Distributions and Incidences of Elementary School Children with Lactose Intolerance Symptoms after Drinking Milk in Korea

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Abstract

Milk contains a number of nutrients required for human growth and development, such as disaccharide lactose which is significantly contained in milk and dairy products. About two thirds of world populations are reportedly suffering from lactose intolerance after drinking milk. Lactose intolerance is defined as a maldigestion of lactose in the human intestine with typical symptoms of abdominal pains, bloating, and diarrhea. In this study, incidence of lactose intolerance has been investigated for the elementary school children for 1 year from July, 2010 to June, 2011. It is found that about 70% of the total elementary students have joined the school milk program. Out of 636 total students that participated in this study, 449 were from the metropolis, 85 from middle-sized city, and 102 from the small town including rural areas (small town/rural areas). For distributions of lactose intolerance, 154 students (24.2%) were found to be positive among the total 636 subjects. Based on the size of the city, the symptoms were the most prevalent for the students in the small town/rural areas at 31.4% (32/102), followed by 30.6% (26/85) in middle-sized city, and 21.4% (96/449) in the metropolis. On the other hand, gender had no significant effect on the incidence of lactose intolerance, shown those for boys and girls were 24.8% (77/310), 23.6% (77/326), respectively. Further research is needed to confirm the correct incidence of lactose intolerance symptoms as the frequency is significantly affected by subject’s digestive functions including irritable bowel syndrome.

Key words: lactose intolerance, incidence rate, fresh milk, school children, breath hydrogen test

Introduction

Milk and dairy products are referred to as an almost complete food to human because protein, calcium, potassium, phosphorus, vitamin B2 (riboflavin), and many other nutrients are contained evenly. Especially, milk is recommended as the ideal food for young children. Lactose, a sort of disaccharide, is a source of energy contained in milk. It is hydrolyzed into glucose and galactose by lactase (β-galactosidase) in the small intestine prior to absorption. Once lactose is absorbed in mucosa of small intestine, it is then in turn utilized to synthesize nondigestible galactooligosaccharides which promote growth of few probiotic bacteria and to improve gut microbiota by inhibiting the growth of harmful organisms in the intestine, promoting digestion and improving the health of the body. Lactose intolerance is clinically diagnosed with the breath hydrogen production test as well as intestinal biopsy in clinical practice (Maffei et al., 1977). About 75% of the world's population genetically lacks innate ability to digest lactose. For the adults, phenotype of lactase persistence, which is able to hydrolyze lactose, is more common in the northern Europeans, but lactase non-persistence or adult-type hypolactasia is prevalent in the other areas (Arola, 1994). From the clinical point of view, physiological condition called lactase non-persistence is known as the lactose intolerance. Lactose intolerance is a congenital disorder of carbohydrate metabolism, caused by unabsorbed lactose in small intestine after when ingesting milk or dairy products containing lactose via osmosis caused by unabsorbed lactose in small intestine. As for the mechanism (Fig. 1), body fluids and electrolytes flow into the lumen and stimulate the nervous system of the small intestine due to hydrogen and methane, carbon dioxide, and others, finally leading to clinical symptoms such as diarrhea, flatulence, abdominal swelling, abdominal pain, and so on. It is commonly known to occur in adults more than children (Bedine and Bayless, 1973; Holsinger, 1978; McCracken, 1971; Paige and Bayless, 1975; Rosensweig, 1969; Savaiano and Leritt, 1987). As for the primary cause of lactose intolerance, an

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enzyme lactase produced naturally decreases with age. Lactase activity is usually highest in infancy, and then gradually decreases to, finally it reaches for adult to 5-10% of that level for adults in infancy (Hertzler and Savaiano, 1996; 1997). Based on the earlier studies (Sahi, 1994; Scrimshaw and Murray, 1988), incidence of lactose intolerance in all of the world was reported to exceed 50% in Africa (Tsega, 1989), and almost 100% in several Asian countries (Andersen and Barfoed, 1978; Simoons, 1978; Tadess, 1992). In the U.S., the difference in incidence rate by its racial difference was observed across racial groups. 15% of whites, 53% of Mexicans, and 80-90% of blacks were positive in lactose intolerance test. In Europe, 2% in Northern Europe and Scandinavia, -70% in Italy and Sicily were reported to be lactose intolerant, showing significant difference across geographical locations. Many methods have been developed to diagnose lactose intolerance in an objective and scientific way, none is perfect but the hydrogen breath test (or breath hydrogen test), has been the current method of choice in many countries (Maffei et al., 1977).

This study was conducted to obtain basic information about distributions and incidence of lactose maldigestion or lactose intolerance symptoms for elementary school children in Korea.

Materials and Methods

Selection of subjects

Elementary school children (10-13 years old) were chosen as subjects who have with no medical history, especially family history of gastrointestinal disease. It was also excluded students with diabetes, use of antibiotics (within 3 wk), and abdominal surgery. This study has been conducted for 1 year from July, 2010 to June, 2011. Each student was allowed to take participate in this experiment by parents’ consent. We are fully understand the experimental ethics guidelines for human subject under KFDA, Korea.

Determination of lactose intolerance

After fasting at least 12 h before the test, all of the subjects were given 400 mL of a full-fat fresh milk product (200 mL×2, Maeil Dairy Co., Korea) adjusted to 20-25°C and consumed in 30 min. Lactose intolerance was judged by two methods as described below.

1) Lactose intolerance by questionnaire

Questionnaire sheet (Appendix) was given to the subject to answer the 20 itemized questions about symptoms which he or she had before and after drinking fresh whole milk: “Not at all” was worth 1 point, “No” 2 points, “I’m not sure” 3 points, “Ordinary” 4 points, “A little” is 5 points, and “Extremely” 6 points (Matthews et al., 2005).

Points of each answer were added and recorded to use statistical analysis. If the total score was above 60 points over the all of questions, then the result was recorded positive for the lactose intolerance test.

2) Test for breath hydrogen concentration (H₂ breath test)

Hydrogen concentration was measured in the expiration gas before and after drinking milk (2 h interval) using Gastrolyzer (Gastro⁺, England). Lactose intolerance test was diagnosed positive when the scores obtained by two individual measurements increased by more than 15 ppm (Fig. 2).

Statistical analysis

The standard t- and χ²-square-tests were used to test differences between experimental groups (Lovelace and Barr, 2005). The effects of certain background factors