

**COW'S MILK
ALLERGY
VERSUS
LACTOSE
INTOLERANCE****SUMMARY**

Consumption of cow's milk and milk products is associated with overall diet quality and adequacy of intake of many essential nutrients including calcium, potassium, phosphorus, protein, vitamins A, D (if fortified), and B₁₂, riboflavin, and niacin. Unfortunately, some individuals may avoid milk and milk products unnecessarily because of adverse reactions to these foods.

Milk protein allergy and lactose intolerance underlie most adverse reactions to cow's milk and milk products. Many differences exist between these conditions, including their cause, prevalence, prognosis, clinical symptoms, diagnosis, and management.

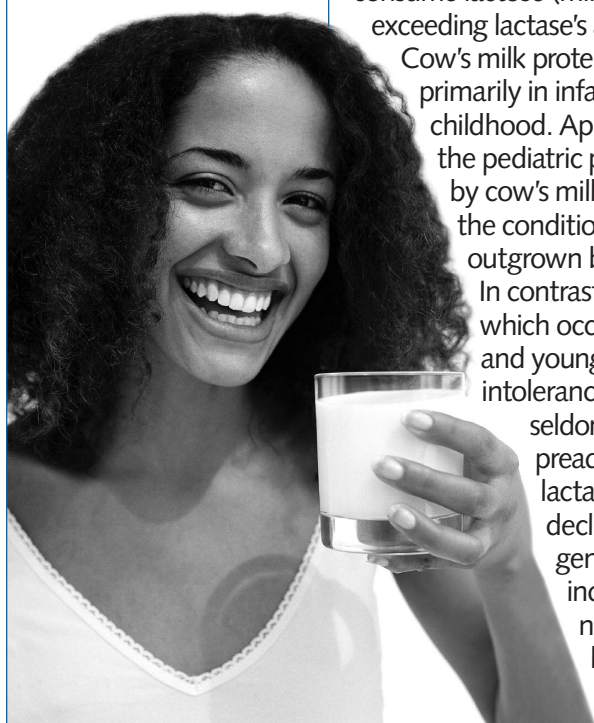
Cow's milk allergy is an immunologically mediated response to one or more of cow's milk proteins. Lactose intolerance, a non-immunological reaction, is the occurrence of symptoms after persons with low levels of the enzyme lactase (lactose maldigesters) consume lactose (milk sugar) in amounts exceeding lactase's ability to digest it.

Cow's milk protein allergy occurs primarily in infancy and early childhood. Approximately 2% of the pediatric population is affected by cow's milk allergy. Moreover, the condition tends to be outgrown by 5 years of age. In contrast to cow's milk allergy, which occurs primarily in infancy and young childhood, lactose intolerance (symptoms) seldom occurs prior to preadolescence. Although lactase activity begins to decline after weaning in genetically predisposed individuals, whether or not the condition becomes symptomatic

depends on a variety of biological, psychological, and dietary factors.

An accurate diagnosis of adverse reactions to cow's milk is critical to ensure an effective dietary management strategy and/or to avoid the unnecessary elimination of cow's milk from the diet. Strict avoidance of cow's milk, milk products, and some food ingredients derived from cow's milk (e.g., casein, whey protein concentrate), with careful attention to the nutritional adequacy of the diet, may be indicated if a diagnosis of cow's milk protein allergy is made. Fortunately, milk protein allergy in infants and young children tends to be a transient condition. As a result of the new U.S. Food Allergy Labeling and Consumer Protection Act, the presence of cow's milk proteins (e.g., casein) can now be readily identified in food products.

Although many people attribute gastrointestinal symptoms to lactose intolerance, controlled clinical trials indicate that lactose is not a major cause of symptoms for lactose maldigesters who consume a typical serving of dairy products (e.g., a cup of milk). Several strategies are available to improve tolerance to lactose. These include consuming milk in smaller amounts more often throughout the day, especially with meals; eating yogurt with live, active cultures; and consuming aged cheeses such as Cheddar. Also, lactose-reduced dairy foods and lactase enzymes are available. Some research demonstrates that tolerance to lactose is improved with repeated exposure to lactose-containing foods such as milk. With careful management, most lactose maldigesters can comfortably consume 3 servings of calcium-rich dairy foods (milk, cheese, yogurt) a day, as recommended by the Dietary Guidelines for Americans. **D**



INTRODUCTION

Because of dairy foods' natural combination of essential nutrients (1), these foods are a key component of dietary guidance issued by the U.S. government and supported by several health organizations (2-6). Unfortunately, some individuals may experience adverse symptoms following intake of cow's milk and other dairy products (7-10).

There are two general causes of reactions to cow's milk: cow's milk allergy and lactose intolerance. Cow's milk allergy is an immunologically mediated response to one or several of cow's milk proteins (7,8). Lactose intolerance, a non-immunological reaction, is the occurrence of symptoms after persons with clinically diagnosed lactose maldigestion (i.e., low levels of the intestinal enzyme, lactase) consume lactose (milk sugar) in amounts exceeding lactase's ability to hydrolyze it into glucose and galactose (7,9,10).

Misperceptions and confusion surround cow's milk protein allergy and lactose intolerance (7-10). Also, many people overestimate the prevalence of these reactions to cow's milk (11,12). A population-based study among 827 young adults in Finland found that although the majority of subjects who reported gastrointestinal symptoms blamed milk and milk products and reduced their intake of these foods, cow's milk was rarely responsible (11). Researchers in Australia reported that the self-diagnosed incidence of cow's milk allergy in a population was ten-fold higher than the clinically diagnosed prevalence (12). Failure to understand reactions to dairy products can lead to unnecessary dietary restrictions and adverse nutritional and health effects (4,8-10).

This Digest reviews the cause, prevalence, prognosis, clinical symptoms, diagnosis, and management of cow's milk allergy and lactose intolerance. Because of cow's milk's nutrient density and health benefits, it is important to accurately diagnose the cause(s) of any symptoms following intake of dairy foods and manage the condition without compromising nutritional status. Fortunately, reactions to milk and other dairy foods affect only a relatively small proportion of the total population



Misperceptions related to adverse reactions to cow's milk can lead to the unnecessary restriction of dairy products and potentially compromise nutritional status and health.

and generally are prevented by dietary strategies.

COW'S MILK ALLERGY

Cause. Cow's milk allergy is a complex disorder involving an abnormal immunological response to one or more of milk's proteins and more than one immunological mechanism (8). Most major cow's milk proteins, both casein and whey (e.g., β -lactoglobulin, α -lactalbumin), have been implicated in allergic responses (8,13). Immunological mechanisms underlying cow's milk allergy include IgE-mediated allergy (immediate hypersensitivity), which is the most common, and non-IgE-mediated cow's milk allergy (delayed hypersensitivity) (8).

The reasons why some individuals develop cow's milk allergy are not well understood, but are thought to involve a complex interaction between genetic and environmental factors (8,14). A family history of atopy and early exposure to cow's milk are risk factors for cow's milk allergy.

Prevalence and Prognosis.

Cow's milk protein allergy develops in approximately 2% of infants and young children (7,8,10,15-17) and is even rarer in adults (0.1% - 0.5%) (8). The prevalence of cow's milk allergy in children is often overestimated, particularly by parents (18), and in the general population if the condition is self-diagnosed (12). The overall prognosis of cow's milk allergy is good, with 80% to 90% of affected infants naturally developing tolerance to cow's milk by 5 years of age (8,17,19).

Clinical Symptoms and Diagnosis.

Symptoms related to cow's milk protein allergy include one or more of cutaneous (e.g., eczema, rashes), gastrointestinal (e.g., nausea, vomiting, diarrhea), or respiratory (e.g., asthma, rhinitis, wheezing) manifestations (8,15-17). Life-threatening anaphylactic reactions to cow's milk are extremely rare (15).

The generally accepted procedure to diagnose cow's milk allergy involves a medical history to verify that the symptoms are related to milk intake, a physical exam to exclude other causes of adverse reactions,

and laboratory tests to identify the specific offending allergen (7,10). In individuals older than one year, either a skin prick test or RAST (radioallergosorbent test) can be used to help diagnose IgE-mediated cow's milk protein allergy (19). If the history, physical exam, and allergy testing point to milk as a potential allergen, the diagnosis is confirmed by well-defined elimination and subsequent oral challenge procedures (7,16,17). In young infants, open challenges are reliable when performed in an appropriate clinical setting. Double-blind, placebo-controlled food challenge testing remains the "gold standard" or the most conclusive method to diagnose cow's milk protein allergy (7,15-17). The double-blind, placebo-controlled food challenge should not be used when there is a history of life-threatening anaphylaxis to a suspected food (7,19).

Management and Prevention. The only effective management strategy for cow's milk protein allergy is avoidance of cow's milk, products derived from cow's milk (yogurt, cheese, cream), and food ingredients derived from cow's milk that contain appreciable intact or partially hydrolyzed milk proteins (casein, caseinates, whey, whey protein concentrates, milk solids, casein hydrolysates, whey hydrolysates) (8,10). Management of existing cow's milk allergy should be aimed at relieving symptoms without compromising nutritional status or growth (8,19). Because restricting dairy food intake in children diagnosed with cow's milk allergy can lead to poor nutritional outcomes for growth and bone health (20-22), elimination diets should be undertaken with the advice of a physician and/or dietitian while closely monitoring children's growth and development (8,19,23).

Formula-fed infants with confirmed cow's milk allergy may benefit from the use of hypoallergenic or soy formula (10,19,23-25). Nearly all infants with cow's milk allergy tolerate extensively hydrolyzed formulas (i.e., formulas in which most of the milk protein has been broken down into free amino acids and peptides) (23,24). If allergic symptoms persist, an elemental formula based on amino acids is generally used (23). Because formulas based on partially hydrolyzed cow's milk proteins

can elicit allergic reactions, they are not recommended for infants with cow's milk allergy (7,24).

Although soy protein allergy is less common than cow's milk protein allergy, some infants and children who experience adverse reactions to cow's milk protein experience similar reactions to soy protein (7,8,25). Nevertheless, the American Academy of Pediatrics indicates that most infants with documented IgE-mediated allergy to cow's milk will tolerate soy protein-based formula (23). Diagnosis of cow's milk allergy should be periodically reconfirmed to avoid the elimination of cow's milk for longer than necessary.

The inclusion of milk proteins in an ever-expanding array of processed foods presents a challenge for children and adults with cow's milk allergy (8). However, since passage of the U.S. Food Allergen Labeling and Consumer Protection Act (FALCPA) (Public Law 108-282) (26), it is now much easier to identify and avoid foods that contain cow's milk protein. According to this law, products labeled on or after January 1, 2006 must clearly indicate the presence of any of the eight major food allergens, one of which is milk, using their "common or usual name" on product labels. If a product contains milk-derived casein, the product's label must use the familiar term "milk" in addition to the less familiar term "casein" so that people with milk allergies clearly understand the presence of the allergen they need to avoid.

Efforts aimed at preventing cow's milk allergy should focus on high risk infants (i.e., those born to parents with a history of allergies). Even among these infants, the development of cow's milk allergy is relatively uncommon. Simple dietary strategies may help prevent cow's milk allergy in high risk infants (14,19). The American Academy of Pediatrics advises breastfeeding or a hypoallergenic formula, or possibly a partial hydrolysate formula as preventive measures, but acknowledges that "conclusive studies are not yet available to permit definitive recommendations" (19). Although rare, sensitization to cow's milk protein can occur prenatally and in breast-fed infants (8). Further study is needed to determine if maternal dietary exclusion

The prevalence of cow's milk protein allergy is relatively rare in infants and young children (~2%) and is generally outgrown by 5 years of age.

during pregnancy and/or lactation minimizes risk of cow's milk allergy in infants, and if any reduction in risk is out-weighed by adverse effects on maternal nutrition (8,27). Soy formula is not recommended to prevent food allergy in high risk infants (19,28,29). Intake of probiotics, especially lactic acid bacteria, during pregnancy, lactation, and in infant formulas may reduce food allergies, including milk protein allergy, in at-risk infants (30-32).

LACTOSE INTOLERANCE

Cause. Lactose (milk sugar) is a disaccharide found naturally in milk and other dairy foods (33,34). To be absorbed and used by the body, lactose must be hydrolyzed by the intestinal enzyme, lactase (β -galactosidase), into the simple sugars, glucose and galactose, for absorption into the bloodstream (33). Most people produce sufficient amounts of lactase at birth and during early childhood to digest lactose (9,35).

There are three basic types of lactase deficiency: congenital, secondary, and primary. Congenital lactase deficiency is an extremely rare condition in which intestinal lactase is absent at birth. Secondary lactase deficiency is a transient condition resulting from a disease, gastrointestinal surgery, radiation treatment, and/or certain medications that damage the lining of the small intestine (35,36). Lactase activity is restored once the underlying problem is resolved. In primary lactase deficiency, lactase activity begins to decrease after weaning, usually after 2 years of age. The timing of this decline is genetically determined and depends on an individual's racial/ethnic background (33,36-38). Primary lactase deficiency or lactase non-persistence is the most common and the type discussed in this *Digest*.

When there is insufficient lactase to digest the amount of lactose consumed, the undigested lactose is fermented by colonic bacteria into methane, hydrogen, and carbon dioxide, which can lead to gastrointestinal symptoms (7,9,33-36). The occurrence of symptoms associated



A diagnosis of lactose maldigestion (lactase non-persistence) or even lactose intolerance (symptoms) does not require exclusion of cow's milk and other dairy products from the diet.

with incomplete digestion of lactose is called lactose intolerance. Most lactose maldigesters do not develop symptoms, and thus are not lactose intolerant.

Prevalence. Lactase non-persistence occurs in an estimated 25% of the U.S. population and 75% of adults worldwide (9,33,39). In general, the prevalence varies widely among different ethnic and racial population groups and is least common among persons of northern European descent (33,37,39). In the U.S., an estimated 90% of Asian Americans, 75% of African Americans, 53% of Mexican Americans, and 15% of Caucasians are lactose maldigesters (33,37,40).

The prevalence of lactose maldigestion or lactase non-persistence is not a reliable indicator of lactose intolerance because most individuals with lactase non-persistence can tolerate moderate amounts of lactose without discomfort (4,5,9,41-48). Lactose intolerance tends to be overestimated because of methods used to diagnose the condition (e.g., if the test uses a large dose of lactose) and/or because of cultural and psychosomatic factors (4,9,36,48,49). A recent meta-analysis of 21 clinical trials that used the amount of lactose typically found in a meal (i.e., 7 to 25 g) versus a placebo found that lactose was not a major cause of symptoms for lactose maldigesters who consumed the amount of lactose in a serving of dairy foods (e.g., one cup of milk or 12 g of lactose) (48).

Clinical Symptoms and

Diagnosis. Lactose maldigesters may experience symptoms such as nausea, cramps, bloating, flatulence, and diarrhea anytime from 30 minutes to 2 hours after consuming too large a dose of lactose from foods or beverages (7,33,34). Low lactase levels per se do not result in symptoms (i.e., lactose intolerance) (34,35,48). Whether and to what extent symptoms occur depends on several factors such as the amount of lactose consumed, individual sensitivity, and the rate of gastric emptying. Cultural and psychological attitudes, as well as biological factors, influence tolerance to lactose or lactose-containing foods such as milk (4,36,42).

Many people mistakenly attribute gastrointestinal symptoms to lactose intolerance and unnecessarily restrict their intake of dairy foods (4,36,41-49). Also, individuals with cow's milk protein allergy may experience symptoms similar to those of lactose intolerance. Therefore, it is important to diagnose lactose malabsorption and/or lactose intolerance using valid methods, rather than self-diagnosis (50).

The breath hydrogen test is the method of choice for diagnosing lactose maldigestion (9,33-36). This test involves measuring breath hydrogen excretion before and at several intervals following a standard dose of lactose. If a large dose of lactose (e.g., 50 g, the amount in one quart of milk) is used and/or if lactose is given in water without other foods, the prevalence of lactose intolerance may be exaggerated (36,37). Researchers are evaluating whether genetic testing could potentially replace or complement traditional methods to diagnose lactase deficiency in adults (35,51-53).

Dietary Management. Persons who consume low intakes of milk and other dairy foods as a result of lactose intolerance generally have inadequate intakes of calcium and other nutrients provided by milk, thereby placing themselves at increased risk of osteoporosis and other chronic diseases (33,36,49,54,55). For this reason, it is important to manage primary lactose maldigestion without compromising nutritional status or health (33,54). Total elimination of dairy foods is unnecessary, nutritionally unwise, and not recommended for individuals with primary lactose maldigestion (2,4,5,9,50). An internationally renowned panel of scientific experts on lactose digestion (9) concluded that lactose intolerance is easily managed and is not a barrier to consuming 3 servings of calcium-rich dairy foods, as recommended by the Dietary Guidelines for Americans (2).

Several factors influence lactose maldigesters' tolerance to dairy foods, including the amount of lactose, whether the lactose-containing food is consumed with a meal, the type of dairy food,

and colonic adaptation (9,35,36). The minimum amount of lactose to cause intolerance differs among individuals and each individual needs to determine how much lactose can be tolerated at a given time and adjust intake of lactose accordingly (34,43,45). Well-controlled, clinical studies have demonstrated that people diagnosed with lactose maldigestion can consume the amount of lactose in one cup (8 ounces) of milk with a meal or 2 cups in divided doses with meals without developing symptoms (43,45,48). In fact, lactose maldigesters have been shown to tolerate a dairy-rich diet containing 1,300 to 1,500 mg calcium/day (equivalent to at least 4 servings of dairy foods) (46,47). Tolerance to lactose-containing foods such as milk is better when consumed with a meal (56).

Some types of dairy foods are better tolerated than others by lactose maldigesters. Chocolate milk may be better tolerated than unflavored milk (57). Hard, aged cheeses (e.g., Cheddar, Swiss) are generally well tolerated because of their low lactose content and high content of solids (33-36). In addition, yogurts with live, active cultures can be comfortably consumed by lactose maldigesters (35,40,58-60). Kefir, a fermented milk, has been demonstrated to improve lactose tolerance (61). Some non-fermented dairy products containing probiotic bacteria such as *L. acidophilus* and bifidobacteria improve lactose digestion in lactose maldigesters, although the effects are less consistent than those achieved with yogurt with live, active cultures, probably due to the levels of probiotic bacteria in the products (60). Lactose-hydrolyzed milk and other dairy products, as well as exogenous lactase (β -galactosidase) in tablets, liquid form, and powder, are available for individuals who have difficulty tolerating lactose (34-36,62). Some research indicates that tolerance to lactose is improved with repeated exposure to lactose-containing foods such as milk and milk products, presumably due to adaptation of colonic bacteria to digest lactose (47,63,64).

For individuals with primary lactase deficiency, dairy food consumption

By using simple dietary strategies such as modifying the amounts and types of dairy products, most individuals with low lactase levels can comfortably consume 3 servings of dairy foods (milk, cheese, yogurt) a day, as recommended by the Dietary Guidelines for Americans.

needs to be managed, not restricted (2,4,9,35,41,49). The National Medical Association, the nation's oldest and largest organization representing African American physicians, recommends that African Americans, many of whom have low levels of lactase, consume 3 to 4 servings/day of lowfat milk, cheese, or yogurt, to improve their health (4). Likewise, the Dietary Guidelines for Americans (2) states that the easiest way for those with lactose intolerance to derive the health benefits associated with consumption of milk and milk products is "to choose alternatives within the milk food group, such as yogurt or lactose-free milk, or to consume the enzyme lactase prior to the consumption of milk products." Also, the American Academy of Pediatrics states that "many children with lactose intolerance can drink small amounts of milk without discomfort, especially when accompanied by other foods" and that "intolerance of the consumption of 250 mL [one cup] or less of milk is rarely seen in preadolescents" (5). **D**

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RELATED RESOURCES

- www.nationaldairycouncil.org
 - Lactose Intolerance – fact sheets, news releases, supportive science (under Nutrition and Product Information, then Reducing Disease Risk)
 - African American Health Education Kit – includes "The Lowdown on Lactose Intolerance" and "Lactose Intolerance and Your Child" (under Health Professional Resources, then Nutrition Education Materials, then Health Education Kits)
 - Lactose Intolerance & Minorities: The Real Story (under Health Professional Resources, then Research Summaries)

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