



## Lactose intolerance

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Lactose intolerance affects more than 50 million Americans. It is one of the most common gastrointestinal disorders seen by primary care physicians. When this disorder is properly diagnosed, the patient is easily treated with education and dietary modifications. Lactose intolerance is commonly misdiagnosed because of its overlapping symptoms of diarrhea and abdominal bloating. This article reviews the etiology, diagnosis, and treatment of lactose intolerance.

(Key words: lactose intolerance, lactase, abdominal bloating, diarrhea, hydrogen breath test)

It is estimated that 50 million Americans have trouble digesting lactose. Although this disorder is usually not dangerous, it can lead to distressing symptoms and multiple office visits to the primary care physician.<sup>1</sup> Lactose intolerance is the inability to digest lactose into its constituents, glucose and galactose, owing to low levels of lactase enzyme in the brush border of the duodenum.<sup>2</sup> Galactose is then converted to glucose in the liver by a series of reactions leading to uridine diphospho (UDP)-glucose.<sup>2</sup>

Multiple etiologies of lactose intolerance exist, the most common being that of primary lactose intolerance, a common disorder in which a low level of lactase develops after weaning.<sup>3</sup> The condition appears to parallel the situation in all other land mammals in which there is

a physiologic decline in lactase activity coincident with weaning.<sup>4,5</sup> This decline in lactase activity in the intestinal mucosa is genetically controlled and follows a permanent course. Primary lactose intolerance may not become clinically evident until puberty or late adolescence.<sup>6,7</sup>

Secondary lactose intolerance is the inability to digest lactose caused by any condition that leads to injury of the intestinal mucosa or to reductions of the functional mucosal surface area. This form of lactose intolerance tends to be transient, depending on the nature of the primary disorder. Causes include diarrhea, inflammatory bowel disease, and the human immunodeficiency virus. Multiple other viral syndromes may lead to secondary lactose intolerance.

Congenital lactose intolerance is an extremely rare disorder in which the small intestines produce no lactase.<sup>3,8</sup> Consumption of any amount of lactose is intolerable and even dangerous for infants whose diarrhea quickly leads to dehydration. This type of lactose intolerance is usually apparent in the first week of life. The infant must be fed a lactose-free diet.<sup>8</sup>

Lactose "malabsorption" is a disorder in which lactose can be broken down,

but, because of an anatomic or cofactor deficiency, the disaccharides are not absorbed. Although this disorder may have a presentation similar to that of lactose intolerance, it does not necessarily parallel it<sup>8</sup> (Table 1).

There appears to be an equal prevalence of lactose intolerance among males and females. Interestingly, up to 45% of women who are lactose intolerant will regain the ability to digest lactose during pregnancy.

Primary lactose intolerance has a high degree of race dependence. The prevalence of primary lactose intolerance in the United States is as follows: 95% to 100% of American Indians; 80% to 90% of blacks, Asians, Mediterraneans, and Jews; and 50% of individuals of Northern and Central European descent<sup>3,8,9</sup> (Table 2). Incidence of secondary lactose intolerance is variable, depending on its underlying etiology. Up to 50% of infants with acute diarrhea have transient lactose intolerance during acute viral syndromes. Most commonly implicated are rotavirus and giardiasis.

### Signs and symptoms

The diagnosis may be suspected when a history of gastrointestinal symptoms follows milk ingestion. Symptoms tend to occur about 30 minutes to 2 hours after consumption of foods that contain lactose. Symptoms such as bloating, cramping, diarrhea, flatulence, and borborygmi will develop in one third to one fifth of individuals with lactose intolerance.<sup>10</sup> Undigested lactose becomes thick as it passes through the small intestines. This thickened lactose combines with colonic bacteria to produce excess hydrogen gas. Lactose that is not absorbed also causes an intraluminal osmotic effect resulting in flatulence, bloating, and loose stools. Another significant change with lactose intolerance is the decrease in stool pH secondary to production of lactic acid and short-chain fatty acids from the fermentation of lactose by colonic bacteria. It should be emphasized that varying degrees of symptoms occur in patients, depending on the severity of their lactose intolerance and on the lactose load

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ingested. Ingestion of only moderate amounts of lactose, 5 g to 12 g or the amount in 90 mL to 240 mL (3 to 8 ounces) of milk, may result in gastrointestinal symptoms. Patients should be educated that symptoms are not caused by allergic reactions to milk proteins, but rather by an inability to break down and absorb milk sugars.

### Diagnosis

A thorough history and physical examination will yield evidence to point the clinician in the right direction. If definitive tests are required to diagnose lactose intolerance, the most practical is the hydrogen breath test (*Table 3*). This test is noninvasive, relatively inexpensive, and not labor intensive. Breath hydrogen levels are measured before and after oral administration of a 50-g bolus of lactose. The hydrogen level will rise secondarily to hydrogen release from the combination of unabsorbed lactose and colonic bacteria.<sup>11</sup> Measurement of stool pH will also lead to evidence of lactose intolerance. Another definitive test is through a small-bowel biopsy for assay of lactase activity. The drawbacks to the latter test include invasiveness and accuracy. Accuracy may be questionable if the lactase deficiency is focal or patchy; therefore, small-bowel biopsy is rarely performed in clinical practice. Another alternative is the lactose absorption test. This test quantifies the amount of lactose digested after a specific amount of lactose is ingested. Assays to rule out secondary causes of lactose intolerance should be considered as the history dictates. If a child or infant is having lactose intolerance, many pediatricians simply recommend changing from cow's milk to a soy formula and observing for a decrease in symptoms to ensue.

### Treatment

Approximately 70% of patients with primary lactose intolerance will respond to a lactose-restricted diet.<sup>3</sup> The remaining 30% are believed to have an underlying irritable bowel syndrome. Primary lactose intolerance can be controlled with strict adherence to a lactose-free or

Type	Pathogenesis
<input type="checkbox"/> Congenital	Enzyme activity absent from birth
<input type="checkbox"/> Primary	Genetically predetermined reduction of enzyme activity during childhood or adolescence
<input type="checkbox"/> Secondary	Reduced to enzyme activity in response to diffuse intestinal insult—giardiasis, rotavirus, tropical sprue, celiac disease, bacterial overgrowth, Crohn's disease, intestinal resection

Population	Prevalence (%)
<input type="checkbox"/> American Indians	95 to 100
<input type="checkbox"/> Mediterranean	80 to 85
<input type="checkbox"/> African black	85 to 90
<input type="checkbox"/> Asian	90 to 100
<input type="checkbox"/> Jewish descent	80 to 95
<input type="checkbox"/> Northern European	40 to 55
<input type="checkbox"/> Mexican American	50 to 75

lactose-reduced diet. The gastrointestinal symptoms of patients who consume milk products can be reduced with the use of commercially available preparations such as Lactaid or Lactrase. These preparations contain the enzyme lactase, which is necessary for the hydrolysis of lactose. Lactose intake limited to less than 240 mL (8 ounces) of milk per day usually causes negligible gastrointestinal symptoms. Individuals with severe lactose intolerance should also watch for hidden lactose, which is often added to prepared foods. Moreover, lactose is used as the base for more than 20% of prescription drugs and 6% of over-the-counter medications.<sup>12</sup>

Secondary lactose intolerance is generally a self-limiting condition that resolves with treatment of the primary disorder. Patients should be advised to limit consumption of dairy products until the primary disorder is resolved.

By eliminating milk products, many patients require calcium supplementation to prevent the effects of osteoporosis. This supplementation can be accomplished using calcium carbonate. Substitution should be emphasized. Yogurt and fermented products such as cheese are better tolerated than milk products.<sup>10</sup> The recommended daily allowance for calcium is 800 mg, which many experts in bone disease believe is too low. Postmenopausal women may require as much as 1500 mg of calcium per day, roughly the amount in a quart and a half of milk. Many foods that are rich in calcium and low in lactose include green vegetables, oysters, sardines, molasses, and tofu (*Table 4*).

The cornerstone to successful treatment is patient education. Reading of food product labels is necessary to prevent unintentional ingestion of lactose-containing products.

**Table 3**  
**Diagnostic Tests for Lactose Intolerance**

Test	Result
<input type="checkbox"/> Breath hydrogen	Rise in breath hydrogen >20 ppm
<input type="checkbox"/> Stool pH	Acid pH (<6.0)
<input type="checkbox"/> Small-bowel biopsy	Disaccharidase assay (<13 IU/g of mucosal protein)
<input type="checkbox"/> Lactose absorption (fecal-reducing substances)	+ to +++++

Key: + = minimal; +++++ = significant.

**Table 4**  
**Calcium and Lactose Content of Some Common Foods**

Food product	Calcium, mg	Lactose, g
<b>■ Vegetables</b>		
<input type="checkbox"/> Broccoli (1 cup)	95 to 175	0
<input type="checkbox"/> Collard greens (1 cup)	145 to 350	0
<input type="checkbox"/> Spinach (1 cup)	60 to 100	0
<input type="checkbox"/> Chinese cabbage (1 cup)	160 to 180	0
<b>■ Dairy products</b>		
<input type="checkbox"/> Ice cream (8 oz)	175 to 200	6 to 8
<input type="checkbox"/> Milk (8 oz)	280 to 320	12 to 14
<input type="checkbox"/> Processed cheese (1 oz)	150 to 220	2 to 4
<input type="checkbox"/> Yogurt (8 oz)	275 to 400	12 to 15
<b>■ Seafood</b>		
<input type="checkbox"/> Shrimp (3 oz)	100	0
<input type="checkbox"/> Oysters (1 cup)	225	0
<input type="checkbox"/> Salmon (3 oz)	165	0
<input type="checkbox"/> Sardines (3 oz)	370	0
<b>■ Other</b>		
<input type="checkbox"/> Molasses (2 tbsp)	270	0
<input type="checkbox"/> Tofu (3 oz)	225	0

### Comment

Lactose intolerance is a disorder frequently seen by the primary care physician. It can be diagnosed by a careful history and physical examination and, when necessary, using diagnostic procedures. Lactose intolerance is generally treated with patient education and maintenance of a lactose-free diet. A carefully chosen diet is the key to reducing symptoms and protecting future health.

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