NATIONAL DAIRY COUNCIL™

State of the Science
Dairy Foods and Health

This resource provides the current state of the science on dairy's role in:

- Health and wellness topics
- Chronic disease prevention and management
- Emerging topics

We hope you will please consider National Dairy Council as an ongoing resource should you have any future needs or questions about dairy foods, dairy science or education efforts.

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National Dairy Council, a non-profit organization founded by U.S. dairy farmers in 1915, is committed to research and education about dairy's role in the diet and its contributions to nutrition and health. The U.S. dairy community is working to be an environmental solution. The dairy community is committed to enhancing natural resources and ecosystems and has collectively set environmental sustainability goals to achieve greenhouse gas neutrality and improve water usage and quality by 2050.

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Dairy Foods and Health

Science Summary
Dairy in Healthy Dietary Patterns

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Overview

Dairy foods, such as milk, yogurt and cheese, are foundational foods included in multiple healthy dietary patterns. These include the Healthy Eating Patterns in the 2020 Dietary Guidelines for Americans (DGA), the Dietary Approaches to Stop Hypertension (DASH) eating plan, as well as those recommended by the American Heart Association (AHA) and guidelines from the National Osteoporosis Foundation. Dairy foods help meet nutrient needs and are associated with better bone health, especially in children and adolescents. Healthy dietary patterns containing low-fat or fat-free dairy foods are also associated with lower risk for cardiovascular disease (CVD) and type 2 diabetes (T2D). Dairy foods can be affordable sources of key nutrients – including high-quality protein, calcium, potassium and vitamin D – and are available in a variety of options to help meet taste, health and wellness needs. By choosing the DGA-recommended daily servings of dairy foods as part of a healthy dietary pattern, Americans ages 6 months and above can enjoy the many benefits dairy foods provide.

Dietary patterns have emerged as a valuable way to guide healthy eating

People eat and drink a variety of foods and beverages that collectively establish a dietary pattern.[1] Dietary patterns are defined as "quantities, proportions, variety or combination of different foods, drinks, and nutrients in diets, and the frequency with which they are habitually consumed."[2] Dietary patterns capture the synergistic and cumulative effects that combinations of foods and beverages – and the nutrients they contain – can have on health.[2] Because dietary patterns contain multiple foods and beverages that work together in relation to health, they may be more predictive of health than any one food or nutrient.[1]

Dairy foods are foundational foods in multiple dietary patterns associated with better health

Dietary Guidelines for Americans:

Americans, on average, consume fewer dairy foods and plant-based foods, such as vegetables, fruits, and whole grains, than recommended in the Healthy U.S.-Style, Healthy Vegetarian and Healthy Mediterranean Style Eating

Patterns.[1] The DGA note that dairy consumption is also linked to impro ved bone health, especially in children and adolescents.[1] Based on consistent evidence from prospective cohort studies, systematic reviews and meta-analyses, the 2020 Dietary Guidelines Advisory Committee concluded that dietary patterns that include low-fat dairy foods are associated with a lower risk of all-cause mortality, cardiovascular disease, overweight, and obesity.[2]

The Healthy U.S. and Vegetarian- Style Dietary Patterns in the 2020 DGA recommend 3 daily servings of low-fat or fat-free dairy foods for those 9 years and older, 2½ servings for children 4-8 years and 2 servings for children 2-3 years.[1] It also recommends 1⅔ to 2 servings of whole- and reduced-fat dairy foods for toddlers 12-23 months and small amounts of yogurt and cheese for infants 6 to 12 months, depending on developmental readiness.[1]

Vegetarian Style Eating Patterns

The Healthy Vegetarian dietary pattern is defined by the DGA as a lacto-ovo-vegetarian diet which includes dairy foods. Adults age 20+ years who reported consuming this pattern had lower energy, saturated fat and sodium intakes.[3]

DASH and Mediterranean eating patterns:

DASH and the Mediterranean diet are well-studied eating patterns that helped shape the DGA recommendations. The DASH eating plan is based on the DASH trial, which found that following a reduced-fat eating plan including 2-3 servings of dairy foods and 8-10 servings of fruits and vegetables per day lower blood pressure in adults with elevated blood pressure.[4,5,6]

Adults participating in the PREMIER study who increased their intakes of dairy products and consumed five or more servings of fruits and vegetables per day lost more weight and had greater reductions in blood pressure than other groups.[7] A review of 68 research and review papers found that prolonged adoption of the DASH diet was shown to have sustained beneficial effects on health.[8] While the original DASH diet trials included mostly low-fat dairy foods, results of a more recent trial showed that the DASH diet is equally effective if whole-fat dairy foods are substituted for low-fat dairy foods.[9]

Systematic reviews found that the DASH diet led to improvements in blood pressure among adults and adolescents as well as reductions in total cholesterol and LDL-C.[10,11] Prospective cohort studies also found lower risk of stroke, CVD and CVD-mortality among adults with high adherence to a DASH diet.[12,13] Several studies suggest that following the DASH dietary pattern is linked with lower risk of overweight and obesity in adolescents and adults.[10,14,15,16]

The Mediterranean diet is described in the scientific literature, generally, as containing high amounts of extra virgin olive oil, vegetables, fruits, cereals, nuts and pulses/legumes, moderate amounts of fish and other meat, dairy foods and red wine, and low amounts of eggs and sweets.[17] Prospective cohort trials indicate that Mediterranean eating patterns that include dairy foods are linked to reduced risk of CVD and diabetes.[18,19,20,21] In a randomized controlled trial of adults at high risk of cardiovascular disease, consuming a Mediterranean style diet with 3-4 daily servings of dairy foods, with no restrictions on fat levels of dairy foods, reduced blood pressure and improved lipid levels compared to a control group consuming a low-fat diet. The authors concluded that a

Mediterranean diet with additional dairy may be appropriate for an improvement in cardiovascular risk factors in a population at risk of CVD.[22]

The DGA Healthy Mediterranean Eating Pattern (HMEP) contains less dairy food than the other DGA healthy eating patterns. Results of a modeling study indicate that replacing one serving of refined grain foods in the HMEP for adults with a serving of low-fat or fat-free dairy foods brings the amounts of several shortfall vitamins and minerals (calcium, potassium, and vitamin D) closer to recommended levels without increasing saturated fat or sodium above recommended ranges.[23]

Dietary patterns recommended by authoritative organizations:

Dairy foods are also part of dietary patterns recommended by medical and health organizations.[24,25,26,27,28,29] The American Heart Association (AHA) emphasizes the importance of healthy dietary patterns to reduce the risk of cardiovascular disease morbidity and mortality. The AHA evidence-based dietary guidance advises choosing healthy sources of protein including low-fat or fat-free dairy products.[24] Furthermore, the AHA guidance states that evidence suggests potential cardiometabolic benefits of consuming fermented dairy such as yogurt, but states that the evidence remains inconclusive.

The 2019 American College of Cardiology/AHA Guidelines on the Primary Prevention of Cardiovascular Disease recommend the DASH diet to help prevent and treat hypertension. These guidelines recommend the DASH diet alongside the Mediterranean and vegetarian diets as heart- healthy eating patterns to help with weight loss and glycemic control with T2D.[30]

The American Academy of Pediatrics, the National Osteoporosis Foundation and the American Diabetes Association also include low-fat or fat-free dairy foods as foods to meet nutrient needs.[26,27,28,29] Dietary patterns outside the U.S. include dairy foods as part of healthy eating patterns. For example, the Southern European Atlantic Diet, the traditional dietary pattern of Northern Portugal and North-Western Spain, includes dairy foods and has been associated with lower risk of all causes of death among older Spanish adults.[31]

There are multiple ways to achieve a high-quality diet and research demonstrates significant associations with lower all-cause death and cardiovascular disease mortality.[32]

Three daily servings of dairy foods provide excellent nutritional value

Americans are currently under consuming dairy foods, at about 2 dairy servings per day on average. Adding just 1 more daily serving can help fill shortfall nutrient gaps.[23,33] In the 2,000 calorie Healthy U.S.-Style Eating Pattern, 3 servings of low-fat or fat- free dairy foods contribute only 12% of daily calories, but 20-69% of many key nutrients, including calcium, vitamin D and potassium, nutrients of public health concern identified by the DGAC.[2] The unique nutrient profile of dairy foods can be difficult to replace with non-dairy foods, even calcium-equivalent foods.[2,33] Non-dairy beverages other than fortified soy beverage are not recommended for children because of variability in their nutrient content and lack of evidence for adequate bioavailability of nutrients.[34]

Researchers modeled the impact of replacing one of the three recommended servings of low-fat or fat-free dairy foods in the Healthy US-style eating pattern with a whole- or reduced-fat option and found that some reduced and whole-fat dairy foods, especially milk, can fit into calorie-balanced healthy eating patterns that align with saturated fat recommendations.[35] Allowing some flexibility in fat level of dairy food servings aligns with the recommendations that calories from solid fats and added sugars are best used to increase the palatability of nutrient-dense foods.[35] Similarly, replacing one serving of refined grain foods with one serving of low-fat, fat-free dairy foods in the Mediterranean diet brings the amounts of key nutrients closer to recommended levels without increasing saturated fat.[23]

A variety of nutrient-dense dairy foods are available

Many dairy food options are available to help tailor healthy eating patterns to meet daily needs. These include lactose-free or lactose-reduced cow's milk and dairy foods made with less sodium, fat or added sugars. Yogurt varieties that contain more high-quality dairy protein, like Greek- or Icelandic-style products, and many cheese varieties are also available.

Dairy foods are often more affordable than replacements used to meet nutrient needs, such as fortified soy beverage and fortified orange juice. An analysis of NHANES data indicated that dairy foods were the least expensive sources of calcium and vitamin D in the American diet as well as low-cost sources for potassium, magnesium and vitamin A.[36]

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Science Summary
Nutrient Contributions of Dairy Foods

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Overview

Consuming dairy foods as part of a healthy dietary pattern helps people thrive at every age, from childhood through adulthood. Dairy foods help Americans meet recommendations for calcium, vitamin D and potassium, 3 of the 4 underconsumed nutrients of public health concern. Dairy foods also make important contributions to the intake of other nutrients, including protein, vitamin A, vitamin B12, riboflavin, phosphorus, zinc, iodine and selenium, in the U.S. diet. The nutrient contributions of dairy foods have been noted in the Dietary Guidelines for Americans (DGA) since the first DGA was released in 1980. On average, Americans do not meet recommendations for dairy food intake. Yet, even at current intake levels, dairy foods supply roughly half of the calcium and vitamin D in the U.S. diet. Meeting recommendations for dairy foods can help Americans close key nutrient gaps and contribute to overall healthy dietary patterns.

Dairy foods are an important part of recommended healthy dietary patterns

The DGA recommends consuming dairy foods, such as milk, cheese and yogurt, as part of healthy dietary patterns associated with reduced risk for several chronic diseases, including type 2 diabetes and cardiovascular disease.[1] The 2020 DGA also recognizes the importance of consuming dairy foods in healthy dietary patterns to achieve peak bone mineral density in childhood and adolescence.[1] The Healthy U.S.-Style Dietary Pattern in the 2020 DGA recommends 3 daily servings of low-fat or fat-free dairy foods for those 9 years and older, 2½ servings for children 4-8 years and 2 servings for children 2-3 years.[1] It also recommends 1⅔ to 2 servings of whole- and reduced-fat dairy foods for toddlers 12-23 months and small amounts of yogurt and cheese for infants 6 to 12 months, depending on developmental readiness.[1]

Dairy foods make important nutrient contributions to the U.S. diet

Milk, cheese and yogurt contribute nutrients essential to the daily nutrition of all Americans. Milk is a nutrient-rich and affordable source of thirteen essential nutrients like protein, calcium, phosphorus, potassium, zinc, iodine, selenium, magnesium and vitamins A, D, B12, riboflavin (B2) and pantothenic acid (B5) in the U.S. diet. Milk is also the leading food source of three nutrients of public health concern (calcium, vitamin D and potassium) for children 2-18 years and the leading food source of calcium and vitamin D for all Americans over the age of 2.[2] Cheese is a good source of high-quality protein, the second leading food source of calcium in the U.S. diet (after milk) for Americans 2 years and older[2] and contributes phosphorus and vitamin A to the U.S. diet.[3,4] Low-fat yogurt is an excellent source of calcium and provides protein, phosphorus, zinc, vitamin B12, pantothenic acid (B5) and riboflavin (B2) as well.[5*]

*USDA FoodData Central (FDC) ID: Low-fat vanilla yogurt 170888

Adults and children 2 years of age and older who meet dairy recommendations are less likely to be below recommendations for a number of essential nutrients including calcium, magnesium, phosphorus, protein, riboflavin, vitamin A, vitamin B12, vitamin D, selenium, zinc, potassium and choline than Americans who do not meet dairy recommendations.[4] However, Americans over the age of 2 consume, on average, about 1½ cups of dairy foods daily, an amount below recommendations for most life stages.[2] Even at current consumption rates, milk, cheese and yogurt contribute, on average, about 52% of the calcium, 51% of the vitamin D, 14% of the potassium, 17% of the protein, 29% of the vitamin A, 28% of the vitamin B12, 21% of the riboflavin (B2), 27% of the phosphorus and 17% of the zinc to the diets of Americans ages 2 and older, while providing 11% of total calories, 26% of saturated fat and 11% of sodium.[2] Inadequate intake of calcium, phosphorus, protein, riboflavin, and vitamin B12 is close to zero among adults and children who meet dairy food recommendations.[4] Adding just 1 daily serving of dairy foods to individuals' current intakes can help Americans move closer to meeting dairy food recommendations and contribute to closing key nutrient gaps.

Current beverage intakes support recommendations for children to drink milk

Drinking milk is an important habit to develop in childhood and carry forward into adulthood. Dairy consumption tends to fall below recommended amounts by the time children go to school, and this trend persists through adolescence and into adulthood.[6] The 2020 DGA recommends drinking milk with meals as one strategy to increase dairy consumption.[1] It also recommends choosing water and unsweetened beverages like 100% fruit or vegetable juice, low-fat or fat-free milk or fortified soy beverages within healthy dietary patterns in place of sugar-sweetened beverages (SSBs) like soda, fruit drinks, sports and energy drinks.[1] SSBs are not a component of USDA Dietary Patterns and are not necessary in the child or adolescent diet.[1] Among milk drinking children ages 2 to 18, milk contributes 32% the calcium, 55% of the vitamin D, 19% of the potassium and just 8% of the calories. White milk contributes no added sugars, and flavored milk contributes, on average, approximately 4% of added sugars to children's diets.[2]

Nutrients in dairy foods can be difficult to replace with other foods

Replacing dairy foods with non-dairy, calcium-equivalent foods can have unintended nutritional consequences. Non-dairy beverages that contain similar amounts of calcium per cup as milk, such as calcium-fortified almond or rice beverage, can be lower in potassium and protein than milk.[5]* More than 50% of the Americans who do not consume adequate amounts of dairy foods consume below the estimated average requirements for calcium, magnesium, vitamin A and vitamin D.[4] Because dairy foods are the lowest cost source of dietary calcium and among the lowest cost sources of riboflavin (B2) and vitamin B12 in the U.S. diet, they are a good value, too.[7]

Four leading health organizations (the Academy of Nutrition and Dietetics, the American Academy of Pediatric Dentistry, the American Academy of Pediatrics and the American Heart Association) recommend that children 1 to 5 years of age not consume plant-based milk alternative beverages except for fortified soy beverage. Their Healthy Beverage recommendations state that non-soy plant-based beverages are inconsistently formulated, meaning they vary in nutrient and added sugar content, and are "not an equal substitute for cow's milk."[8] The DGA similarly states that consuming almond, rice, coconut, oat and hemp 'milks' "does not contribute to meeting the dairy group recommendation," because the nutrient content of these plant-based beverages is not similar to dairy milk and fortified soy beverages.

*FDC IDs: Almond beverage: 1097550; Rice beverage: 171942

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Science Summary
Milk & Health

Overview

Milk is a delicious and nutritious beverage produced fresh in every U.S. state. Milk is made possible by dairy farmers committed to responsibly producing milk to nourish Americans while remaining mindful of natural resources. Different milks help meet different people's health, taste and cooking needs. The variety of milks available includes whole, reduced-fat (2% milk fat), low-fat (1% milk fat), fat-free and flavored options. For people with lactose intolerance (LI), there are lactose-free varieties as well. Milk is a nutrient-rich and affordable source of thirteen essential nutrients like protein, calcium, phosphorus, potassium, zinc, iodine, selenium, magnesium and vitamins A, D, B12, riboflavin (B2) and pantothenic acid (B5) in the U.S. diet. The Dietary Guidelines for Americans (DGA) and the American Academy of Pediatrics (AAP) recommend consuming low-fat or fat-free dairy foods like milk every day as part of healthy dietary patterns to help Americans 2 years and older meet their nutrient needs.

Drinking milk helps Americans meet dairy food recommendations

Dairy foods like milk are foundational foods in healthy dietary patterns. Healthy dietary patterns, which include low-fat and fat-free dairy foods, are associated with a lower risk for cardiovascular disease, type 2 diabetes and obesity.[1] In adults, drinking milk has been linked to an 8 percent lower risk of high blood pressure and stroke.[2,3] Consuming dairy foods like milk is also linked to improved bone health throughout childhood and into adulthood.[4–9] For older adults, drinking milk and eating other dairy foods is associated with a lower risk of hip fracture in both men and women.[7,9–13]

While cow's milk should not be given to infants before 12 months of age, the 2020 DGA recommends providing small amounts of cheese and yogurt as complementary foods to infants beginning around 6 months of age and depending on developmental readiness. For toddlers 12-23 months who no longer consume human milk, the 2020 DGA recommends 1⅔ to 2 servings of whole- and reduced-fat dairy foods (whole milk, reduced-fat cheese and reduced-fat plain yogurt) as part of the Healthy U.S.-Style Dietary Pattern.[1] The DGA recommends that children transition to low-fat and fat-free milk, cheese and yogurt at 2 years of age and consume 2 servings of dairy foods daily from 2-3 years. The DGA recommends 2½ daily servings of low-fat or fat-free dairy foods for children 4-8 years and 3 servings for those 9 years and older in the Healthy U.S.-Style Dietary Pattern.[1]

Young children come the closest to meeting DGA recommendations. Toddlers 12-23 months consume 2½ servings of dairy foods per day, on average, most of which is milk.[1] Dairy consumption tends to fall below recommendations by the time children go to school, and this trend carries forward through adolescence and into adulthood.[14] American adults 19 years and older typically consume only 1½ servings of dairy foods daily, about half of which is milk.[15] Encouraging adults and children to add 1 more daily serving of dairy foods like milk to their dietary pattern is a practical way to help meet dairy recommendations.[16,17]

Drinking milk helps Americans get the essential nutrients their bodies need

Milk makes important nutrient contributions to the U.S. diet.[18-20] Adults and children 2 years and older who meet dairy recommendations are less likely to be below recommendations for a number of essential nutrients including calcium, magnesium, phosphorus, protein, riboflavin, vitamin A, vitamin B12, vitamin D, selenium, potassium and choline.[21]

Milk is also the leading food source of three nutrients of public health concern (calcium, vitamin D, potassium) for children 2-18 years and is the leading food source of calcium and vitamin D for all Americans over the age of 2.[15] Milk provides, on average, over 34 percent of the daily vitamin D intake, 19 percent of the daily calcium intake and 9 percent of the daily potassium intake of Americans 2 years and older.[15] For school-age children and adults, adding 1 more serving of low-fat or fat-free dairy foods every day to their current dietary patterns would help meet nutrient needs.[16,17]

Nutrients from milk are difficult to replace with most milk alternatives

Many alternative beverages to milk are available but often are not nutritionally equivalent to milk.[22] Milk contains 8 grams of high-quality protein per 8-ounce cup serving, while almond, rice and coconut "milks" contain 1 or fewer grams of protein per serving, unless fortified.[23]* Proteins from animal food sources like milk are complete and high-quality because they provide all amino acids. Proteins from plant sources vary in quality.[24] Although the DGA includes soy beverages and yogurt in the dairy group if they are fortified with calcium and vitamins A and D, these fortified soy alternatives are not commonly consumed by Americans and contribute very little nutrition to the average U.S. diet.[1,15] Milk is also an affordable source of key nutrients like calcium and vitamin D.[25] Other beverages, like calcium-fortified orange juice, are not nutritionally equivalent to milk and are more expensive sources of calcium.[25] The DGA notes that alternative beverages, such as almond, rice, coconut and hemp "milks," are also not nutritionally equivalent to milk and are therefore not included in the dairy group.[1]

Drinking milk every day is a healthy habit for children to develop

Beverages make important contributions to children's nutrition.[14,18] As children get older, they tend to choose less nutritious beverages, like sugar-sweetened beverages (SSBs), instead of milk.[14] The 2020 DGA recommends choosing water and unsweetened beverages like 100% fruit or vegetable juice or low-fat or fat-free milk or fortified soy beverages within healthy dietary patterns in place of SSBs like soda, fruit drinks, sports and energy drinks.[1] SSBs contribute 25 percent of added sugars in the diets of children 2-5 years[18] and up to 50 percent of added sugars in the diets of adolescents.[26] Flavored milk contributes, on average, approximately 5-6 percent of added sugars[18] to

* FDC IDs: Almond beverage: 174832; Rice beverage: 171942; Coconut beverage: 174116

the diets of children 2-11 years and only 2 percent of added sugars for adolescents.[26] Through the School Breakfast Program and the National School Lunch Program, schools can offer low-fat and fat-free plain and flavored milks.[27,28] Children who eat school meals (breakfast or lunch) every day report consuming more servings of dairy foods and, subsequently, consume more calcium than children who do not regularly eat school meals.[29] School-aged children who drink flavored milk tend to have higher milk[30] and nutrient consumption (calcium and magnesium), but not necessarily higher added sugars intake, than children who drink only plain milk.[31] Drinking milk is an important habit to develop in childhood and carry forward into adulthood.

What to know about lactose intolerance and milk allergy

Some people feel discomfort after drinking milk, which may be due to LI or possibly milk allergy (MA). Individuals who are sensitive to lactose ("lactose intolerant") do not make enough lactase, an enzyme that breaks down lactose during digestion.[32,33] People with LI may experience discomfort like bloating or gas after consuming some dairy products. LI is different from MA, which is an immune reaction to milk protein(s) that can manifest with several different symptoms.[34] While MA is most common among young children, children often "outgrow" MA by early adolescence.[35,36] LI is less common among young children.[33] Dairy avoidance, whether due to MA, LI or other reasons, can lead to inadequate consumption of important nutrients.[32,33] While both MA and LI should be diagnosed and treated by a doctor, people with MA should avoid dairy foods[35] and ensure their diet includes other sources of the essential nutrients contained in dairy foods. Management strategies, like selecting lactose-free milk, consuming dairy foods in smaller servings and eating dairy foods with other foods can help most people with LI continue to enjoy dairy.[33]

Note: One serving refers to 1 cup-equivalent. For milk, 1 cup-equivalent equals 1 cup

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Science Summary
Cheese & Health

Overview

Cheese is delicious and nutritious and can start with just 3 ingredients: milk, starter culture and salt. This process can be done in so many ways that there are nearly 2,000 varieties of cheese. Cheese is also a nutrient-rich food that contributes protein, calcium, phosphorus and vitamin A to the U.S. diet. For vegetarians, cheese and other dairy foods are important sources of high-quality protein. For people with lactose intolerance (LI), cheese can be a source of dairy nutrients with minimal lactose. Three servings of low-fat and fat-free dairy foods, including cheese, are recommended for Americans 9 years and older as part of the Healthy U.S.-Style and Healthy Vegetarian Dietary Patterns in the 2020 Dietary Guidelines for Americans (DGA). A 2016 systematic review concluded that eating cheese is not associated with cardiovascular disease (CVD) risk, based on high-quality evidence, and may be associated with a lower risk for stroke and type 2 diabetes (T2D), based on moderate-quality evidence. Cheese can be an important and nutrient-dense part of healthy dietary patterns.

Eating cheese helps Americans meet dairy food recommendations

Dairy foods like cheese are foundational foods in healthy dietary patterns. Healthy dietary patterns, which include low-fat and fat-free dairy foods, are associated with lower risk for both CVD and T2D.[1] Eating dairy foods is also linked to improved bone health, especially in children and adolescents.[2,3] Limited evidence also indicates that eating cheese daily is linked to a protective effect on bone health in adults as well.[4]

Cheese can be included in healthy dietary patterns across the lifespan. The 2020 DGA recommends providing small amounts of cheese and yogurt as complementary foods to infants beginning around 6 months of age, depending on developmental readiness. While cow's milk should not be given to infants before 12 months of age, the 2020 DGA recommends 1⅔ to 2 servings of whole- and reduced-fat dairy foods (whole milk, reduced-fat cheese and reduced-fat plain yogurt) for toddlers 12-23 months who no longer consume human milk as part of the Healthy U.S.-Style Dietary Pattern.[1] Children can transition to low-fat and fat-free dairy foods like cheese beginning at 2 years of age. The 2020 DGA recommends 2 daily servings of low-fat or fat-free dairy foods for children 2-3 years, 2½ for children 4-8 years and 3 for those 9 years and older in the Healthy U.S.-Style Dietary Pattern.[1]

Young children come the closest to meeting DGA recommendations. Toddlers 12-23 months years eat 2½ servings of dairy foods per day, on average.[1] Dairy food consumption tends to fall below recommended amounts by the time children go to school, and this trend carries forward through adolescence and into adulthood.[1] American adults 20 years and older average just 1½ servings of dairy foods daily.[1] Encouraging adults and children to add 1 more daily serving of dairy foods like cheese to their dietary patterns is a practical way to help meet dairy recommendations.[5,6]

Eating cheese helps Americans meet nutrient recommendations

Cheese makes important nutrient contributions to the U.S. diet.[7] Cheese is a good source of high-quality protein and contributes other essential nutrients such as calcium, phosphorus and vitamin A to the U.S. diet.[7,8] Cheese provides about 28 percent of calcium, 9 percent of protein, 9 percent of vitamin D, 13 percent of vitamin A and 8 percent of vitamin B12 to the diets of Americans 2 years and older, on average, and contributes approximately 11 percent of total fat, 18 percent of saturated fat and 6 percent of total calories.[9] Cheese is the second leading food source of dietary calcium in the U.S. diet (after milk) for Americans 2 years and older.[9] With thousands of varieties of cheese available worldwide, there are many options for incorporating cheese into healthy dietary patterns.

For those with LI, avoiding dairy foods can lead to inadequate consumption of shortfall nutrients like calcium.[10] Eating small amounts of aged, hard cheeses such as Parmesan, Cheddar and Swiss, which contain minimal lactose, may be an effective approach to manage LI and still consume important dairy nutrients.[10,11] For vegetarians, cheese and other dairy foods can be important sources of high-quality protein. Even in the context of a plant-rich diet, it is important to consume adequate amounts of dairy foods such as cheese to meet nutrient needs.[1] Low-fat or fat-free dairy foods are included in all of the dietary patterns within the 2020 DGA, including the Healthy Vegetarian Dietary Pattern.[1]

What to know about sodium in cheese

Sodium, in the form of salt, is essential to cheesemaking. It helps develop flavors, consistency and texture and helps preserve cheese and prevent spoilage.[12] Although cheese is a source of sodium in the U.S. diet,[9] different cheeses contain different amounts of sodium. Some cheeses like Swiss and ricotta cheese tend to be made with less sodium and are naturally low-sodium choices. Advances in food science have also made it possible to reduce the sodium in cheese while maintaining flavor, quality and safety.[12]

Reducing sodium consumption, increasing potassium consumption and engaging in regular physical activity can help lower blood pressure for those with prehypertension or hypertension.[13] A systematic review concluded that high-quality evidence indicates no link between cheese consumption and the risk for hypertension.[14] In other studies, cheese consumption was related to reduced blood pressure, as well as an 8 percent lower risk of developing high blood pressure.[15] Cheese can also be incorporated into the Dietary Approaches to Stop Hypertension (DASH) diet, a dietary pattern high in fruit, vegetables and low-fat dairy foods, recommended by the American Heart Association to lower blood pressure.[16–19] The 2020 DGA highlights the DASH diet and reduced sodium consumption as effective dietary strategies for adults who would benefit from lowering their blood pressure.[1]

Eating cheese may be linked with health benefits

Eating cheese has also been linked with health benefits. Systematic reviews found that moderate-quality evidence indicates eating cheese may be associated with a lower risk for T2D.[14,20] Evidence from a meta-analysis also supports a link between eating cheese and a 10 percent lower risk for stroke, with the largest risk reductions observed with daily consumption of about 40 grams (~1½ ounce) of cheese.[21] Another study found that the risk of developing T2D may depend on the types and food sources of saturated fatty acids (SFA).[22] While there was no relationship between overall SFA intake and the risk of developing T2D, consumption of SFA commonly found in cheese was related to a lower risk of developing T2D.[22]

Links between cheese consumption and CVD risk differ from what would be expected based on the SFA content of cheese. A systematic review found that high-quality evidence from two meta-analyses and a prospective study indicated no association between cheese consumption and CVD risk.[14] Several additional studies concluded that eating cheese was linked to a lower risk of CVD, including stroke.[23–26] This difference in the expected versus observed health impacts of cheese may be due to the unique physical structure, or matrix, of protein, vitamins and minerals in cheese.[27] More research is needed to understand if the links between cheese and T2D and CVD are due to the amount of SFA in cheese, nutrients such as calcium or the physical structure of cheese.

Cheese can be part of healthy dietary patterns

The DGA recommends low-fat or fat-free dairy foods for Americans ages 2 years and older.[1] The majority of cheese eaten in the U.S., however, is not low-fat or fat-free. Low-fat and fat-free cheese account for less than 1 percent of total cheese sales in the U.S.[28] However, food pattern modeling indicates that one serving of whole- or reduced-fat cheese can be incorporated into healthy dietary patterns while staying within recommended calorie and saturated fat levels.[29] Eating cheese can be part of a healthy dietary pattern.

Note: One serving refers to 1 cup-equivalent. For cheese, 1 cup-equivalent equals 1 ½-ounce portion of natural cheese (cheddar, mozzarella, Parmesan) or 2 oz processed cheese.

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Science Summary

Yogurt & Health

Overview

Yogurt is a nutrient-rich food that has been nourishing people for centuries. Made by culturing milk, yogurt contributes essential nutrients such as protein, calcium, phosphorus, zinc, vitamin B12, pantothenic acid (B5) and riboflavin (B2) to recommended healthy dietary patterns. Different yogurts help meet different people's health, taste and cooking needs. Yogurt varieties available include low-fat, fat-free, flavored and sweetened options as well as different styles like Greek and Icelandic. Lactose-free yogurt is also available. Emerging research indicates that healthy dietary patterns that include yogurt may be linked with a reduced risk for chronic diseases, long-term weight maintenance, improved bone health and reduced markers of chronic inflammation. The Dietary Guidelines for Americans (DGA) and the American Academy of Pediatrics (AAP) recommend eating low-fat or fat-free dairy foods like yogurt every day to help meet nutrient needs.

Eating yogurt helps Americans meet dairy food recommendations

Dairy foods like yogurt are foundational foods in healthy dietary patterns. Healthy dietary patterns, which include dairy foods, are associated with reduced risk for several chronic diseases, including cardiovascular disease (strong evidence) and type 2 diabetes (moderate evidence).[1-3] The DGA also recognizes the importance of consuming dairy foods in healthy dietary patterns to achieve peak bone mineral density in childhood and adolescence.[3-5] The DGA recommends that Americans consume dairy foods as part of healthy dietary patterns throughout the lifespan, beginning in the complementary feeding stage. At about 6 months of age, small amounts of yogurt and cheese can be introduced to infants, depending on developmental readiness.[3] The DGA recommends 1⅔ to 2 servings of whole- and reduced-fat dairy foods for toddlers 12-23 months no longer consuming human milk or infant formula as part of the Healthy U.S.-Style Dietary Pattern. It also recommends 2 daily servings of low-fat or fat-free dairy foods for children 2-3 years, 2½ for children 4-8 years and 3 for those 9 years and older in the Healthy U.S.-Style Dietary Pattern.[3] Young children come the closest to meeting DGA recommendations. Toddlers 12-23 months consume 2½ servings of dairy foods per day, on average.[3] Dairy food consumption tends to fall below recommended amounts by the time children go to school, and this trend carries forward through adolescence and into adulthood.[6] American adults 20 years and older average just 1½ servings of dairy foods daily. Overall, yogurt makes up only about 2 percent of the dairy foods consumed by Americans.[6] Encouraging adults and children to add 1 more daily serving of dairy foods like yogurt to their eating pattern is a practical way to help meet dairy recommendations.[7,8]

Eating yogurt helps Americans meet nutrient recommendations

Yogurt contains nutrients important for the daily nutrition of Americans. Low-fat yogurt is an excellent source of calcium,[9] a nutrient of public health concern in the U.S. due to low consumption,[6] as well as protein, phosphorus, zinc, vitamin B12, pantothenic acid (B5) and riboflavin (B2).[9]* Cross-sectional studies conducted in the U.S., Canada and the U.K. indicate that children and adults who ate yogurt on any given day had better diet quality than those who did not eat yogurt.[10–12] Yogurt eaters had a higher intake of several key nutrients including potassium, calcium, magnesium, vitamin D, riboflavin (B2) and fiber compared to non-eaters.[11,12] In children 2-18 years, yogurt provides, on average, about 19 percent of calcium, 11 percent of vitamin D, 12 percent of potassium, 14 percent of vitamin B12 and 10 percent of protein.[12] Among adults 19 years and older, yogurt provides 22 percent of calcium, 16 percent of vitamin D, 11 percent of potassium, 16 percent of vitamin B12 and 11 percent of protein, on average.[12]

Some yogurts contain added sugar to help reduce its natural tartness.[9] The DGA notes that a small amount of added sugar can improve the palatability of nutrient-dense foods, like low-fat and fat-free yogurt, within a healthy eating pattern.[3] Sweetened yogurt contributes to the added sugars intake of Americans in different amounts depending on age. Yogurt contributes about 18 percent of added sugars to the diets of infants 6-11 months, according to national survey data from 2005-2016.[13] Among toddlers 12-24 months, sweetened yogurt contributes 7 percent of added sugars, according to data from 2015-2016,[6] and yogurt contributes about 1 percent of added sugars to the diets of Americans 2 years and older, according to data from 2015-2018.[14]

Choosing yogurt as a snack can improve the nutrient-density of dietary patterns

Yogurt is among the most nutrient-dense snacks eaten by Americans.[15] Yogurt, like milk and cheese, is a good source of high-quality protein, and as part of a diet higher in protein, yogurt may help promote satiety when eaten as a snack.[16,17] Eating dairy foods, including yogurt, as a snack is linked with better diet quality among young children 2 to 10 years.[18] Adults who regularly ate at least 5 servings of yogurt per week had healthier dietary patterns overall and consumed fewer sweets and sugar-sweetened beverages than adults who consumed less yogurt.[19] Snacking on yogurt can help Americans eat more nutrient-dense diets.

Research indicates yogurt may be linked with lower risk for cardiovascular disease and type 2 diabetes

Eating yogurt has been linked with a range of health benefits, including a reduced risk for cardiovascular disease (CVD), type 2 diabetes (T2D) and less weight gain over time.[20] In adults, eating yogurt has been linked to a 10 percent lower risk of high blood pressure,[21] and one meta-analysis found that eating at least 7 ounces of yogurt per day was linked with a decreased risk for CVD compared to eating less yogurt.[22] High-quality evidence supports a link between eating yogurt and a reduced risk of T2D as well.[1] Results of two meta-analyses and a follow-up study of 3 large prospective cohort studies indicate that eating yogurt, or increasing yogurt consumption by ½ serving per day, is associated with an 11 to 27 percent lower risk of developing T2D in adults.[2,23,24] Another meta-analysis concluded that eating 60 grams of yogurt per day (245 grams yogurt = one 8-ounce cup) compared to eating no yogurt decreased T2D risk by 17 percent.[25] A recent cross-sectional study reported that, in adults, eating yogurt was associated with lower body weight and body mass index, as well as a 23 percent lower risk of being overweight or obese.[12]

*USDA FoodData Central (FDC) ID: Low-fat vanilla yogurt 170888. One serving refers to one cup-equivalent. For yogurt, 1 cup-equivalent equals 1 cup.

Eating yogurt is linked with decreased risk for obesity and inflammation

Emerging evidence indicates that eating yogurt may also support bone health and reduce markers of inflammation.[20,26] Eating yogurt has also been linked with improved markers of bone health in both younger and older adults.[27,28] A meta-analysis of three prospective cohort studies also concluded that eating yogurt was also linked to a reduced risk of hip fracture in older women.[29] Eating yogurt is also not linked to higher levels of inflammation and may help lower markers of inflammation. Healthy pre-menopausal women eating 1½ servings of low-fat yogurt every day for 9 weeks had reduced markers of chronic inflammation compared to women eating a yogurt (non-dairy) alternative.[26] In three additional randomized controlled trials, interventions including yogurt did not increase levels of biomarkers of inflammation.30–32 More research is needed to confirm these findings.

What to know about lactose in yogurt

Lactose intolerance (LI) may lead some individuals to avoid or decrease dairy food consumption. Dairy avoidance, whether due to LI or other reasons, can lead to inadequate consumption of important nutrients like calcium.[33] Yogurt does contain lactose; however, the cultures used to make it can help digest lactose in the body. While LI should be diagnosed and treated by a health care professional, the live cultures in yogurt can make it easier for people with LI to tolerate.[34–36] Greek-style and Icelandic-style yogurts are strained after being cultured, which can result in less lactose, more protein and less calcium than unstrained yogurts[9,37,38*] Lactose-free varieties of yogurt are also available.

*FDC ID: Traditional Icelandic skyr: 776018

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Science Summary
Milk as a Recommended Beverage

NATIONAL DAIRY COUNCIL™

Overview

Drinking milk helps children, adolescents and adults in the U.S. meet their nutrient needs, including for nutrients of public health concern. Leading health organizations recommend drinking milk as a critical component of healthy diets for young children, and the 2020 Dietary Guidelines for Americans (DGA) recommends choosing low-fat or fat-free milk as a beverage as part of healthy dietary patterns for Americans 2 years and older. Research indicates that consuming dairy foods, including milk, is not related to an increased risk of obesity in children, adolescents or adults and may help reduce risk. Encouraging adults and children to add 1 more daily serving of dairy foods like milk to their dietary pattern is a practical way to help Americans meet dairy recommendations.

Drinking milk is an affordable way for Americans to meet their nutrient needs

The 2020 DGA recommends 3 daily servings of low-fat or fat-free dairy foods, including milk, for those 9 years and older, 2 1/2 for children 4-8 years and 2 for children 2-3 years as part of the Healthy U.S.-Style Dietary Pattern.[1] It also recommends $1\frac{2}{3}$ to 2 servings of whole- and reduced-fat dairy foods for toddlers 12-23 months. While children under 12 months of age should not drink cow's milk, the DGA recommends providing small amounts of yogurt and cheese to infants 6-12 months, depending on developmental readiness.[1] Adults and children 2 years of age and older who meet dairy recommendations are less likely to be below recommendations for a number of essential nutrients including calcium, magnesium, phosphorus, protein, riboflavin, vitamin A, vitamin B12, vitamin D, selenium, potassium and choline.[2] Milk is also the leading food source of three nutrients of public health concern (calcium, vitamin D, potassium) for children 2-18 years and is the leading food source of calcium and vitamin D for all Americans over the age of two.[3] Milk provides, on average, over 35% of the daily vitamin D, 19% of the daily calcium and 9% of the daily potassium intake of Americans 2 years and older.[3]

Yet fewer than 1 in 3 children 2-18 years and roughly 1 in 7 adults 19 years and older meet recommendations for dairy intake.[2] On average, young children come the closest to meeting dairy recommendations, and dairy consumption tends to fall below recommended amounts by the time children go to school, a trend that continues through adolescence and into adulthood.[4] Toddlers 12-23 months years consume $2\frac{1}{2}$ servings of dairy foods per day, on average, most of which is milk.[1] American adults 19 years and older typically consume only 1½ servings of dairy foods daily, about half of which is milk.[3] Because a serving of low-fat milk costs about 20 cents,[5]* drinking milk is also a practical and affordable way to help close or reduce nutrient gaps and meet dairy recommendations. Dairy foods including milk are the lowest cost sources of dietary calcium and vitamin D in the U.S. diet and are among the lowest cost sources of potassium, magnesium, vitamin A, riboflavin (B2) and vitamin B12.[6,7]

Drinking milk helps achieve nutrient adequacy within recommended limits for energy and added sugars

The 2020 DGA recommends choosing water and unsweetened beverages like 100% fruit or vegetable juice or low-fat or fat-free milk or fortified soy beverages within healthy dietary patterns in place of sugar-sweetened beverages (SSBs) like soda, fruit drinks, sports and energy drinks.[1] SSBs are not a component of USDA Dietary Patterns and are not necessary in the child or adolescent diet.[1] Nonetheless, as children age, they tend to choose less nutritious beverages, like SSBs, instead of milk, a trend that carries through to adulthood.[4] Consumption of milk drops significantly with age, with milk accounting for almost one-third (32.1%) of beverage intake for 2–5 years of age but dropping to less than 15% of beverage intake among adolescents and teenagers 12-19 years.[8] Children 4-19 years who consume most of their beverage calories from sources other than milk and 100% fruit juice had lower diet quality scores and consumed more calories and added sugars than children who consumed most of their beverage calories from milk or 100% fruit juice.[9] The 2020 DGA notes, "increasing intakes of sugar-sweetened beverages and decreasing intakes of dairy are dietary components with notable and concerning shifts in consumption throughout youth."[1]

Plain milk provides no added sugars and flavored milk provides, on average, 5-6% of added sugars[10] to the diets of children 2-11 years and about 2% of added sugars to the diets of adolescents.[11] The American Academy of Pediatrics (AAP) Policy Statement on snacks, sweetened beverages, added sugars and schools supports the addition of small amounts of sugars to nutrient-dense foods like milk to increase consumption by children.[12] The AAP uses flavored milk as an example of the balance needed to limit added sugars while still promoting nutrient-rich foods.

Leading health organizations recommend young children drink milk as part of a healthy dietary pattern

Four leading health organizations, the Academy of Nutrition and Dietetics, the American Academy of Pediatric Dentistry, the AAP and the American Heart Association published Healthy Beverage Recommendations for children 0-5 years of age.[13] The statement recognizes milk as a "critical component of a healthy diet" and recommends 2-3 cups per day of whole milk for children 12-24 months, 2 cups of low-fat or fat-free milk for children 2-3 years and 2½ cups of low-fat or fat-free milk for children 4-5 years. The DGA and Healthy Beverage Recommendations statement align in their recommendations that children should not consume plant-based milk alternative beverages, except for fortified soy beverage. As the Healthy Beverage Recommendations statement asserts, non-soy plant-based beverages are inconsistently formulated, meaning they vary in nutrient and added sugar content, and are "not an equal substitute for cow's milk."[13]

*Milk cost (approximately 20 cents per serving) based on U.S. average price of unflavored, branded and private label milk per gallon.

Research indicates beneficial or neutral links between consuming dairy foods and obesity

Obesity is a critical public health concern in the U.S. and puts children and adults at risk for poor health in the immediate and long term.[14] The 2020 DGA states that healthy dietary patterns are associated with a lower risk of obesity. Research conducted since 2015 indicates that consuming dairy foods including milk in recommended amounts is linked with beneficial impacts on children's body mass index (BMI) and that children and adolescents consuming dairy foods as part of calorie-balanced dietary patterns are more likely to achieve a lean body type. Results of two meta-analyses,[15,16] one systematic review,[17] and seven prospective cohort and cross-sectional studies[18–24] indicate that consuming dairy foods, including milk, in recommended amounts is not related to measures of childhood obesity.

Drinking milk is also not related to an increased risk of being overweight in adults and may reduce the risk of becoming overweight or developing obesity. A systematic review including 16 studies on milk intake found that drinking milk reduced obesity risk in adults by 23%.[16] A meta-analysis of six studies found no evidence that consuming dairy foods, including milk, was linked with an increased risk of overweight and obesity in adults.[25] A second meta-analysis found that, in the context of an energy-restricted diet, higher intake of dairy foods like milk resulted in lower fat mass and body weight.[26]

Emerging evidence from randomized controlled trials and prospective observational studies also indicates a potential beneficial effect of consuming dairy foods, including milk, on adiposity measures in adult women.[27–30] More research is needed to fully describe the associations between consuming dairy foods as part of a calorie-balance healthy dietary pattern and healthy weight maintenance.

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Public Health Across the Lifespan

Science Brief
Dairy in Pregnancy and Lactation

NATIONAL DAIRY COUNCIL™

Quality nutrition in the first 1,000 days benefits maternal health and helps the child thrive

The importance of nutrition in the first 1,000 days – from conception to about 2 years of age – cannot be overstated and has been a leading topic of much research in recent years.[1-5] When becoming pregnant, women undergo several hormonal, metabolic and physiological changes. Throughout pregnancy and lactation, energy and nutrient requirements are increased to support normal development and health of the fetus and infant. Optimizing nutrition during this period is critical for maintaining pregnancy, placental function and lactation,[2,5,6] and is especially important for neural system development in utero and after birth.[1,3,7-9]

In the first 1,000 days, the brain grows more rapidly than any other time in a human's life.[10] While all nutrients are necessary for brain growth, inadequate consumption of key nutrients during this stage can lead to lifelong deficits in brain function even despite subsequent nutrition repletion.[11] Evidence from preclinical (animal) research and human clinical research has convincingly shown that such deficits during pregnancy can have irreversible adverse effects on a child's lifelong neurocognitive function.[1,2,7,8,12,13] In 2018, the American Academy of Pediatrics published a policy statement, Advocacy for Improving Nutrition in the First 1,000 Days to Support Childhood Development and Adult Health, which identified 3 macronutrients and 11 micronutrients as key nutrients for early brain development (**Table 1**).[3] For several of these nutrients, a deficiency early in life has been linked to long-term health consequences.[1,3,7]

Table 1. Nutrients of concern from key pediatric and health organizations for the general public, women of reproductive age, women who are pregnant or lactating and/or infants.

2020-2025 Dietary Guidelines for Americans[14]
Nutrients of concern for the general public: Calcium, vitamin D, potassium and fiber
Nutrients of concern for pregnant and lactating women: Iron, folate, choline and iodine With vegetarian or vegan dietary patterns, there is potential risk for insufficient consumption of iron, choline, zinc, iodine, vitamin B12 and long-chain polyunsaturated fatty acids [eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA)]. Pregnant women should consult with a healthcare provider to determine whether and how much supplementation of these nutrients is needed.
Nutrient of potential concern for young women of reproductive age: Vitamin B12

American Academy of Pediatrics[3]
2018 policy identified 14 key nutrients that support neurodevelopment: Protein,[a,b] long-chain polyunsaturated fatty acids,[a] carbohydrates, zinc,[a,b] copper,[a] iron,[a] choline,[a,b] folate,[a] iodine,a,b selenium,[b] vitamin A,[b] vitamin B12,[b] vitamin B6 and vitamin K. For several nutrients (including iodine, choline, vitamin B12), deficiency early in life has been linked to the potential for long-term health consequences.
World Health Organization[15]
Iodine deficiency remains the single greatest cause of preventable brain damage and mental retardation worldwide. For several nutrients (including iodine, choline, vitamin B12), deficiency early in life has been linked to the potential for long-term health consequences.

[a]Nutrients that meet the principles for demonstrating a critical or sensitive period during development.
[b]Nutrients for which dairy foods are important dietary sources.

Leading pediatric and health organizations recognize the importance of several micronutrients, including iodine, choline and Vitamin B12, during pregnancy and lactation for early growth and development (**Table 1**). For the first time, the 2020-2025 Dietary Guidelines for Americans (DGA) included nutrition guidance for pregnant and lactating women.[14] The guidelines identified calcium, vitamin D, potassium and fiber as nutrients of public health concern for all Americans, including pregnant and lactating women. Iron, folate, choline and iodine were noted as specific nutrients of concern for pregnant and lactating women and vitamin B12 as a nutrient of potential concern for young women of reproductive age. The DGA also noted that vegetarian or vegan dietary patterns during pregnancy and lactation may increase risk for inadequate consumption of certain nutrients, specifically iron, choline, zinc, iodine, vitamin B12 and potentially the long-chain polyunsaturated fatty acids (eicosapentaenoic acid [EPA] and docosahexaenoic acid [DHA]) (**Table 1**).

Iodine, choline and vitamin B12 are critical nutrients for brain development in early life, yet pregnant and lactating women may be at risk for under-consuming these nutrients

Specific to iodine, the World Health Organization (WHO) states that iodine deficiency remains the single greatest cause of preventable brain damage worldwide.[15] However, a 2017 U.S. survey of obstetrician members of the American Medical Association (n=277) and midwife members of the American College of Nurse-Midwives (n=199) revealed that about one-third of participants did not know about the importance of maternal iodine adequacy for fetal brain development or thought that iodine deficiency was not harmful for the fetus.[16] In addition, although prenatal multivitamins were recommended by almost all participating health professionals, few specifically recommended those that contain iodine: 75% of survey participants prescribed lower amounts of iodine than recommended by health professional organizations or did not recommend iodine supplementation for women prior to or during pregnancy and lactation.[16] This may be due to a lack of knowledge about iodine nutrition and an absence of specific guidelines by some obstetrical and midwife organizations (e.g., American College of Obstetricians and Gynecologists [ACOG]) to ensure adequate iodine consumption during pregnancy. Nutrition education is needed for healthcare professionals to ensure awareness of the importance of adequate iodine consumption – and other nutrients critical to cognitive development – before and during pregnancy and lactation.

Iodine

Iodine is essential for many metabolic processes in the body, such as metabolic regulation and thermogenesis.[13,17,18] An indispensable component of thyroid hormones, iodine is critical for normal neurodevelopment during pregnancy and early in a child's life.[13,17,18] In particular, thyroid hormones are required for proper development of nerve cells in the brain (i.e., neurogenesis), structural formation of brain regions (i.e., neuronal migration) and nerve cell maturation, including axonal and dendritic formation and growth, synaptogenesis and myelination. Iodine cannot be synthesized by the body, making it an essential nutrient that must be obtain through the diet.[19-22] When consumed, most iodine is absorbed across the digestive tract and is either used by the thyroid gland for thyroid hormone synthesis or by the kidney for urinary excretion. Importantly, about 90% of the iodine that is absorbed is excreted within 24 hours, emphasizing the importance of adequate nutrition to maintain proper levels of this essential micronutrient in the body.

Dairy milk and other dairy foods are significant contributors to iodine adequacy in the diet.[23-25] Other commonly consumed foods that contain iodine include fish, eggs and iodized salt (in countries where iodine fortification is voluntary or mandatory). According to the DGA, women who do not regularly consume foods providing iodine (dairy, eggs, seafood) and/or do not use iodized salt are more likely to have insufficient intakes of iodine and may need to increase intake from dietary supplements. In the U.S. and many European countries, dairy milk and other dairy foods have been shown to be major dietary sources of iodine during pregnancy and lactation and in women of childbearing years, and higher consumption of dairy milk and other dairy foods by pregnant women and women of childbearing years has been shown to increase the likelihood of iodine sufficiency.[26-29] This suggests that women who consume little or no milk and dairy foods may be at increased risk for iodine deficiency. Furthermore, breastmilk iodine content is dependent on maternal iodine intake and is the sole source of iodine for exclusively breastfed infants.

While tracking iodine status at the individual and population level has critical public health implications, there are important gaps and limitations in the U.S. and globally to do so. Considered the current gold standard, WHO recommendations monitoring the iodine status of populations via urinary iodine concentrations (UIC) in spot urine samples. This is a widely used methodology to assess population iodine status in regional surveillance, epidemiology and clinical research.[15] For example, NHANES research utilizes the WHO criteria to classify iodine status by the median UIC as a proxy for iodine consumption in U.S. populations.[26,27,30-32] Yet, since most iodine absorbed by the body is readily excreted in the urine, UIC is considered a sensitive marker of current, but not long-term (i.e., habitual), iodine consumption or thyroid function. As such, UIC is not a reliable indicator of iodine status in individuals, and currently there are no valid biomarkers to assess the iodine status of individuals. Tracking of iodine status through assessment of dietary patterns may be an important method to complement UIC data. Until recently, the iodine content of foods in the U.S. and many countries has been lacking in food databases that are used to assess nutrient consumption in the general public. In 2020, a collaboration of the USDA, the Food and Drug Administration (FDA) and the Office of Dietary Supplements (ODS) led to the development and release of a database containing iodine content of nationally representative foods and dietary supplements (available at FoodData Central, www.ars.usda.gov/mafcl),[23-25] which revealed the iodine content of some foods can vary considerably. Sources of variability include the iodine content in soil, irrigation practices, and, for dairy products, the iodine in the cows' diets and/or iodophor sanitizers used to keep cows' udders healthy.[33,37] The iodine content of commercial seaweeds is particularly variable (16 to 2,984 ug/g), and although rarely consumed in the U.S., the consumption of some seaweeds can lead to excessive iodine intakes.[33-35]

In the U.S., the iodine status of most of the population is considered adequate: however, evidence from NHANES research indicates that pregnant women may have mild or borderline iodine deficiency.[26-29] During pregnancy, many hormonal and metabolic changes occur that influence thyroid-related functions. Notably, thyroid hormone production is increased by 50% and placental uptake of maternal thyroid hormones begins early in gestation; thus, iodine requirements are increased during pregnancy.[17] This increased iodine requirement is vital to cognitive development of the fetus during the first half of pregnancy, because fetal neural system development depends on the transfer of maternal thyroid hormones across the placenta.[13] Many health professional organizations in the U.S. and globally recommend that women who are planning to become pregnant and women who are pregnant or lactating take a daily dietary supplement containing 150 ug of iodine.[36-38]

Although evidence is limited, mild-to-moderate iodine deficiency in women of childbearing years and lactating women also may lead to adverse effects on neurocognitive development of the fetus and young child.[18,39] In addition, an emerging body of literature, largely from observational studies, indicates that mild-to-moderate iodine deficiency during pregnancy also may be associated with deficits in neurocognitive development well into the childhood years.[17,18] It is well documented that when maternal iodine consumption during pregnancy is severely deficient, deficits in cognitive development of the child are potentially irreversible.[17,40-43] More research, particularly well-designed, adequately powered cohort studies and randomized controlled trials (RCTs), is needed to better understand neurocognitive outcomes in children of mothers with mild-to-moderate iodine deficiency before and during pregnancy and lactation. The development of robust, validated biomarkers to accurately evaluate iodine status both at the individual and population level will be instrumental to these efforts.

Choline

Choline supports a diverse number of metabolic and structural functions in the body.[44-46] While choline is notably known as a vital component of cellular one carbon (1-C; **Table 2**) metabolism as a methyl donor, choline also is essential in the body for cholinergic neurotransmission and lipid and cholesterol transport, and plays a structural role in cell membranes (i.e., phosphatidylcholine, sphingomyelin). Humans can synthesize choline, but not in sufficient amounts to meet choline needs across the lifecycle.

At current consumption levels, dairy foods along with meats and eggs are the top 3 food sources of choline.[45,47,48] Food sources of choline include animal-based foods (e.g., meat, eggs and dairy foods) as well as some plant-based foods. Choline is present in foods in both fat-soluble and water-soluble forms, with animal and plant foods generally being rich in fat- and water-soluble forms, respectively.[44] Human milk contains mainly water-soluble forms (primarily phosphocholine and glycerophosphocholine) as does dairy milk (primarily glycerophosphocholine). Choline consumption from dietary supplements has historically been limited because it is commonly absent (or present only in low amounts) in most supplements,[14,49] although that may be changing.

Exclusive breastfeeding is universally recommended, including by the most recent DGA for at least the first six months after birth followed by breastfeeding along with complementary foods, including yogurt and cheese, over the next six months.[14] Choline levels in breastmilk increase rapidly between seven and 22 days after birth and thereafter remain relatively stable.[50] The amount of water-soluble choline is similar in breastmilk of lactating women who consume vegetarian, vegan or non-vegetarian diets.[51] Choline levels in preterm breastmilk are notably lower than those in full-term breastmilk.[50,52] and it has been suggested that preterm infants may be choline deficient at birth.[53]

Table 2. An overview of cellular one carbon metabolism[a]

What is one-carbon (1-C) metabolism?[a]
One carbon metabolism is a multi-nutrient metabolic network centered around folate metabolism. Folates are 1-C (also known as methyl groups) donors and acceptors in the cell, and this transfer of 1-C units supports cellular metabolism (synthesis and breakdown of various compounds, such as DNA).[82]
What are 1-C metabolism-related nutrients?
Folate, vitamin B6, methionine, choline, vitamin B12 and betaine[83]
How is 1-C metabolism, function and nutrient adequacy linked to health outcomes and cognition?
A child's growth and development are metabolically stressful periods characterized in part by increased requirement of 1-C nutrients. The nervous system and brain are particularly sensitive to nutrient availability during development.
Inadequate consumption of these methyl donor nutrients can impact maternal health, pregnancy and birth outcomes; perinatal growth and development and long-term programming effects.[57,84,85] One suggested mechanism from animal studies and observational studies is the role of dietary methyl donors (i.e., folate, vitamin B12 and choline) on fetal programming via epigenetic regulation involving DNA methylation before and during pregnancy and lactation.[85,96]

[a]Adapted from K. Klatt, personal communication, August 16, 2022

Most Americans, including pregnant and lactating women, fall short of the recommended amounts of choline.[44,54] The recommended intake (Adequate Intake, AI) for choline by women of childbearing years and during pregnancy and lactation is 425, 450 and 550 mg/d, respectively. Average choline consumption during pregnancy, for example, are 70% of the AI. The DGA encourage women who are pregnant and lactating to consume a variety of choline-containing foods across all food groups.[14] This includes the recommended servings from the dairy and protein food groups and from the beans, peas and lentils subgroup to help achieve amounts compatible with the AI. Increasing consumption of dairy foods from the current 1.85 cup-equivalent servings to the recommended 3 cup-equivalent servings per day could help many pregnant women get closer to meeting choline recommendations.

The importance of sufficient choline consumption during pregnancy is becoming increasingly evident from emerging clinical research and a large body of preclinical animal research. Research on potential health benefits associated with maternal choline status and consumption has focused largely on neurocognitive development of offspring in the first few years after birth, and less so on maternal health and pregnancy outcomes. Overall, studies in humans show that higher choline consumption during pregnancy protects against neural tube defects during fetal development and enhances neurocognitive development into early childhood.[55-60] While based on a more limited body of science, daily consumption of 450–1000 mg choline, which is close to the current AI and up to twice the AI, respectively, has been proposed as an adequate range that can both support fetal development[55-60] and improve pregnancy outcomes.[61] Large-scale, long-term clinical trials that are designed to evaluate the impact of a range of choline consumption levels on a broad scope of clinical outcomes and metabolic health markers are needed to establish recommendations for maternal choline consumption for optimal fetal development and reduced risk of pregnancy complications.

Vitamin B12

Vitamin B12 is a water-soluble vitamin that is important in cellular metabolism and DNA synthesis, the formation of red blood cells and neurocognitive development beginning early in pregnancy.[62] In particular, vitamin B12 is a critical cofactor for two key enzymes in cellular 1-C metabolism pathways (**Table 2**).[62]

Vitamin B12 consumption is almost exclusively derived from animal foods, including dairy milk and other dairy foods.[63] Other dietary sources include vitamin B12 fortified foods such as ready-to-eat cereals, some nutritional yeasts and dietary supplements (many dietary supplements contain vitamin B12, but in highly variable amounts).[63] According to the DGA, vegetarian and vegan diets may not provide sufficient amounts of vitamin B12 during pregnancy and lactation, for exclusively breastfed infants, and for infants and toddlers due to vitamin B12 intake relying on consumption of animal source foods (and dietary supplements).[14] This aligns with research suggesting that dairy milk and other dairy foods are important dietary sources of vitamin B12 during pregnancy and lactation. For example, an NHANES study showed that pregnant women who consumed 3 or more cup-equivalents of dairy foods daily had higher vitamin B12 intakes than those who consumed 2 cup-equivalents, 1 cup-equivalent or less than 1 cup-equivalent of dairy foods each day.[26] Other NHANES studies also have shown that consumption of vitamin B12 from foods during pregnancy is similar to that of non-pregnant women and in the general U.S. population.[26,64-66]

There are numerous gaps in our current understanding of the vitamin B12 content in breastmilk.[67,68] While limited research indicates that vitamin B12 concentrations in breastmilk can be increased by increasing maternal consumption of B-12-containing foods and with vitamin B12 supplementation during lactation, further research is needed. Overall, a better understanding of sources of variability in breastmilk levels of vitamin B12, specifically maternal blood levels of vitamin B12 and/or methodology for vitamin B12 analyses, is needed. Future research should define reference values for vitamin B12 in human breastmilk, which then will help inform recommendations for vitamin B12 amounts needed during lactation and by infants.

Several published reviews have examined associations between maternal vitamin B12 status before and/or during pregnancy and maternal health, pregnancy and birth outcomes and neurocognitive development of offspring, yet the studies are highly variable in methodology and findings.[62,69-75] Systematic reviews of studies from across the globe, many cross-sectional, report limited and inconsistent evidence for associations between maternal vitamin B12 status and maternal health (including anemia, pre-eclampsia and gestational diabetes).[62,75] Other bodies of literature have shown an increased risk of neural tube defects with low maternal vitamin B12 status[62,71] and that maternal vitamin B12 deficiency during pregnancy may be associated with increased risk of preterm birth and low birthweight in newborns;[72,73,76] yet, findings are inconsistent and more research is clearly needed.

One factor that likely plays a role in the variability among study findings is that vitamin B12 deficiency can be challenging to diagnose, especially in pregnant women.[77,78] The symptoms of vitamin B12 deficiency are not unique to vitamin B12 deficiency, and all of the vitamin B12 status biomarkers typically utilized in health screenings and/or studies are affected by the normal physiological and hormonal changes that take place during pregnancy.[79,80] In addition, a classic symptom of vitamin B12 deficiency, macrocytic anemia, also is a symptom of folic acid deficiency; therefore, high folate status can "mask" vitamin B12 deficiency and supplementation with folate may be recommended.[81]

Overall, more well-designed studies are needed to evaluate the effects of varying degrees of maternal vitamin B12 deficiency and benefits of vitamin B12 consumption or supplementation before and/or during pregnancy and lactation on neurocognitive development of children. Part of this work will be to clearly define and standardize vitamin B12 biomarker testing and reference ranges for a broad range of populations, including for women before and during pregnancy (each trimester), pregnancy-related complications, different ethnic groups, vegetarians, vegans and for those with pre-existing medical conditions.[77,81]

Dairy milk and other dairy foods can help meet recommended amounts of iodine, choline and vitamin B12 during pregnancy and lactation

Milk, cheese and yogurt are nutrient-rich foods that are important dietary sources of several essential nutrients, including iodine, choline and vitamin B12, for optimal health across the lifespan and particularly for maternal and infant health. Evolving evidence indicates that insufficient consumption of iodine,[17,18,40,41,88,89] choline[24,55-57] and vitamin B12[70,71,90-93] may increase risk for pregnancy complications, preterm birth, low birthweight and/or result in adverse effects on neurocognitive development. Women who are pregnant or lactating, particularly those who do not regularly consume the recommended amounts of dairy foods, may consume inadequate amounts of these nutrients. There is an opportunity to raise awareness about the public health implications of nutrition for early life cognitive development. Dairy foods can be a part of the solution as a nutritious, affordable and accessible source of critical nutrients, including iodine, choline and vitamin B12, to help ensure children have a fair start to a lifetime of wellness.

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Science Summary

Dairy Foods Help Nourish Infants and Toddlers

NATIONAL DAIRY COUNCIL™

Overview

Leading pediatric and health organizations recognize the benefits of milk and dairy foods in the early years after birth. Exclusive breastfeeding is recommended for at least the first 6 months followed by breastfeeding along with a variety of nutrient-dense complementary foods from all food groups, including dairy (i.e., cheese, yogurt), to support early growth and build a life-long foundation for healthy eating. Food allergies, including dairy milk allergy, are rare and typically develop in the first 2 years after birth, then decline through childhood. Pediatric and health organizations recommend introducing potentially allergenic foods, including dairy foods, during the complementary feeding period. After the first birthday, whole dairy milk is recommended as the primary beverage, and water may be given to help quench thirst. As part of a healthy diet for 1-2 year-olds, the 2020 Dietary Guidelines for Americans (DGA) recommends 1 ⅔ to 2 cup equivalents of dairy foods (whole milk, yogurt, cheese) depending on daily calorie needs. In this age group, milk and dairy foods contribute more than 25% of daily energy consumed and about 40% of protein and vitamin A, 77% of vitamin D, 64% of calcium, 31% of magnesium, one-third or more of potassium and zinc – and less than 18% of daily sodium intake. For toddlers with confirmed dairy milk allergy, lactose intolerance or parental preference to avoid dairy foods, the only acceptable plant-based alternative to dairy milk is unsweetened fortified soy beverage. Other plant-based beverages lack or fall short of key nutrients found in dairy milk and have been linked to nutrient deficiencies and metabolic imbalances. Leading pediatric and health organizations recognize the benefits of dairy milk and foods for early childhood.

Leading pediatric and health organizations recognize the benefits of milk and dairy foods in the early years after birth

Guidance from leading pediatric and health organizations for infant and toddler feeding practices is grounded in decades of research assessing nutritional requirements for healthy growth, cultural influences on eating patterns and key developmental milestones.[1-3] Exclusive breastfeeding is universally recommended,[1, 2, 4-8] including most recently by the 2020 Dietary Guidelines for Americans (DGA),[9] for at least the first 6 months after birth followed by breastfeeding along with complementary foods, including yogurt and cheese, over the next 6 months. An iron-fortified infant formula is the only acceptable alternative for breastmilk from birth to 12 months.[2, 7] The American Academy of Pediatrics (AAP)[7] and others[2, 10] further state that when mutually desired by mother and child, breastfeeding may continue beyond 12 months.

Beginning at about 6 months of age, parents are encouraged to offer a wide variety of nutrient-dense complementary foods from all food groups, including the dairy group (i.e., plain, unsweetened whole milk yogurt, cheese), to help support infant growth and to begin to build a foundation for healthy eating.[2, 3, 5, 9, 11] In the United States (U.S.), breastmilk, infant formulas and baby foods are the top three sources of energy intake by 6-12 month old infants and together account for 74% of daily calories; table foods and other beverages make up the remaining 26%.[12] Health professional organizations in the U.S. concur that the transition from breastmilk and/or infant formula to regular dairy milk should not occur before the first birthday[2, 9, 13] because of increased risk for intestinal bleeding.[2, 14] About a third (34%) of 6-12 month old infants in the U.S., however, are given fluid dairy dairy milk too early.[3]

The 2020 DGA recommends, as part of a healthy diet, 1-2 year-olds consume 1 ⅔ to 2 cup equivalents (eq) of dairy foods (whole milk, yogurt, cheese) depending on daily calorie needs (~700-1000 kcal/d).[9] Whole dairy milk is recommended as the primary beverage for most toddlers by four leading health organizations comprising a 2019 expert panel: the AAP, Academy of Nutrition and Dietetics, American Academy of Pediatric Dentistry and the American Heart Association.[2, 10] In addition to whole dairy milk being an important source of energy and key nutrients for growth, a systematic review and meta-analysis of 20 cross-sectional and 8 prospective cohort studies of 1-18 year-old children showed that consumption of whole dairy milk (3.25% fat) compared with lower fat milks (0.1-2% fat) was associated with a lower likelihood of overweight or obesity.[15] Consumption of water, but not other beverages, also is encouraged to help quench thirst and meet fluid requirements.[2, 9-11]

Dairy's unique nutrient package provides key nutrients for healthy growth and development

The nutritional adequacy of the diet of infants and toddlers, environmental influences and the child's genetic background all play important roles in healthy growth and development.[16, 17] Inadequate or excess amounts of energy, individual nutrients and/or nutrient combinations can affect the development of organs, including the brain,[17] bone[18] and gastrointestinal system[19] and can have lasting consequences.[16, 20] Consistent with the 2020 DGA recommendation that a variety of foods from all food groups be offered starting at about 6 months of age[9], most 6 to 12 month old infants consume fruits (84%), vegetables (79%) and grains (89%); about half (47%) in this age group consume protein foods; and 19% and 11% consume cheese and yogurt, respectively.[3]

Beginning at 1 year of age, dairy milk replaces breastmilk and/or infant formula as the main beverage for toddlers and young children. Nearly all (96%) toddlers consume dairy milk, 66% consume cheese, and 22% consume yogurt[3] with average consumption of 2.5 cup eq/d of dairy foods (milk, 2.1 cup eq; cheese, 0.4 cup eq; yogurt, 0.1 cup eq).[9] Milk, cheese and yogurt are important sources of energy and nutrients for toddlers (12-24 months), together contributing more than 25% of daily energy, about 40% of protein and vitamin A, 77% of vitamin D, 64% of calcium, 31% of magnesium, one-third or more of potassium and zinc[12] – and less than 18% of daily sodium.[21] Milk alone is the number 1 food source of energy, protein, calcium, vitamin D, potassium, vitamin A, magnesium and zinc for this age group.[12] Although consumption of macronutrients and most micronutrients is generally adequate from birth to 2 years of age in the U.S.,[22, 23] nutrient gaps exist for iron between 6 and 12 months and for vitamin D, vitamin E, potassium and fiber between 12 and 24 months of age.[9, 23] In addition, toddlers overconsume sodium[9, 22, 23] and added sugars.[9]

Yogurt and cheese as complementary foods help establish healthy eating habits

Infants begin to learn how to eat when first offered complementary foods.[24-26] Preferences for specific foods also are learned, and offering a variety of nutrient-dense foods can help establish healthy eating habits that extend at least into early adulthood.[24] The overall goal in shaping an infant's eating behavior is to match their consumption to their energy and nutrient needs for healthy growth and development.[25, 26] Offering foods with a variety of flavors and textures can help with early acceptance of healthy foods across all food groups.[2] Yogurt and cheeses, for example, provide unique sensory experiences (e.g., texture, taste, flavors) that can contribute to healthy eating habits. Plain, unsweetened yogurt alone or with fruits and/or vegetables is a nutritionally sound approach for a sour/tangy taste experience, and cheese comes in a variety of textures ranging from soft and solid to lumpy (e.g., cottage cheese). Portion sizes vary and depend in part on when 6-12 month-old infants are developmentally ready to accept the individual dairy foods.[27, 28] The Child and Adult Care Food Program (CACFP) meal pattern guidance for this age group states that up to 2 ounces of cheese, up to 4 ounces of cottage cheese and/or up to 4 ounces of yogurt may be offered at breakfast, lunch and/or supper.[27] It has been proposed that with repeated exposure to a new food, infants associate its sensory properties to its energy density and at least to some extent learn to modulate amounts eaten.[24]

Although health professional guidance states that complementary foods should be introduced starting at 6 months of age,[2, 9] about half (47%) of U.S. infants are first offered complementary foods between 4 and 6 months of age[3]. The 2020 Dietary Guidelines Advisory Committee (DGAC) report, however, concluded that introducing complementary foods at 4-5 months of age does not offer long-term advantages or disadvantages with regard to the select developmental indicators examined: growth, size, body composition, overweight or obesity; iron status; or risk of developing food allergy, atopic dermatitis/eczema, or asthma during childhood.[3] Even though offering complementary foods before 4 months of age is not recommended,[3, 11] a third (32%) of U.S. infants are introduced to complementary foods before the age of 4 months.[3, 9, 29]

Experts support early introduction of potentially allergenic foods, including dairy

While food allergies typically develop in the first 2 years after birth,[30] they are rare and impact 6-8% at 1 year of age,[30] and are immune system reactions to specific proteins in foods, not the food as a whole. Immunogenic responses involve mainly the skin, respiratory system and digestive system[2, 31] and may be IgE-mediated or non-IgE-mediated.[32-34] Symptoms range from mild to severe and can be immediate (within hours) or delayed (days to weeks after exposure).[31, 32] When digestive symptoms are present, differential diagnostics may be needed to distinguish. from other causes such as lactose intolerance, which is a sensitivity to lactose (a disaccharide) and not an allergy[32, 33] While any food can elicit an allergic response, nine types of foods account for the vast majority of food allergies: peanuts, eggs, milk and dairy, tree nuts, soy, wheat, fish, shellfish and sesame.[35, 36] Some allergies, including dairy milk and egg allergy, peak at around 1 to 2 years of age and then fall progressively through childhood.[37] Dairy milk allergy in the U.S is reported to affect about 1.5% of infants (<12 m), 4.3% of toddlers at 2 years of age and 1.1% of 11-13 year-old children.[37] Health professional guidance is widely available in the U.S.[32, 34] and globally[31, 38, 39] to help physicians diagnose dairy milk allergy, manage symptoms in infants and children and help ensure proper nutrition for healthy growth and development.

Pediatric and health organization recommendations about when to introduce potentially allergenic foods, including dairy foods, have shifted in recent years – from delaying introduction until after the first birthday to introducing these foods during the complementary feeding period.[3, 9, 32, 34] Most recently, a 2019 Nutrition Evidence Systematic Review, which was conducted as part of the USDA and the Department of Health and Human Services Pregnancy and Birth to 24 Months project, concluded that moderate evidence suggests no relationship between the age of complementary food introduction and risk of developing food allergy, atopic dermatitis/eczema or childhood asthma.[40] This review informed the 2020 DGAC scientific report, which concurred with these findings[3] and led the 2020 DGA to recommend introducing infants to potentially allergenic foods, including yogurt and cheese, beginning at around 6 months of age.[9]

In the 2019 Systematic Review, yogurt and cheese were included among the other complementary foods examined, however, fluid dairy milk (in the form of dairy milk-based infant formulas and regular dairy milk) was not.[40] The majority (81%) of infants in the U.S. are fed infant formula, including dairy milk-based formulas and/or regular milk in the first year after birth.[41] Among these infants, 69% are fed dairy milk formula, 5% are fed gentle/lactose-reduced infant formulas, 12% are fed soy-based infant formulas, 6% are fed specialty formulas and 13% are fed regular milk (e.g., dairy milk, flavored milks, soy beverage). While fluid dairy milk did not meet the predetermined definition of complementary foods for the systematic review, it was noted that future work should include systematic review of studies that examined fluid dairy milk consumption during the first year of life in relation to allergy-relevant health outcomes.[40]

Yogurt consumption by infants and toddlers – evidence for gut health benefits

A 2019 systematic review of seven randomized,[42-48] one observational[49] and two prospective cohort[50, 51] studies found that consumption of yogurt by healthy infants and toddlers and those with infectious diarrhea was linked to gut health benefits.[52] Collectively, these studies examined effects of yogurt consumption on a broad range of interrelated outcomes that included duration of diarrhea, intestinal colonization and later risk of atopic disease. Yogurt consumption by infants and toddlers was shown to have beneficial effects on recovery from infectious diarrhea[43-45, 47] and on intestinal microbial composition,[46, 49] which included increased colonization with lactobacilli and bifidobacteria.[49] The two prospective cohort studies further showed that yogurt consumption by infants (<12 m of age) was associated with reduced risk of atopic dermatitis after the first birthday,[50, 51] and in one of these studies, with a positive effect on food sensitivity.[51] Conclusions about these benefits, however, are constrained due to the small number of studies, diverse endpoints examined, cultural influences across studies (i.e., developed/under-developed regions across the globe) and study population differences (e.g., healthy; acute/persistent diarrhea, malnutrition and/or hospitalization). More research clearly is needed to advance our understanding of the rapid and complex changes in intestinal microbiota and concurrent maturation of the immune system when new foods, including dairy foods, are added to the diet of infants and toddlers.[53-55] As noted in a 2021 review by a leading expert in gut microbiology, “Although current data is often fragmentary and observational, it can be concluded that the nutrition that a child receives in early life is likely to impinge not only on the development of the microbiota at that time, but also on the subsequent lifelong, functional relationships between the microbiota and the human host.”[54]

Plant-based milk alternatives are not recommended for toddlers and young children

Most toddlers and young children tolerate dairy milk.[14] Among the many plant-based milk alternatives available today, unsweetened fortified soy-based beverage is the only one acceptable milk alternative for the approximately 4% of toddlers with dairy milk allergy.[9, 10, 14] Although often labeled as "milk" (e.g., rice milk, almond milk, etc.), many plant-based milk alternatives lack or fall short of key nutrients found in dairy milk.[10, 14] A 2020 position paper by the North American Society for Pediatric Gastroenterology, Hepatology and Nutrition (NASPGHAN) states that "without adequate compensation for nutrients not supplied in such a product, [plant-based "milk"] can place a young child at risk."[14] In addition to the potential for inadequate consumption of energy, protein and select micronutrients, adverse effects on growth, nutritional status and health indicators including protein-energy malnutrition and metabolic and electrolyte disorders have been found.[14]

The energy and nutrient content of plant-based beverages is highly variable.[14] In addition, most have a lower protein content than dairy milk per serving and lower protein quality. The NASPGHAN position paper estimated that an 8-ounce serving of soy- or pea-based milk-alternative provides about 60% of the protein-equivalent found in an 8-ounce serving of dairy milk, and for oat-, rice- and almond- based milk alternatives, dairy milk protein-equivalents are even lower at around 36%, 8% and 2%, respectively.[14] Although the protein quality of these milk alternatives can be improved by adding limiting amino acids, this often leads to unpleasant flavor and aroma profiles. Sweeteners can be and are added to improve the taste (as high as 17 g per serving),[14] however, consumption of sweetened beverages, including sweetened forms of plant-based milk alternatives, by toddlers and young children is not recommended.[9, 10, 14] Parents are encouraged to consult with their health care provider when considering a plant-based milk alternative to dairy milk for a toddler or young child with allergies or lactose intolerance, or if parental preference is to avoid dairy products.[10, 14] Leading pediatric and health organizations agree that unsweetened dairy milk should be the main beverage for all other toddlers (12-24 m) and young children[2, 9, 10, 14] along with water to quench thirst and, if necessary, fortified soy beverage as the alternative to dairy milk.[2, 9, 10]

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Science Summary

Dairy and Bone Health

NATIONAL DAIRY COUNCIL™

Overview

Daily consumption of dairy foods like milk, cheese and yogurt is part of the Dietary Guidelines for Americans (DGA) recommendations for children, adolescents and adults. Research indicates that dairy foods are integral dietary components for building and maintaining healthy bones throughout the lifespan, from early childhood to late adulthood. Dairy foods contain nutrients essential for bone growth and development, including calcium, vitamin D, phosphorus, potassium and magnesium. Consuming adequate amounts of dairy foods daily helps ensure that children and adolescents achieve peak bone mass, which is associated with reduced risk for osteoporosis later in life. Consuming dairy foods throughout adulthood, including older adulthood, can help ensure the maintenance of healthy bones and is linked with reduced fracture risk. Research published since 2015, highlighted below, provides further support for the 2020 DGA recommendations that all Americans ages 9 and older consume three servings of low-fat or fat-free dairy foods as part of the Healthy U.S.-Style Dietary Pattern, accompanied by adequate physical activity, to support bone health.

Leading health organizations recommend eating dairy foods daily to achieve peak bone mass

Developing peak bone mass by young adulthood with good nutrition, including adequate calcium and vitamin D intake, and physical activity is one strategy to optimize bone health and reduce the risk of bone diseases later in life.[1,2] The importance of consuming dairy foods as part of healthy dietary patterns to achieve peak bone mineral density in childhood and adolescence has been recognized by numerous health professional organizations as well as the 2020 DGA.[3] The Healthy U.S.-Style Dietary Pattern in the 2020 DGA recommends 3 daily servings of low-fat or fat-free dairy foods for those 9 years and older, 2½ servings for children 4-8 years and 2 servings for children 2-3 years.[3] It also recommends 1⅔ to 2 servings of whole- and reduced-fat dairy foods for toddlers 12-23 months and small amounts of yogurt and cheese for infants 6 to 12 months, depending on developmental readiness.[3] Milk is the top food source of important nutrients for bone health, including calcium, vitamin D and potassium, among Americans 2 years and older.[4-6] The National Institutes of Health (NIH) stress the importance of calcium for bone development and highlight that consuming the recommended 3 servings of dairy foods per day during childhood and adolescence can help meet calcium requirements.[7] The American Academy of Pediatrics (AAP) recommends that pediatricians "encourage increased dietary intake of calcium- and vitamin D-containing foods and beverages," such as dairy products.[2] Like the 2020 DGA, the AAP recommends that children 4 to 8 years consume "2 to 3 servings of dairy products" or calcium-equivalent foods daily and that adolescents consume 4 servings per day of dairy or calcium-equivalent foods.[2]

Consuming dairy foods is linked with improved bone mineral density in children and adolescents

Three systematic reviews[1,8,9] and a clinical trial[10] demonstrate the importance of consuming dairy foods for children and adolescents to achieve peak bone mass. One systematic review indicated that consuming dairy foods was linked with greater bone mineral content during childhood in 6 of the 7 trials it reviewed.[9] Similarly, a second systematic review showed that, in 8 of 11 randomized controlled trials, consuming dairy foods was associated with greater bone mineral content and density in children and adolescents.[8] A 2016 systematic review and position statement from the National Osteoporosis Foundation (NOF) also indicated a beneficial role of dairy foods for bone mineral density from childhood through late adolescence.[1] After the authors of the NOF review assessed over 150 studies on lifestyle factors related to peak bone mass in children, adolescents and young adults, they determined that the links between calcium and bone health and between physical activity and bone mass and density were supported by the strongest evidence ("grade A"). Good evidence, "grade B," supported the links between dairy intake and bone health, vitamin D intake and bone health and physical activity and bone structure.[1]

A clinical trial assessed the impact of consuming an additional 3 servings of dairy foods daily (in addition to usual dairy food intake) on bone mass accrual, comparing it to usual intakes of dairy foods in boys and girls from 8 to 16 years of age.[10] The only difference between the two groups is that the group consuming additional servings of dairy foods had greater gains in bone mineral content of the tibia.[11] This study reinforces the importance of adequate calcium intake for bone health in childhood and adolescence.

Consuming dairy foods is linked to better bone mineral density and bone mass maintenance in adults

Research indicates that consuming dairy foods helps maintain bone mass throughout adulthood and is associated with reduced fracture risk and greater bone mineral density. Results of four systematic reviews indicate the importance of meeting dairy recommendations to help maintain bone mineral density in adulthood.[12–15] Among women, low milk intake during adolescence was associated with a 1.7% to 3% lower hip bone mineral density in adulthood.[12] Two reviews found that eating yogurt was linked to better bone health.[13,14] In one of these reviews, higher yogurt intake (compared with low or no intake) was linked with reduced risk of hip fracture, and eating cheese daily was linked with higher bone mineral density.[13] A meta-analysis found that eating dairy foods increased bone mineral density in women, concluding that "dairy product consumption should be considered an effective public health measure to prevent osteoporosis in postmenopausal women."[15]

Evidence from prospective cohort studies and clinical trials indicates that consuming dairy foods does not negatively impact bone health outcomes and may be linked to improved bone health. According to one prospective cohort study, higher intakes of milk, milk and yogurt, and milk, yogurt and cheese were linked to greater bone mineral density in men.[16] Similarly, a study that assessed bone health in 1,955 women across the menopausal transition found that dairy food intake was not linked with loss of bone mineral density or fracture risk.[17] Dairy food intake was low overall among study participants, with 65% consuming less than 1.5 servings of dairy foods per day. Another prospective study found that consuming dairy foods was not linked with bone mineral density over a 4 year period.[18] Results of two clinical trials indicate that eating yogurt may benefit bone mineral density in older adults[19] and may benefit bone turnover and bone metabolism in young adult males when paired with regular physical activity.[20] In a third clinical trial, eating dairy foods and taking calcium and vitamin D supplements led to greater bone calcium retention in post-menopausal women.[21]

Dairy foods may help maintain bone mineral density with weight loss

Obesity affects nearly 42% of U.S. adults.[22] However, treating obesity with weight loss can decrease bone mineral density, especially in women.[23] Emerging evidence indicates that consuming dairy foods as part of a healthy dietary pattern in weight-reduction programs may help maintain bone health. In one clinical trial, post-menopausal women participating in a weight loss study consumed either 4-5 servings of low-fat dairy foods per day or calcium and vitamin D supplements. Participants consuming dairy foods had better bone health outcomes than those in the control group.[24] A second trial of 35 adolescent girls with overweight or obesity found that the 19 girls assigned to consume 4 servings of dairy foods per day had better bone health markers (decreased bone resorption) than the 16 girls assigned to consume less than 2 servings of dairy foods daily.[25]

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Science Summary
Lactose Intolerance

Overview

Dairy foods such as milk, yogurt and cheese are an integral part of healthy eating patterns in the United States (U.S.), providing important shortfall nutrients like calcium, potassium and vitamin D, as well as other essential nutrients. The Dietary Guidelines for Americans (DGA) recommends 3 daily servings of low-fat or fat-free dairy foods for those 9 years and older in the Healthy U.S.-Style and Vegetarian Dietary Pattern. Lactose intolerance (LI) is a real condition that can include digestive discomfort and social stress. It affects people differently and deserves individualized management. It may also lead some individuals to avoid or limit dairy food consumption, which can result in missing out on many essential nutrients found in dairy foods. Currently, LI is not associated with risk of poor health outcomes, such as osteoporosis or cancer, but more studies are needed to address these research areas. Objective diagnosis by health professionals coupled with personalized management strategies can help many Americans who experience LI symptoms enjoy dairy foods in their eating patterns and meet nutrient needs.

Dairy foods make important nutrient contributions to the eating patterns of Americans

The goal of the DGA is to enable individuals throughout the lifespan to have healthy eating patterns that promote health and reduce the risk of chronic disease.[1] Dairy foods (milk, yogurt and cheese) make up an important and affordable food group within healthy eating patterns, providing a significant portion of essential nutrients to the American diet such as high-quality protein, calcium, potassium and vitamin D.[1,2] The 2020-2025 DGA recommends 3 servings of low-fat or fat-free dairy foods for Americans 9 years and older, 2½ servings for children 4-8 years and 2 servings for children 2-3 years as part of the Healthy U.S.-Style and Vegetarian Dietary Pattern Eating Pattern.[1] Additionally, the DGA recommends 1⅔ to 2 servings of whole- and reduced-fat dairy foods for toddlers 12-23 months and small amounts of yogurt and cheese for infants as early as 6 months (depending on developmental readiness).[1]

Understanding the difference between lactase non-persistence and lactose intolerance

Given the importance of dairy foods for meeting the nutrient needs of Americans, it is important to consider potential barriers to dairy food consumption, such as *lactose intolerance (LI)*. LI is characterized by a group of symptoms, such as abdominal pain, bloating, gas and/or diarrhea, that occur after the consumption of dairy foods. If a person develops these symptoms due to the inability to break down milk sugar, *lactose* (Table 1), that person is said to have LI.[3,4]

Table 1. Definitions of Lactose and Lactase[4]

Lactose	A disaccharide (sugar) of glucose and galactose, and the main carbohydrate in milk (5%). Found in mammalian milk and dairy foods including yogurt and cheese.
Lactase	An enzyme that is released in the small intestine. Breaks down lactose into its component monosaccharides, glucose and galactose, for absorption.

Lactase, an enzyme active in the small intestine of the digestive tract, is necessary for the proper breakdown of lactose when consumed. Infants are born with high lactase activity,[5,6] and sometime after age two, individuals will typically experience a natural decline in intestinal lactase activity (also known as *lactase non-persistence*).[3,4,7,8] No standard age or time course is associated with the gradual loss of lactase activity, and research suggests a regional and ethnic variability in the onset of lactase non-persistence.[8]

Lactase malabsorption is the inability of an individual to absorb lactose in the small intestine due to an underlying cause, with the most common reason being lactase non-persistence.[9–11] LI is a highly individualized condition; the types and severity of symptoms, and the amount of lactose that triggers symptoms, varies among and within individuals.[3]

U.S. and global estimates of lactase non-persistence

Lactase non-persistence is reported in nearly 70% of the global adult population,[12] signifying lactose malabsorption is not a disease but a common characteristic of human genetics (Table 2).[4,12] Lactase non-persistence is least common in northern Europe, with less than 10% of adults being lactase non-persistent in Sweden and Denmark.[12] The frequency of lactase non-persistence increases in southern Europe, with 50% of adults being lactase non-persistent in Spain and Italy.[12] Lactase non-persistence is extremely high in Asian countries; greater than 99 percent of adults in China are lactase non-persistent.[12] On a global basis, there is limited recent research on the prevalence of lactose non-persistence in children under age five. Data is based on research from the 1960s-70s of varying evidence quality, with studies reporting a range between 0-17.9% prevalence of LI in this age group.[13]

In the U.S., about 36% of the adult population overall is lactase non-persistent,[14] with lactase non-persistence in 20-30% of white persons of European or Scandinavian decent, 70% of Mexicans and 80% of African Americans.[12] Lactase non-persistence is detected in 70% of Ashkenazi Jews (generally those of East European descent) in America, 100% of Native Americans and 100% of Native Alaskans.[12]

Whereas the prevalence of lactase non-persistence can be determined by genetic analysis, and lactose malabsorption determined by a number of clinical tests, the true global prevalence of LI is unknown, as not everyone with lactose malabsorption will experience LI following consumption of lactose. Symptoms of LI caused

Table 2. Global Estimates for Lactose Malabsorption in Adults*

	Estimated Prevalence of Lactose Malabsorption, %	Confidence Interval, 95%
Asia and Oceana		
Australia	44%	(35, 53)
Cambodia	68%	(66, 71)
China	85%	(83, 86)
India	61%	(58, 64)
Japan	73%	(59, 86)
New Zealand	10%	(8, 11)
South Korea	100%	(100, 100)
Thailand	84%	(79, 90)
Vietnam	100%	(100, 100)
Eastern Europe, former Soviet Republics		
Czech Republic	81%	(75, 87)
Estonia	28%	(25, 31)
Hungary	39%	(36, 41)
Poland	43%	(39, 47)
Russia	61%	(59, 64)
Ukraine	61%	(51, 71)
Americas		
Brazil	60%	(58, 62)
Canada	59%	(44, 74)
Colombia	80%	(73, 87)
Mexico	48%	(44, 52)
United States	36%	(33, 39)
Middle East/Northern Africa		
Cyprus	16%	(15, 18)
Egypt	68%	(66, 71)
Israel	89%	(88, 91)
Saudi Arabia	28%	(25, 31)
Turkey	69%	(66, 71)
Western Sahara	53%	(41, 65)
Southern, Eastern, Western Africa		
Botswana	88%	(78, 98)
Ethiopia	77%	(75, 79)
Kenya	39%	(34, 43)
Namibia	93%	(89, 96)
Niger	13%	(7, 19)
Tanzania	45%	(41, 49)
Western, Northern, Southern Europe		
Belgium	15%	(13, 17)
Denmark	4%	(0, 9)
France	36%	(32, 39)
Germany	16%	(15, 18)
Ireland	4%	(-1, 9)
Italy	72%	(71, 74)
Spain	29%	(27, 31)
United Kingdom	8%	(7, 9)

*Data in table are summarized from the Supplementary Appendix to Storhaug et al.[14]

by lactose malabsorption are dependent on a variety of factors, such as amount of lactose eaten, whether the lactose-containing food is eaten alone or with other foods as well as the gut microbiome of an individual.[4,12] In the U.S., several surveys demonstrate that self-reported LI (4-12%) is lower than the estimated prevalence of lactase non-persistence (36%).[15–19]

Lactose intolerance: The importance of proper diagnosis for patient care

Obtaining a proper diagnosis is an important step when it comes to managing LI. LI is a complex condition, and many LI symptoms can mimic those of other conditions (*e.g.*, irritable bowel syndrome),[3,4] so it is important to determine the underlying cause in order to best help the patient. For example, some individuals believe they have LI, though objective testing indicates they can digest lactose.[20] Health professionals recommend objective testing (*e.g.*, the breath hydrogen test) to help ensure proper diagnosis,[20] which may help those with LI find personalized dietary strategies that they deserve with the guidance of health care professionals. Self-diagnosis and/or improper diagnosis may cause individuals to forfeit the consumption of dairy foods, and by extension the essential nutrients needed for health that dairy foods provide, without a resolution of symptoms.

Link of lactose intolerance to nutritional status and disease risk

Nutritional status

LI is a real and complex condition that may cause individuals to limit dairy food consumption. However, evidence supports that avoidance of dairy foods by those with LI may hinder individuals from receiving nutrients critically important for health, predisposing them to diseases related to poor diet quality. The American Academy of Pediatrics encourages children with LI to keep dairy foods in their diet to help meet nutrient needs.[21] In 2010, the National Institutes of Health issued a consensus statement on LI and health and provided guidance on the condition; an important finding was that individuals with LI may avoid dairy foods and, as a result, consume less calcium and vitamin D, which can contribute to low bone mineral density and other adverse health outcomes.[3] A cross-sectional study in 2011 of a national sample of U.S. adults indicated that non-Hispanic white, non-Hispanic black and Hispanic adult men and women who self-reported LI consumed less calcium from dairy foods than adults who did not self-report LI.[22] In alignment with this study, a 2013 joint consensus statement on LI from the National Medical Association and the National Hispanic Medical Association encouraged African Americans and Hispanic Americans to eat 3 servings of low-fat or fat-free dairy foods daily.[20] According to the statement, minority groups consume fewer dairy foods than the general population and are at a higher risk for developing certain disease conditions, such as hypertension and diabetes,[20] which are associated with low calcium intake from dairy foods.[23] A 2016 commentary from the Belgian Bone Club and the European Society for Clinical and Economic Aspects of Osteoporosis, Osteoarthritis and Musculoskeletal Diseases stated that dairy avoidance was associated with detriment to bone health of those with LI, and unnecessary since yogurt and cheese were well tolerated in these populations.[24] In 2015, Jones et al. found that frequency of predicted lactase persistence in Africa was higher in milk versus non-milk drinkers, although authors observed that this relationship was driven by regional and linguistic differences in the study population.[25] Similarly, results from Chin et al. suggest that lactase persistence, as determined by genetic testing, may influence the intake of certain dairy products in U.S. individuals differently depending on ethnicity.[26] In 2021, a cross-sectional study in Indonesian older adults observed that LI tended to be higher in non-dairy users, and that intakes of protein, calcium, vitamin D and vitamin B12 were lower among non-dairy than dairy users.[27]

Bone health

Public health organizations in Europe and North America continue to recommend 3 servings of dairy per day to ensure adequate nutrient consumption, particularly for bone health.[1,3,24,28] Currently, the influence of lactase non-persistence and LI on bone health is unclear. The results of an ecological correlation study in East and West Africans suggest that the relationship between dairy consumption and osteoporosis risk is influenced by genetic differences in lactase persistence and non-persistence in distinct ethnic populations.[29] A 2018 meta-analysis of 5 case control studies from Finland, Austria, Italy and Spain indicated primary lactase deficiency was associated with reduced bone mineral density in post-menopausal women.[30] In 2019, Hodges et al. summarized data from human and animal studies and concluded that reduced bone density and fragility fractures are increased not by LI, but by reduced calcium consumption associated with dairy avoidance.[28] In 2020, a cross-sectional study of 496 American hip arthroplasty patients by Hamilton et al. concluded that LI was not associated with bone mineral density.[31] A 2021 prospective cohort study of 183 Turkish immigrants living in Germany indicated there was no significant association between LI, calcium intake and markers of bone metabolism or bone mineral density.[32] More studies are needed to develop a robust body of scientific evidence surrounding this topic.

Limited research assessing the role of LI in bone health has also been conducted with children and young adults. In the Adequate Calcium Today study, a school-based randomized intervention provided instructional and behavioral education on the importance of calcium consumption for bone health to 292 (out of 473) Asian, Hispanic and non-Hispanic White sixth-grade girls; following the intervention, calcium intake and total body bone mineral content did not differ between intervention groups, but there was a greater increase in spinal bone mineral content in lactose digesters versus maldigesters.[33] In a 2021 study with Chinese and Malay children, neither LI nor calcium intake were associated with bone health status.[34] In another 2021 cross-sectional study of 300 Malay, Chinese and Indian young adults, LI was not associated with bone health status.[35] More research is necessary to better understand the relationship between lactase persistence and LI and bone health across different life stages and ethnic populations.

Cancer

Scientific evidence investigating the role of LI on risk of cancer is limited. One narrative review concluded that LI was not associated with risk of colorectal or ovarian cancers.[36] This review also observed that there is currently insufficient evidence to establish a relationship between LI and prostate cancer.[36] Similarly, a 2017 cohort study found no association between LI and colorectal cancer.[37]

A personalized approach: Lactose intolerance doesn’t have to be a barrier to consuming dairy foods

Many people with LI may want to enjoy the taste, convenience and variety that dairy foods offer, but may be uncertain about the types or amounts of dairy foods to choose. The 2020-2025 DGA recommends low-lactose and lactose-free dairy products for individuals who are lactose intolerant.[1] A proper diagnosis through a health professional can help people with LI find a personalized management strategy that allows them to enjoy a variety of nutrient-rich dairy foods that can fit in their eating patterns.

Milk

A 2010 systematic review concluded that individuals with presumed LI or lactose malabsorption can tolerate 12 grams of lactose in a single dose, the amount contained in a serving of low-fat milk (Table 3), with minimal or no symptoms when consumed with other foods.[38] Consistent with these results, demand for dairy foods in China (driven by milk and yogurt consumption) has consistently grown in recent years,[39] despite that lactose malabsorption is estimated to occur in ~99% of Chinese adults.[12]

Strategies to enjoy milk for those with LI include drinking small amounts of milk at a time, consuming milk with meals and opting for low-lactose and lactose-free milk. As of 2021, 98% of stores in the U.S. sold lactose-free milk,[40] making it a widely available and increasingly popular option for those with LI.

Table 3. Lactose Content of Selected Dairy Foods in the United States

	Serving Size (1 cup-equivalent)	Lactose Content
Dairy Food		
Milk, low-fat and fat free (FDC* 746772, 746776)	1 cup (246 g)	12 g
Yogurt, Greek, plain, fat-free (FDC 330137)	1 cup (250 g)	6.5 g
Cheese, mozzarella, low moisture, part skim (for pizza; FDC 329370)	1.5 ounces (42 g)	0.3 g
Processed cheese, American (FDC 325198)	2 ounces (57 g)	1.4 g
Cheese, cheddar (FDC 328637)	1.5 ounces (42 g)	<0.1 g
Lactose-free milk	1 cup (246 g)	0 g
Ultra-filtered milk	1 cup (246 g)	0 g**
Fortified soy beverages	1 cup (246 g)	0 g

*Food Data Central database; https://fdc.nal.usda.gov/.
**Some ultra-filtered milk may contain lactose.

Yogurt

Yogurt containing live and active cultures is known to be well tolerated and efficacious for improving lactose digestion in individuals with lactose malabsorption. When yogurt contains live cultures, these bacteria may provide lactase to help the body break down lactose.[38,41–43] Some preliminary studies are finding other options that may show promise to help reduce LI symptoms, such as probiotic[43–45] and prebiotic consumption.[46–48]

Cheese

Natural cheeses such as Cheddar, Colby, mozzarella and Monterey Jack are virtually lactose-free, because 90% of the lactose in milk is removed along with the water and whey during the renneting process. The remaining lactose is fermented into lactic acid.[49]

Conclusion

Dairy foods contribute a significant amount of essential nutrients to the American diet. A barrier to dairy consumption can be LI, which is a real and individual condition that can be managed by tailored dietary guidance, providing the opportunity for people with LI to benefit from dairy's nutrition. The prevalence of LI is unknown and difficult to estimate. Proper diagnosis of LI by a health care professional is paramount for understanding effective, personalized management strategies that can help individuals enjoy diverse dairy foods and healthy eating patterns. Overall, scientific evidence is lacking that addresses gaps in knowledge surrounding the impact of LI on nutritional status, health and disease risk across life stages and ethnic populations.

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Science Summary
Dairy and Cardiovascular Disease

NATIONAL DAIRY COUNCIL™

Overview

Dairy foods such as milk, cheese and yogurt are foundational foods in healthy dietary patterns. The dairy group contributes important shortfall nutrients, including calcium, vitamin D and potassium to the American diet. Low-fat and fat-free dairy foods are part of the Dietary Guidelines for Americans (DGA) and American Heart Association (AHA) recommended healthy dietary patterns for Americans 2 years and older. An extensive body of research indicates that consuming dairy foods is associated with multiple health benefits, and several meta-analyses and prospective studies published since 2015 conclude that consuming dairy foods is not linked to increased risk for cardiovascular disease (CVD) or coronary artery disease (CAD) and is associated with reduced risk for stroke. This research provides further support for the importance of including low-fat or fat-free dairy foods in healthy dietary patterns.

Healthy dietary patterns can help lower risk for CVD and decrease public health costs

CVD is the leading cause of death in the U.S., accounting for nearly 23 percent of all deaths in 2018.[1] CVD includes several diseases of the heart and blood vessels that can impair heart function, while CAD and stroke are specific types of CVD that affect the arteries that feed the heart or brain.[2] Annual estimates of health care costs and lost productivity due to CVD and stroke in the U.S. exceed $300 billion.[3] The 2020 DGA states that a healthy dietary pattern is associated with beneficial outcomes for CVD and recommends 3 daily servings of low-fat or fat-free dairy foods for those 9 years and older, 2½ servings for children 4-8 years and 2 servings for children 2-3 years as part of the Healthy U.S.-Style Dietary Pattern.[4] The DGA also recommends 1⅔ to 2 servings of whole- and reduced-fat dairy foods for toddlers 12-23 months who no longer consume human milk as part of the Healthy U.S.-Style Dietary Pattern.[4] Small amounts of yogurt and cheese are recommended as complementary foods for infants 6 to 12 months, depending on developmental readiness.[4] The AHA also recommends that adults consume low-fat or fat-free dairy foods, depending on energy needs, as part of its 2016 Guidelines on Lifestyle Management to Reduce Cardiovascular Risk.[5]

Eating dairy foods is not linked to higher risk of CVD, CAD or stroke

Total dairy intake as well intake of specific dairy foods have been linked with reduced risk of adverse cardiometabolic outcomes. Total dairy intake is not associated with increased risk for CVD, CAD or stroke and may be associated with reduced risk according to results of one systematic review,[6] 5 meta-analyses,[7–11] 9 systematic reviews and meta-analyses[12–20] and 11 prospective cohort studies.[21–31] Some studies also found that eating cheese and yogurt was linked to a reduced risk of CVD outcomes.[8,18] This Science Summary highlights the results of these studies.

Growing body of evidence indicates eating dairy foods is not linked to CVD risk

A 2016 systematic review that rates quality of evidence found that high-quality evidence indicates cheese consumption is not associated with increased risk for CVD, and moderate-quality evidence indicates total dairy food intake, as well as yogurt intake, is not associated with increased risk for CVD.6 A systematic review and meta-analysis of 27 studies reporting 8,648 cases of CVD found inverse associations between total dairy intake and risk of CVD.[32] A systematic review and meta-analysis of 22 prospective cohort studies with data from 91,057 participants and follow-ups ranging from 8 to 26 years found that low-fat dairy food and cheese intake were associated with a reduced risk of stroke and that consuming cheese was also associated with a reduced risk of coronary heart disease.[33] Total dairy intake was linked with a reduced risk of CVD in women in a 2019 meta-analysis,[19] and a second meta-analysis of 15 prospective cohort studies on cheese and health outcomes found that eating cheese was associated with a lower risk for total CVD.[10] Additional meta-analyses including 30 prospective cohort studies showed significantly decreased CVD risk[8] and a 4% reduction in risk of stroke, ischemic heart disease and CVD mortality[18] linked with consuming fermented dairy foods such as yogurt.

Prospective evidence finds dairy food consumption is not linked to increased risk for CAD

Evidence from prospective cohort studies indicates that consuming dairy foods is not associated with increased risk for CAD and eating specific dairy foods like cheese may decrease risk. Results of a systematic review of prospective research on dairy and chronic diseases, including CAD, indicate that total dairy food intake is not linked with increased risk for CAD, based on high-quality evidence.[6] This review also found that moderate-quality evidence indicates that drinking milk or eating cheese or yogurt is not linked to increased risk for CAD, and the authors concluded that "there is no evidence that the consumption of any form of dairy product is detrimentally associated with the risk of any cardiovascular-related clinical outcome."[6] Two meta-analyses published since then report similar results. A meta-analysis on the relationship between dairy foods and cardiometabolic disease found that total dairy (15 studies) and milk (13 studies) intakes were not associated with CAD,[34] and a meta-analysis of 15 prospective cohort studies on cheese and CVD-related health outcomes found that cheese consumption was associated with a 14 percent lower risk for CAD.[10] Similarly, a large meta-analysis of 31 prospective cohort studies of dairy intake and CVD in over one million participants also indicated that cheese intake was associated with a reduced risk of CAD.[16] Finally, a systematic review of randomized controlled trials found that consuming dairy foods may exert a protective effect or no effect on cardiovascular risk factors, including reduced total cholesterol and increased high-density lipoprotein (HDL) cholesterol, though dairy intake did slightly increase low-density lipoprotein (LDL) cholesterol and triglycerides.[35] More research is needed to clarify these results.

Total dairy food consumption as well as cheese and yogurt consumption linked to lower risk for stroke

Total dairy food consumption is linked with a reduced risk for stroke,[6,20,32] according to systematic reviews and meta-analyses published since 2015. Consuming specific dairy foods like cheese[10] and milk was also either not linked with stroke or linked with lower risk of stroke.[6,12,16,34,36] A 2016 systematic review concluded that total dairy food consumption, as well as cheese consumption, is associated with reduced risk for stroke.[6] This review also found that consuming milk, yogurt and whole-fat dairy is not associated with increased risk for stroke, based on moderate-quality evidence.[6] Systematic reviews and meta-analyses from 2017 and 2018 also reported inverse associations between total dairy intake and risk of stroke.[20,32] Another systematic review and meta-analysis of 18 prospective cohort studies found consuming yogurt, butter and total dairy were not associated with risk for stroke, and drinking 200 grams per day of milk (245 grams milk = one 8-ounce cup) was associated with a 7 percent lower risk for stroke.[36] A meta-analysis from 2018 echoed this conclusion, also indicating that increasing milk intake by 200 grams per day was associated with an 8% lower risk of stroke.[34] Results of three additional meta-analyses indicated that cheese consumption was linked with a reduced risk of stroke: one reported that cheese consumption was associated with a 10 percent lower risk for stroke,[10] one found cheese consumption decreased stroke risk by 7 percent[12] and a final meta-analysis found that both total dairy and cheese intake were associated with a reduced risk of stroke.[16]

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Science Summary
Dairy and Type 2 Diabetes

NATIONAL DAIRY COUNCIL™

Overview

Dairy foods such as milk, cheese and yogurt are foundational foods in healthy dietary patterns. The dairy group contributes important shortfall nutrients, including calcium, vitamin D and potassium to the American diet. Low-fat and fat-free dairy foods are part of the Dietary Guidelines for Americans (DGA) recommendations for healthy dietary patterns for Americans 2 years and older. A growing body of research indicates that consuming dairy foods is associated with multiple health benefits, including a reduced risk of type 2 diabetes (T2D). This summary provides an overview of studies conducted since 2015 on the links between dairy food consumption and T2D and provides further support for consuming dairy foods as recommended in the 2020 DGA.

Healthy dietary patterns can help lower risk for T2D and decrease public health costs

T2D affects the lives of more than 30 million American adults and accounts for 90–95 percent of all diagnosed cases of diabetes.[1] Another 84 million American adults have prediabetes, putting them at greater risk of developing T2D.[2] Poor-quality diet and physical inactivity are recognized as key contributors to the epidemics of overweight, obesity and other diet-related chronic diseases including T2D.[3–5] A healthy diet is part of the foundation for T2D prevention, treatment and management.[6] Milk, cheese and yogurt, regardless of fat content, are recommended parts of healthy dietary patterns, within calorie limits, according to the Joslin Diabetes Center's 2018 clinical nutrition guidelines for overweight and obese adults with T2D or prediabetes or those at risk for developing T2D.[7] The 2020 DGA states that healthy dietary patterns are associated with reduced risk for several chronic diseases, including T2D,[5] and the DGA's Healthy U.S.-Style Dietary Pattern recommends 3 daily servings of low-fat or fat-free dairy foods for those 9 years and older, 2½ servings for children 4-8 years and 2 servings for children 2-3 years.[5] It also recommends 1⅔ to 2 servings of whole- and reduced-fat dairy foods for toddlers 12-23 months and small amounts of yogurt and cheese for infants 6 to 12 months, depending on developmental readiness.[5]

Research continues to explore links between dairy food consumption and lower risk for T2D

The 2020 DGA recommendations to include dairy foods in healthy dietary patterns builds on conclusions from previous DGAs as well as from the body of scientific evidence published on the topic. Since 2015, 1 meta-analysis,[8] 2 systematic reviews,[9,10] 4 systematic reviews with meta analyses,[11–14] 14 prospective studies[15–28] and 2 longitudinal studies[29,30] have been published on the links between consuming dairy foods and T2D risk. These studies, discussed in the following sections, indicate that consuming dairy foods has beneficial or neutral associations with T2D incidence in adults and that these associations vary with specific dairy foods.

Low-fat dairy foods linked to reduced T2D risk in systematic reviews and meta-analyses

Six systematic reviews of prospective cohort studies or randomized control trials report that consuming dairy foods, especially yogurt and low-fat dairy foods, is linked with a reduced risk of T2D.[8–13] A systematic review[9] concluded that high-quality evidence indicates that consuming low-fat dairy foods, as well as eating yogurt, is associated with lower risk for T2D. It also indicated that total dairy food consumption, as well as cheese consumption, is associated with lower risk for T2D, based on moderate-quality evidence. Three reviews that conducted meta-analyses[8,10,12] assessed results of over 15 cohort studies and found that both total and low-fat dairy consumption were linked with a reduced risk of T2D. Mishali et al.[12] also concluded that women consuming the highest amounts of dairy compared to women consuming the lowest amounts of dairy were 13 percent less likely to develop T2D. This finding was not observed in males in this meta-analysis. Alvarez-Bueno et al. found that consuming 200-400 grams (g) of dairy foods per day led to the largest reduction in T2D risk.[10] Results of three meta-analyses[8,11,13] found that eating yogurt was linked to lower risk of T2D. In one study, eating 80 g of yogurt daily (245 g yogurt = one 8-ounce cup) was linked with a 14 percent lower risk for T2D.[8] In the second study, eating yogurt regularly (daily or weekly) was associated with a 27 percent lower risk for T2D in seven prospective cohort studies.[11] In the third study, Fan et al. concluded that eating 60 g of yogurt per day decreased T2D risk by 17 percent, and drinking 200 g of milk per day decreased the risk for developing T2D by 9 percent.[13]

Prospective evidence indicates beneficial or neutral links between dairy intake and T2D

Results of 12 of the prospective cohort studies explored the relationship between dairy consumption and T2D, primarily reporting beneficial and neutral associations.[15–18,21,22,25–30] Large cohort studies in the U.S., Europe and Australia found no association between total dairy,[15] dairy fat,[16] yogurt[30] or milk[25] intake with T2D risk. In an Australian cohort, a healthy dietary pattern with adequate fruit and dairy food intake was linked with reduced risk of T2D and could have prevented 23-37 percent of cases.[26] Total intake of dairy foods, as well as eating yogurt and drinking low-fat milk, were associated with lower T2D risk in a Mediterranean cohort of older adults.[19] Results of other studies also indicate that total intake of dairy foods, including whole-fat dairy foods like milk, cheese and yogurt, is associated with a lower risk of T2D.[17,27,28] Consuming whole-fat yogurt was linked to lower rates of T2D in one prospective cohort study.[20] A cohort study of 8,574 Korean adults found that eating yogurt was associated with reduced risk of T2D, though consuming milk, cheese and other sources of calcium was not linked with T2D risk.[18] In a smaller study of 699 adults, participants who consumed more yogurt (1 or more servings per week) had a lower incidence of T2D than less frequent consumers.[29]

Among a cohort of Swedish adults, higher intakes of cheese, fermented milk and butter were associated with lower T2D risk.[21] One study of three large U.S. cohorts concluded that decreasing total dairy intake by one or more servings daily was linked with a higher risk of T2D. This study also found that eating more yogurt (½ cups or more) daily decreased T2D risk by 11 percent while eating more cheese (½ servings or more daily) increased T2D risk by 9 percent.[22] Similarly, Guasch-Ferré et al. found that drinking whole milk was not associated with T2D risk, while consuming 1 serving of either butter or cheese was associated with higher risk.[20]

Fatty acid biomarkers of dairy food intake also associated with lower T2D risk

Results of a systematic review and meta-analysis and two additional prospective cohort studies indicate that biomarkers of dairy fatty acid consumption or consuming dairy fat in cheese may be linked with lower risk of T2D. A systematic review and meta-analysis found that individuals with higher blood levels of the biomarker trans-palmitoleic acid, a fatty acid principally derived from dairy, were less likely to develop T2D.[14] Results from two large prospective cohorts also indicate that higher levels of dairy fat biomarkers in plasma were associated with lower incidence of T2D.[23,24] One of these studies found that higher levels of saturated fatty acids derived from cheese were linked with a lower risk of T2D but this same relationship was not observed in milk-derived saturated fatty acids.[24] More research is needed to better understand these links.

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Science Summary
Dairy and Blood Pressure

Overview

Dairy foods such as milk, cheese and yogurt are foundational foods in healthy dietary patterns. Low-fat and fat-free dairy foods are part of the Dietary Guidelines for Americans (DGA) and American Heart Association (AHA) recommended healthy dietary patterns for Americans 2 years and older. A growing body of evidence indicates that consuming dairy foods is linked with reduced risk for high blood pressure and may help maintain or lower elevated blood pressure. This summary provides an overview of the research published since 2015 on the link between consuming dairy foods and blood pressure.

Healthy dietary patterns can help lower risk for high blood pressure and decrease healthcare costs

High blood pressure is a major risk factor for cardiovascular disease (CVD).[1] Over 45 percent of American adults have high blood pressure, and between 2014–2015, total healthcare costs and lost productivity associated with high blood pressure was $55.9 billion.[1] Lifestyle guidelines for prevention of cardiovascular risk factors, including high blood pressure, emphasize weight control, physical activity, smoking avoidance, limited alcohol consumption and healthy dietary patterns.[1] The Dietary Approaches to Stop Hypertension (DASH) diet, a reduced-fat diet containing up to three servings of low-fat dairy foods and 8 to 10 servings of fruits and vegetables, lowers elevated blood pressure.[2,3] The 2020 DGA describes the DASH diet as a "healthy dietary pattern."[4] The AHA recommends the DASH diet to reduce elevated blood pressure.[5] It also recommends including low-fat and fat-free dairy foods in healthy dietary patterns to reduce elevated blood pressure and CVD risk.[5]

The 2020 DGA states that healthy eating is associated with lower blood pressure in adults, including older adults,[4] and recommends 3 daily servings of low-fat or fat-free dairy foods for those 9 years and older, 2½ servings for children 4-8 years and 2 servings for children 2-3 years as part of the Healthy U.S.-Style Dietary Pattern.[4] The DGA also recommends 1⅔ to 2 servings of whole- and reduced-fat dairy foods for toddlers 12-23 months who no longer consume human milk as part of the Healthy U.S.-Style Dietary Pattern.[4] Small amounts of yogurt and cheese are recommended as complementary foods for infants 6 to 12 months, depending on developmental readiness.[4]

Eating dairy foods linked to lower blood pressure in systematic reviews and meta-analyses

Since 2015, 2 systematic reviews and meta-analyses, 5 prospective cohort studies and 9 trials have been published that contribute to the body of science on the links between dairy intake and healthy blood pressure in adults and adolescents. In 2016, a systematic review[6] of prospective research on the links between dairy and cardiovascular health, including blood pressure, found that high-quality evidence consistently indicates that total dairy food consumption is associated with a reduced risk of hypertension. This review also found that high-quality evidence indicates cheese consumption is not associated with the risk of hypertension, and moderate-quality evidence indicates that milk consumption may be associated with a reduced risk of hypertension. A 2017 systematic review and meta-analysis summarized the evidence on the relationship of the intakes of 12 major food groups, including dairy, with the risk of hypertension.[7] This meta-analysis identified 9 prospective studies that assess the link between dairy foods and hypertension.[7] In a dose-response analysis, increasing dairy intake by about 1 cup per day was associated with a 5 percent reduction in hypertension risk.[7] Systematic reviews and meta-analyses published since 2015[6,7] indicate that total dairy food as well as milk consumption is linked to lower risk of elevated blood pressure. Specific dairy foods like cheese are not linked with hypertension risk, though these findings need confirmation.

Prospective evidence indicates consuming dairy foods is linked with reduced risk for high blood pressure

Prospective cohort studies have also been used to assess the impact of dairy food intake on blood pressure. Like the systematic reviews and meta-analyses on the topic, evidence from prospective cohort studies consistently reports a beneficial relationship or no relationship between consuming dairy foods and blood pressure. In 37,124 Chinese adults assessed as part of the Singapore Chinese Health Study, daily milk drinkers had a lower risk of hypertension than nondrinkers did.[8] Another prospective cohort study that evaluated dairy intake and blood pressure in nearly 180,000 Americans found that participants who consumed at least 3 servings of dairy per day (versus less than ½ serving per day) had a 13 percent lower risk of high blood pressure.[9] In 57,547 adults from 21 countries, consuming at least 2 servings of dairy per day was linked with a lower incidence of high blood pressure.[10] In a study of 40,526 French women, overall dairy consumption was not linked with high blood pressure, but risk of hypertension increased with processed cheese consumption.[11]

Clinical trials find eating low-fat or whole-fat dairy foods helps maintain or lower elevated blood pressure

Clinical studies indicate that consuming recommended amounts of dairy foods does not increase blood pressure and, in some studies, especially studies conducted in adults at risk for elevated blood pressure, consuming dairy foods was linked to lower blood pressure. Results of 5 randomized clinical trials also indicate that consuming dairy foods has neutral or beneficial links with blood pressure in adults.[12–16] In one large randomized intervention trial of the DASH diet, adults who both increased their dairy intake to more than 1½ servings per day and consumed more than 5 servings of fruits and vegetables per day had the greatest reductions in blood pressure.[12] A crossover trial with overweight adults found that a diet including up to 6 servings of dairy foods daily reduced both systolic and diastolic blood pressure compared to a diet with less than 1 daily serving of dairy foods.[13] Rietsema et al. noted that this effect may have been due to the calcium content of the high dairy versus the low dairy diet.[13] Similarly, a randomized crossover trial of 49 adults with hypertension found that adding 4 or more daily servings of fat-free dairy foods reduced systolic blood pressure and improved vascular function compared to a similar diet without dairy foods.[14]

Whole-fat dairy products have also been found to have neutral or beneficial impacts on blood pressure. In a study of 36 healthy adults, when a standard DASH diet was compared with a higher-fat DASH diet including whole milk dairy foods, both the higher fat and standard DASH diets resulted in lowered blood pressure.[15] In a crossover clinical trial, 60 participants who added 4 servings per day of whole-fat dairy products (milk, cheese, yogurt) to their normal diet had no significant changes in blood pressure compared to participants adding 4 servings per day of plant-based foods (coconut milk, peanuts, orange juice, applesauce).[16]

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Science Summary
Dairy and Sarcopenia and Osteoporosis

Overview

Including dairy foods in healthy dietary patterns can help people thrive at every age, including older adulthood. Eating dairy foods, a source of high-quality protein and other essential nutrients, may reduce the risk of age-related conditions such as sarcopenia (loss of muscle mass and strength) and frailty. Consuming dairy foods may also help older adults maintain healthy bones by reducing the risk of bone mineral density loss and lowering the risk of osteoporosis-related falls and fractures. The 2020-2025 Dietary Guidelines for Americans (DGA) recommends that adults consume 3 servings of low-fat or fat-free dairy foods daily as part of the Healthy U.S.-Style Dietary Pattern.

Dairy foods help support the nutritional needs of older adults

As the population of older adults in the U.S. continues to grow, the nutrition challenges these adults face will become even more serious public health concerns. Older adults may struggle with healthy eating due to age-related changes and obstacles including socioeconomic factors, depression, changes in taste, physical ability to chew and swallow and body composition, along with reductions in appetite from medications and reduced mobility, among other challenges.[1–5] While men and women 70 years and older consume sufficient calories, on average, they do not consume enough of the nutrients of public health concern for Americans 2 years and older-calcium, vitamin D, fiber and potassium- and tend to exceed recommendations for daily sodium and saturated fat intake.[6] Older adults are also at risk for low intakes of protein and vitamin B12.[6]

Consuming dairy foods as part of healthy dietary patterns can help older adults thrive. Dairy foods like milk, yogurt and cheese are important sources of several shortfall nutrients for older adults, including protein, calcium, potassium, vitamin D and vitamin B12.[7] Dairy foods also provide high-quality nutrition at an affordable price[8] and are available in a variety of textures and flavors that may appeal to older adults experiencing physical challenges with eating. However, Americans 70 years and older consume, on average, less than 1½ servings of dairy foods per day.[9] The 2020 DGA recommends that all Americans 9 years and older consume 3 daily servings of low-fat or fat-free dairy foods in the Healthy U.S.-Style Dietary Pattern.[6] Adding at least one more daily serving of dairy foods to the dietary patterns of older adults can help bring them closer to meeting dairy recommendations.[10,11]

Dairy foods are an important source of high-quality protein that can help meet the unique nutrition needs of older adults

Older adults have low intakes of protein relative to the Estimated Average Requirement (EAR),[7] and the 2020 DGA identifies dairy foods as a source of dietary protein for older adults.[6] Milk, cheese and yogurt are good sources of high-quality protein, which helps support bone health and preserve muscle mass and physical function in older adults as part of healthy dietary patterns.[12] Milk provides 8 grams (g) of high-quality protein per cup, and hard cheeses such as Cheddar and Colby provide 10 g or more of protein per 1½ ounce serving.[13]* Some styles of yogurt like Greek yogurt can provide more than 20 g of protein per cup.[13]* A modeling study examining the effect of increasing plant-based foods or dairy foods on protein intake in older adults found that doubling the intake of dairy foods could help older adults meet their protein needs. In contrast, doubling intake of plant-based foods resulted in an approximate 22 percent decline in protein consumption.[14] Because older adults currently do not meet dairy food recommendations, adding one more serving of dairy foods to their current diets would move them closer to both protein intake recommendations and dairy recommendations from the 2020 DGA.[6,10,11]

Eating dairy foods may lessen risk of sarcopenia and frailty among older adults

Sarcopenia, or the loss of skeletal muscle strength and mass, accelerates with age, contributes to adverse health outcomes in older adults and may lead to substantial healthcare costs.[15,16] Frailty is also a common clinical syndrome in older adults, and it carries increased risks for poor health outcomes including institutionalization, falls, hospitalization and mortality.[17] Nutritional factors such as inadequate protein and energy intake play a role in the development of both sarcopenia and frailty.[14,18–21] Results of systematic reviews and prospective cohort studies indicate that consuming dairy foods like milk, cheese and yogurt in recommended amounts throughout older adulthood may help reduce the risk of sarcopenia and frailty by supporting muscle mass and muscle strength.

Results of two systematic reviews indicate that consuming dairy foods (low-fat milk, cheese and yogurt) may be beneficial for preserving muscle mass and muscle strength in adults 50 years and older, thereby reducing the risk of sarcopenia.[15,22] Two prospective cohort studies also reported similar results. One prospective cohort study found that consuming more than 7 servings per week of low-fat milk and yogurt versus less than 1 serving per week was linked with lower risk of frailty, slow walking speed and weight loss.[23] Another prospective cohort study concluded that consuming more meat and dairy foods was linked with a lower risk of developing physical frailty.[24]

Dairy foods may help support bone health in older adults

Eating dairy foods may also help older adults maintain healthy bones. Osteoporosis, the condition of porous, brittle and fragile bone, affects approximately 54 million Americans.[25] One out of every two postmenopausal women will experience an osteoporosis-related fracture at some point in her lifetime.[26] While some factors that affect peak bone mass are not modifiable (gender, ethnicity, genetics), others such as nutritional status, physical activity and body composition are modifiable. Unfortunately, older adults tend to fall short of meeting recommendations for nutrition needs associated with bone health like adequate calcium, vitamin D and potassium intake.[7]

*FDC IDs: Cheddar: 1098009; Colby: 173416; Greek Yogurt: 1097564

Results of meta-analyses, a systematic review and longitudinal cohort studies indicate that eating dairy foods may be beneficial for bone health in older adults. Meta-analyses and systematic reviews as well as a prospective cohort study provide evidence that dairy foods can increase bone mineral density and reduce the risk of hip fracture.[27–33] A large systematic review with data from 91 publications concluded that moderate evidence indicates that daily intake of low-fat or fat-free dairy foods as part of a healthy dietary pattern may be associated with improved bone mineral density and fewer fractures in adults 50 years and older.[32] In two U.S. cohorts of approximately 43,000 men and 80,000 postmenopausal women aged 50 years and followed for up to 32 years, each 1 cup daily serving of milk was associated with an 8 percent lower risk of hip fracture.[33] Total dairy intake, about half of which was milk, was associated with a 6 percent lower risk of hip fracture per daily serving.[33] Some research reports that consuming dairy foods may not have an impact on certain indicators of bone health in older adults, such as bone mineral density, risk of falling and osteoporotic fractures.[34–37] These results indicate a need for continued research to further explain the links between dairy food intake and bone health in older adults.

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Emerging Topics

Science Summary
Dairy Matrix

NATIONAL DAIRY COUNCIL™

Overview

The 2020-2025 Dietary Guidelines for Americans (DGA) recommends including dairy foods like milk, cheese and yogurt in healthy dietary patterns to meet nutrient needs and reduce the risk for chronic diseases. Historically, the DGA has recommended that most Americans choose low-fat or fat-free dairy foods, because whole- and reduced-fat dairy foods contain more calories as well as more saturated fat, a type of fat that increases blood levels of low-density lipoprotein cholesterol (LDL-C), a blood biomarker used to predict CVD risk.[1,2] Emerging evidence that will be described in this summary indicates that consuming dairy foods, even whole-fat dairy foods, is not linked to higher risk for CVD and, in some cases, is linked to lower risk. Considering the physical structure of dairy foods alongside their nutrient and non-nutrient components may help explain why whole-milk dairy foods have different health impacts than would be expected based on their saturated fat content alone. This science summary explores the emerging body of research on the food structure or food matrix and the bioactive components of food, both potential reasons why sometimes foods, including dairy foods, and nutrients, like saturated fats, do not always have a predictable impact on health.

People eat food, not nutrients: defining the food matrix

The food matrix refers to the relationships between the nutrient and non-nutrient components of foods, including vitamins, minerals and bioactive components as well as physical structure, texture and form (e.g., solid, gel, liquid).[3] The food matrix concept can be used to address how the relationships between nutrient and non-nutrient components impact digestion, absorption and physiological functions important for health. In a commonly cited study about the matrix effect,[4] researchers assessed how well carotenoids (beta-carotene and alpha-carotene) were released and available for absorption in a model of the human digestion system when different preparations of carrots (raw bite size pieces, cooked bite size pieces, raw pulp, raw pulp with oil, cooked pulp, cooked pulp with oil) were added. Even though the same food with the same nutrients was used in each case, cooking, pulping and adding oil all affected the amount of beta-carotene accessible for absorption. The preparation of the carrots and changes to their physical structure impacted how much of their nutrients were available for use by the human body. A similar study found that the manner in which almonds were prepared (whole unroasted almonds, whole roasted almonds, chopped roasted almonds and almond butter) affected the amount of calories available for absorption.[5] The "matrix effect" occurs with other foods as well, including dairy foods.

Food structure may explain why whole-fat dairy foods have different health impacts than expected

The examples with carrots and almonds illustrate how food form can affect digestion and absorption of nutrients. The matrix concept applied to dairy foods may help explain why whole-fat dairy foods do not have the same impact on CVD risk as other foods that contain saturated fat. Results of two randomized controlled trials,[6,7] a prospective cohort trial,[8] and a meta-analysis[9] provide a snapshot of the evidence that indicates consuming dairy foods like milk, cheese and yogurt is not linked with higher CVD risk, even when whole-fat options are selected instead of low-fat or fat-free ones. A randomized crossover trial compared the impacts on blood lipids of drinking 2 cups of whole milk or 2 cups of fat-free milk daily.[6] After three weeks, the group drinking whole milk had higher levels of high-density lipoprotein cholesterol (HDL-C), but there were no other differences between the two groups.[6] Another randomized controlled trial[7] compared a modified Dietary Approaches to Stop Hypertension (DASH) diet containing 2-3 daily servings of whole-fat dairy foods to the standard DASH diet, which includes 2-3 servings per day of low-fat or fat-free dairy foods.[10] The modified DASH diet with whole-fat dairy foods lowered blood pressure, reduced blood levels of triglycerides, did not increase total cholesterol or LDL-C and also did not decrease HDL-C, effects similar to those observed with a standard DASH diet.[7]

A prospective cohort trial found that consuming saturated fat from dairy foods posed a lower risk for developing CVD than consuming saturated fat from meat.[8] The authors note that the "health effects of the entire food rather than the content of any single nutrient might be most relevant to understanding associations between dietary consumption and health outcomes." Finally, a meta-analysis by Chen et al. indicates that eating cheese, even regular-fat cheese, was not linked with an increased risk for total CVD or coronary heart disease.[9] These studies indicate that consuming whole-fat milk, cheese and yogurt is not linked with higher risk for CVD. The fat in milk is the most complex fat naturally occurring in food with over 400 types of fatty acids.[11] This complexity of dairy fat, part of the dairy matrix, might help explain why the link between dairy food consumption and CVD risk is independent of saturated fat content. However, research in this area is ongoing, and there is not yet a precise understanding of the mechanisms involved.

Dairy foods are more than the sum of their nutrients: introducing dairy bioactives

As researchers seek to understand how dairy foods impact chronic disease risk, there is increasing interest in the myriad of unique non-vitamin and non-mineral components in dairy foods known as bioactive compounds. All dairy foods begin as milk, a complex food designed by nature to provide life-sustaining nutrition. Milk contains hundreds of bioactive compounds embedded within its macronutrients (fat, carbohydrates, protein) and inherent physical structure. These bioactive compounds may help explain why saturated fat from whole- and reduced-fat cheese, milk and yogurt does not have the same physiological effects as non-dairy sources of saturated fat. Bioactive peptides, or protein fragments, that may benefit health are among the most well-known of milk's bioactive compounds.[12] While most of the research to date has been conducted in animal or *in vitro* studies rather than human clinical trials, milk-based bioactive peptides have been shown to exhibit antihypertensive, antimicrobial, antithrombotic, immunomodulatory, antioxidant and mineral binding functions, with some peptides having bioactivity in multiple areas.[12–14] There is also some research on bioactive dairy lipids and carbohydrates but, as with bioactive peptides, much of this research has not been conducted in humans. This emerging area of research on dairy bioactives may help progress understanding of the mechanisms behind the health benefits linked with consuming dairy foods.

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Science Summary

Whole- and Reduced-fat Dairy Foods and Cardiovascular Disease

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Overview

The 2020–2025 Dietary Guidelines for Americans (DGA) recommends choosing low-fat or fat-free milk, yogurt and cheese as part of healthy eating patterns. Dairy foods such as milk, yogurt and cheese make significant nutrient contributions to the diets of Americans. Recommendations to reduce saturated fat consumption are intended to lower rates of cardiovascular disease (CVD), including coronary heart disease (CHD; commonly resulting in a heart attack) and cerebrovascular disease (commonly resulting in a stroke). Current evidence indicates dairy food consumption, regardless of fat content, is not associated with risk for CVD. The growing evidence base supports reassessing the role of full- and reduced-fat dairy foods in healthy eating patterns to inform future nutrition guidance regarding CVD and other cardiometabolic diseases.

Dietary guidelines recommend dairy foods as part of healthy eating patterns to lower risk for cardiovascular disease

The 2020-2025 DGA states, "the dietary pattern may better predict overall health status and disease risk than individual foods or nutrients" and is based on evidence that demonstrates a healthy eating pattern is associated with beneficial outcomes for CVD.[1] Low-fat or fat-free dairy foods are included in healthy eating patterns in the DGA, as well as in recommended eating patterns from other authoritative bodies in the United States (U.S.) and around the world.[1–3] The unique nutrient package of dairy foods helps meet nutrient recommendations and may help contribute to overall diet quality.[4]

Recommendations are to replace saturated fat with unsaturated fat to reduce cardiovascular risk

Current recommendations from the DGA and the American College of Cardiology/American Heart Association Guidelines are to limit saturated fat consumption and replace saturated fat with unsaturated fats in the diet.[1,5] Strategies offered by the DGA and American Heart Association to meet current recommendations include switching to low-fat and fat-free dairy foods and choosing fat-free or low-fat milk instead of 2% or whole milk and lower fat cheese in place of regular cheese.[1,6] Heart disease is the leading cause of death in the U.S.,[7] and the link between saturated fat consumption and low-density lipoprotein (LDL) cholesterol (an established risk factor for CVD)[8] has been a primary rationale for recommending low-fat or fat-free dairy foods. However, research evaluating the link between dairy food consumption and health outcomes like heart attack and stroke has yielded different conclusions than research on the impact of saturated fat consumption on biomarkers of disease, such as LDL-cholesterol. Current evidence indicates that dairy food consumption is not linked to risk of CVD, and in some cases is linked to reduced risk.[9]

Dairy food consumption, regardless of fat content, does not increase risk for cardiovascular disease: systematic reviews and meta-analyses

Authoritative guidance advises reducing saturated fat consumption in general. At the same time, a large body of evidence published over the last two decades indicates that total dairy consumption, whether full-fat or low-fat, does not increase risk for CVD.[9,10] A systematic review published in 2016, based on meta-analyses of prospective cohort studies, concluded total dairy consumption was not associated with risk for CVD (based on moderate-quality evidence).[9] In 2017, a meta-analysis of 29 cohort studies with 938,465 participants reported no association between total dairy consumption, including high- and low-fat varieties, and CHD or CVD.[11] Three other recent meta-analyses of prospective cohort studies also reported dairy consumption had an inverse association with CVD risk[12] and CVD mortality[13] or a neutral association with CHD risk.[14] A 2021 French prospective study found no association between dairy consumption and CVD or CHD risk.[15] A 2021 meta-analysis of 55 prospective cohort studies found that total dairy consumption was associated with lower risk for CHD, stroke and hypertension.[16] Similarly, a 2021 systematic review and meta-analysis reported consumption of total dairy, low-fat dairy (including milk and yogurt with fat content lower than full-fat equivalents and low-fat cheese) and full-fat dairy (including full-fat milk and yogurt and high-fat cheese) had no association with CHD or ischemic stroke.[17]

Potential underlying mechanisms behind the relationship between dairy fat consumption and CVD risk: randomized controlled trials

Blood lipids

Randomized controlled trials (RCTs) have been designed to test the potential mechanisms underlying the observed benefits of total and full-fat dairy consumption on risk for CVD. In 2021, one meta-analysis of RCTs found that dairy consumption had no significant effect on lipids, including total, LDL and high-density lipoprotein (HDL) cholesterol, and triglycerides (TG).[18] A year prior, another meta-analysis of RCTs found that probiotic yogurt consumption significantly reduced total and LDL-cholesterol in subjects with mild to moderate hypercholesterolemia without significant effects on HDL cholesterol and TG.[19] Recent RCTs have similarly indicated that full-fat dairy consumption does not adversely affect blood lipids.[20-22] For instance, Engel et al. demonstrated that when healthy adults consumed 0.5 liters of full-fat or fat-free milk per day for three weeks as part of their habitual diet, there were no significant differences in effects on total and LDL-cholesterol or TG concentrations.[23] When comparing reduced- or full-fat versus low-fat dairy consumption, Mitri et al. demonstrated no differences in lipid parameters in subjects with type 2 diabetes after six months.[24] Lastly, Schmidt et al. showed that over three servings of full-fat milk, cheese and yogurt daily for twelve weeks did not affect blood lipids, including total, LDL and HDL cholesterol or TG when compared with a low-dairy and low-fat dairy diet in men and women with metabolic syndrome.[25]

Blood pressure

RCTs indicate a neutral[20,22,24–26] or beneficial[27,28] effect of dairy fat consumption on blood pressure. For example, compared with no dairy consumption, consuming full-fat dairy for four weeks did not significantly affect blood pressure or vascular function.[26] When researchers compared a high-dairy diet with a low-dairy diet for six weeks, the high-dairy diet (composed of reduced-fat dairy foods) resulted in lower systolic and diastolic blood pressure in overweight men and women.[27] McDonald et al. showed that milk consumption, regardless of fat content, attenuated impairments in vascular endothelial function by limiting oxidative stress in individuals with prediabetes.[29] A trial conducted in adolescent boys who were regular soda drinkers showed that consuming reduced-fat milk instead of soda for three weeks resulted in significantly lower systolic blood pressure.[28]

Milk is a complex food: The unique role of dairy fat and the dairy food matrix in health

The fat in milk is the most complex of all naturally occurring fats.[30,31] Bovine milk fat contains over 400 types of fatty acids, including short-, medium- and long-chain fatty acids ranging in length from four to 24 carbons.[30] Only about 15 of the identified fatty acids are present at levels of 1 percent or higher which underscores the intricate complexity of the lipid composition of milk.[30] The unique composition of milk fat in whole-fat dairy foods is a topic of ongoing research investigation.

Evidence indicates that the food matrix of dairy foods may modulate the effects of dairy fat on CVD biomarkers and associated risk.[32,33] A case-cohort study across nine European countries observed that CHD incidence was higher per 1% increase in energy consumption of saturated fat from red meat and butter, whereas it was lower per 1% increase in energy consumption of saturated fat from yogurt and cheese.[34] Other research has reported that consumption of saturated fats from dairy foods is associated with differential effects on cardiometabolic risk factors,[35] including favorable effects on CVD[36] and ischemic heart disease[37] risk. In addition, emerging evidence suggests that milk polar lipids, a class of fats unique to dairy, play a beneficial role on cardiometabolic health through mechanisms that modulate lipid metabolism, gut health and systemic inflammation.[38] Thus, the complexity of dairy fat, which is part of the total food matrix of milk, yogurt and cheese, might help explain why the link between dairy food consumption and neutral or lower CVD risk is independent of saturated fat content. Research in this area is ongoing, and there is not yet a precise understanding of the mechanisms involved.

Conclusion

The current body of evidence indicates dairy foods, regardless of fat content, contribute beneficial nutrients to the diet and are not associated with increased risk for CVD. As Drouin-Chartier et al. concluded, "although there are still key research gaps to address, evidence suggests either a neutral or a favorable association between dairy intake and cardiovascular-related outcomes. These data are consistent with current dietary guidelines, which place dairy as one of the pillars of healthy eating. However, the review also emphasized that the recommendation to focus on low-fat in place of regular- and high-fat dairy is currently not evidence-based. Further research is needed to specifically address this key research gap."[9]

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Science Summary

Dairy and Inflammation

Overview

Dairy foods such as milk, cheese and yogurt are foundational foods in healthy dietary patterns recommended by the Dietary Guidelines for Americans (DGA). Healthy dietary patterns that include dairy foods are linked with lower risk of key chronic diseases such as type 2 diabetes, cardiovascular disease and obesity. These noncommunicable diseases are sometimes called "inflammatory diseases," because they often co-occur with chronic, systemic inflammation. Lifestyle factors such as diet may impact chronic inflammation. Emerging evidence indicates that consuming dairy foods, including whole- and reduced-fat dairy foods, is not linked to increased levels of inflammatory markers. Some research indicates that consuming certain dairy foods may be linked to lower levels of some inflammatory markers.

Healthy dietary patterns with dairy can help lower risk for chronic diseases linked with inflammation

Chronic diseases like cardiovascular disease (CVD), type 2 diabetes (T2D) and obesity affect millions of Americans and result in high healthcare costs and lost productivity.[1–3] These conditions are also associated with higher levels of inflammatory markers.[4,5] A healthy diet is the foundation for prevention and management of several chronic diseases, including CVD, T2D and obesity.[5–10] The Scientific Report of the 2020 Dietary Guidelines Advisory Committee emphasizes this point, stating that risk factors for CVD, such as inflammatory markers, are "favorably influenced by habitual adherence to dietary patterns that include fruits, vegetables, whole grains, legumes, nuts, unsaturated vegetable oils, fish, seafood, [and] lower fat dairy products."[11] The Healthy U.S.-Style Dietary Pattern in the 2020 DGA includes these foods, recommending 3 daily servings of low-fat or fat-free dairy foods for those 9 years and older, 2½ servings for children 4-8 years and 2 servings for children 2-3 years.[10] It also recommends 1⅔ to 2 servings of whole- and reduced-fat dairy foods for toddlers 12-23 months and small amounts of yogurt and cheese for infants 6 to 12 months, depending on developmental readiness.[10]

Eating dairy foods is not linked to inflammatory markers in systematic reviews or meta-analyses

Eating dairy foods does not increase levels of inflammatory biomarkers in individuals without a milk protein allergy, according to results of two meta-analyses and three systematic reviews. Six of the randomized controlled trials of healthy adults included in a meta-analysis by Benatar et al.[12–18] assessed the impact of low-fat or high-fat dairy foods on levels of C-reactive protein (CRP), a commonly used biomarker of inflammation produced by the liver. There were no differences in CRP levels between the dairy-rich diets and the control diets in four of these studies, even when higher-fat dairy foods were included in the dairy intervention. Zemel et al. reported lower levels of CRP at the end of a 28-day study,[16] and Stancliffe et al. also reported significantly lower CRP levels in the group consuming 3.5 daily servings of dairy foods.[14] Another meta-analysis used an "inflammatory score," which combines many biomarkers of inflammation into a single metric, to evaluate the results of 52 trials on dairy intake and inflammation.[19] This meta-analysis concluded that diets containing dairy foods, especially fermented dairy foods, had a modest anti-inflammatory effect most apparent in individuals with metabolic disorders like obesity. Three systematic reviews reported similar results, concluding that eating dairy foods had a beneficial impact or no impact on levels of inflammatory markers in both healthy individuals[20,21] and those with metabolic disorders.[20–22]

Clinical trials find that consuming dairy foods exerts no change or favorable change on some biomarkers of inflammation

In addition to the studies covered in meta-analyses and systematic reviews, at least five additional randomized controlled trials[23–27] have been published on the links between dairy foods and inflammation. These studies provide additional evidence that eating dairy foods does not cause inflammation in adults.

In one study, 139 adults with risk factors for metabolic syndrome ate either ~3 ounces of whole-fat cheese, low-fat cheese or a bread and jam control with the same amount of calories for 12 weeks.[23] There were no differences in CRP levels between these groups, indicating that a dairy-rich diet, even with whole-fat cheese, was not linked with increased inflammation. In another study[24] completed by 52 middle-aged adults, participants consumed an energy-deficit diet providing either high or low amounts of dairy foods for 24 weeks. There were no differences in CRP levels between the two groups after the intervention. In a similar randomized crossover study,[25] 45 middle-aged, overweight men and postmenopausal women consumed a high-dairy diet (5-6 daily servings of dairy foods) or a low-dairy diet (<1 daily serving of dairy foods) for 6 weeks. There was no significant difference in CRP levels between the two groups following the intervention. A randomized crossover trial of 92 men and women with abdominal obesity also found no differences in CRP levels after participants ate a diet rich in saturated fat from cheese, a diet rich in saturated fat from butter, a diet rich in monounsaturated fatty acids, a diet rich in polyunsaturated fatty acids, or a low-fat high carbohydrate diet for 4 weeks.[27] Another randomized controlled trial assessed the impact of eating yogurt on markers of chronic inflammation in healthy women with and without obesity.[26] Women consumed 12 ounces of either low-fat yogurt or soy pudding for 9 weeks. Eating yogurt led to decreased levels of several, but not all, markers of inflammation measured in this study in both the women with obesity and the women without obesity.

Dairy foods are scored as neutral or “anti-inflammatory” by dietary inflammation scoring system

A new, validated approach to assessing dietary and lifestyle factors that affect systemic inflammation was published in 2019.[28] The research team used food frequency questionnaires and levels of inflammatory biomarkers to assess dietary intake and create an inflammation biomarker score. They validated this score with 3 study populations including over 14,000 Americans. Both high-fat dairy foods (including whole- and reduced-fat milk, yogurt, cheese and ice cream) and low-fat dairy foods (including low- and fat-free milk, low-fat cheeses and ice cream) received negative scores (-0.14 and -0.12, respectively), indicating an anti-inflammatory effect. This scoring system, in conjunction with the other published literature on the topic, indicates that dairy foods do not cause inflammation and are either neutral or mildly anti-inflammatory.

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Science Summary
Dairy Innovation

NATIONAL DAIRY COUNCIL™

Overview

Dairy foods such as milk, cheese and yogurt are foundational foods in healthy dietary patterns. Consuming dairy foods helps Americans meet recommendations for important shortfall nutrients, including calcium, vitamin D and potassium, and contributes several other essential nutrients, too. An emerging body of research indicates that eating dairy foods may also be linked with reduced risk of chronic diseases like type 2 diabetes (T2D) and cardiovascular disease (CVD). However, most Americans do not meet the recommendations for dairy foods from the Dietary Guidelines for Americans (DGA). Lactose intolerance (LI) as well as concerns about added sugars and saturated fats may lead some individuals to avoid or reduce dairy food consumption, which can result in missing out on the essential nutrients in dairy foods and the health benefits linked with adequate dairy consumption. Recent evidence indicates that dairy foods with little- or no- lactose and/or added sugars are now widely available in the U.S. Evidence also indicates that whole- and reduced-fat dairy foods can be included in healthy dietary patterns. A variety of nutrient-dense milk, cheese and yogurt options are widely available so Americans can select dairy foods to meet their nutrient needs and taste preferences and move closer to meeting recommendations for healthy dietary patterns from the 2020-2025 DGA.

Lactose-free dairy foods are widely available and an increasingly popular option for Americans

In addition to thirteen essential nutrients including protein, calcium, phosphorus, zinc, selenium, iodine and vitamins A, D, B12, riboflavin (B2), niacin (B3) and pantothenic acid (B5), milk contains a sugar called lactose, which individuals with LI are not able to digest. LI is medically defined as a group of symptoms, such as bloating, gas and diarrhea, that occur in some people after they consume certain dairy foods.[1,2] While some individuals with LI avoid dairy foods, LI does not have to be a barrier to adequate dairy intake. Consuming smaller amounts of dairy foods throughout the day and with other foods can help individuals with LI tolerate as much as 12 grams of lactose at a time, which is about the amount of lactose in one cup of milk.[3,4] The 2020-2025 DGA also notes that individuals with LI can select lactose-free or reduced-lactose dairy foods to meet dairy recommendations.[5] Lactose-free milk is another option for individuals with LI and is currently available in about 96 percent of U.S. retail food outlets.[6-8] About 18 percent of American households keep lactose-free milk in the refrigerator.[6-8]

Yogurt with live and active cultures is another option for individuals with LI.[4,9,10] The culturing process used to make yogurt helps break down lactose, which may make it easier for people with LI to digest. Natural cheeses such as Cheddar, Colby, mozzarella, and Monterey Jack are virtually lactose-free, because 90 percent of the lactose in the milk used to make these cheeses is removed along with the water and whey during the renneting process of cheesemaking. The remaining lactose is fermented into lactic acid.[11] While individuals with LI may choose to substitute milk with plant-based alternatives such as almond, rice and coconut beverages, these beverages vary in their nutrient composition, fortification levels and amounts of added sugars, as they are not subject to uniform standards.[12]

One serving of whole- or reduced-fat dairy foods can fit into recommended healthy dietary patterns

Dairy foods are available in different varieties. Milk is available in whole, reduced-fat (2% milk fat), low-fat (1% milk fat), fat-free and flavored options. Yogurts and cheeses of different fat levels are also available. The 2020-2025 DGA recommends 3 daily servings of low-fat or fat-free dairy foods for those 9 years and older, 2½ for children 4-8 years and 2 for children 2-3 years in the Healthy U.S.-Style Dietary Pattern.[5] The DGA also recommends balancing calorie intake and limiting intake of saturated fats to less than 10 percent of calories per day as part of healthy dietary patterns. Yet Americans primarily choose whole- or reduced-fat dairy foods.[13] Whole- and reduced-fat dairy foods (milk, cheese and yogurt) contain more saturated fats and can contain more calories than low-fat and fat-free versions. However, results of a recent modeling study indicate that one of the three recommended servings of dairy foods for those 9 years and older can be a whole- or reduced-fat dairy food, while staying within saturated fat and calorie limits and meeting nutrient needs.[14] There is a growing body of evidence of a neutral or even beneficial role of whole- and reduced-fat dairy foods on cardiometabolic disease risk.[15-21] Dairy fat is the most complex naturally-occurring fats with over 400 types of fatty acids.[22] The complexity of dairy fat may help explain why consuming whole- and reduced-fat dairy foods is not linked to higher risk of CVD, T2D and overweight and obesity.

Many dairy options have reduced sugar or "no added sugar" and more Americans are choosing unflavored and unsweetened yogurt

Eating yogurt has been associated with a range of health benefits, including a reduced risk for CVD and T2D, and emerging evidence also indicates that eating yogurt, including sweetened yogurt, may reduce markers of inflammation.[23-26] However, the 2020-2025 DGA recommends limiting intake of added sugars to no more than 10 percent of total calories for all Americans over the age of 2.[5] This recommendation is consistent with the Food and Drug Administration's (FDA) daily value of not more than 50 grams per day of added sugars for children and adults aged 4 and above.[27] Yogurts without added sugars are available on the market to help Americans stay within added sugar limits while still having the option to choose yogurt to meet dairy recommendations. Between 2015 and 2019, yogurts with a "no added sugar" claim increased by over 32 percent and the number of yogurts with "less sugar" noted on the label increased by 33 percent.[28] Plain yogurt, which is both unsweetened and unflavored, has also become a popular choice for Americans. In 2019, plain yogurts comprised 13 percent of U.S. yogurt sales.[29]

Conclusions

Nutrient-rich dairy foods are an important part of healthy dietary patterns.[5] Many options for dairy foods are widely available, including reduced-lactose and lactose-free products, whole-fat, reduced-fat, low-fat and fat-free products and products with reduced sugar or no added sugars. The wide range of milk, cheese and yogurt options helps to ensure that Americans of all ages can find dairy foods to meet their taste preferences and align with recommendations in the 2020-2025 DGA for healthy dietary patterns.

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