Table 3.** Results of the ultrasound examination of the liver in healthy children and in children with functional gastrointestinal disorders (n=131)

| Indicator | The value of indicators in children with FGID | Reference values |
|---|---|---|
| Liver | Right lobe<br>up to 12 months: 66.5±0.4 mm<br>13-22 months: 72.5±0.5mm<br>Left lobe<br>up to 12 months: 33.6±0.3 mm<br>13-22 months: 36.1±0.3 mm | up to 12 months: 65-70mm<br>13-22 months: 70-75mm<br><br>up to 12 months: 32-35 mm<br>13-22 months: 35-38mm |
| | V. porta:<br>5.2±0.1mm | 5-6 mm |
| | V. hepatica dextra:<br>2.5±0.1mm | 2-3 mm |
| | V. hepatica sinistra:<br>2.4±0.1mm | 2-3 mm |
| | D. hepaticus communis:<br>3.6±0.1mm | до 4 mm |
| | D. choledochus:<br>4.9±0.1mm | до 6 mm |

*Source: compiled by the authors of this study*

The obtained data confirm that the examined children, despite the existing clinical symptoms, did not have organic pathology and there were no signs of inflammatory reactions.

## INSTRUMENTAL EXAMINATION OF THE GASTROINTESTINAL TRACT IN FUNCTIONAL GASTROINTESTINAL DISORDERS IN YOUNG CHILDREN

Considering that the fibroesophagogastroduodenoscopy (FGDS) method of the study is quite traumatic for the examined contingent of patients (examining the mucous membrane of the esophagus, stomach and duodenum using an endoscope, which is inserted through the root of the tongue into the listed parts of the digestive tract), in our opinion, the diagnosis of functional gastrointestinal disorders in young children can be made without FGDS and the study can be used only if there are indications.

Therefore, FGDS was performed on 10 children from each examined group, the clinical course of the disease in whom was the most severe. The need for examination of the entire group was not justified, since no pathological changes were observed during endoscopic examination of the esophagus, stomach, and duodenum in children with functional gastrointestinal disorders, which confirms the absence of organic changes in the mentioned parts of the gastrointestinal tract.

The results obtained during the study in children with functional gastrointestinal disorders were as follows (extract from the medical history No. 102 of child R., 14 months):

The esophagus without pathological findings, the cardia is located at a distance of 21 cm from the front teeth. The stomach contains a small amount of secretory fluid with mucus. The gastric mucosa is pale pink, unremarkable. The pylorus is centrally located, passable. The duodenal mucosa is pale pink, without visible changes.

Children with dyspepsia underwent ultrasound examination of the abdominal cavity as a safe and highly informative diagnostic method for diseases of the digestive tract.

The study revealed the following ultrasound picture (table 3):

Ultrasound examination of the liver revealed no abnormalities in children with functional gastrointestinal disorders. The sizes of the liver and its vessels, bile ducts corresponded to reference values.

There were isolated cases of irregular shape of the gallbladder due to bends in the neck area - in 15 examined children (11,5±2,8%). No changes of the gallbladder walls were detected, their thickness did not exceed 3 mm.

The pancreas had no pathological changes in any case during ultrasound examination - a homogeneous echostructure and smooth contours of the gland were detected.

The examined contingent also underwent a coprological examination, which was carried out in three stages: macroscopic, chemical and microscopic examination.

Macroscopic examination revealed no abnormalities – the consistency of the stool was mushy in 91,2% of cases, the color was yellow (80,3% of children), less often light yellow or yellowish-brown.

During chemical examination, blood in the stool was not detected in any case.

The most characteristic changes in the coprogram of children with functional gastrointestinal disorders were:

1. the presence of small amounts of leukocytes in the stool in 110 children (83,9±3,2%).
2. the presence of mucus in the stool in 109 (83,2±3,3%) of the examined children.
3. the presence of neutral fat in 55 (42,0±4,3%) children, while it is not normally detected in healthy children.
4. presence of intracellular starch in the feces in 32 (24,5±3,8%) cases.
5. presence of plant-based fiber: partially digested - in 22 children (16,8±3,3%), digested - in 10 children (7,7±2,3%). Undigested plant-based fiber was found in 49 cases (37,5±4,2%), it may be present in the feces of healthy children.
6. a small amount of muscle fibers (+) - in 6 examined children (4,6±1,8%).

Isolated cases of detection of connective tissue fibers in the feces were observed, which may be the result of impaired gastric and intestinal digestion and impaired pancreatic secretion.

Elastic fibers or erythrocytes were not found in any examined child with functional gastrointestinal disorders.

The findings of coprological examination in children with FGIR are presented in fig. 4:

Thus, based on the analysis of clinical characteristics of the course of functional gastrointestinal disorders in young children, the following conclusions can be drawn.
- in the examined children, the leading clinical symptoms were decreased appetite or even refusal to eat, flatulence, constipation and pain syndrome.
- in terms of physical development, deviations were detected in the form of body weight deficiency, low levels of physical development and its disharmony.
- in the examined children with FGIR, changes in laboratory parameters were noted: hypoproteinemia, dysproteinemia, hypocalcemia.
- during instrumental studies, the following changes were detected: flatulence; the presence of leukocytes, mucus, neutral fat, intracellular starch, partially digested and digested plant-based fiber, muscle fibers in the feces.

## DISCUSSION

"Functional gastrointestinal disorders are a diverse combination of gastrointestinal symptoms without structural or biochemical abnormalities." A new definition was created and agreed upon in the Rome IV criteria, which considers functional gastrointestinal disorders as disorders of gut-brain interaction [13,14]. FGID are associated with any combination of certain functions: motility, impaired visceral hypersensitivity, altered mucosal and immune functions, altered gut microbiota, and altered central nervous system (CNS) function.

The functional nature of the changes is relative and depends on the level of research used: the absence of changes at the organ, tissue and cellular levels does not exclude the presence of molecular and subcellular changes [15]. Morphological changes can be observed only at the ultrastructural level - when using electron microscopic histochemistry, immunocytochemistry, autoradiography. The approach to diagnosing FGID should include a careful history taking with special emphasis on red flags - signs of potentially dangerous pathological conditions. Currently, there is no unique laboratory marker that confirms the presence of FGID, so clinical examination remains the basis for diagnosis [16].

Given the prevalence of functional digestive disorders among young children, it is recommended that in the presence of typical complaints (flatulence, abdominal pain, appetite disorders, constipation) a thorough examination of children be carried out in order to identify disorders that occur in this pathology (indicators of physical development, protein and mineral metabolism). In the presence of clinical signs of functional gastrointestinal disorders in young children, the principles of "step-up" therapy should be followed in the examination and treatment: invasive examination methods should be used only in case of ineffectiveness of the proposed correction methods.

## CONCLUSIONS

1. The most significant risk factors for the development of FGID in young children can be considered to be a certain inconsistency of nutrition with the functional capabilities of the child's organism in the form of artificial feeding (100% of children) and early introduction of complementary feeding (64,8%), which can serve as the basis for developing measures to prevent the development of functional gastrointestinal disorders.

2. It has been established that the clinical manifestation of functional gastrointestinal disorders in both infants and children over 1 year of age is dominated by the phenomena of flatulence (74,2%), abdominal pain syndrome (70,4%), decreased appetite (48,6%) or temporary refusal to eat (36,0%), impaired intestinal motility in the form of functional constipation (34,8%), which are accompanied by impaired physical development (in the form of body weight deficiency (79,4%) and/or low level of physical development and its disharmony). These changes typically occur against the background of impaired digestion of food ingredients and are combined with hypoproteinemia, dysproteinemia, hypocalcemia, characteristic changes in the coprogram (moderate

number of leukocytes (83,9%), the presence of mucus (83,2%), neutral fat (42,0%), starch (24,5%) and plant-based fiber (partially digested – 16,8%, digested – 7,7%).

3. For young children with functional gastrointestinal disorders, physiological values of the level of immunoglobulins, inflammatory cytokines are characteristic, no significant deviations in the level of pituitary and thyroid hormones from the reference values were found.

## REFERENCES


1. Mahesan A, Kamila G, Gulati S. Pediatric Functional Gastrointestinal Disorders: Pathophysiology, Diagnosis and Management. J Transl Gastroenterol. 2024;2(2):101-108. doi: 10.14218/JTG.2023.00075. DOI
2. Velasco-Benítez CA, Collazos-Saa LI, García-Perdomo HA. Functional Gastrointestinal Disorders in Neonates and Toddlers According to the Rome IV Criteria: A Systematic Review and Meta-Analysis. Pediatr Gastroenterol Hepatol Nutr. 2022;25(5):376.
3. Mahesan A, Kamila G, Gulati S. Pediatric Functional Gastrointestinal Disorders: Pathophysiology, Diagnosis and Management. J Transl Gastroenterol. 2024;2(2):101-108. doi: 10.14218/JTG.2023.00075. DOI
4. Velasco-Benítez CA, Gómez-Oliveros LF, Rubio-Molina LM et al. Diagnostic Accuracy of the Rome IV Criteria for the Diagnosis of Functional Gastrointestinal Disorders in Children. J. Pediatr. Gastroenterol. Nutr. 2020;72:538–541. doi: 10.1097/MPG.0000000000003030. DOI
5. Shvets OV. Patohenetychno-oriientovana terapiia funktsionalnykh hastrointestynalnykh rozladiv [Pathogenetically-oriented therapy of functional gastrointestinal disorders]. Zdorovia Ukrainy. 2023;19(1):40-41. (Ukrainian)
6. Nyankovsky SL, Pyshnyk AI. Osoblyvosti fizychnoho rozvytku ditey doshkil'noho viku z psykhomotornymy porushennyamy. [Peculiarities of physical development of preschool children with psychomotor disorders.]. Problemy klinichnoyi pediatriyi. 2022;1:87-100. (Ukrainian)
7. Koppen IJ, Nurko S, Saps M et al. The pediatric Rome IV criteria: what's new? Expert Rev Gastroenterol Hepatol. 2017;11(3):193-201. doi: 10.1080/17474124.2017.1282820. DOI
8. Ostashko SI. Protokol diahnostyky ta likuvannya funktsional'nykh hastrointestynal'nykh rozladiv u ditey. [Protocol for the diagnosis and treatment of functional gastrointestinal disorders in children]. Praktykuyuchyy likar. 2012;2:36-42. (Ukrainian)
9. Godovanets OS, Nechytaylo YM. Osoblyvosti obminu bilkiv, lipidiv ta vuhlevodiv u peredchasno narodzhenykh ditey: analiz pokaznykiv ta patofiziolohichni mekhanizmy porushen'. [Features of protein, lipid and carbohydrates metabolism in premature children: analysis of indicators and pathophysiological mechanisms of disorders]. Aktual'ni pytannya pediatriyi, akusherstva ta hinekolohiyi. 2024;(2):35–40. doi:10.11603/24116-4944.2023.2.14258. (Ukrainian) DOI
10. Lishchuk OZ, Suslyk GI, Safonova OV. Suchasni pohlyady na osnovni metabolichni ta rehulyatorni efekty tyreoyidnykh hormoniv (ohlyad literatury). [Modern views on the main metabolic and regulatory effects of thyroid hormones (literature review)]. Dosyahnennya klinichnoyi ta eksperymental'noyi medytsyny. 2021;1:12-16. (Ukrainian)
11. Mamenko ME, Shleenkova GO. Vplyv funktsional'noho stanu hipofizarno-tyreoyidnoyi systemy na nervovo-psykhichnyy rozvytok ditey rann'oho viku. [The influence of the functional state of the pituitary-thyroid system on the neuropsychiatric development of early childhood]. Suchasna pediatriya. Ukrayina. 2020;3(107):23–28; doi 10.15574/SP.2020.107.23. (Ukrainian)
12. Semmes EC, Burt TD, Chen J-L et al. Understanding Early-Life Adaptive Immunity to Guide Interventions for Pediatric Health. Front Immunol. 2020;11:1-14. doi: 10.3389/fimmu.2020.595297. DOI
13. Yefanova AO, Myshyna MV. Syndrom zryhuvannya u ditey rann'oho viku: diahnostyka i korektsiya. Suchasna pediatriya.[Regurgitation syndrome in young children: diagnosis and correction]. Suchasna pediatriya. Ukrayina. 2020;1(105):38-42. (Ukrainian)
14. Alonso-Bermejo C, Barrio J, Fernández B et al. Functional gastrointestinal disorders frequency by Rome IV criteria. Anales de Pediatría (English Edition). 2022;96(5):441–447. doi: 10.1016/j.anpede.2021.05.013. DOI
15. Steutel NF, Zeevenhooven J, Scarpato E et al. Prevalence of Functional Gastrointestinal Disorders in European Infants and Toddlers. J. Pediatr. 2020;221:107–114. doi: 10.1016/j.jpeds.2020.02.076. DOI
16. Chia LW, Nguyen TVH, Phan VN et al. Prevalence and risk factors of functional gastrointestinal disorders in Vietnamese infants and young children. BMC Pediatr. 2022;22(1):1–7. 2022;22(1):315. doi: 10.1186/s12887-022-03378-z. DOI


## CONFLICT OF INTEREST

The Authors declare no conflict of interest

## CORRESPONDING AUTHOR


**Olesya M. Horlenko**
Uzhhorod National University
14 Universytetska St, 88000 Uzhhorod, Ukraine
e-mail: ohorlenko@gmail.com

**ORCID AND CONTRIBUTIONSHIP**
Olesya M.Horlenko: 0000-0002-2210-5503 A B E F
Gabriella B. Kossey: 0000-0003-0811-4929 A B D F
Adrian I.Tomey: 0000-0002-6095-8937 A E F
Kamila Voronych: 0000-0001-8484-9965 A F
Nataliia V. Sochka: 0000-0002-3973-2976 A E F
Lybov Yu. Pushkash: 0000-0003-4651-4608 A F
Mariana Yu. Synenko: 0009-0004-6876-0716 A F

A – Work concept and design, B – Data collection and analysis, C – Responsibility for statistical analysis, D – Writing the article, E – Critical review, F – Final approval of the article

**RECEIVED:** 17.03.2026
**ACCEPTED:** 30.06.2026