Mistaken Beliefs and the Facts About Milk and Dairy Foods

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Milk and other dairy products are an important part of the human diet, but some people believe that they are harmful. This article explores some of these beliefs, examines the scientific evidence, and gives suggestions so that nutritionists can help consumers make informed decisions. The topics include lactose intolerance, raw milk, pasteurization, milk and mucus, milk and asthma, milk and allergies, and recombinant bovine growth hormone. Many people believe that lactose-intolerant individuals should not consume milk or dairy products, but in fact lactose tolerance varies, and drastic dietary restrictions may not be needed. Others believe that if someone has once suffered from lactose intolerance, that person always will. The fact is that a person's tolerance can change over time. In addition, self-diagnosis of lactose intolerance is often incorrect. Some people drink raw milk rather than pasteurized milk because they believe it is healthier and safer and that pasteurization destroys beneficial things in milk. These beliefs are all false, and in fact, raw milk poses a significant health risk. There are other beliefs that exist surround milk and its effect on the respiratory tract and allergies. The facts are that milk does not cause increased mucus production, nor does it cause or worsen allergies or asthma. Some members of the public fear that the hormones in milk can affect the humans who drink it, but this is false. Belief in many of the mistaken notions outlined in this article is widespread and pervasive in the United States at present. Even health professionals often accept such fallacies as truth. Health professionals can play an important role in dispelling these nutrition myths through nutrition education and counseling.
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Milk and other dairy products are an important part of the human diet. However, milk consumption in the United States has decreased in recent decades.[1] One reason is that a variety of beliefs exist among individuals that dairy consumption can result in digestive problems or cause other harm. This article explores some of these beliefs, examines the scientific evidence, and gives suggestions so that nutritionists and other health professionals can help consumers make informed decisions.

Belief: Lactose-intolerant people should not consume milk or dairy products.

Fact: Drastically restricting or eliminating dairy products from the diet may not be necessary. Health and nutrition authorities recommend that dairy products remain in the diet of many lactose-intolerant individuals.

It is best to check with a physician before, not after, cutting milk products out of one's diet because of suspected lactose intolerance. Many factors affect the impact of lactose on the gastrointestinal tract, and drastic dietary restrictions of dairy products may not be needed. For many who have experienced unpleasant gastrointestinal signs and symptoms after consuming a dairy product, even in small amounts, the cause may be due to conditions other than lactose intolerance. These people may in fact be able to consume lactose-containing milk and dairy products without negative effects. A National Institutes of Health (NIH) expert panel; the American Academy of Pediatrics; the National Medical Association; the Special Supplemental Nutrition Program for Women, Infants, and Children; and the 2010 Dietary Guidelines for Americans concur that it is important for people with lactose intolerance to get the health and nutritional benefits associated with milk and milk products. They encourage daily consumption of dairy foods.[2–7]

Lactase deficiency, sometimes called hypolactasia or lactose intolerance, is a syndrome typically characterized by signs and symptoms such as diarrhea, bloating, flatulence, and/or abdominal pain that occur after lactose ingestion.

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These signs and symptoms are a result of maldigestion due to a deficiency of the lactose-digesting enzyme, lactase.[2] Lactase breaks down lactose for absorption into its simple sugar constituents, galactose and glucose. Lactase is located in the enterocyte cells in the brush border of the small intestine and is concentrated in the jejunum.[8] When lactose cannot be absorbed in the small intestine, it passes undigested into the colon, where it is metabolized by bacteria into carbon dioxide, hydrogen gas, and short-chain fatty acids (FAs) in amounts that may exceed the colon's absorptive ability.[9] These gases and FAs may cause flatulence, abdominal pain, bloating, and an osmotic watery diarrhea, all of which are signs and symptoms of lactose intolerance.[8,10] However, lactose maldigestion does not cause symptoms in all people who are affected by it. The amount of lactose consumed at one time, the residual intestinal lactase activity, the health of the gut's surface, individual sensitivity to the products of lactose fermentation, and colonic microflora also play a part in determining what symptoms manifest.[2] Lactase deficiency and lactose intolerance are complex in etiology. Some who attribute their gastrointestinal problems to lactose intolerance may be suffering from other conditions and may in fact be able to consume lactose-containing milk and dairy products without discomfort.

Belief: Everyone who has experienced gastrointestinal trouble following consumption of milk and milk products will always have these problems.

Fact: Tolerance of lactose in milk and milk products depends on the type of condition and the food consumed. A person's tolerance to lactose may change over time.

There are 3 forms of lactase deficiency, which can affect people in different ways, to different degrees, and for different periods. These are (1) congenital lactase deficiency, (2) lactase nonpersistence, and (3) secondary lactase deficiency (SLD). Congenital lactase deficiency is an extremely rare hereditary single autosomal recessive disorder that is evident early in life and results in diarrhea of the newborn at the first exposure to breast milk.[8] The only treatment is lifelong avoidance of lactose.

Lactase nonpersistence, also known as primary lactase deficiency, results from declining lactase activity (nonpersistence) due to a decrease in the genetic expression of lactase, starting at ~5 to 10 years of age.[10] This means that some people do not produce sufficient lactase, which is required to digest lactose, a major carbohydrate in milk. Most of the world's population is lactase deficient, because lactase activity declines dramatically after weaning from the breast. Middle Eastern, Asian, some African, and North American native populations all have a high prevalence of lactase nonpersistence (60%–100%).[10] Northern Europeans, Indians, and several African ethnic groups are exceptions in that they have much lower percentages of lactase nonpersistence (eg, 2%–30%).[10]

Another common form is secondary, or acquired, lactase deficiency, which results from the loss of lactase activity in people with some lactase persistence. Secondary lactase deficiency is often caused by a gastrointestinal illness that damages the brush border of the small intestine and is generally reversible.[8] Secondary lactase deficiency can also occur in patients with viral gastroenteritis, celiac disease, giardiasis, and bacterial overgrowth[9] that damage the gut mucosa and eliminate lactase. People suffering from SLD should see a doctor, avoid lactose-containing foods until it resolves, and gradually reintroduce these foods back into their diets. Secondary lactase deficiency is generally reversible, although the condition may persist for up to a year following an acute illness.[10]

Belief: Self-diagnosis of lactase deficiency is simple, based on the appearance of symptoms following ingestion of dairy products, including milk.

Fact: Self-diagnosis is often incorrect and leads to unnecessary elimination of dairy products and their nutritional components. See a doctor if you suspect lactase deficiency. In addition to SLD, viral or bacterial infections also may cause symptoms and signs similar to lactase deficiency. These symptoms can be wrongly attributed to milk and milk products, and sufferers may not seek the proper treatment for their illness. There are objective clinical testing procedures that a physician can perform to accurately diagnose lactase deficiency. The 2 most objective tests, the hydrogen breath test and the lactose tolerance test, are described in Table 1. Less objective methods such as food and sign/symptom diaries, elimination diets, and elimination and challenge trials[12] are not recommended.

Belief: Even small amounts of lactose-containing foods will cause serious symptoms and discomfort in lactose-intolerant people.

Fact: Most lactose-intolerant people do not have symptoms with small amounts of lactose-containing foods.

Studies have indicated that most people who believe they are lactose intolerant can tolerate moderate amounts of lactose without suffering gastrointestinal symptoms.[12–16] One double-blind study found that more than half of lactose maldigesters reported gastrointestinal symptoms after consuming both a lactose-free milk and milk with 7 g of lactose, indicating that some individuals may misattribute their symptoms to lactose ingestion.[13] A meta-analysis comparing intolerance symptoms of lactose maldigesters after ingesting lactose under masked conditions found that the severity of gastrointestinal symptoms reported was no different when consuming 12 g of lactose than a placebo, leading authors to conclude that the dose of lactose consumed is a contributing factor to symptom presence and severity.[14] A double-blind investigation also found that subjects diagnosed with lactase nonpersistence could consume 2 cups of milk per day, one at breakfast and one at dinner.[15]

TABLE 1 Clinical Tests for Lactose Malabsorption

Clinical Test	What It Measures	What the Test Involves
Hydrogen breath test[a]	Hydrogen produced by the fermentation of lactose by colonic bacteria is absorbed and excreted in the breath.[10]	The patient consumes 50 g of lactose (equivalent to the amount in 1 L of milk), followed by measurement of hydrogen levels in their breath over a 3- to 6-h period.[8]
Lactose tolerance test	This test is positive if blood glucose rises <20% from fasting, and the patient experiences gastrointestinal symptoms.[11] Blood glucose rises if the patient is digesting the lactose.	This test is a series of blood glucose measurements over 3 h after a lactose load is swallowed.

[a]The hydrogen breath test has about a 20% false-negative rate, so some people who are lactase deficient are missed.[11]

Those with signs and symptoms of lactose intolerance (diarrhea, flatulence, abdominal pain, and bloating) can try a number of strategies to increase their dairy intake and glean the nutritional benefits of increased dairy consumption. Taking in smaller amounts of lactose-containing foods at a time and spacing out the intake of lactose may help reduce symptoms. Consuming milk and dairy with snacks or meals, or with foods that slow gastric emptying, such as high-fat or high-fiber foods, can help slow the digestion of lactose and reduce symptoms.[11,17] Depending on the severity of their symptoms, some lactose maldigesters may be able to tolerate certain dairy products, and choosing such products can help increase calcium intake. Yogurts (particularly those with active bacterial cultures) and most hard cheeses contain less lactose and may be more readily tolerated than fluid milk.[16] Patients can also take lactase enzyme tablets when consuming dairy products, or choose milks with prehydrolyzed lactose. Tolerance to lactose can be increased through routine exposure; this can improve the colonic bacteria's efficiency of lactose metabolism.[16,17] Health professionals can help patients maintain a healthy and varied diet by teaching them about the above strategies, the most commonly tolerated dairy products, lactase supplements, and dairy alternatives.

Belief: People who are lactase deficient or lactose intolerant are also allergic to cow's milk.

Fact: Real cow's milk allergy (CMA) is not the same as lactase deficiency or lactose intolerance.

Cow's milk allergy is often confused with lactase deficiency, but the 2 conditions differ in that CMA is a true allergy, an immune response to the proteins in cow's milk, and is usually detected in early infancy.[18] Cow's milk allergy is very rare, occurring in approximately 2% to 6% of young children and 0.1% to 0.5% of adults.[18] Those with CMA experience additional extraintestinal symptoms and gastrointestinal symptoms when consuming milk proteins. These may include muscle and joint pain, headaches, dizziness, lethargy, oral ulcers, cardiac arrhythmias, acne, sore throat, increased urination, impaired short-term memory, and depression.[8] As little as 0.1 mL of cow's milk can produce an allergic reaction in individuals with CMA.[18] Treatment of CMA, in proven cases, involves complete avoidance of all foods containing milk or milk products. This poses many nutritional challenges, especially for growing children, and increases a family's need for professional nutritional advice on alternative diets that restrict dairy foods without compromising overall nutrition. Calcium and vitamin D intake needs to be monitored in lactose-intolerant patients, and fortified foods or dietary supplements recommended when the diet is low in these nutrients.

Lactose intolerance and CMA should be diagnosed by a physician specialist and not assumed, because the symptoms of lactose intolerance may actually be caused by another condition, such as a viral or bacterial infection, and, if so, lactose avoidance may not help. Patients who are confirmed to have CMA need to restrict certain (or all) dairy foods without compromising their overall nutrition.

Belief: Pasteurization alters milk's nutritive value.

Fact: Pasteurization kills pathogens and microorganisms that cause spoilage, but does not significantly change the nutritive content of milk.

Between 1998 and 2005, there were 45 outbreaks of illness from unpasteurized milk or cheese in the United States, resulting in 1007 illnesses, 104 hospitalizations, and 2 deaths.[19] These figures are most likely gross underestimates, because foodborne illnesses are not always recognized or reported. Also, use of organic, local, raw, and "health" foods is trending upward with increasing popularity in recent years, and because unpasteurized milk products often fall into these categories, this increase in intake could lead to more cases.

Pasteurization is a process of heating raw milk, followed by rapid cooling, to kill pathogenic bacteria, yeasts, and molds. The 2 types of pasteurization are the "batch" (or holding) method, which involves heating the milk to 145°F for at least 30 minutes, and the "flash" method, in which the

milk is heated to 161°F for 15 seconds.[20] Pasteurization makes milk safe to drink. It kills pathogens and also inactivates enzymes that contribute to early spoilage and flavor changes and extends milk's shelf life to 10 to 14 days.[21] Some myths regarding pasteurization persist; for example, that it destroys vitamin C or alters the bioavailability of calcium in milk, but these are false.[22,23]

A recent review of the benefits of pasteurization discusses the evidence showing minimal losses of vitamins and minerals from milk during pasteurization.[23] Pasteurization does not alter the bioavailability of vitamin C in milk. The vitamin C content in milk is highly variable, as it is dependent on the cow's diet, and varies between 0 and 6 mg, the average being less than 0.5 mg.[23] Dairy products are not a major source of vitamin C in the diet. There is also minimal loss of B vitamins and fat-soluble vitamins from milk during pasteurization, and milk is routinely fortified with vitamins A and D.[23] Pasteurization kills the pathogens without significantly changing the nutritive value of milk.[21,23]

In the early 20th century, rural-to-urban migration was common, and milk from farms was often sent to distant cities or was produced from cows housed in crowded, unsanitary urban conditions. The contaminated milk that resulted caused many disease outbreaks and illnesses, and lawmakers at the state level responded by imposing regulations on the dairy industry. By the late 1930s, regulations requiring pasteurization and restricting the sale of raw milk were in effect in nearly all states in the United States.[24] Because the sale of raw milk was not federally banned across all cities, counties, and states, outbreaks of milkborne illness continued to occur from the 1940s to the 1970s. In 1987, the US Food and Drug Administration (FDA) final regulations, mandating pasteurization of all milk and milk products for human consumption involved in interstate commerce, went into effect after a long battle in the courts.[21,24] Exceptions exist, as the sale of raw milk and raw milk products is legal in 28 states, with varying restrictions designed to decrease risks of foodborne illness.[24] It is legal to sell raw milk cheese aged for more than 60 days, although there have been foodborne disease outbreaks associated with such cheeses.[25]

Belief: Raw milk is safer and healthier than pasteurized milk.

Fact: Raw milk and raw milk products are risky. They should never be consumed by vulnerable populations, such as the elderly, infants, children, pregnant women, and immunologically compromised individuals (such as people undergoing chemotherapy or who are HIV-positive).

Raw milk advocates believe that raw milk is "healthier" than pasteurized milk, claiming that it has beneficial bacteria, enzymes, and FAs that are removed during pasteurization and that the "natural" bacteria present in the milk are good for digestion. Others feel that raw milk is nonallergenic and that drinking pasteurized milk causes allergies.

Some people believe that raw milk has constituents, such as nisin, lactoferrin, xanthine oxidase, lactoperoxidase, lysozyme, oligosaccharides, and bacteriocins, that kill harmful pathogens such as Shiga toxin–producing *Escherichia coli* in milk and that these are naturally occurring antimicrobial enzymes that are inactivated during pasteurization.[22,23,26] This is not entirely correct. Nisin is a toxin produced by bacteria that is present in minute amounts in raw milk.[22] Lactoperoxidase, which can have bacteriostatic activity in the presence of bacterial byproducts, retains 70% of its activity after pasteurization.[23,26] Lactoferrin, a compound that scavenges free iron, is not affected by pasteurization, nor is lysozyme, a bactericidal enzyme that works in conjunction with lactoferrin.[23,26] Oligosaccharides, which bind pathogens to prevent their adherence to mucosal receptors, are heat stable.[26] Xanthine oxidase, an enzyme linked to flavor, and bacteriocins, which have some antimicrobial action, both retain activity after pasteurization.[26] The minimal benefits that these compounds may afford are vastly outweighed by the risks of drinking raw milk, which include contracting an illness that may have chronic complications and, potentially, death.

Health professionals are concerned about raw milk because foodborne pathogens, causing both acute and chronic illnesses, are associated with raw milk, and the risk of contracting illness is considerable (Table 2). Common bacterial pathogens found in raw milk are *E coli*, *Listeria monocytogenes*, *Salmonella* species, *Campylobacter jejuni*, *Staphylococcus aureus*, *Mycobacterium tuberculosis*, *Mycobacterium bovis*, *Brucella abortus*, *Coxiella burnetii*, and *Yersinia enterocolitica*.[22,26] These pathogens cause gastrointestinal and other illnesses, as well as potentially serious long-term negative health effects. Hemolytic uremic syndrome and thrombotic thrombocytopenic purpura are microvascular diseases affecting the kidney that are caused by some of these pathogens, and kidney transplantation has been required in some patients with hemolytic uremic syndrome.[32] Guillain-Barré syndrome, which can result from *C jejuni* infection, causes neuromuscular paralysis and may result in patients becoming bedbound and ventilator-dependent.[33] Toxic shock syndrome is an acute illness that is caused by *S aureus* infection that can have potentially fatal complications, including shock, renal failure, heart failure, and adult respiratory distress syndrome.[34]

Raw milk can become contaminated at any point during milk production and processing: through fecal contamination of milk with fertilizer made from manure of infected cows, from bovine mastitis, or from contaminated water used for irrigation on farms.[25,26] Pathogens can also persist in biofilms on the equipment if the organisms are introduced to processing plants.[25] Humans become infected by consuming raw milk or raw milk products. Raw milk is a food safety risk not only for those who consume it, but

TABLE 2 Prevalence of Bacterial Pathogens in Raw Bulk Tank Milk

Pathogen	Illness in Humans	Prevalence Estimates in Raw Bulk Tank[a] Milk
STEC (Shiga toxin–producing *E coli*)	Diarrhea, diarrhea-associated hemorrhagic colitis, hemolytic uremic syndrome, thrombotic thrombocytopenic purpura.	Limited data; >1%–27%
Listeria monocytogenes	Septicemia, meningitis, spontaneous abortions, or stillbirths in pregnant women.	1%–13%
Salmonella species (including *Salmonella typhimurium*)	Salmonellosis, typhoid fever.	<1%–9%
Campylobacter jejuni	Diarrhea, chronic gastritis, enterocolitis, septicemia, Guillain-Barré syndrome.	<1%–12%
Enterotoxigenic *Staphylococcus aureus*	Toxic shock syndrome.	Prevalence unknown; frequent cause of mastitis in cows, linked to several foodborne illness outbreaks caused by raw milk
Mycobacterium tuberculosis	Tuberculosis.	Prevalence unknown[b]
Mycobacterium bovis	Zoonotic tuberculosis (ie, tuberculosis that can be transmitted from animals to humans).	Prevalence unknown[b]
Brucella species (including *Brucella abortus*)	Brucellosis: flulike symptoms, severe infections of the central nervous system or lining of the heart; chronic symptoms include fevers, joint pain, and fatigue. *B abortus* causes abortion of fetus in pregnant animals.[27]	Prevalence unknown[b]
Coxiella burnetii	Q fever: high fevers, severe headache, general malaise, myalgia, confusion, sore throat, chills, sweats, cough, nausea, vomiting, diarrhea, abdominal pain, chest pain, pneumonia, and weight loss (acute: mortality of 1%–2%). Chronic Q fever can result in endocarditis and has a 65% mortality rate.[28]	21% in England in Wales[29,b]
Yersinia enterocolitica	Yersinosis: fever, abdominal pain, bloody diarrhea, rash (erythema nodosum), joint pain.[30]	6%–48% in the US

Prevalence estimates based on Leonard and Sheehan,[22] Oliver et al,[25] and Jayarao and Henning.[31]

[a]Bulk tank refers to the large storage and cooling tanks at dairy farms that hold the raw milk until it is picked up for processing and pasteurization.

[b]Prevalence in the United States has not been studied; however, these pathogens are known to be present in raw milk.

also for anyone living in the household of a consumer, because of the risk of cross-contamination of other food. Because pasteurization was mandated in the US milk supply, the percent of foodborne and waterborne disease outbreaks attributable to milk has decreased markedly, from 25% (in 1938) to 1% (in 2002).[35] Problems continue to occur, however. In March 2010, the FDA reported 12 cases of illness caused by *C jejuni* that were linked to raw milk consumption in the Midwest.[36] Also in March 2010, Whole Foods Markets Inc pulled all raw milk and raw milk products (with the exception of cheeses) from its stores in Washington, Pennsylvania, California, and Connecticut,[37] following lawsuits filed by Whole Foods customers who suffered kidney failure requiring transplant after consuming

raw milk purchased in the store and contaminated with *E coli*.[36,37]

Belief: Raw or farm milk protects children from developing allergies and asthma.

Fact: There is little scientific evidence that raw milk protects against allergies and asthma.

Raw milk advocates claim that raw milk consumed early in life protects children from developing allergies and asthma.[38] Although it is difficult to separate milk consumption from other aspects of the environment and lifestyle of families who chose to feed their children milk straight from the cow, there is little evidence to support this view.

One study on this subject used questionnaires to examine the consumption of farm foods (including milk), versus store-bought foods, and their association with asthma and allergies in children of farm families or those raised with an anthroposophic lifestyle (a quasi-philosophical belief system based on the teachings of Rudolf Steiner, who advocated limited use of antibiotics, medications, and vaccinations).[39] Consumption of farm milk was significantly and inversely related to physician-diagnosed asthma, rhinoconjunctivitis, and current rhinoconjunctivitis symptoms, and these effects were evident both in children who lived on farms and in those who did not.[39] However, the study did not include a control group of children in an urban environment who consumed only farm foods and another control consuming only store-bought foods. Nevertheless, there was no difference in asthma prevalence between families who boiled the raw milk and those who did not, indicating that a factor other than pasteurization may have played a role in the protective effect.[39]

The bottom line is that raw milk poses a health risk. Those who are adamant about drinking raw milk should be encouraged to inquire about the safety regulations and contamination management plans, such as Hazard Analysis and Critical Control Points plans, at the farms from which they purchase their milk. Milk produced at farms that have Hazard Analysis and Critical Control Points plans in place may be safer, but there are no guarantees.

Belief: Drinking milk causes asthma and other allergic conditions.

Fact: The causes of asthma are many, but milk and milk products are rarely among them.

Some people believe that asthma sufferers should avoid milk so as to not exacerbate their symptoms. Others believe that cow's milk consumption early in life can cause children to develop allergic conditions, such as asthma. Some food allergies can cause respiratory or systemic reactions, but true CMA or other true allergies have different signs and symptoms.

Milk has been implicated in causing several types of allergic conditions, one of which is atopic asthma, a form of asthma caused by allergies. Asthma is characterized by airway narrowing due to smooth muscle contraction, airway wall edema, and vascular congestion. These are worsened by inflammatory exudates and the increased mucus secreted by patients with asthma.[40] Because many believe that drinking milk causes an increase in mucus production, milk is often avoided by patients with asthma or restricted by the parents of children with asthma.

Studies have not found a decrease in a measure of lung function (forced expiratory volume [FEV]) or other symptoms in asthmatics after consuming cow's milk. A randomized, double-blind, placebo-controlled, prospective study of 25 adult patients with mild asthma, who had no history of CMA, found no statistically significant decrease in FEV, or increased rhinorrhea (runny nose), cough, or bronchospasm in patients after consuming cow's milk compared with a placebo.[41] A study of 11 asthmatic patients and 10 nonasthmatic patients, none of whom had a CMA, found no change in FEV or forced expiratory flow 3 hours after patients consumed whole cow's milk, skim cow's milk, or water,[42] indicating that no additional mucus production contributed to obstruction of the airway.

In a study of the relationship between cow's milk exposure and asthma in infants from birth to 36 months who had a family history of atopic asthma or allergies, there was no association between cow's milk consumption and childhood asthma. There was a slight positive association between milk consumption and asthma from 6 to 12 months, but it was not statistically significant. Milk had a significant protective effect with respect to asthma, however, from 24 to 36 months of age.[43] Absence of a control group with no history of allergies and the presence of many confounding factors limit the reliability of this study, unfortunately.

There is good evidence suggesting that milk and dairy foods do not cause or worsen asthma symptoms. People should not exclude dairy products for this reason, unless they have a documented CMA that causes a respiratory reaction.

Belief: Drinking milk causes increased mucus production, so people should avoid it when they are ill, especially with colds.

Fact: Milk does not cause mucus production, and there is no reason to avoid it when sick with the common cold.

Mucus hydrates and preserves the mucous membrane and provides a barrier that traps foreign materials and transports them out of the airway via the action of cilia.[40] Many believe that consuming dairy products causes an increase in mucus production in the respiratory tract and should therefore be avoided during illness. Others believe that dairy should be avoided at all times by those with chronic respiratory conditions.

Scientific studies on the perceived association between milk and mucus production are few. However, several trials were done in the early 1990s, using both objective measures of mucus production and subjective assessments of sensory experiences after milk ingestion. Little

evidence was found to support the association between milk and mucus. In an Australian study of parents of children with pulmonary disease waiting in a pediatric pulmonology office, nearly 60% of respondents believed that drinking milk causes mucus production, and both believers and nonbelievers reported avoiding giving milk while their children were ill, on the advice of family members, pediatricians, other physicians, and health professionals.[44] Although saliva production increases after drinking milk (or water), the concentration of the components of mucus responsible for viscosity actually decreases while drinking milk.[45] Milk and saliva can lead to the clumping of droplets of the two together in the throat, and it is possible that the sensory perception of an increase in mucus is actually the sensation of milk mixing with saliva.[45]

In a double-blind study, participants consumed 300 mL of a milk-based drink and an identical-tasting soy placebo and recorded their symptoms after 5 minutes, 4 hours, and 1 day later.[46] Three of the symptoms measured significantly in both the milk and placebo groups: "coating," "need to swallow," and "thicker saliva," but there was no difference in responses between the milk and the placebo group, and thus, the "milk mucus effect" was not specific to milk.[46] Those who said they believed in the mucus theory were more likely to report symptoms after drinking milk and were also more likely to be aware of these symptoms. In another study, healthy volunteers were inoculated with rhinovirus 2 (the common cold), and nasal secretions were collected and weighed for 10 days.[47] No association was found between milk consumption and mucus weights. Thus, the few studies that have been done show that there is no increase in mucus production after milk consumption. People who believe in the milk-mucus connection are more likely to feel the sensations of "more mucus" after ingestion of milk, but these sensations may be due to the perception of the milk and saliva mixture itself, or a placebo effect. Milk and dairy products need not be avoided or excluded from the diet due to a fear of increased mucus production.

Belief: Milk from cows treated with recombinant bovine growth hormone (rBGH) has higher levels of bovine GH (BGH) than milk from untreated cows.

Fact: There are no differences in BGH levels in milk from rBGH-treated or untreated animals. Even if there were, our digestive tracts would break down the BGH and render it inactive.

Growth hormone is produced by the pituitary gland and is essential for mammary tissue development during puberty, pregnancy, and milk production in mammals.[48] Human GH influences milk production and is necessary for growth during puberty. Bovine GH, also known as bovine somatotropin), has been studied extensively and shown to greatly increase milk yield in dairy cows. Recombinant BGH was developed in the 1990s[49] using recombinant genetic technology, which involves the introduction of foreign or synthetic gene sequences into an animal, plant, or microbe for the production of a specific protein (such as rBGH). Scientists have found that rBGH increases milk production in cows that are in good nutritional status and good health that are raised with appropriate hygiene.[49] An rBGH formulation, Posilac®, has been developed for commercial sale.[49] Critics feared that it would cause everything from a change in milk's nutritive value to cancer in milk drinkers. One European article even called for an embargo on the sale of milk, milk products, and meat from US cows treated with "hormones."[50] In December 1990, the NIH held the Technology Assessment Conference on Bovine Somatotropin to evaluate the available evidence on the effects of rBGH on milk production in cows and its activity in humans. It concluded that BGH is a protein that is digested and destroyed in the gastrointestinal tract and therefore cannot have any hormonal activity in humans.[51] The NIH cited evidence that BGH did not have an impact on growth when it was injected into children with growth failure, showing that human GH receptors cannot recognize the bovine form.[51] Other national and international agencies (including the American Medical Association and the World Health Organization) reviewed the literature on the safety of rBGH, and all concluded that the use of rBGH posed no adverse health or safety risks to humans or cows.[51]

The FDA approved Posilac in 1993 after an extensive review of the available evidence.[52] The FDA continues to review studies that have come out since the initial approval and has failed to find evidence that rBGH is unsafe. The FDA does not require that the use of rBGH be noted on the food label of fluid milk and milk products. However, it does allow producers to indicate on their labels that the milk did not come from cows treated with rBGH, provided the claim is backed by a signed certificate stating so.[49] There is no evidence that rBGH-free labeled milks and milk products are different in any way than their conventional counterparts. However, rBGH-free–labeled products are generally more expensive than conventional products, because of the lower milk output of cows not treated with the hormone and marketing considerations.

CONCLUSIONS

The 2010 Dietary Guidelines Advisory Committee (DGAC) and the 2010 Dietary Guidelines Report state that fluid milk and milk product consumption is low enough to be concerning in both adults and children and urges efforts to increase consumption.[53,54] The DGAC stated that dietary intakes of calcium, potassium, vitamin D, and dietary fiber, 3 of which are found in milk, are low in the American diet.[53] The 2010 DGAC reported that intakes of fluid milk and milk equivalents (such as cheese or fortified soymilk)

are less than the recommended amount per day for adults and adolescents aged 9 to 18 years and for children aged 4 to 8 years.[53] The 2010 Dietary Guidelines for Americans recommend 3 cups per day of fat-free or low-fat milk (or milk products and milk equivalents) for adults and adolescents aged 9 to 14 years, 2½ cups per day for children aged 4 to 8 years, and 2 cups per day for children aged 2 to 3 years.[54] Milk and dairy products contain many essential nutrients, and dairy consumption is associated with diet quality and adequate intake of multiple nutrients (calcium, phosphorus, riboflavin, vitamin B_{12}, protein, potassium, zinc, iron, magnesium, vitamin A, and vitamin D).[55] Belief in many of the mistaken notions outlined in this article is widespread among the public and health professionals. Mistaken self-diagnoses of lactose intolerance and/or CMA may lead to unnecessary dietary restrictions of milk and milk products, or consumption of raw milk, which carries its own, often profound, health risks. Health professionals can play an important role in dispelling these nutrition myths through nutrition education and counseling.

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