



LACTOSE INTOLERANCE: NEW UNDERSTANDINGS

SUMMARY

Low-fat and fat-free milk, cheese, and yogurt are nutrient-rich foods and a key component of a healthful diet. Yet, people may avoid these foods because of concerns about lactose intolerance. Eliminating dairy foods may not only be unnecessary to manage lactose intolerance, but it also may lead to nutrient shortcomings which may result in adverse health effects, concluded an expert panel convened by the National Institutes of Health (NIH) to examine lactose intolerance and health.

Lactose intolerance is described as gastrointestinal disturbances that may be experienced following intake of an amount of lactose (i.e., natural milk sugar) greater than the body's ability to digest and absorb it. Lactose maldigestion is a genetically controlled decline in the activity of lactase, the enzyme necessary to digest lactose. A diagnosis of lactose maldigestion does not mean that an individual will experience lactose intolerance (digestive discomfort).

The NIH Consensus Development Conference on lactose intolerance and health addressed the latest research on lactose intolerance, including its prevalence, the health outcomes of dairy exclusion diets, and strategies to effectively manage lactose intolerance. The following are some of the conclusions of the NIH expert panel, along with findings from recently published research.

- The true prevalence of lactose intolerance in the general U.S. population is unknown. However, new research indicates that its prevalence may be much lower than previously estimated.
- A major concern is that individuals with lactose intolerance may avoid dairy foods and consume insufficient amounts of nutrients found in dairy foods such as

calcium and vitamin D, among others. This in turn may predispose them to increased risk of osteoporosis as well as other adverse health outcomes.

- Adults and adolescents diagnosed with lactose malabsorption have been shown to tolerate at least 12 g of lactose (equivalent to the amount in 1 cup of milk or yogurt) at one time, particularly if ingested with other foods, with little or no discomfort. There is some evidence to suggest that regularly consuming lactose may increase the amount that can be tolerated by adults and adolescents with lactose malabsorption.
- Strategies to manage lactose intolerance should be individualized and can include consuming small amounts of milk at a time, preferably with food, yogurt with live and active cultures, natural cheeses, and lactose-free dairy foods (e.g., lactose-free milk). Lactose-free milk, which comes in various fat levels and flavors, is real milk just without the lactose. Although non-dairy milk substitutes such as soy beverages may be recommended for those with lactose intolerance, acceptance of such products should be considered. A recent large-scale taste acceptance study found that both lactose tolerant and lactose intolerant individuals liked the taste of lactose-free cow's milk products more than the tested soy beverages.

In addition to the NIH expert panel, other government and health professional organizations including the 2005 Dietary Guidelines for Americans, the American Academy of Pediatrics, and the National Medical Association recommend that individuals with lactose intolerance try to keep dairy foods in their diet.



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INTRODUCTION

Hippocrates first described lactose intolerance around 400 BC (1). However, only within the past 25 years has our knowledge of this condition significantly increased (1). Lactose intolerance is described as gastrointestinal discomfort (e.g., diarrhea, abdominal pain, bloating) that may be experienced following intake of an amount of lactose (i.e., natural milk sugar) greater than the body's ability to digest and absorb it (1-6). Lactose malabsorption occurs because of a genetically-controlled decline in the activity of lactase (lactase nonpersistence or lactase insufficiency), the enzyme necessary to digest lactose into glucose and galactose (1-6). Tests to diagnose lactose malabsorption include the breath hydrogen test (i.e., the "gold standard"), intestinal biopsy, and genetic testing (2). Individuals with lactose malabsorption may or may not develop gastrointestinal disturbances (i.e., lactose intolerance) (2,6).

Despite lactose intolerance's long history and recent progress in our understanding of this condition, misperceptions about its prevalence and management prevail. Of particular concern is the potential public health burden from inadequate nutrient intake that may result from the belief that milk and other dairy foods need to be excluded from the diet of those with lactose intolerance (1,2,7). To answer some of the pressing questions related to lactose intolerance and to educate healthcare providers and the public about the current science related to lactose intolerance, a National Institutes of Health (NIH) Consensus Development Conference on lactose intolerance and health was recently held (2). A 14-member panel of experts developed a consensus statement based on information presented by the conference speakers, comments from conference participants, relevant research from the published literature, and results of a systematic review of the literature (2). The latter was prepared through the Agency for Healthcare Research and Quality Evidence-based Practice Centers program by the University of Minnesota Evidence-based Practice Center (8).

The public health burden from nutritional deficiencies attributed to lactose intolerance has not been established. This led the National Institutes of Health (NIH) to convene an expert panel to develop a consensus statement on lactose intolerance and health based on the science.



This *Digest* presents some of the conclusions of the NIH expert panel on lactose intolerance and health, as well as recent research and statements on lactose intolerance by health professional organizations.

PREVALENCE OF LACTOSE INTOLERANCE

The NIH expert panel concluded that lactose intolerance is a real and important clinical condition, but that its true prevalence in the general U.S. population is unknown (2). Although there is insufficient evidence to determine the true prevalence of lactose intolerance and lactose malabsorption, reported occurrences vary across racial and ethnic groups (2,3). According to the NIH expert panel's report, European Americans have the lowest reported occurrence, while African Americans, Hispanic Americans, Asian Americans, and Native Americans have higher, albeit variable, prevalence rates (2).

Lactose intolerance is low in children younger than six years, but increases with age, peaking between 10 and 16 years (2). Little evidence indicates that lactose intolerance increases in older adults (2). The majority of people with lactose malabsorption (e.g., determined by breath hydrogen tests) do not have clinical lactose intolerance (i.e., gastrointestinal discomfort) (2,9). Also, many individuals who think they are lactose intolerant (i.e., self-diagnosis) are not lactose malabsorbers, which suggests that the cause of their gastrointestinal discomfort is unrelated to lactose (i.e., due to other physiological conditions, a learned food aversion, or social and cultural perceptions) (2,6).

A recently published study assessing self-reported lactose intolerance suggests that national prevalence estimates of perceived lactose intolerance may be far lower than previously reported from studies of lactose maldigestion (10). In this study, a national multiethnic sample of 1,084 adults (i.e., 486 European Americans, 355 African Americans, and 243 Hispanic Americans) completed a survey which was conducted using Computer-Assisted Telephone

Interviewing techniques (10). The overall prevalence rate of age-adjusted, self-reported lactose intolerance for the three groups in the U.S. was 12% (10). About 8% of European Americans, 10% of Hispanic Americans, and 19.5% of African Americans considered themselves to be lactose intolerant (10).

The researchers point out that these rates are much lower than earlier estimates based on lactose maldigestion, which were approximately 15% in European Americans, 50% in Mexican Americans, and 80% in African Americans (10). These high population-wide rates for lactose maldigestion may be explained by the method used to diagnose maldigestion. In the past, lactose maldigestion was commonly diagnosed by breath hydrogen tests using a challenge amount of up to 50 g of lactose (i.e., equivalent to the amount of lactose in 1 quart or 4 cups of milk) in water consumed after an overnight fast (6,10). The researchers suggest that this high challenge dose of lactose may overestimate the proportion of people who experience symptoms following intake of a typical serving of milk (i.e., 1 cup of milk contains 12 g lactose) (10).

HEALTH OUTCOMES OF LIMITING INTAKE OF DAIRY FOODS

A major concern is that individuals with lactose intolerance, either self-diagnosed or clinically diagnosed, may avoid dairy foods and consume insufficient amounts of dairy food nutrients such as calcium and vitamin D, among others, which may predispose them to increased risk of osteoporosis and other adverse outcomes (2,7). Dairy foods (milk, cheese, and yogurt) contribute many nutrients to the U.S. diet that are important for good health, including calcium, potassium, phosphorus, magnesium, zinc, protein, vitamin A, vitamin D, vitamin B₁₂, and riboflavin (11-13). Consuming dairy foods can help meet recommendations for nutrients limiting in Americans' diets such as calcium, potassium, and magnesium (14,15). The 2005 Dietary Guidelines for Americans recommends 3 cups per day of low-fat or fat-free milk or equivalent milk products



Evidence is insufficient to accurately assess the prevalence of lactose intolerance in the U.S. population. However, findings from a recent study suggest that age-adjusted, self-reported lactose intolerance rates may be far lower than previously estimated.

for those aged nine years and older (15). For children two to eight years, 2 cups per day of low-fat or fat-free milk or equivalent milk products are recommended (15). Higher dairy food intake as part of a healthy diet leads to higher nutrient intake, better diet quality, and bone health, may help maintain a healthy weight, and has been associated with reduced risk of several diseases and conditions: osteoporosis, hypertension, colon cancer, metabolic syndrome, and diabetes (16-18).

According to the NIH expert panel, the health outcomes of dairy exclusion diets depend on whether nutrients such as calcium and vitamin D are provided in sufficient amounts by non-dairy foods (2). From childhood through adulthood, avoiding dairy foods may be a major factor limiting adequate calcium intake (2). Excluding dairy foods may exacerbate the risk of osteoporosis, especially for persons already at the highest risk, such as women and certain racial/ethnic groups (2).

African Americans have a low intake of dairy foods, which may be attributed in part to lactose intolerance (19-21). Although the majority of studies including African Americans indicate that osteoporosis is less prevalent in this group compared to white and Asian Americans, osteoporosis is still a concern for African Americans (6,19,20). African Americans' low intake of dairy foods may place them at risk for inadequacies of other nutrients such as vitamin D that play a beneficial role in bone health (2,21,22). The NIH expert panel also reports that diets excluding dairy foods may adversely affect health outcomes other than osteoporosis (e.g., high blood pressure, development of adenomatous colon polyps) (2). African Americans' low dairy consumption may lead to nutritional deficits that increase their potential risk of hypertension, obesity, certain cancers, and diabetes (19,20).

THE AMOUNT OF DAILY LACTOSE TOLERATED BY LACTOSE INTOLERANT INDIVIDUALS

Determining the amount of lactose that can be tolerated is critical to developing evidence-based dietary recommendations that meet the nutrient needs of lactose

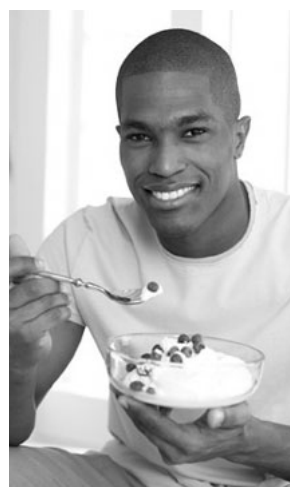
intolerant individuals (2). Whether and to what extent individuals appropriately diagnosed with lactose maldigestion will develop intolerance (symptoms) following intake of foods and beverages containing lactose depends on a variety of factors (2). These include the level of lactase enzyme activity, gastric emptying rates, fecal bacterial metabolites, colonic mucosal absorptive capacity, and intestinal transit time (2). In addition, individuals differ in the severity of lactose intolerance discomfort due to differences in the perception of abdominal pain and the psychological impact of pain and social discomfort (2).

Based on the evidence, the NIH expert panel suggests that adults and adolescents diagnosed with lactose malabsorption can consume at least 12 g of lactose in a single dose (i.e., equivalent to the amount of lactose found in 1 cup of milk or yogurt), particularly if ingested with other foods (2). Lactose malabsorbers can tolerate larger amounts of lactose if consumed with foods and distributed throughout the day (2). However, symptoms usually develop in lactose malabsorbers who consume 50 g lactose (i.e., the amount found in 4 cups of milk or 1 quart) as a single dose without food (2). Additional studies are needed to provide evidence-based and culturally sensitive recommendations about the amount of lactose that can be tolerated, particularly by children, adolescents, and pregnant or lactating women (2).

STRATEGIES TO MANAGE LACTOSE INTOLERANCE

Persons with lactose intolerance need an individualized strategy to manage the condition while ensuring an adequate intake of nutrients important for bone health and other clinical outcomes (2). Such a strategy could include small amounts of dairy foods, lactose-free dairy products (e.g., lactose-free milk), and/or suggestions for alternate nutrient sources (2). The NIH expert panel states that even in persons with lactose intolerance, small amounts of milk, yogurt, hard (generally known as natural)

Avoiding milk and other dairy foods due to concerns about lactose intolerance may not only be unnecessary, but also could lead to nutrient shortcomings, which may predispose individuals to adverse health outcomes, according to the NIH expert panel on lactose intolerance and health.



cheeses, and lactose-free dairy foods may be effective management approaches (2). Yogurt's ability to be comfortably consumed by some lactose maldigesters is attributed to the release of microbial β -galactosidase or lactase from yogurt starter cultures after consumption (4). Also, yogurt's semi-solid state delays gastric emptying and intestinal transit time which slows the delivery of lactose to the intestine (4). Natural cheeses such as Cheddar or Swiss contain minimal lactose because of its removal in the whey during cheese-making and the conversion of any remaining lactose entrapped in the curd to lactic acid and other acids during aging (4).

A wide variety of lactose-free dairy products (e.g., reduced-fat, low-fat, fat-free, chocolate, and whole milk, ice cream, cottage cheese) are available in today's marketplace. These lactose-free dairy products contain the same nutrients as their regular counterparts, just without the lactose. Preliminary data indicate that gradually increasing lactose intake over time may be helpful for some individuals (2,5,23,24). Possible mechanisms for this response include adaptive changes in colonic functions (motility, transit, pH) and gut microflora (e.g., increased microbial β -galactosidase) (5). Because individuals with lactose intolerance may be hesitant to consume a food they believe causes adverse effects, education may be one of the most effective strategies to optimize outcomes and avoid the unnecessary restriction of foods (2).

In most cases, individuals with lactose intolerance can include dairy foods in their diet if they follow certain strategies (1-4,9). In fact, for those with lactose intolerance, health and nutrition authorities recommend keeping dairy foods in the diet to help them meet their nutrient needs (15,19,20,25-27). The 2005 Dietary Guidelines for Americans includes the recommendation that people with lactose intolerance try lower lactose dairy options to ensure that they get the important nutrients found in dairy foods (15). The American Academy of Pediatrics (AAP), in its

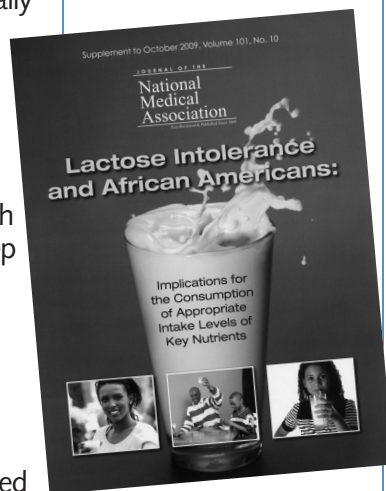
reports on lactose intolerance (25) and on bone health (26), recommends that children with lactose intolerance continue to consume dairy foods to help meet calcium, vitamin D, protein, and other nutrient needs for bone health and overall growth. The AAP cautions that lactose intolerance usually does not require avoidance of dairy foods (25).

The Special Supplemental Nutrition Program for Women, Infants and Children (WIC) supports lactose-free milk before non-dairy options for those with lactose intolerance (27). Soy beverages may be substituted for milk (with medical documentation for children) if the soy beverage is fortified to reflect the major nutrients found in cow's milk (27). Interestingly, a recent large-scale study of 893 adult consumers (Caucasians, African Americans, Hispanics) found that lactose-free cow's milk scored significantly higher for overall liking and acceptability than tested soy-based products among study participants, which included both lactose tolerant and lactose intolerant individuals (28). To help lactose intolerant individuals meet their nutritional needs, it is important to know their taste acceptance and liking of milk-substitute beverages to help ensure that a product will actually be consumed (28).

The National Medical Association (NMA), the nation's largest and oldest organization representing African American physicians, recommends that African Americans and others with lactose intolerance make efforts to keep dairy foods in their diets to help meet nutrient recommendations (19,20). In its most recent statement, the NMA suggests strategies that health professionals can use to educate their lactose intolerant patients and help them increase their intake of dairy-based nutrients (20). These strategies include:

- educating African Americans about the critical role three daily servings of dairy foods play in ensuring adequate intake of calcium, riboflavin, protein, potassium, and/or other essential nutrients;

The NIH expert panel, along with a number of government and national health professional organizations, agree that in most cases individuals with lactose intolerance can still include dairy foods in their diet by using effective management strategies.



- encouraging patients to be formally tested for lactose intolerance;
- gradually increasing regular exposure to lactose-containing foods;
- providing health education regarding the beneficial role of dairy nutrients in hypertension, obesity, diabetes, and other chronic diseases; and
- recommending other milk or milk products (e.g., yogurts, lactose-free milk and other low lactose products in the milk food group or lactase enzyme supplements when consuming milk group foods) to reduce the risk of nutritional shortcomings (20).

The NMA's report concludes that "it is possible to consume dairy even in the face of a history of maldigestion or lactose intolerant issues," and that "it is essential for physicians to communicate [these] key messages to their patients" (20).

FUTURE RESEARCH NEEDS

The NIH expert panel identified several areas for future research to better understand and manage lactose intolerance (2). First, it recognized the need for a study to determine the prevalence of lactose intolerance in the U.S. population across ethnicity and age groups. This study should measure the prevalence of self-reported symptoms at baseline, and determine the prevalence of lactose malabsorption with or without symptoms following a blinded lactose challenge. The relationship between self-reported symptoms and the presence of lactose malabsorption based on a blinded challenge in individuals with lactose malabsorption should be clarified (2).

Additional studies are needed to determine the amount of lactose that can be tolerated by lactose malabsorbers of different race/ethnicity, age, and gender (2). With respect to appropriate management strategies, studies are needed to define a tolerable amount of lactose, clarify the efficacy of prebiotics and probiotics

in supplements and yogurt, and determine the effect of obtaining calcium from non-dairy products and nutritional supplements on health outcomes, including bone mineral content and fractures (2). Once effective strategies have been identified, educational programs and behavioral and culturally sensitive approaches to encourage adoption of the recommended dietary changes need to be developed and tested in people with lactose intolerance.

CONCLUSION

Although the true prevalence of lactose intolerance in the U.S. population is unknown, evidence suggests that it may be far lower than previously estimated (2,10). The majority of people with lactose malabsorption do not have clinical lactose intolerance (i.e., gastrointestinal disturbances) and many who think they are lactose intolerant are not lactose malabsorbers (2).

Many individuals with lactose intolerance avoid dairy foods and consume inadequate amounts of calcium, vitamin D, and other essential nutrients found in dairy foods (e.g., potassium, phosphorus) which may potentially increase their risk of decreased bone accrual, osteoporosis, and other adverse health outcomes. Although individuals vary in their tolerance to lactose, available evidence indicates that many individuals with lactose malabsorption can consume one serving (1 cup) of milk at a time, especially with other foods, with no or minor discomfort (2). Yogurt with live and active cultures, natural cheeses, and lactose-free dairy products (e.g., lactose-free milk) are also well tolerated (2). Gradually increasing intake of lactose over time may improve its tolerance.

While much remains to be learned, health professionals can play a key role in dispelling misperceptions

regarding lactose intolerance. By recommending specific strategies to keep dairy foods in the diet, health professionals can help their patients obtain the health benefits associated with consuming three daily servings of dairy foods, as recommended by the 2005 Dietary Guidelines for Americans (i.e., for those aged nine years and older) (15) and *MyPyramid* Food Guidance System (www.mypyramid.gov). **D**

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