Lactose Intolerance in Thai Adults

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Lactose intolerance is common in Thai adults who ingest cow's milk but its incidence has not been clearly defined. The authors evaluated 45 volunteers (15 males, 35 females), aged 21-31 yrs old, who drank one 240-ml box of milk daily. A Lactose tolerance test was performed using a breath- hydrogen test (BHT) after oral intake of 25 g of lactose dissolved in 250 ml of water. The presence of gastrointestinal symptoms of lactose intolerance, flatulence, abdominal pain and diarrhea, were recorded. Twenty-one subjects (47%) were categorized as lactose malabsorbers and intolerant, two subjects (4%) were malabsorbers but tolerant, and 22 of 45 (49%) were absorbers and tolerant. The incidence of lactose malabsorption was, thus, 51%; symptoms of intolerance were found in 21 of the 23 malabsorbers, making the incidence of lactose intolerance 47%. In the lactose malabsorbant and intolerant group, the more breath-hydrogen (H_2) the more symptoms observed. All subjects who had a negative breath-H_2 test had no symptoms. The breath-H_2 test should be used as a standard method to evaluate lactose absorption and lactose tolerance. The incidence of lactose intolerance has decreased from the past and the symptoms are not so severe that the people limit the consumption of milk since it is a major source of food containing good quality of protein and calcium.

Keywords : *Lactose malabsorber, Lactose absorber, Lactose intolerance, Lactose tolerance, Lactase, Breath-hydrogen test*

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In Thailand, the consumption of fresh milk and other dairy products has considerably increased. However, some people limit their intake of dairy products because of the resulting symptoms of lactose intolerance. Reduction of lactose hydrolyzing capacity of intestinal lactase results in lactose maldigestion or malabsorption, the terms often being used interchangeably[1]. Gastrointestinal symptoms occur when lactose, the major carbohydrate in milk, is not digested by lactase, an enzyme of the small intestinal mucosa. Consequently, the non-digested or unabsorbed lactose is fermented by the bacterial flora of the colon leading to the production of gases and short-chain fatty acids. Hydrogen, one of the gases produced, diffuses into the blood circulation via the large intestinal mucosa and exhales via expired air. Lactose malabsorption is, therefore, diagnosed when breath-H_2 level increases more than 20 parts per million (ppm) over the baseline level using the breath-hydrogen test (BHT), the most widely used technique to analyze lactose absorption[1-5]. Hydrogen, methane, and carbon dioxide gases are produced resulting in flatulence, bloating, or the passage of flatus via the rectum. The excessive lactose remaining from bacterial fermentation creates an osmotic effect and water is absorbed into the lumen of the large bowel causing osmotic diarrhea.

Lactose intolerance usually occurs in Thai adults who ingest cow's milk but its incidence in Thailand has not been clearly defined. The present study was done in order to determine the incidence of lactose malabsorption and lactose intolerance in Thai adults who drink 240 ml of milk daily using the BHT.

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Material and Method

Subjects

The present cross-sectional study was done at Siriraj Hospital between August 2000 and August 2001. Fifty Thai adult volunteers (15 males, 35 females), medical students and medical personnel, ranging in age from 21 to 31 years old were included. All drank one serving (240 ml) of milk daily. Inclusion criterias were as follows: 1) healthy physical condition 2) non-smoker 3) no history of current diarrhea or constipation in the previous 2 weeks 4) had not received antibiotic drugs within 2 weeks prior to the study 5) did not consume any slowly digesting foods like beans, bran or other high-fiber cereals the day before the test was performed. Subjects were excluded if they were allergic to cow's milk or had a baseline breath-H_2 concentration > 20 parts per million (ppm) before intervention; a breath-H_2 concentration > 20 ppm which may indicate incomplete fasting, the ingestion of slowly digested food the day before or the presence of bacterial overgrowth in the small intestine. Of the 50 subjects that participated, five were excluded due to the high baseline level of H_2, leaving 45 subjects eligible to be analyzed. Subjects were informed and gave their consent that they may develop gastrointestinal symptoms because of lactose intolerance.

Intervention

The subjects fasted overnight for a minimum of 10 hours, consuming only water until the test started. In the morning, the authors collected their breath samples at 0 min for baseline, then at 30-, 60-, 90-, and 120- minutes after oral ingestion of the test substrate, 25 g of lactose in 250 ml of water (10% solution). Eating was not allowed during the test. Symptoms of intolerance, including abdominal cramp, flatulence, watery stool, or passing of flatus via the rectum were recorded at the times the breath hydrogen test was done and then on until the evening.

Hydrogen breath analysis

In order to obtain the alveolar air sample without contamination by dead space air (the part of the expired air which was not from the alveolar region of the lung) and lack of room air, the authors used an AlveoSampler (QT01091), a polyethylene bag assembled with a three-way stopcock that was fitted with a syringe for sample collection. Each 20 ml of breath sample was analyzed for H_2 level using chromatographic analysis (Quintron model 12i Microlyzer, QuinTron Instruments, Milwaukee, Wisconsin, USA). Hydrogen concentration was expressed in parts per million.

Lactose malabsorption was defined when the breath-H_2 level increased to more than 20 ppm over the baseline level. Lactose intolerance was determined when the increase in H_2 was accompanied by one or more gastrointestinal symptoms after consumption of lactose solution

Statistical analysis

Data are presenteded as maximums, minimums, and means. The authors used SPSS (version 11.5; SPSS Inc, Chicago) for analyses.

Results

As shown in Fig. 1, the breath-H_2 concentrations of lactose malabsorbers were markedly higher than those of lactose absorbers. In Fig. 2, 23 of the 45 subjects (51%) demonstrated lactose malabsorbption after ingestion of 25 g of lactose. Seven of them (15.5%) showed signs of malabsorption at the 60 min interval, 7 at 90 mins, and nine at 120 mins.

Table 1 demonstrates the relationship between lactose absorbesr-malabsorbers and lactose tolerant-intolerant. Twenty-two subjects (49%) were lactose absorbers and all tolerated the ingestion of 25 g of lactose. Most of the lactose malabsorbers (21 of 23; 91%) had symptoms of intolerance. In the malabsorption group, two subjects (9%) were lactose tolerant.

Table 2 shows the relationship between breath-H_2 difference from baseline and gastrointestinal symptoms of carbohydrate malabsorption. All lactose absorbers had no symptoms, whereas lactose malabsorbers developed symptoms either abdominal

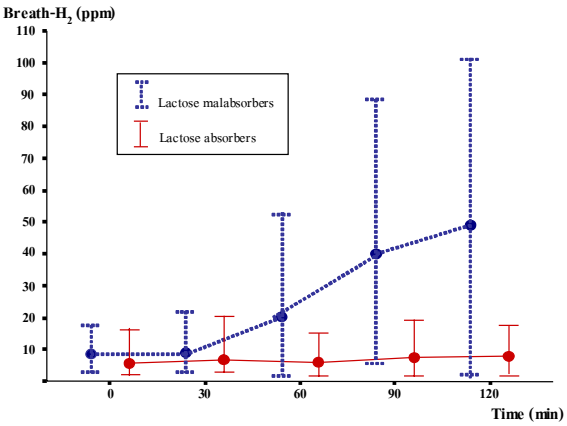

Fig. 1 Minimum, maximum, and mean levels of breath-H_2 of lactose malabsorbers and lactose absorbers during 120-minute test

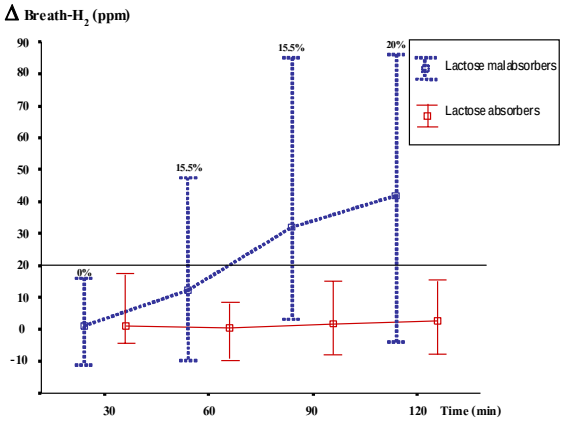

Fig. 2 Maximum, minimum, and mean levels of difference in breath H_2 from baseline and percentage of lactose malabsorbers during 120-minute test

Table 1. Percentage of lactose absorbers and malabsorbers, lactose tolerance and intolerance (n = 45)

	Lactose tolerance (%)	Lactose intolerance (%)
Lactose absorbers	49	-
Lactose malabsorbers	4	47

Table 2. Relationship between breath-H_2 difference from baseline and gastrointestinal symptoms

ΔH_2 (ppm)	Number of subjects			
	No symptom	Symptoms		
		Abdominal discomfort	Diarrhea	Abdominal discomfort & diarrhea
< 20 (n = 22)	22	-	-	-
21-30 (n = 4)	2	2	-	-
> 30 (n = 19)	-	11	-	8

ΔH_2 = difference in breath-H_2 gas from baseline

discomfort or accompanying diarrhea. Abdominal discomfort occurred when the difference of breath-H_2 was between 20 to 30 ppm. Most of the lactose malabsorbers (19 of 23, 83%) whose difference in breath-H_2 >30 ppm developed both symptoms of abdominal discomfort and diarrhea.

Discussion

In the present study, the authors found that 23 of 45 (51%) of the Thai adults were lactose malabsorbers using 25 g lactose oral load test. The lactose tolerance test was performed by having the participants ingest 25 g of lactose dissolved in 250 ml of water instead of whole milk for several reasons. First, it was physically easier to drink 250 ml of solution than to consume 510 ml of whole milk, which was 4.9 g lactose per 100 ml[6], at one time in order to get an equal amount of lactose. Second, these subjects regularly drank a 240-ml serving of whole milk before the study. Third, the gastric emptying time of whole milk is longer than that of lactose solution and will, thus, delay the appearance of lactose in the colon leading to prolonged duration of the study. The standard lactose tolerance test consists of 1 g of lactose per kg body weight, up to 25-50 g, dissolved in 6-8 oz water. A smaller dose of 25 g is sufficient and accepted as a standard dose for the breath-test in adults[7]. A larger dose of 50 g causes intolerant patients to feel considerable discomfort, and it is not suitable to consume a liter of milk in one sitting. For any carbohydrate malabsorption test, the standard sugar-dose should be dissolved in at least 6-8 oz of water, to ensure that the intake volume is enough to stimulate emptying of the stomach when the solution is ingested[7]. A variety of physiological factors such as gastric emptying time, rate of ingestion, and volume of load may change the symptomatic response to lactose[8].

Lactose malabsorbers presented with a significant increase in breath-H_2 over the baseline levels at 30-120 min. after ingestion of the lactose load. The authors excluded 5 subjects who had a base H_2 greater than 20 ppm. This high H_2 level suggested that they may not have followed the instructions to completely avoid carbohydrate and fiber intake the night before the test, or they had bacterial overgrowth. In two of five subjects, the breath-H_2 levels gradually decreased after the beginning of the test. This shows that they were not lactose malabsorbers. On the contrary, three of them had a second rise in breath-H_2 levels following the initial decrease at beginning of the test. This occurrence was thought to be consistent with the bolus of lactose reaching the colon[9] indicating that they were malabsorbers. Consequently, the incidence of lactose malabsorption in Thai adults may be higher than the 51% reported in the present study. The study of Varavithya et al[10], in 1976, showed that all Thai children over 4 years of age were lactose malabsorbers, whereas, in 1999, Soontornchai et al[11] found that 77% of 39 healthy Thai adults became lactose malabsorbers after consumption of 12 g of lactose in 250 ml of water. The improvement of lactose malabsorption in Thai adults may be a result of the educational campaign advising not only children, but also adolescents and

adults, to drink fresh milk everyday. Regular consumption of milk causes continued stimulation of lactase activity by maintaining lactose in the diet and enough expression of lactase level even though the prevalence of primary adult lactose malabsorption is 90-100% in Eastern Asia[12].The review of Scrimshaw et al[13] and Sahi[14] demonstrated that the prevalence of lactose maldigestion was above 50% in South America, Africa, and Asia, reaching almost 100% in some Asian countries.

Lactase, one of the disaccharidases, is located only on small intestine enterocytes and is an important enzyme for the hydrolization of lactose, the principle carbohydrate of mammal milk, into glucose and galactose. The lactase gene (LCT), which is located on chromosome 2, determines messenger RNA expression and encodes lactase activity[15]. The lactase activity is genetically determined and different at various stages of development. The lactase activity expresses at high levels in infants and remains so in lactase persistent adults who are northern and central Europeans and their migrating descendant (prevalence of lactose maldigestion of 2% in Scandinavia, 6% in Australia and 9% in New Zealand)[13,14] in contrast to lactase non-persistent adults, who have low lactase expression. Although the onset and extent are somewhat variable, genetically programmed down-regulation of the lactase is detectable in children from the second year of life[16]. Lactase non-persistence, or primary hypolactasia, tends to be the most frequent phenotype in populations where fresh milk does not form a significant part of the adult diet. Lactase non-persistence individuals can drink only a limited amount of whole milk without experiencing gastrointestinal symptoms. In the present study, 21 of 45 subjects (47%) who regularly consumed a 240-ml serving of fresh milk containing 12 g of lactose without experiencing symptoms of intolerance, when loaded with 25 g of lactose, were intolerant. Of the 23 subjects in the lactose malabsorption group, most of them (91%) had gastrointestinal symptoms; two subjects (9%) tolerated the test without gastrointestinal disturbance.

In the lactose malabsorbant and intolerant group, the more breath-hydrogen (H_2) the more symptoms observed. On the other hand, all subjects who had a negative result of breath-H_2 test had no symptoms. Therefore, the breath-H_2 test is confirmed that it is an effective method to evaluate lactose absorption and lactose tolerance.

In general, people should not avoid consuming milk. Although 70-100% of adults worldwide are lactose malabsorbers, milk and dairy products are major sources of calcium-rich food. Therefore, the symptoms resulting from lactose maldigestion are not a hindrance for pre- and postmenopausal women to intake a dairy-rich diet supplying 1500 mg Ca/day[17] in common with the study by Pribila et al who presented that there was colonic adaptation to the high-lactose diet and lactose maldigestion should not be a restricting factor in developing adequate calcium diets[18]. In the present study, the subjects in the lactose intolerant group could drink a 240-ml box of milk (12 g lactose) without experiencing gastrointestinal symptoms, so the authors, therefore, suggest that they do not consume 2 boxes in one sitting, but consume the 2 boxes at separate times. Another way to relieve the symptoms of lactose intolerance is to ingest fresh yogurt, fermented milk containing lived-lactic acid bacteria called probiotics, instead of fresh milk because lactose is hydrolyzed by -galactosidase produced by those organisms[4,19].

In conclusion, the breath-H_2 test is a standard method to analyze lactose absorption and tolerance. In order to maintain lactase activity and avoid the symptoms of lactose intolerance, milk should continue to be consumed after weaning in infancy.

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การศึกษาภาวะการไม่ทนต่อน้ำตาลแล็กโทสในผู้ใหญ่ไทย

นฤมล เด่นทรัพย์สุนทร, พิภพ จิรภิญโญ, นุชน้อย ธรรมมนศิริ, ศศิธร จันทรทิณ, เรณู วงษ์อาน

คนไทยวัยผู้ใหญ่เกิดอาการของภาวะการไม่ทนต่อน้ำตาลแล็กโทสได้บ่อยเมื่อดื่มนมวัว แต่อุบัติการณ์ดังกล่าวยังไม่ปรากฏแน่ชัดในปัจจุบัน คณะวิจัยได้ทำการศึกษาหาอุบัติการณ์ของความไม่ทนต่อน้ำตาลแล็กโทสในอาสาสมัครจำนวน 45 คน เป็นเพศชาย 15 คน เพศหญิง 35 คน อายุตั้งแต่ 21 ถึง 31 ปี โดยที่อาสาสมัครมีการดื่มนมวัวปริมาณ 240 มิลลิลิตรเป็นประจำทุกวัน การทดสอบความทนต่อน้ำตาลแล็กโทสเริ่มต้นโดยให้อาสาสมัครดื่มสารละลายน้ำตาลแล็กโทส 250 มิลลิลิตร ที่มีปริมาณน้ำตาลแล็กโทส 25 กรัม ภายหลังจากงดอาหารมาเป็นเวลาอย่างน้อย 10 ชั่วโมง โดยมีการตรวจวัดปริมาณก๊าซไฮโดรเจนในลมหายใจออกของอาสาสมัคร ณ เวลาเริ่มต้นการทดลอง และภายหลังการดื่มสารละลายน้ำตาล ทุก 30 นาที รวมเป็นระยะเวลา 2 ชั่วโมง และมีการบันทึก อาการทางระบบทางเดินอาหารที่เกิดขึ้นจากภาวะการไม่ทนต่อน้ำตาลแล็กโทส ได้แก่ ท้องอืด ปวดแน่นท้อง อุจจาระร่วง ผลการศึกษาพบว่าอาสาสมัคร 21 คน (ร้อยละ 47) มีการดูดซึมน้ำตาลแล็กโทสผิดปกติ และเกิดอาการทางระบบทางเดินอาหาร 2 คน (ร้อยละ 2) มีการดูดซึมน้ำตาลแล็กโทสผิดปกติแต่ไม่เกิดอาการ 22 คน (ร้อยละ 49) สามารถดูดซึมน้ำตาลแล็กโทสได้ปกติและไม่เกิดอาการ ดังนั้นอุบัติการณ์ของการดูดซึมแล็กโทสที่ผิดปกติ และการเกิดอาการจากการไม่ทนต่อน้ำตาลแล็กโทสมีค่าร้อยละ 51 และ 47 ตามลำดับ ในกลุ่มที่มีการดูดซึมน้ำตาลแล็กโทสผิดปกติและเกิดอาการพบว่ายิ่งมีปริมาณก๊าซไฮโดรเจนในลมหายใจมากอาสาสมัครจะมีอาการทางระบบทางเดินอาหารมาก อาสาสมัครทุกคนที่การทดสอบให้ผลลบจะไม่มีอาการ ดังนั้นการตรวจวัดก๊าซไฮโดรเจนในลมหายใจออกสามารถใช้เป็นมาตรฐานในการทดสอบการดูดซึมน้ำตาลแล็กโทสและภาวะการทนน้ำตาลแล็กโทส กล่าวโดยสรุปอุบัติการณ์ของภาวะการไม่ทนต่อน้ำตาลแล็กโทสพบได้น้อยลงและอาการที่เกิดขึ้นไม่รุนแรงมาก ดังนั้นประชาชนจึงไม่ควรจำกัดการบริโภคนม เนื่องจากนมยังคงเป็นอาหารที่อุดมด้วยโปรตีนและแคลเซียม