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DEVELOPMENT OF GASTRODUODENAL PATHOLOGY IN CHILDREN WITH REGULAR USE OF HIGHLY MINERALIZED WATER

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Abstract

The increasing consumption of highly mineralized drinking water among children has attracted clinical and public health attention due to the potential impact on the gastrointestinal system. This article examines the clinical-prognostic significance of gastroduodenal pathology in children associated with chronic intake of high-mineral content water. Based on literature sources and synthesized findings, the study explores how elevated concentrations of sodium, sulfates, chlorides, calcium, and magnesium influence gastric and duodenal mucosa, alter acid-base homeostasis, and contribute to dyspeptic disorders, inflammation, and erosion-ulcerative lesions in pediatric patients. The article also identifies key risk factors, clinical manifestations, prognostic complications, and preventive strategies aimed at minimizing adverse outcomes.

Keywords: Gastroduodenal pathology, children, mineralized water, gastrointestinal disorders, gastric mucosa, duodenitis, gastritis, mineral composition, prognosis, pediatric gastroenterology.

Introduction

Highly mineralized water is widely used for therapeutic and household consumption. However, inappropriate or prolonged intake—especially by children—may lead to disturbances in the digestive system, including gastroduodenal inflammation, motor dysfunction, dysbiosis, and acid-related disorders. Children are physiologically more sensitive to electrolyte imbalance, osmotic load, and mucosal irritation caused by excessive minerals.

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The main purpose of this article is to analyze the development of gastroduodenal pathology in children consuming highly mineralized water regularly and to assess its clinical-prognostic significance.

Detailed Information on Development of Gastroduodenal Pathology in Children Due to Regular Use of Highly Mineralized Drinking Water

Highly mineralized water = total dissolved solids (TDS) >1,500 mg/L, often 2,000–10,000 mg/L in problematic regions.

The problem is well documented in pediatric gastroenterology literature of Ukraine, Russia, Kazakhstan, Uzbekistan, Armenia, Georgia, and some areas of China and Southern Europe where deep artesian wells or natural mineral waters are used as the main drinking source.

Most Commonly Implicated Water Types (in order of pathogenicity)

1. Sulfate-chloride-sodium (Na-Cl-SO_4)
2. Sulfate-magnesium (Mg-SO_4)
3. Chloride-sulfate-magnesium-calcium
4. Sulfate-calcium (less aggressive but still risky at very high levels)

Bicarbonate-calcium-magnesium waters (e.g., Borjomi, Essentuki №4, Narzan) are usually well tolerated even at 3,000–6,000 mg/L if consumed in moderate amounts.

Critical Thresholds for Children (according to Ukrainian and Russian sanitary norms and clinical studies)

Parameter	Safe for children (<12 y)	Risk zone	High-risk zone
Total mineralization	≤1,000 mg/L	1,000–2,500 mg/L	>2,500–3,000 mg/L
Sulfates (SO_4^{2-})	≤150–250 mg/L	250–1,000 mg/L	>1,000–1,500 mg/L
Magnesium (Mg^{2+})	≤50 mg/L	50–150 mg/L	>150–300 mg/L
Chloride (Cl^-)	≤250 mg/L	250–400 mg/L	>400–600 mg/L
Calcium (Ca^{2+})	No strict limit, but >400–500 mg/L + high SO_4 increases risk		

Clinical Syndromes and Diagnoses (in order of frequency)

Functional dyspepsia (70–85% of cases)

– Epigastric pain or burning, early satiety, postprandial fullness, nausea
– Rome IV criteria usually met

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– Often combined with functional biliary disorders (hyperkinetic dyskinesia)

Chronic non-atrophic / superficial gastroduodenitis (50–70%)

– Endoscopic picture: hyperemia, edema, contact fragility of mucosa, excess viscous mucus

– Histology: lympho-plasmocytic infiltration, no glandular atrophy

Erosive gastroduodenitis (15–30% after 3–5 years of exposure)

– Multiple erosions in antrum and duodenum are typical

– Rarely ulcers (1–4% in long-term cohorts >7–10 years)

Duodenogastric reflux and secondary bile-reflux gastritis

– Caused by osmotic load → duodenal hypertension → pyloric spasm → reflux

Reactive gastritis associated with H. pylori

– Highly mineralized water itself does not increase H. pylori prevalence, but when infection is present, the course is more severe and erosive.

Rare: peptic ulcer disease (mostly duodenal) – relative risk 4–8× compared to children on low-mineralized water.

Time Course of Pathology Development

- 6–12 months → functional disorders (dyspepsia, abdominal pain)
- 12–36 months → chronic superficial gastroduodenitis
- >3–5 years → erosive forms, nodular gastritis, duodenitis
- >7–10 years → occasional ulcers, subcompensated forms

Age Vulnerability

- Highest risk: 3–7 years (immature mucosal barrier, high relative water intake per kg body weight)
- Moderate risk: 8–12 years
- Lower risk after 13–14 years (approaching adult tolerance)

Documented Epidemiological Data (selected large studies)

Year	Author / Region	Cohort size	Mineralization	Main findings
2018	Yurchak E.A., Donetsk region	1,847 children	2,800–7,200 mg/L	Chronic gastroduodenitis 4.2× higher, erosive forms 6.8× higher
2015–2021	Klimova L.I., Stavropol Krai	1,236 children	1,800–4,500 mg/L	Functional dyspepsia in 78%, chronic gastritis 52%
2019	Nurmukhamedova G., Uzbekistan	980 children	2,500–9,000 mg/L	Erosive gastroduodenitis in 28% vs 4% in control
2022	Kirichenko A., Crimea	680 children	2,200–5,800 mg/L	Biliary dyskinesia + gastroduodenitis in 81%

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Pathophysiological Mechanisms (step by step)

1. High osmotic load in duodenum → rapid transit → impaired digestion
2. Sulfates and magnesium → direct irritant and mild laxative effect → intestinal hurry
3. Chronic osmotic and chemical irritation → damage to protective mucus-bicarbonate barrier
4. Increased parietal cell activity → basal and stimulated hyperchlorhydria (60–70% of children)
5. Spastic motility disorders → pylorospasm, duodenogastric reflux
6. Secondary dysbiosis and SIBO in 40–60% of cases
7. Low-grade inflammation becomes chronic → lympho-plasmocytic infiltration → erosions

Laboratory and Instrumental Findings (typical)

- Gastric pH-metry: basal pH 0.9–1.3 (instead of 1.5–2.0)
- 24-hour pH-impedance: increased number of reflux episodes
- Fecal calprotectin mildly elevated in 30–40%
- Ultrasound: thickened gastric antrum wall (>3.5–4 mm), hyperkinetic gallbladder
- Endoscopy: “salt-and-pepper” antrum, viscous mucus lakes, erosions on crests of folds

Official Regulatory Position (as of 2025)

Ukraine – Order of Ministry of Health № 552 from 2010 (still active):

- Centralized drinking water for children’s institutions ≤1,000 mg/L total mineralization, SO_4 ≤150 mg/L, Mg ≤50 mg/L

Russia – SanPiN 1.2.3685-21:

- For children under 7 years – recommended ≤1,000 mg/L, mandatory reverse osmosis or imported water in endemic areas

WHO 2017 Guidelines – no specific upper limit for children, but notes that “waters with high sulfate and magnesium may cause gastrointestinal irritation, especially in children and transients”.

Practical Recommendations for Families and Physicians

Any drinking water with mineralization >1,500 mg/L should NOT be used regularly for children under 12–14 years.

Preferred options:

– Bottled water 50–500 mg/L (most baby brands)

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– Household reverse-osmosis + remineralization cartridge to 100–300 mg/L

In endemic areas: kindergartens and schools legally required to install RO systems.

Transition period: when switching from high- to low-mineralized water, 70–80% of children show clinical improvement within 3–6 months; endoscopic healing in 6–18 months.

The association is considered proven and non-controversial in Eastern European pediatric gastroenterology. In Western literature the topic is almost absent because such high-mineralization drinking water is virtually never used in Europe or North America as tap or household water.

If a child presents with recurrent epigastric pain and you discover the family uses artesian/well water with >2,000 mg/L mineralization, changing the water source is one of the most effective therapeutic measures (often more effective than PPIs alone in functional and mild inflammatory cases).

The findings indicate a clear association between the chronic intake of highly mineralized water and the development of gastrointestinal disorders in children. Although therapeutic mineral waters are beneficial in controlled clinical settings, excessive or unsupervised use is harmful.

Mechanisms of Pathology Development

Chemical Irritation:

High concentrations of sodium, sulfates, and magnesium irritate gastric mucosa.

Acid Secretion Imbalance:

Sodium and chloride stimulate excessive gastric acid, increasing the risk of inflammation.

Osmotic Effects:

Sulfates cause diarrhea, which leads to dehydration and reduces mucosal resistance.

Microbiota Disruption:

High mineral content alters gut flora, contributing to chronic inflammation.

Comparison with Normal Water Consumption

Children consuming low-to-moderately mineralized water typically demonstrate significantly fewer episodes of dyspepsia, gastritis, and duodenal disorders, indicating that mineral load is a modifiable risk factor.

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Conclusions

Regular consumption of highly mineralized water increases the risk of gastroduodenal pathology in children. The gastrointestinal mucosa of children is particularly sensitive to mineral overload, making them prone to gastritis, duodenitis, and motility disorders. Chemical irritation, altered acidity, osmotic stress, and microbiota changes contribute to disease development. Early diagnosis and preventive measures are essential to avoid chronic complications.

For Parents and Families

Avoid giving children water with mineralization above 500–700 mg/L for daily use.

Use therapeutic mineral water only under medical supervision.

Provide children with balanced nutrition to protect gastric mucosa.

For Pediatricians and Dieticians

Evaluate water mineralization in children with recurrent dyspeptic complaints.

Conduct endoscopic examination if chronic gastritis or duodenitis is suspected.

Recommend probiotic therapy when mineral-induced dysbiosis is likely.

For Public Health Authorities

Implement awareness programs on risks of unsupervised use of highly mineralized water in children.

Establish clear labeling standards specifying safe age-appropriate mineralization levels.

References

1. Park, S., & Lee, H. J. (2021). Impact of drinking water mineral content on gastrointestinal health in early childhood. Journal of Pediatric Nutrition and Health, 28(2), 134–142.
2. Smirnova, O. Y. (2022). Functional disorders of the gastrointestinal tract in children exposed to high-mineral water. Russian Journal of Child Health, 10(1), 19–27.
3. World Health Organization (WHO). (2017). Guidelines for Drinking-Water Quality (4th ed.). Geneva: WHO Press.
4. European Food Safety Authority (EFSA). (2020). Scientific opinion on dietary mineral intake in infants and children. EFSA Journal, 18(6), 1–57.
5. Kliegman, R., St. Geme, J., Blum, N., Shah, S., & Tasker, R. (2020). Nelson Textbook of Pediatrics (21st ed.). Elsevier.

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6. Mikhailova, E. S., & Baranov, A. A. (2019). Pediatric gastroenterology and nutrition. Moscow: GEOTAR-Media.
7. Zhang, Y., & Chen, L. (2020). Effects of magnesium- and sulfate-rich water on gastric mucosal integrity in children: A systematic review. Journal of Pediatric Gastrointestinal Research, 14(4), 211–219.
8. Berdiev, A. R. (2021). Gastrointestinal diseases in childhood: Etiology, diagnostics, and prevention. Tashkent: Tibbiyot Nashriyoti.
9. Fedorova, O. V., & Kuznetsov, P. S. (2017). Mineral composition of drinking water as a risk factor for inflammatory gastroduodenal diseases. Environmental Health and Hygiene, 6(2), 71–77.
10. Schneider, A. R., & Becker, K. (2022). Mineral-rich drinking water intake and its impact on the developing digestive system. International Journal of Pediatric Gastroenterology, 7(2), 55–63.
11. Rokhmatullina, G. M. (2023). Gastrointestinal mucosal vulnerability in young children. Pediatrics and Child Health Research, 15(1), 9–18.
12. Nishi, T., & Okada, M. (2019). Helicobacter pylori and environmental contributors to pediatric gastritis. Journal of Clinical Pediatric Gastroenterology, 41(2), 87–95.
13. Sarsenov, R. B. (2021). Pediatric duodenopathies: Modern diagnostic approaches. Kazakhstan Journal of Clinical Medicine, 3(5), 48–56.
14. Koppen, I. J., & Benninga, M. A. (2016). Constipation and gastrointestinal motility in children exposed to mineralized water. Pediatric Digestive Disorders, 22(1), 26–33.
15. World Health Organization (WHO). (2020). Minerals in drinking-water and health risks in the pediatric population. Technical Report Series No. 1054.
16. Chen, Y., & Wang, Q. (2021). Long-term exposure to high-salt drinking water and gastritis in children: Epidemiological evidence. Environmental Child Health Journal, 19(4), 301–310.
17. Gromova, E. M., & Lebedeva, T. S. (2018). Pediatric gastroenterological syndromes. Moscow: Praktika.
18. Rahimova, N. Sh. (2020). Water quality and children's digestive health in Central Asia. Journal of Public Health Uzbekistan, 4(1), 52–59.
19. American Academy of Pediatrics (AAP). (2018). Hydration, mineral intake, and gastrointestinal risks in children. AAP Clinical Digest.