FIBER AND SOME MICRONUTRIENTS IN THE DIET OF CHILDREN AGED 10 TO 14 YEARS OLD WITH PEPTIC ULCER DISEASE

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Peptic ulcer disease is a common gastrointestinal condition where diet is crucial in its prevention and treatment. This prospective cross-sectional study involving 246 children aged 10 - 14 diagnosed with peptic ulcer disease at the National Children's Hospital was conducted to evaluate the fiber intake and micronutrients in their diet. The study recorded 85.4% of males and 14.6% of females. About two-thirds of the children consumed vegetables daily, while fruits and juices were consumed less frequently. However, the children's diet did not meet the recommended fiber intake. Deficiencies in calcium, vitamin D, and vitamin A were also noted after dietary analysis. Thus, nutritional counseling is recommended for children with peptic ulcer disease to ensure adequate fiber intake and address micronutrient deficiencies to improve treatment outcomes.

Keywords: Fiber, micronutrients, peptic ulcer disease, children.

I. INTRODUCTION

Peptic ulcer disease is a common gastrointestinal condition affecting all age groups and can cause serious complications if not treated promptly. In 2019, it was estimated that there were approximately 809 million cases of peptic ulcer disease globally, an increase of 25.82% compared to 1990.[1] The prevalence of peptic ulcer disease in children ranges from 5 - 22% depending on the study.[2]

Assessing the nutritional status of children with peptic ulcer disease is essential for appropriate and timely dietary interventions. Diet interviews provide useful information on eating habits and dietary intake, allowing identification of nutritional needs and adjustment for proper intervention. A suitable diet is crucial for children with peptic ulcer disease for their growth, for reducing gastric acid secretion, and minimizing gastric mucosal damage, thus aiding in ulcer healing and reducing undesirable symptoms. A review by Milly Ryan-Harshman indicated that a diet high in fiber, especially vegetables and fruits, helps reduce the risk of peptic ulcer disease.[3] Additionally, micronutrients have been shown in several studies to correlate with *H. pylori* infection and peptic ulcer disease by modulating or promoting host immune and inflammatory responses.[4]

In Vietnam, there are few studies on the diet of children with peptic ulcer disease, especially concerning fiber and micronutrients. This study aims to evaluate the intake of fiber and micronutrients in the diet of children aged 10 to 14 with peptic ulcer disease at the National Children's Hospital.

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II. MATERIALS AND METHODS

1. Subjects

Selection criteria

Children aged 10 - 14 diagnosed with peptic ulcer disease and treated

at the Gastroenterology Clinic and the Gastroenterology Department of the National Children's Hospital.

Children and their families consent to participate in the study.

Diagnosis of peptic ulcers: Presence of surface mucosal necrosis of the stomach, duodenum with a minimum diameter of 0.5cm penetrating through the muscularis propria layer diagnosed in endoscopy.

Exclusion criteria: Children with other conditions requiring dietary changes or those with dietary restrictions for other reasons.

2. Methods

Research duration and location: The study was conducted from October 2022 to the end of March 2024 at the National Children's Hospital.

Research design: Prospective cross-sectional descriptive study.

Sample size and selection: Convenient sampling.

Data Collection Methods:

- 24-hour dietary recall, frequency of certain food consumption, and general information about the children were collected using a pre-designed questionnaire at the time of diagnosis of peptic ulcers by upper gastrointestinal endoscopy.

+ The frequency of food consumption was assessed for the 1 month preceding the child's interview date. The 24-hour dietary intake was evaluated one day before the child's clinic visit to ensure the highest accuracy.

+ In the questionnaire about the frequency of food consumption, we listed vegetables with low fiber content (1.5g or less per 100g of food) such as baby corn, radish, okra, pumpkin, cabbage, etc. The remaining vegetables have high fiber content. We also listed fruits with high fiber content (1.5g or more per 100g of food) such as dragon fruit, rose apple, guava, etc. The remaining fruits have low fiber content. The classification of sweet and sour fruits was based on the children's perception.

+ The amounts of fiber and vitamins in the 24-hour dietary intake were calculated according to the "Vietnam Food Composition Table" 2007 by the National Institute of Nutrition and the Ministry of Health and then compared to the "Recommended Nutrient Intakes for Vietnamese" 2016 by the National Institute of Nutrition and the Ministry of Health.

Data processing: Data was entered using Kobotoolbox, and Microsoft Excel 2010; and processed with Stata 13.0 using appropriate statistical algorithms. Descriptive statistics were adopted to examine the frequency, percentage, and mean of characteristic data.

3. Research ethics

Research subjects were informed and voluntarily participated in the study. The information collected will be kept confidential and provided for research purposes. The study was approved by the Medical Ethics Committee of the National Children's Hospital (no: 3012/BVNTW-HĐĐĐ, December 15, 2022).

III. RESULTS

During the study period, we collected data from 246 children who met the inclusion criteria.

Table 1. Gender distribution of participating children

Gender	Number	Percentage	Boy/girl ratio
Boys	210	85.4%	5.8/1
Girls	36	14.6%	
Total	246	100%	

Boys accounted for the majority of the study participants, with a boy/girl ratio of 5.8/1.

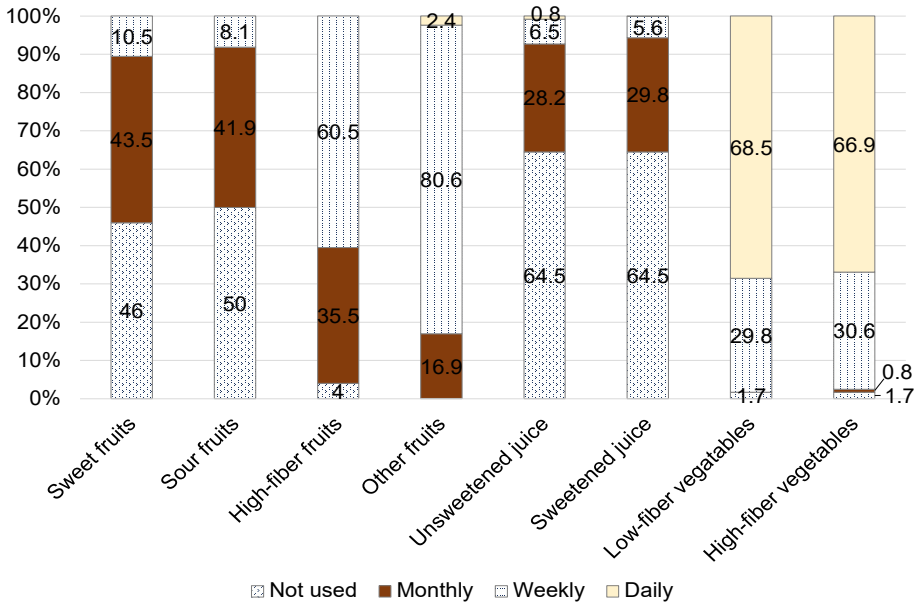

Chart 1. Frequency of fruit and vegetable consumption among study participants

About two-thirds of the children consumed vegetables daily, while fruits and juices were consumed less frequently.

Table 2. The amount of fiber in the diet of the children participating in the study

Gender	Age	n	Recommendation (g)	Response	Fibre (g)	Min (g)	Max (g)
Boys	10 - 11	97	20 - 22	19.5 - 21.5%	4.3 ± 1.7	1.35	9.01
	12 - 14	113	20 - 22	20.9 - 23%	4.6 ± 1.7	1.5	10.5
Girls	10 - 11	22	20 - 22	19.1 - 21%	4.2 ± 2.9	1.38	11.7
	12 - 14	14	20 - 22	22.2 - 24.5%	4.9 ± 2.4	3.1	9.8
Total	10 - 11	119			4.3 ± 1.9	1.35	11.7
	12 - 14	127			4.6 ± 1.8	1.5	10.5

The diet of the children in the study group provides a very low amount of fiber compared to the recommended intake for their gender and age group.

The current diet does not provide enough calcium, and vitamin A . Calcium only meets 59.5 - 67.3% of the requirement, vitamin A meets 23.9 - 45.9% depending on gender and age group. Vitamin D meets 18 - 18.6% depending on gender and age group (Chart 2).

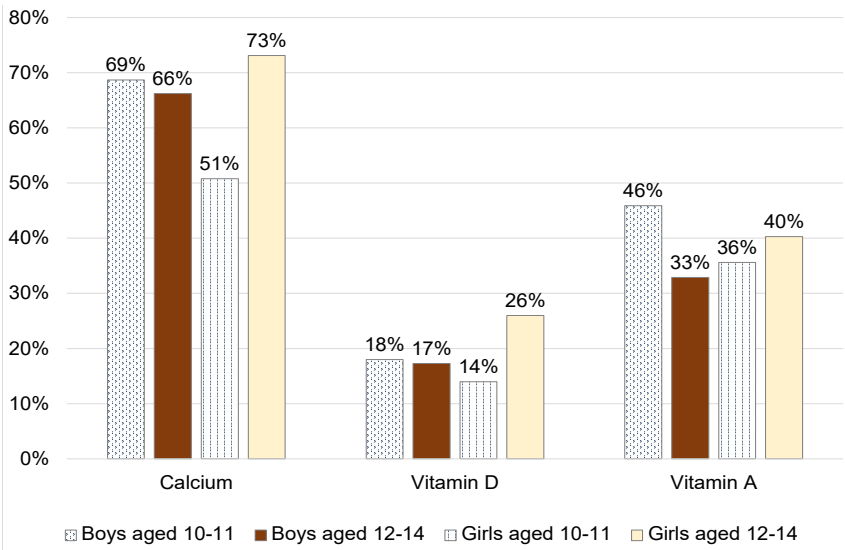

Chart 2. The response levels of calcium, vitamin D, and vitamin A in the group of children participating in the study compared to the recommendations

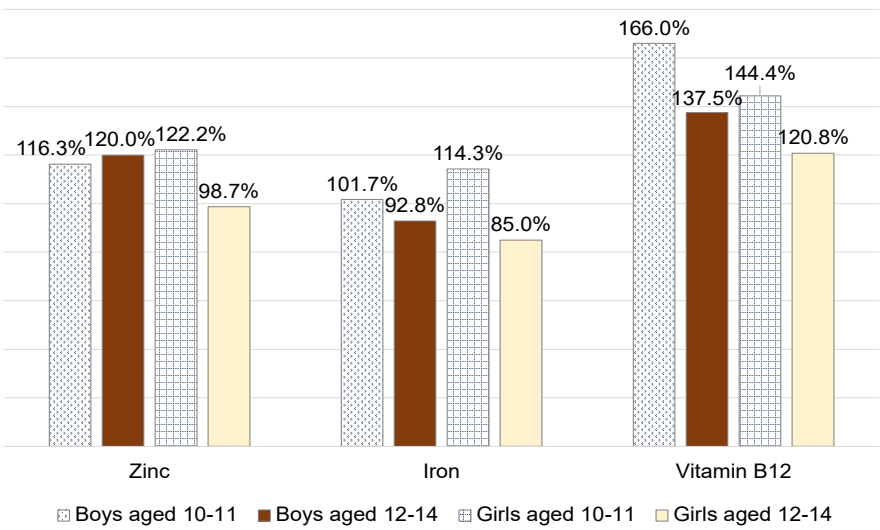

Chart 3. Zinc, iron, and vitamin B_{12} intake compared to recommendations

The diet of the study participants met the recommended intake for zinc, iron, and vitamin B_{12} by gender and age.

IV. DISCUSSION

According to a study by Nguyen Thi Viet Ha, et al, the highest prevalence of peptic ulcer disease was in children over 10 years old, accounting for 62.3%.[5] Therefore, our study targeted children aged 10 to 14 diagnosed with peptic ulcer disease at the National Children's Hospital. We collected data from 246 children diagnosed with peptic ulcer disease. Our results showed that peptic ulcer disease was predominantly found in males (85.4%), with a male/female ratio of 5.8/1. This ratio is similar to the findings of Nguyen Phuc Thinh (5.7/1) and Nguyen Huu Hieu (4.7/1).[6,7]

Through the 24-hour dietary recall and food frequency questionnaire, we found that

most children consumed vegetables daily, while fruits and juices were consumed less frequently. However, the quantity of vegetables and fruits consumed was not substantial, resulting in a very low fiber intake compared to the recommended levels. Our study found that fiber intake in the children's diet only met 19.1 - 24.5% of the recommended levels, which is very low. Individuals with duodenal ulcers may swallow more air, leading to bloating and abdominal distension. Fiber helps reduce the transit time of food in the intestine, allowing air to pass through more quickly, and reducing bloating and stomach acid. A diet rich in fibers for individuals with a peptic ulcer is advisable (20 to 30 g/day, according to WHO - World Health Organization), because fibers act as buffers, reducing the concentrations of bile acids in the stomach and the intestinal transit time, resulting in less abdominal bloating, thus decreasing discomfort and pain in the gastrointestinal tract.[8]

Vegetables and fruits are the primary sources of fiber in children's diets. A review by Milly Ryan-Harshman indicated that a diet high in fiber, especially vegetables and fruits, helps reduce the risk of peptic ulcer disease.[3] Soluble fibers, found in apples, oatmeal, and pear are responsible, for instance, for an increased viscosity in the intestinal content. Insoluble fibers (whole grains, granola, flaxseed) increase stool bulk, reduce transit time in the large intestine, and make fecal elimination easier and quicker. Fibers regulate bowel function, which makes them vital for the well-being of healthy people and in the dietary treatment of many pathologies.[8] Compared to vegetables that need to be cleaned and cooked, fruits retain more fiber and nutrients. Moreover, fruits are rich in vitamins and minerals. Consuming fruit juices containing vitamin C can enhance iron absorption, improving anemia in children with peptic ulcer disease. However, fruits should not be mixed with sugar, milk, or spices as they can irritate the stomach lining.

Besides evaluating fiber intake, our study also noted deficiencies in certain micronutrients in the children's diet. The current diet did not provide sufficient calcium, and vitamin A. Calcium only met 59.5 - 67.3%, and vitamin A met 23.9 - 45.9% of the recommended levels, varying by gender and age. In addition to the endogenous source of vitamin D from sunlight, the diet provided 18 - 18.6% of the recommended vitamin D level. The children had sufficient iron, zinc, and vitamin B_{12} intake.

Vitamin D plays an important role in calcium metabolism. The study subjects, aged 10 - 14, are in the puberty stage, experiencing rapid growth, so an insufficient intake of this nutrient can affect their height and bone structure development during growth. Calcium is one of the main mineral components of bone tissue, essential for proper bone formation. Children with peptic ulcer disease often use acid-suppressing medications, which can reduce calcium absorption.

Calcitriol binds to vitamin D receptors (VDR) found throughout the human body with numerous binding sites. Therefore, vitamin D regulates many biological processes. The ubiquitous presence of VDR seems to be one of the key factors through which vitamin D metabolites participate in immune protection. The active involvement of vitamin D in the immune process has been confirmed by numerous studies showing the relationship between vitamin D deficiency and the incidence of various infections. Respiratory, gastrointestinal, and urinary tract infections, as well as systemic infections, are associated with low vitamin D levels and seem to be preventable

by vitamin D supplementation.[4] Although there is controversy over the effectiveness of vitamin D supplementation in the eradication of *H. pylori*, many studies have reported an inverse interaction between serum vitamin D levels and *H. pylori* infection. Furthermore, vitamin D may reduce the side effects of antibiotic treatment by maintaining the normal composition of the gut microbiota.[9]

Vitamin A helps children grow and develop physically, enhances vision, and boosts the immune system. For children with peptic ulcer disease, vitamin A accelerates ulcers healing. Although the role of provitamin A is not fully understood, some studies have shown the protective role of β-carotene in preventing inflammation caused by *H. pylori*.[4] Vitamin A is abundant in meat, fish, eggs, milk, and vegetables with dark green, yellow, and red colors such as sweet leaves, pumpkin, etc. Children with peptic ulcer disease should consume these foods. Beta-carotene, the most important source of vitamin A in the body, is an effective antioxidant that helps inhibit gastritis caused by *H. pylori*. Astaxanthin, the most effective immune-stimulating carotenoid, shifts the regulation of helper T cells to Th2 when *H. pylori* alters the immune balance between Th1 and Th2. Although astaxanthin inhibits the growth of *H. pylori* and gastritis, it does not reduce cytokine levels in infected tissue. Furthermore, an in vitro study showed that astaxanthin could prevent *H. pylori*-induced apoptosis as well as its intracellular replication through the regulation of autophagy.[9]

Zinc helps children have a better appetite, enhances absorption, increases protein synthesis, and boosts the immune system. Zinc protects the gastric mucosa. Zinc deficiency or overload affects growth, morphology, immune response, and neurological and endocrine activities. At the cellular level, zinc plays a crucial role in proliferation, differentiation, and apoptosis. Sempértegui et al. reported an inverse correlation between *H. pylori*-induced gastritis and zinc levels in the gastric mucosa.[10] Interestingly, natural immunity exploits high concentrations of zinc and copper in macrophages to eliminate trapped bacteria. Given that this element plays various roles for both *H. pylori* and the host's immune system, further research is needed to elucidate the interaction between zinc bioavailability and *H. pylori*-induced inflammation.

Antacids can also reduce iron absorption, causing iron deficiency anemia. Moreover, gastrointestinal bleeding is one of the main complications of peptic ulcer disease. Iron deficiency can be a key indicator of *H. pylori* infection, and many studies have attempted to elucidate this relationship. Some studies indicate a correlation between *H. pylori* infection and iron deficiency or iron-dependent anemia, regardless of the presence of peptic ulcer disease. However, the origin and mechanisms behind this potential relationship are not fully understood. It is suggested that due to *H. pylori*'s higher iron requirements compared to other pathogens, competition for dietary iron results in reduced iron absorption in the host.[11] Furthermore, the progression of *H. pylori* infection can cause inflammation or peptic ulcers, leading to blood loss through the gastrointestinal tract. Additionally, *H. pylori* induces hepcidin expression, which in turn reduces iron secretion from macrophages.[12] The reduction in free iron elements can lead to poor cobalamin absorption since the cobalamin transporter depends on iron. To prevent iron deficiency, children with peptic ulcer disease may need higher iron supplementation than the usual recommended intake.

Vitamin B_{12} deficiency is common in patients with peptic ulcer disease due to prolonged use of antacids, which hampers the bioavailability of this vitamin. Vitamin B_{12} can be synthesized by gut microbiota in the colon but is not absorbed. Deficiency of this vitamin results in poor cell division and megaloblastic anemia. It is estimated that 80 - 90% of patients with vitamin B_{12} deficiency will develop neurological changes if untreated. Therefore, it is recommended to supplement 2.4 µg/day of this vitamin, which can be obtained from animal products such as milk, meat, and eggs. For patients with atrophic gastritis, one of the main complications is poor absorption of vitamin B_{12} or cobalamin. Shuval-Sudai and Granot showed a correlation between *H. pylori* infection and the frequency of reduced cobalamin levels.[13] The use of acid-suppressing drugs and changes caused by *H. pylori* to the stomach's pH are likely the main reasons for poor vitamin B_{12} absorption. Many studies suggest that *H. pylori* infection may play a significant role in reducing acid production and weak secretion of intrinsic factors, thereby leading to vitamin B_{12} deficiency.[14]

V. CONCLUSION

Among the 246 children participating in the study, males accounted for the majority of the study participants. The diet of this group of children did not provide enough fiber according to dietary recommendations. Some micronutrients were found to be lacking after dietary analysis, including calcium, and vitamin A.

VI. RECOMMENDATIONS

Children with gastric and intestinal ulcers should be advised on nutrition to adopt a suitable diet contributing to adequate fiber intake and limiting nutritional deficiencies, thereby enhancing treatment outcomes.

REFERENCES

1. Xie X, Ren K, Zhou Z, et al. The global, regional and national burden of peptic ulcer disease from 1990 to 2019: A population-based study. *BMC Gastroenterol*. 2022;22(1):58. doi:10.1186/s12876-022-02130-2.

2. Guariso G, Gasparetto M. Update on Peptic Ulcers in the Pediatric Age. *Ulcers*. 2012;2012. doi:10.1155/2012/896509.

3. Ryan-Harshman M, Aldoori W. How diet and lifestyle affect duodenal ulcers. Review of the evidence. *Can Fam Physician Med Fam Can*. 2004;50:727-732.

4. Nabavi-Rad A, Azizi M, Jamshidizadeh S, et al. The Effects of Vitamins and Micronutrients on *Helicobacter pylori* Pathogenicity, Survival, and Eradication: A Crosstalk between Micronutrients and Immune System. *J Immunol Res*. 2022;2022:4713684. Published 2022 Mar 16. doi:10.1155/2022/4713684.

5. Nguyen Thi Viet Ha, Nguyen Thi Hong Nhan, Phan Van Nha. Valuation of quadruple therapy regimen with bismuth for eradication of *Helicobacter pylori* - induced gastroduodenal ulcers in children. *Journal of Medical Research*. 2022;149(1):172-178. doi:10.52852/tcncyh.v149i1.556.

6. Nguyen Phuc Thinh, Hoang Le Phuc, Nguyen Viet Truong, et al. Clinical manifestations and management of peptic ulcer diseases in children at Children's Hospital 1 from june 2013 to january 2014. *Ho Chi Minh City Journal of Medicine*. 2014;18(4):41 - 47.

7. Nguyen Huu Hieu, Nguyen Thi Viet Ha. Clinical, laboratory characteristics and antibiotic resistance of *Helicobacter pylori* - induced gastroduodenal ulcers in children. *Journal of Medical Research*. 2021;143(7):134-141. doi:10.52852/tcncyh.v143i7.248.

8. Vomero ND, Colpo E. Nutritional care in peptic ulcer. *Arq Bras Cir Dig*. 2014;27(4):298-302. doi:10.1590/S0102-67202014000400017.

9. Lee H, Lim J W, Kim H. Effect of astaxanthin on activation of autophagy and inhibition of apoptosis in *Helicobacter pylori*-infected gastric epithelial cell line AGS. *Nutrients.* 2020;12(6).

10. Sempertegui F, Diaz M, Mejia R, et al. Low concentrations of zinc in gastric mucosa are associated with increased severity of *Helicobacter pylori*-induced inflammation. *Helicobacter.* 2007;12(1):43-48.

11. Demerdash DME, Ibrahim H, Hassan DM, et al. Helicobacter pylori associated to unexplained or refractory iron deficiency anemia: an Egyptian single-center experience. *Hematol Transfus Cell Ther.* 2018;40(3):219-225. doi:10.1016/j.htct.2018.02.001.

12. Haile K, Yemane T, Tesfaye G, et al. Anemia and its association with *Helicobacter pylori* infection among adult dyspeptic patients attending Wachemo University Nigist Eleni Mohammad Memorial Referral Hospital, Southwest Ethiopia: a cross-sectional study. *PLoS One.* 2021;16(1):e0245168. Published 2021 Jan 14. doi:10.1371/journal.pone.0245168.

13. Shuval-Sudai O, Granot E. An association between Helicobacter pylori infection and serum vitamin B12 levels in healthy adults. *J Clin Gastroenterol*. 2003;36(2):130-133. doi:10.1097/00004836-200302000-00008.

14. Ravi K, Joseph J, Thomas D M. *Helicobacter pylori* infection and vitamin B-12 deficiency-a cross sectional study. *Asian Journal of Medical Sciences.* 2017;8(4):16-20. doi: 10.3126/ajms.v8i4.17280.