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Prevalence of Lactose Malabsorption and Lactose Intolerance in Pediatric Patients with Selected Gastrointestinal Diseases

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A – research concept and design; **B** – collection and/or assembly of data; **C** – data analysis and interpretation; **D** – writing the article; **E** – critical revision of the article; **F** – final approval of article

Abstract

Background. Lactase is an enzyme involved in the hydrolysis of lactose. Deficiency of the enzyme (hypolactasia) may be determined genetically or arise secondarily to disease of small intestine. Under this condition, lactose enters the colon where it is fermented by intestinal microflora and turns to gases and short-chain fatty acids, causing gastrointestinal symptoms known as lactose intolerance (LI).
Objectives. To investigate the incidence of lactose malabsorption (LM), LI and the coexistence of these two conditions in children with upper gastrointestinal tract diseases (UGTD), malabsorption syndrome, inflammatory bowel disease (IBD) and functional gastrointestinal disorders (FGID).
Material and Methods. Hydrogen breath test (HBT) was conducted in 387 pediatric patients in years 2010–2013. Two hundred thirty two children with gastrointestinal tract diseases were selected and assigned to groups – UGTD, malabsorption syndrome, IBD or FGID. For each group the frequency of LM, frequency and severity of LI and the frequency of their co-occurrence were calculated.
Results. Lactose malabsorption was observed in 37.08% of patients with gastrointestinal diseases. Positive HBT result was the most common in children with malabsorption syndrome (52.50%) and less common in UGTD (30.85%), especially in ulcer disease (23.53%). Symptoms after lactose ingestion affected 36.64% of the subjects, and were more specific to lactose malabsorbers than to lactose absorbers (72.10% vs. 15.75%). The higher frequency of LI was noted in children with FGID, especially in irritable bowel syndrome (IBS) (65.22%). The lowest incidence of symptoms was obtained in children with UGTD, especially in those with ulcer disease (27.44%). The incidence of LM with LI was noted in 27.16% of all patients and was the highest in IBS (47.83%) and the lowest in ulcer disease (15.78%).
Conclusions. Lactose malabsorption is a common problem in children with gastrointestinal diseases, especially in children with bowel diseases. Lactose intolerance is related to LM, but does not affect all malabsorbers (**Adv Clin Exp Med 2015, 24, 5, 863–871**).

Key words: lactose intolerance, beta galactosidase, malabsorption, gastrointestinal disorders, children.

Lactase (β-galactosidase) is an enzyme produced in the brush border of the small intestine, involved in the hydrolysis of milk disaccharide (lactose) to monosaccharides – glucose and galactose. Under lactase deficiency condition (hypolactasia) undigested sugar enters the colon, where intestinal microbiota ferment it into short-chain fatty acids (SCFAs) and gases (hydrogen, methane and carbon dioxide). The excessive production of gases is related to abdominal pain, bloating, distention, cramping and flatulence. High level of unabsorbed sugar and SCFAs cause an osmotic load in colon, which may contribute to diarrhea. Gastrointestinal symptoms after lactose ingestion are known as lactose intolerance (LI) and concern only a part of people with hypolactasia. The appearance and severity of these complains are due to lactase activity and the dose of lactose, gastrointestinal transit time, composition of gut microflora and the ability of products absorption by colon [1, 2].

There are few causes of lactase deficiency, but only two of them are the most common – primary

and secondary hypolactasia. Primary (adult-type) hypolactasia is an enzyme deficiency determined by single nucleotide polymorphisms. The incidence of hypolactasia increases with age after weaning. The age of occurrence and the prevalence of lactase deficiency depends on ethnic origin. Secondary hypolactasia is related to many intestinal diseases with enteropathy as celiac disease (CD), Crohn's disease, acute infections and severe malnutrition. After resolution of the disease and regeneration of the intestinal brush border lactase activity is restored [2].

The coexistence of lactose malabsorption (LM) and mentioned gastrointestinal diseases is clear – damaged intestinal villi are related to reduced or inhibited production of the enzyme [3, 4]. Increasingly more studies showed that lactase deficiency and colonic fermentation may play an important role in functional gastrointestinal disorders (FGID), especially in irritable bowel syndrome (IBS) [5, 6]. There is little or lack of studies evaluating the frequency of LM in children with gastroesophageal reflux disease (GERD), gastric and/or duodenal ulcer disease and functional constipation.

The aim of the study was to evaluate the prevalence of LM and LI, symptoms severity and the coexistence of LM and LI in children with selected gastrointestinal diseases as upper-gastrointestinal tract diseases (UGTD), malabsorption syndrome, inflammatory bowel diseases (IBD) and FGID. Subsequently, the frequencies obtained in disease entities were compared.

Material and Methods

Patients diagnosed and treated in 2nd Department of Pediatrics, Gastroenterology and Nutrition of Wroclaw Medical University between 2010 and 2013 were subjected to the hydrogen breath test (HBT). The examination was conducted in the morning after overnight fast in accordance with standard procedures (Fig. 1). The Gastro+ Gastrolyzer® (Bedfont Scientific Ltd.) breath hydrogen monitor was used. An increase in hydrogen molecules level in exhaled air over 20 ppm (parts per million), compared to the fasted exhalation, was considered as a positive result. During 12 h after lactose ingestion patients were asked about gastrointestinal symptoms as: abdominal pain, bloating, distention, nausea, cramping and loose stools/diarrhea appearance. Due to the difficulty in symptoms identification by patients, three groups of symptoms were developed – lack of symptoms, moderate symptoms (discomfort without loose stool/diarrhea) and severe symptoms (discomfort with loos stool/diarrhea). A positive HBT result meant LM. Lactose intolerance was defined as symptoms occurrence after lactose ingestion.

Among 387 patients examined with HBT, 232 children were selected to the further analysis. This group included patients with diagnosis of GERD, gastric and/or duodenal ulcer disease, malabsorption syndrome (CD or secondary malabsorption due to enteropathy or gastrointestinal

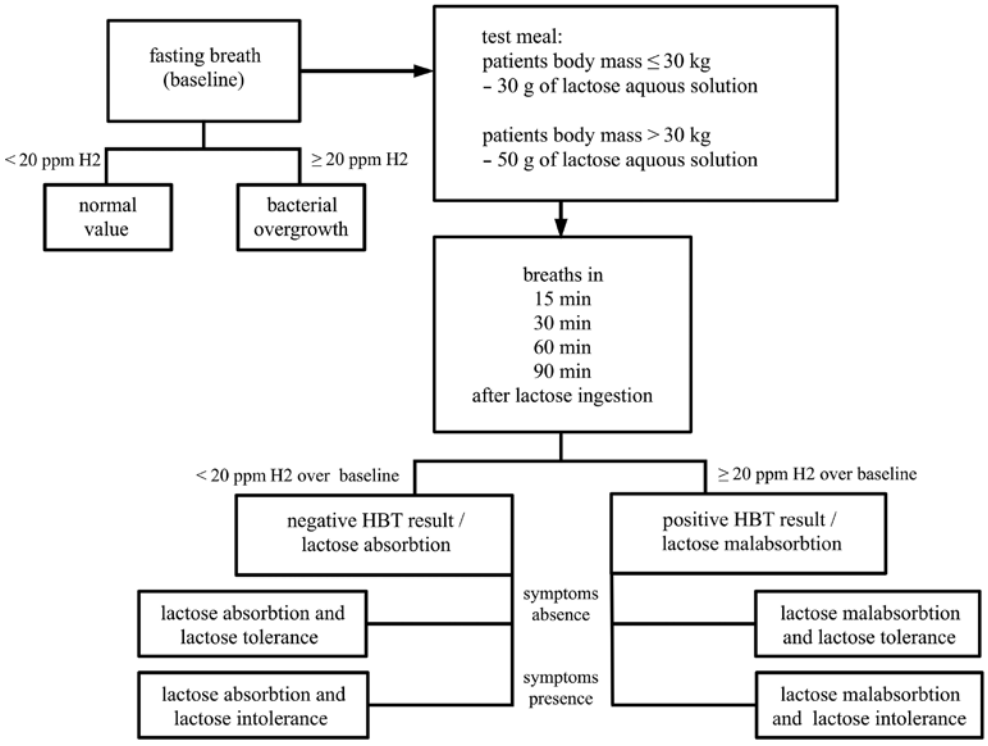

Fig. 1. The procedure of HBT and results interpretation

infections), IBD (Crohn's disease, ulcerative colitis or undefined IBD), functional constipation and IBS and excluded patients with pulmonary diseases (as asthma) and with antibiotic treatment (during last month). Children with GERD and ulcer disease were connected in one group of UGTD. Children with functional constipation and IBS were collected in a group of FGID. All diseases were diagnosed by standard procedures and examinations [7–9]. Functional disorders of gastrointestinal tract were diagnosed in children over 4 years of age according to Rome III criteria [10].

The data was collected and analyzed using STATISTICA 10 software (STATSOFT, Poland). The prevalence of LM and LI, severity of symptoms and the prevalence of LM with LI in each group were calculated. The differences in these incidences between groups were assessed by Pearson's χ^2 test with Yates correction. Additionally, the average and minimal and maximal values of age in each group were estimated and compared by Kruskal-Wallis and Mann-Whitney *U* tests. Differences with p values less than 0.05 were considered significant.

The study protocol was approved by Local Ethic Committee of Wroclaw Medical University (KB–206/2010). The patient' caregivers and patients over 16 years of age gave informed consent for their data to be used.

Results

Subjects Characteristics

Among 232 studied children (96 boys and 136 girls), 94 children revealed UGTD (43 with GERD and 51 with gastric and/or duodenal ulcer disease), 40 children – malabsorption syndrome, 25 children – IBD (11 with Crohn's disease, 7 with ulcerative colitis and 7 with undefined IBD), and 73 children – FGID (50 with functional constipation and 23 with IBS). The mean age of participants was 11.08 years (Table 1). We found significant differences in the age of subjects between studied groups ($p < 0.001$). Children with gastric and/or duodenal ulcer disease, IBD and IBS were older than children with GERD ($p < 0.05$, $p < 0.001$ and $p < 0.01$) and with constipation ($p < 0.01$, $p < 0.001$ and $p < 0.001$). Children with IBD and IBS were older than children with malabsorption syndrome (both $p < 0.001$).

Lactose Malabsorption

Based on HBT we found LM in 37.08% of children with gastrointestinal diseases. The highest frequency of positive HBT result was observed in children with malabsorption syndrome (primary

Table 1. Subjects characteristics – number of subjects in each group, age and sex

Group	Diagnosis	N [%]	Age [years] (min–max)	Sex N [%]	
				m	f
1.	upper gastrointestinal tract diseases	94 (40.52%)	11.20 (0.24–17.98)	37 (39.36%)	57 (60.64%)
1a	gastroesophageal reflux	43	10.29 (2.86–17.98)	22	21
1b	gastric and/or duodenal ulcer disease	51	11.97 (0.24–17.94)	15	36
2.	malabsorption syndrome	40 (17.24%)	9.40 (2.50–16.75)	20 (50.00%)	20 (50.00%)
3.	inflammatory bowel diseases	25 (10.77%)	13.86 (7.20–18.48)	12 (48.00%)	13 (52.00%)
4.	functional gastrointestinal disorders	73 (31.47%)	10.88 (4.17–17.99)	27 (36.99%)	46 (63.01%)
4a	functional constipation	50	9.53 (4.17–17.55)	17	33
4b	irritable bowel syndrome	23	13.83 (7.77–17.99)	10	13
Total		232 (100%)	11.08 (0.24–18.48)	96 (41.38%)	136 (58.62%)

Table 2. Frequency of HBT results in disease groups and statistical significance of differences in HBT results prevalence between each group

Group	Diagnosis	HBT N [%]		Statistical significance							
		+	–	**1**	**1a**	**1b**	**2**	**3**	**4**	**4a**	**4b**
1.	upper gastrointestinal tract diseases	29 (30.85%)	65 (69.15%)	–	ns.	ns.	*	ns.	ns.	ns.	ns.
1a	gastro-esophageal reflux	17 (39.53%)	26 (60.47%)	ns.	–	ns.	ns.	ns.	ns.	ns.	ns.
1b	gastric and/or duodenal ulcer disease	12 (23.53%)	39 (76.47%)	ns.	ns.	–	**	ns.	ns.	ns.	*
2.	malabsorption syndrome	21 (52.50%)	19 (47.50%)	*	ns.	**	–	ns.	ns.	*	ns.
3.	inflammatory bowel diseases	11 (44.00%)	14 (56.00%)	ns.	ns.	ns.	ns.	–	ns.	ns.	ns.
4.	functional gastrointestinal disorders	25 (34.25%)	48 (65.75%)	ns.	ns.	ns.	ns.	ns.	–	ns.	ns.
4a	functional constipation	14 (28.00%)	36 (72.00%)	ns.	ns.	ns.	*	ns.	ns.	–	ns.
4b	irritable bowel syndrome	11 (47.83%)	12 (52.17%)	ns.	ns.	*	ns.	ns.	ns.	ns.	–
Total		86 (37.08%)	146 (62.93%)	1	1a	1b	2	3	4	4a	4b

ns. – not significant; * – $p < 0.05$; ** – $p < 0.01$.

and secondary) and the lowest frequency was among children with UGTD. The difference in prevalence of HBT results between these groups was statistically significant ($p < 0.05$).

After splitting UGTD and FGID into subgroups the frequencies of LM were low in children with ulcer disease (23.53%) and in children with functional constipation (28.00%); in GERD and IBS subgroups the incidences of LM were higher (39.53% and 47.83%). The strongest significant difference in lactose malabsorption frequency was found between gastric and/or duodenal ulcer disease and malabsorption syndrome groups ($p < 0.01$), and the subsequent differences were seen between gastric and/or duodenal ulcer disease and IBS groups ($p < 0.05$) and between malabsorption syndrome and constipation groups ($p < 0.05$) (Table 2).

Symptoms Prevalence and Severity

More than one third of all subjects had gastrointestinal symptoms after lactose ingestion – 72.10% of children with positive HBT result and 15.75% of children with negative HBT result. Moderate symptoms were about three times more frequent than severe symptoms in all subjects. In subjects with LM, moderate symptoms were about two times more frequent than severe ones. The occurrence of gastrointestinal symptoms was highly related to positive HBT result (Table 3).

The highest frequency of gastrointestinal aliments was found in children with FGID and in children with IBD (about 40%). The lowest prevalence of symptoms was characteristic for groups with UGTD and malabsorption syndrome (a little over 30%). In each group the symptoms appearance was related to positive HBT result. Between all groups we did not find any differences in symptoms occurrence. After splitting the patients with UGTD and FGID into subgroups the highest frequency of aliments was seen in children with IBS (65.22%) and the lowest – in children with gastric and/or duodenal ulcer disease (27.44%). Moreover, all IBS children with positive HBT result had gastrointestinal symptoms after lactose ingestion (Table 4). In this group was observed also the highest prevalence of symptoms with negative HBT result. The χ^2 analysis showed significant differences in the incidence of aliments between IBS group and children with GERD ($p < 0.05$), gastric and/or

Table 3. Frequency of symptoms according to HBT result and p value for the difference in symptoms occurrence between lactose absorbers and lactose malaborbers

Symptoms severity	N [%]	HBT N [%]		p value
		+	–	
Lack of symptoms	147 (63.36%)	24 (27.91%)	123 (84.25%)	< 0.001
Moderate symptoms	63 (27.16%)	42 (48.84%)	21 (14.38%)	
Severe symptoms	22 (9.48%)	20 (23.26%)	2 (1.37%)	
Total	232 (100%)	86 (37.08%)	146 (62.93%)	

duodenal ulcer disease ($p < 0.01$), malabsorption syndrome ($p < 0.05$) and functional constipation ($p < 0.001$).

Moderate symptoms (as abdominal pain, bloating, distention or nausea) were most common in GERD group (37.21%) and the least often in malabsorption group. Severe symptoms (defined as incident of loose stool or diarrhea) were the most often in children with IBS (30.44%), and the least often in children with functional constipation (2.00%).

Lactose Malabsorption with Lactose Intolerance

Lactose malabsorption with LI was found in 27.16% of participants. The highest incidence of LM with LI was found in children with IBS (47.83%) and all IBS children with LM were lactose intolerant. The lowest incidence of LM with LI was observed in children with ulcer disease (15.78%). Statistically significant difference in the frequency of LM with LI was found only between those two groups ($p < 0.01$). In IBD, malabsorption syndrome and GERD lactose LM with LI was about 30%, in functional constipation – 22%.

Discussion

Lactose malabsorption affects up to 30% of healthy children and adolescents in Poland. About 18% of preschool children are lactose malabsorbers and the frequency increases with age to reach a value over 30% in adolescents [11]. Lactose malabsorption is also reported in 11–19.4% of healthy adolescents up to 15 years of age and 22% in those aged from 15 to 19 years [12–14]. These frequencies are consistent with the prevalence of genotype determining lactase non-persistence (-13910 C/C) in Poland. Genetic examinations have indicated -13910 C/C genotype in nearly 31% of individuals. However, only 24.5% of those subjects (aged 18–20 years) were lactose malabsorbers, according to hydrogen/methane breath test results, which accounted for 7.7% of the total sample [15]. This study has shown that primary hypolactasia is very rare in Poland among young healthy people and, in many cases, lactose malabsorption may be secondary.

Lactose malabsorption is an important cause of chronic abdominal pain in children and is noted in 37% of pediatric patients with dyspeptic symptoms, including 5.5% of cases with gastrointestinal infections and CD [16]. In our study the frequencies of LM in children with gastrointestinal diseases aged up to 19 years were noted. The incidence of positive HBT result in all subjects was about 37%. As we suspected, in children with malabsorption syndrome (primary and secondary) and in IBD group the highest frequencies of LM were observed. Celiac disease, food allergy or gastrointestinal infections lead to the intestinal villi atrophy and the reduction of brush border enzymes [4, 17, 18]. Severe and moderate villous atrophy inhibits lactase secretion in about 70% of patients [3]. After the disease regression lactase activity returns – most of lactose malabsorbers with CD improves their HBT results after 12 months of gluten-free diet. It is due to the intestinal villi recovery according to Marsh scale – from type III (a-c) before diet to types II and I after 12 months of diet [4]. Lactose malabsorption affects about 38% of children with CD and about 30% of children with secondary malabsorption [19]. Our results demonstrated that about half of the children with malabsorption syndrome (due to CD, enteropathy or gastrointestinal infections) are lactose malabsorbers. A slightly lower incidence of LM was observed in IBD (44%). Studies have shown that Crohn's disease highly

Table 4. The prevalence of symptoms in gastrointestinal diseases depending on HBT result

Group	Diagnosis (HBT result)	Lack of symptoms	Moderate symptoms	Severe symptoms	p value
1.	upper gastrointestinal tract diseases (+)	8 (8.51%)	16 (17.02%)	5 (5.32%)	**< 0.001**
	upper gastrointestinal tract diseases (–)	54 (57.45%)	11 (11.70%)	0 (0%)	
1a	gastro-esophageal reflux (+)	4 (9.30%)	11 (25.58%)	2 (4.65%)	< 0.001
	gastro-esophageal reflux (–)	21 (48.84%)	5 (11.63%)	0 (0.00%)	
1b	gastric and/or duodenal ulcer disease (+)	4 (7.84%)	5 (9.80%)	3 (5.88%)	< 0.001
	gastric and/or duodenal ulcer disease (–)	33 (64.71%)	6 (11.76%)	0 (0.00%)	
2.	malabsorption syndrome (+)	10 (25.00%)	6 (15.00%)	5 (12.50%)	< 0.05
	malabsorption syndrome (–)	17 (42.50%)	2 (5.00%)	0 (0.00%)	
3.	inflammatory bowel disease (+)	3 (12.00%)	4 (16.00%)	4 (16.00%)	< 0.001
	inflammatory bowel disease (–)	12 (48.00%)	2 (8.00%)	0 (0.00%)	
4.	functional gastrointestinal disorders (+)	3 (4.11%)	16 (21.92%)	6 (8.22%)	**< 0.001**
	functional gastrointestinal disorders (–)	40 (54.79%)	6 (8.22%)	2 (2.74%)	
4a	functional constipation (+)	3 (6.00%)	11 (22.00%)	0 (0.00%)	< 0.001
	functional constipation (–)	32 (64.00%)	3 (6.00%)	1 (2.00%)	
4b	irritable bowel syndrome (+)	0 (0.00%)	5 (21.74%)	6 (26.09%)	< 0.01
	irritable bowel syndrome (–)	8 (34.78%)	3 (13.04%)	1 (4.35%)	
Total		147 (63.36%)	63 (27.16%)	22 (9.48%)	

predisposes patients to the loss of lactase activity. The prevalence of positive HBT result was almost three-fold higher in Crohn's disease patients than in healthy and arises with disease activity (almost twofold) and with disease duration [20]. A high prevalence of LM (70%) was found in IBD patients, despite disease remission. Patients with Crohn's disease were more prone to LM than patients with ulcerative colitis, which may be explained by the location of the small intestine. There was also observed a high incidence of methane excretion in both – Crohn's disease (16%) and ulcerative colitis (17%) patients [21]. In our study hydrogen only has been taken into account, which could underestimate the incidence of LM in our subjects.

About 34% of patients with FGID were lactose malabsorbers. After splitting this group into the subgroups – constipation and IBS – we observed two different frequencies of positive HBT result. In IBS children LM was more common than in children with constipation (48% vs. 28%), but the difference between these two frequencies was

not significant. Similar results were obtained in another study – 25% of children with constipation and 50% of children with IBS were lactose malabsorbers [22]. Many studies showed a relationship of saccharides intolerance and colonic microflora imbalance with functional disorders, especially with IBS. Examination of genetic polymorphism revealed the incidences of lactose non-persistence genotypes (-13910 C/C and -22018 G/G) in IBS patients are comparable to the incidences in healthy persons. Lactose non-persistence genotypes, however, was more common in subjects with diarrhea-IBS than in other IBS types (constipation and alternate) and than in healthy subjects [23].

We observed the lowest frequency of LM in UGTD children, which was significantly different from the frequency in children with CD and secondary malabsorption. In GERD subgroup the prevalence of positive HBT result was higher than in children with gastric and/or duodenal ulcer disease. Patients with UGTD are often treated with proton pomp inhibitors (PPI). These drugs inhibit gastric acid production and their long-term use may lead to small intestinal bacterial overgrowth. It was noted that patients treated by PPI have a low amount of anaerobes in gastrointestinal tract, but there is no evidence that these medications cause secondary malabsorption [24]. In the present study GERD group did not differ from other groups in incidence of LM, but we observed significantly lower LM frequency in ulcer disease group than in IBS group.

Symptoms after lactose ingestion were noted in almost 40% of subjects and were highly related to LM. We observed aliments in about 70% of children with positive HBT result and in about 16% of children with negative HBT result. The highest incidence of LI was noted in children with IBS and the lowest in children with ulcer disease. Other studies have shown that LI affects only 14.5–18.25% of children with LM and 0.07–1.2% of healthy children [12, 13]. Higher frequencies of symptoms in our subjects may be due to the specificity of comorbidities action. The symptoms occurrence and severity depend on many factors as oro-cecal transit time, the activity of lactase and the dose of lactose, intestinal microflora fermentation (intensification and intermediate/final products), the ability of products utilization and individual sensitivity [1, 2].

Our results confirmed that LI is a common problem in children with IBS. In this group we observed also more severe complaints than in other groups – about one third of these patients had loose stool or diarrhea after lactose ingestion, whereas only up to 6% of children with UGID or malabsorption syndrome had severe symptoms. The other study also confirmed the occurrence of diarrhea after lactose in about 30% of patients with FGID. However, flatulence, bloating, fullness and borborygmie after lactose were the most common complaints in those patients [6]. In subjects with functional constipation one of the lowest incidence of symptoms was noted and only one patient (2%) had severe aliments. Variations in the frequency and severity of symptoms may be a result of intestinal microbiota imbalance. There are some differences in colonic microflora composition between the types of IBS (diarrhea or constipation predominant). Diarrhea-IBS patients have the lower number of *Lactobacillus* spp. than constipation-IBS subjects, whereas in constipation type is a higher number of *Veillonella* spp. than in healthy subjects [5]. Other studies have shown a higher amount of *Enterobacteriaceae* and decreased amount of *Lactobacillus* and *Bifidobacteria* in constipation-IBS subjects compared to healthy subjects. The variation in fecal microbiota is related to different fermentation pathways and products excretion as hydrogen or methane [25], which results in different symptoms severity and appearance [1].

Over 40% of our GERD patients were lactose intolerant and the vast majority of them had moderate symptoms. It was shown that GERD is a second most common disease, just after SIBO, comorbid with LI in children [26]. Lactose intolerance may contribute to reflux-like symptoms in about 30% of patients with FGID [6] and the incidence of LM and LI is high in patients with reflux-like dyspepsia compared to healthy individuals. A few-weeks low-lactose diet decreases the frequency of reflux symptoms. It is assumed that gastro-esophageal reflux in LI may be caused by extensive gas production influencing abdominal distention [27]. The role of SCFAs colonic production in weakening of low esophageal sphincter pressure was also observed [28]. It can be concluded that LI predisposes patients to GERD development.

A large number of patients and longtime data collection allowed us to present a reliable incidence of LM and LI in the most common gastrointestinal diseases affecting children. However, some limitations of our studies need to be considered. At first, the age of patients between particular disease groups differed significantly. Children with gastric and/or duodenal ulcer disease, IBD and IBS were older than children with GERD, functional constipation and malabsorption syndrome. It is known that the frequency of primary hypolactasia increases with age [11], so the age disproportion in our subjects might a little overestimate the prevalence of LM in groups contained older children compared to others. Second limitation resulted from the measurement of hydrogen level

exclusively, which could underestimate the prevalence of LM in our groups. Studies showed that in some cases methane is the only product which can be detected by breath test and only the use of HBT may give a false-negative results even in 12% of patients. Methane production seems to be related to prolonged intestinal transit time and may be common in constipation and in constipation predominant IBS [22, 29]. However, another study demonstrated about 17% of lactose breath test results in IBD were only methane positive [21]. Because of lactose fermentation products variety, a mixed hydrogen-methane breath test needs to be performed to assess a more accurate picture of LM in children with gastrointestinal diseases. A high incidence of LM and LI may be due to the dose of lactose we used – 50 g in children heavier than 30 kg or 30 g in children up to 30 kg. These dosages are equivalents of one liter and more than two cups of milk respectively, which are not physiological doses, but it is according to a standard procedure of the lactose malabsorption diagnosis. The high amount of lactose in an aqueous solution allowed us to observe LM and LI in a very short time. However, it might elevate the frequency and the severity of symptoms compared to complaints after normal lactose-contained meal [30].

We conclude that LM is a very common problem in gastrointestinal diseases, especially in those affecting a bowel. Symptoms after lactose are highly related to LM, but do not affect all lactose malaborbers (excluding IBS children).

References

[1] **He T, Venema K, Priebe MG, Welling GW, Brummer J-RM, Vonk RJ:** The role of colonic metabolism in lactose intolerance. Eur J Clin Invest 2008, 38, 541–547.

[2] **Brown-Esters O, Mc Namara P, Savaiano D:** Dietary and biological factors influencing lactose intolerance. Int Dairy J 2012, 22, 98–103.

[2] **Nieminen U:** Duodenal disaccharidase activities in the follow-up of villous atrophy in coeliac disease. Scand J Gastroenterol 2001, 36, 507–510.

[4] **Ojetti V, Gabrielli M, Migneco A, Lauritano C, Zocco MA, Scarpellini E, Nista EC, Gasbarrini G, Gasbarrini A:** Regression of lactose malabsorption in coeliac patients after receiving a gluten-free diet. Scand J Gastroenterol 2008, 43, 174–177.

[5] **Malinen E, Rinttilä T, Kajander K, Mättö J, Kassinen A, Krogius L, Saarela M, Korpela R, Pavla A:** Analysis of the fecal microbiota of irritable bowel syndrome patients and healthy controls with real-time PCR. Am J Gastroenterol 2005, 100, 373–382.

[6] **Wilder-Smith CH, Materna A, Wermelinger C, Schuler J:** Fructose and lactose intolerance and malabsorption testing: the relationship with symptoms in functional gastrointestinal disorders. Aliment Pharmacol Ther 2013, 37, 1074–1083.

[7] **Iwańczak F (ed.):** Gastroenterologia dziecięca. Wybrane zagadnienia. Borgis® Wydawnictwo Medyczne, Warszawa 2003, 1st ed., 40–51, 75–85, 86–97, 115–123.

[8] IBD Working Group of the European Society for Paediatric Gastroenterology, Hepatology and Nutrition: Inflammatory bowel disease in children and adolescents: recommendations for diagnosis – the Porto criteria. J Pediatr Gastroenterol Nutr 2005, 41, 1–7.

[9] **Husby S, Koletzko S, Korponay-Szabó IR, Mearin ML, Phillips A, Shamir R, Toncone R, Giersiepen K, Branski D, Catasii C, Lelgeman M, Mäki M, Ribes-Koninckx C, Ventura A, Zimmer KP:** European Society for Pediatric Gastroenterology, Hepatology, and Nutrition guidelines for the diagnosis of coeliac disease. J Pediatr Gastroenterol Nutr 2012, 54, 136–160.

[10] **Rasquin A, Di Lorenzo C, Forbes D, Guiraldes E:** Childhood functional gastrointestinal disorders: child/adolescent. Gastroenterology 2006, 130, 1527–1537.

[11] **Landowski P:** Występowanie nietolerancji laktozy u dzieci i młodzieży i jej wpływ na stan odżywienia i rozwój fizyczny. PhD thesis, Medical University of Gdańsk 2002.

[12] **Szostak-Węgierek D:** Występowanie hipolaktazji u dzieci w wieku szkolnym w Warszawie. Pediatr Pol 1999, 74, 13–17.

[13] **Kwiecień J, Szadkowski L, Szostak W, Żabka A, Karczewska K, Kasner J:** Hipolaktazja u dzieci szkolnych z terenu Zabrza. Pediatr Współcz 2005, 7, 15–18.

[14] **Czaja-Bulsa G, Marasz A,Brodzińska B, Szechter-Grycewicz A, Musiał B:** The impact of hypolactasia on milk and dairy product consumption. Gastroenterol Pol 2012, 19, 114–118.

[15] **Mądry E, Lisowska A, Kwiecień J, Ryszard M, Korzon-Burakowska A, Drzymała-Czyż S, Mojs E, Walkowiak J:** Adult-type hypolactasia and lactose malabsorbtion in Poland. Acta Biochim Pol 2010, 57, 585–588.

[16] **Toporowska-Kowalska E, Kowalska E, Wąsowska-Królikowska K:** Hipolaktazja jako przyczyna bólów brzucha u dzieci. Pediatr Współcz 1999, 1, 31–33.

[17] **Pociecha W, Balcerska A:** Częstość występowania nietolerancji sacharydów i zaburzeń wchłaniania u dzieci z biegunką rotawirusową. Gastroenterol Pol 1999, 6, 125–132.

[18] **Hutyra T, Iwańczak B:** Ocena częstości występowania nietolerancji laktozy w alergii pokarmowej u dzieci. Pol Merk Lek 2008, 25, 340–344.

[19] **Hutyra T:** Ocena nietolerancji laktozy i aktywności disacharydaz jelitowych w niektórych chorobach przewodu pokarmowego u dzieci. PhD thesis, Medical University of Wroclaw 2007.
[20] **Von Tirpitz C, Kohn C, Steinkamp M, Greeling I, Maier V, Moller P, Adler G, Reinshagen M:** Lactose intolerance in active Crohn's disease: Clinical value of duodenal lactase analysis. J Clin Gastroenterol 2002, 34, 49–53.
[21] **Eadala P, Matthews SB, Waud, JP, Green JT, Campbell AK:** Association of lactose sensitivity with inflammatory bowel disease – demonstrated by analysis of genetic polymorphism, breath gases and symptoms. Aliment Pharmacol Ther 2011, 34, 735–746.
[22] **Landowski P, Kamińska B, Szumera M, Brodzicki J, Radys W, Korzon M:** Ocena bakteryjnych procesów fermentacyjnych zachodzących w jelicie grubym dzieci z wybranymi schorzeniami przewodu pokarmowego. Przegl Gastroenterol 2007, 2, 38–41.
[23] **Kumar S, Ranjan P, Mittal B, Singh R, Ghoshal UC:** Lactase persistence/non-persistence genetic variants in irritable bowel syndrome in an endemic area for lactose malabsorption. J Gastroenterol Hepatol 2012, 27, 1825–1830.
[24] **Williams C, McColl KEL:** Review article: proton pump inhibitors and bacterial overgrowth. Aliment Pharmacol Ther 2006, 23, 3–10.
[25] **Chassard C, Dapoigny M, Scott KP, Crouzet L, Del'homme C, Marquet P, Martin JC, Pickering G, Ardid D, Eschalier A, Dubray C, Flint HJ, Bernalier-Donadille A:** Functional dysbiosis within the gut microbiota of patients with constipated-irritable bowel syndrome. Aliment Pharmacol Ther 2012, 35, 828–838.
[26] **Małecka M, Bobrus M, Kosielska J, Czkwianiac E:** The analysis of incidence of the most common clinical symptoms and comorbidity in children with lactose intolerance conducted on the basis of own material. Gastroenterol Pol 2010, 17, 397–400.
[27] **Minenna MF, Palieri A, Panella C, Ierardi E:** Gastro-oesophageal reflux disease and lactose malabsorption: Casual comorbidity or neglected association? Dig Liver Dis 2006, 38, 437–438.
[28] **Piche T, Zerbib F, Bruley des Varnnes S, Cherbut C, Anini Y, Roze C, Le Quellec A, Galmiche JP:** Modulation by colonic fermentation of LES function in humans. Am J Physiol Gastrointest Liver Physiol 2000, 278, 578–584.
[29] **De Lacy Costello BPJ, Ledochowski M, Ratcliffe NM:** The importance of methane breath testing: a review. J Breath Res 2013, 7, 1–8.
[30] **Ghoshal UC, Kumar S, Misra A, Mittal B:** Lactose malabsorption diagnosed by 50-g dose is inferior to assess clinical intolerance and to predict response to milk withdrawal than 25-g dose in and endemic area. J Gastroenterol Hepatol 2013, 28, 1462–1468.

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